

Working with Schools in STEM Public Engagement

Approaches taken by Wellcome
Trust-funded research centres
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Executive summary

“We will expect all of our major research groups to engage with the public about their work and will offer them support and training to do so.”

Wellcome Trust Strategic Plan 2010–2020

Making links with schools, for many organisations, is a major route to engaging the public with science, technology, engineering and maths (STEM). However, engaging with schools in a way that is effective is often a challenge for research institutions. This report presents the findings of a study of the public engagement programmes run by Wellcome Trust research centres and how they engage with schools.

Visits were made to each of the centres, and interviews were conducted with a range of personnel. Where possible, these interviews included the centre’s director, as well as researchers and individuals responsible for coordinating public engagement activity. These visits were supplemented by telephone and email communication. The following questions were addressed:

1. To what extent do engagement programmes that involve schools form part of the strategic objectives of the centres?
2. Which factors encourage or hinder the development of engagement programmes that involve schools?
3. Which mechanisms are and could be used to strengthen links with schools?
4. Which conditions need to be put in place to encourage, support and sustain relationships and programmes?
5. Which types of advice and support would be welcomed to improve the effectiveness and impact of links with schools?

In addition, telephone interviews were conducted with ten teachers (two primary and eight secondary) from schools who had used one or more of the centres in some capacity. These interviews explored the five questions set out above from the schools’ perspectives.

Despite the overall enthusiasm and personal commitment to working with schools, the majority of centres have yet to fully incorporate these activities into their planning. Looking at the centres as a group regarding work with schools, they lie on an evolutionary continuum in which there is a pattern of increasing integration of the activities into the overall work of the centre. All the centres recognise there is much to do.

Based on the evidence from the interviews, key elements in helping centres to raise the profile and impact of their work with schools include individual commitment to such activities (particularly from the Director), appointing a coordinator with dedicated time, agreeing on strategic objectives and medium-term goals, incorporating the activities into governance arrangements, allocating a core budget, and establishing monitoring and impact measures for reporting and improvement purposes. Consideration needs to be given to the timescale for the changes, which need to become embedded in the culture of the centre as they do not happen overnight.

The teachers interviewed were very positive about the experiences they and their students had with the centres and emphasised the positive way in which the researchers interacted with the young people. Building up relationships over several years was considered to further enhance the value of the interactions.

Several clear messages come from the findings of this project:

- Establishing and sustaining work with schools as part of public engagement programmes is not easy and is not always given the recognition it deserves.
- The majority of the activity depends on enthusiasts and is widely seen as being over and above their required responsibilities.
- For the activities to be useful, the interventions should not only meet the needs of the schools but also provide value for the centres that can be articulated.
- There is more that can be done with only modest resource implications.

- Formalising the arrangements for the governance, staffing, budgets and planning would help to increase the programmes' effectiveness, impact and recognition; however, scope must be given for innovation and the enthusiasm of individuals, both of which must be encouraged.

It is clear that across the centres, a great deal of good activity with schools is occurring as part of their public engagement programmes. Overall commitment to this work is high, and there is a desire to improve the quality, quantity and range of the activities being undertaken. Several of the centres have started to explore ways in which further developments might take place.

Recommendations

In responding to these findings and strengthening the public engagement work of the centres, the Wellcome Trust and the centres should do the following:

- Include and explicitly fund a public engagement programme that includes work with schools in each of the funded research centres.
- Develop a more strategic approach to the way in which centres approach work with schools, including:
 - appoint a public engagement coordinator with time dedicated to developing links with schools
 - establish work with schools and public engagement activities as a core area of activities with its own objectives and a defined budget
 - plan programmes with other stakeholders, including schools (e.g. through teachers' panels)
 - strengthen processes for monitoring, measuring and evaluating impact
 - encourage enthusiastic and committed individuals, a 'can-do attitude' and the sharing of ideas.
- Establish a community of practice for the centres to work together to exchange ideas on activities and – just as importantly – to share good practice in terms of planning, organising and evaluating programmes and activities. In particular, there should be an annual workshop (possibly over two or three days) in which the issues are explored and progress is shared. Communication between these workshops could be supported by various electronic and digital media, as appropriate.
- Publish materials to support the centres in developing and implementing their strategies, objectives and programmes. The guidelines that accompany this report, 'Working with Schools in STEM Public Engagement', are an initial contribution to these supporting materials.
- Make several small grants available (e.g. up to ten grants of £5000–£10 000 per year), which centres could bid for to enhance their work with schools.
- Review the progress of centres in this area in three years' time and incorporate public engagement activity, including work with schools, as a discrete reporting line in centre funding reviews.

Introduction

Efforts by researchers and research institutions to engage the wider public with science, technology, engineering and maths (STEM) have increased significantly in recent years. Many organisations aim their activities at young people to generate interest in STEM subjects and careers in STEM and related sectors. An obvious route to this audience is making links with schools; however, engaging with schools in an effective way that leads to improvements in the experiences and achievements of young people is often a challenge for research institutions.

Traditionally, contact with schools was usually made through local authorities, but the situation has changed markedly in the past 10–15 years. Today a complex environment has resulted from changes in government policies giving increased autonomy to schools, the introduction of academies and free schools outside local authority control, and shifts in local authority services. The landscape is further complicated by the increasing number of organisations (charitable foundations, non-governmental organisations, industry and universities) wishing to engage with schools and the lack of clear channels through which contacts can be made.

The difficulties faced by the organisations wishing to work with schools are mirrored by the frustrations felt by schools. Already under pressure from performance tables, schools receive large numbers of requests to get involved in a wide range of initiatives and campaigns across different curriculum areas, not just STEM. Thus the challenge of engaging with schools, especially those defined as ‘hard to reach’, is becoming more and more complex.

Aims of the study

This report presents the findings of a study, the main aim of which was to examine how Wellcome Trust-funded research centres might, through their public engagement programmes, engage with schools more effectively to contribute to improvements in the quality of STEM education available for young people.

A secondary aim was to explore what schools consider to be the benefits of engaging with research centres and ways in which such engagements might be better facilitated to further improve the quality of the experiences available.

In particular, the study endeavoured to:

- gain an overview of current practice in relation to school links as part of the public engagement activity of the centres
- identify examples of the approaches used
- explore how the effectiveness and impact of the approaches are evaluated
- develop some guidelines to help centres improve the quality and sustainability of their engagement with schools.

This report sets out the findings of the study and makes proposals for enhancing research centres’ work with schools. It should be emphasised, however, that many of the issues addressed also relate to public engagement activities more generally. A separate document, ‘Working with Schools in STEM Public Engagement’, offers some guidelines (exemplified with case studies) for research centres developing their work with schools.

Basis of the report

The findings of this project are based on evidence collected in two stages:

Stage 1: Scoping study

- (a) Desk-based research to identify existing publications designed to provide support for organisations working with schools and any research that has addressed this particular issue. The principal searches were conducted using internet search engines (Google and Google Scholar), the British Educational Index and the Education Research Index Catalogue.
- (b) Reviewing the websites of each of the centres, plus collating additional materials, including extracts from the annual reports of centres where available.

- (c) Telephone conversations (30–40 minutes each) with people from three centres and the Wellcome Trust. In addition, a face-to-face conversation was held with the Head of Special Projects, who has overall responsibility for supporting public engagement activities relating to the research centres.

Stage 2: Centre visits and interviews

- (a) This was the main data-gathering phase, during which each of the centres was visited and interviews were conducted with a range of personnel. Where possible, this included the centre Director, as well as researchers and individuals responsible for coordinating public engagement activity. These visits were supplemented by telephone and email communication.
- (b) Telephone interviews were conducted with ten teachers (two primary and eight secondary) from schools who had used one or more of the centres in some capacity.

Existing literature

Research relating to public engagement with STEM is increasing and reflects not only the volume of activity but also the wider discussion on the nature of public engagement in this arena (see, for example, Holliman et al., 2009). Within the wider debate that is taking place, “activities with children and young people – whether in the lab, at schools and colleges, in museums or at science festivals – are central to...understandings of public engagement” (Burchell et al., 2009, p.48). Despite this, no formal research studies or evaluations have been identified specifically examining the ways in which universities, institutions or research centres engage with schools in STEM subjects or any other field.

In their 2008 report for DIUS, Coyne and Goodfellow examined universities’ links with schools in STEM subjects.¹ Their report outlines the wide range of quality activities that are undertaken by universities, but it also highlights the fragmented way in which such activities take place. The recommendations for universities strongly reflect this fragmentation as they focus on “working more effectively within each institution [and] coordinating effectively with partners on reviewing the balance of activity between aspiration and attainment at different stages of a pupil’s development”. In short, the conclusion would seem to be that universities should take a more strategic approach to their engagement with schools.

Although there are many evaluations of individual projects in which organisations have worked with schools, the mechanisms for making links with schools were not evaluated in any significant manner. There are, however, a few examples of guidelines for working with schools, written for different groups such as employers in general (ISBA and DCSF, 2008), small businesses (FSB, 2008) and museums (Bristow, 2006). Two guides (Macdonald, 2004; Bamforth, 2005) and a resource pack (HEAE, 2003) that specifically focus on outreach with schools in areas of STEM are also available.

In addition, government initiatives (NCCPE, 2010) to increase the levels of public engagement activity have generated materials to support such work (e.g. ‘The engaging researcher’, Duncan and Spicer, 2010). RCUK, on behalf of the research councils, produced the publication ‘Engaging Young People with Cutting Edge Research: A guide for researchers and teachers’ (RCUK, 2010).

Not surprisingly, there is overlap in the content of the guides but, despite being published in the past five years, they need updating – especially in the information relating to education matters such as curriculum and qualification requirements.

It is worth noting the study by Burchell et al. (2009), which highlights two key issues: the fact that work with schools and young people is seen as integral to public engagement, and the tensions that are experienced in this area of activity between researchers and their organisations. Both findings are also reflected in the present study.

¹ The Department for Innovation, Universities and Skills is now the Department for Business, Innovation and Skills (BIS).

Centres and areas of activity

The 11 centres used for this study all receive funding from the Wellcome Trust. The eight designated Wellcome Trust Research Centres and the Sanger Institute received core funding at the time of this study. The Wellcome Trust makes a significant contribution to the Diamond Light Source facility and is a major partner and funder in the Francis Crick Institute, which is due to open in 2015. Table 1 lists the centres and their areas of research activity.

All 11 centres have a clear strategic vision for carrying out world-class scientific research and are expected to engage with the public about their work.² As part of these public engagement activities, all of the centres have some links with schools, but – unsurprisingly – their level of involvement varies.

Current situation in the centres

There is no question that all the centres have a commitment to public engagement and, to varying degrees, to working with schools and young people. All of the centres have a general public statement of their commitment to engaging the public with their work. A large majority of the activities provided by the centres for schools take place because of the personal commitment and enthusiasm of individual researchers and technical and administrative staff, but not all centre personnel get involved.

Although there is no doubting the positive attitudes, the overwhelming view is that work with schools is not part of the job: as one researcher put it, “it’s a hobby, really”. The majority of researchers involved derive satisfaction from their involvement and express this in various ways, including “It gives me the opportunity to step back and remind myself why I do science in the first place”. A few go so far as to say “I am made to think about my research in a different way,” or “developing cutting-edge ideas at the boundary between art and science helps me to think through problems”.

To a large extent, the range of activity and the degree to which staff are involved reflects the age, history, location, size and personnel of the centre. In general, the more established centres have more sophisticated approaches to their work with schools, reflecting the fact that building relationships with schools takes time. For some centres this work is done through direct links with particular schools, but for others it occurs via other events (e.g. science festivals to which the centre makes a contribution). The majority of the work is done with secondary schools, but there are several examples of ways in which centres engage with primary schools.

Activities involving direct contact with schools include:

Talks in schools

By far the most common type of activity is for centre researchers to go out to schools to give a talk, usually addressed to secondary-aged young people. Most of these talks result from requests, which are often one-off, for someone to talk to the A-level biologists or for “a scientist” to come to a primary school.

School visits to the centres

Visits to centres by school groups also feature strongly and, like the talks, tend to arise from schools approaching the centre. In the centres with more established programmes, some schools make repeated visits, which can be specifically designed to address a particular aspect of the curriculum.

² See the Wellcome Trust Strategic Plan 2010–2020.

Table 1. Research centres funded by the Wellcome Trust included in this study

Centre	Current research activity
Wellcome Trust Centre for Cell Biology, University of Edinburgh	The synthesis, processing, localisation and degradation of RNA; epigenetic control of chromosome function; mechanisms of cell growth and duplication; and the rules that govern cellular architecture.
Wellcome Trust Centre for Cell Matrix Research, University of Manchester	Cell matrix assembly and tissue regeneration, including precise molecular details of its composition; cell matrix signalling; and cell fate and cancer.
Wellcome Trust Centre for Molecular Parasitology, University of Glasgow	A range of studies on the basic research of parasite biology and associated translational activities, such as disease intervention and molecular epidemiology, using parasites from several genera including <i>Trypanosoma</i> , <i>Plasmodium</i> , <i>Leishmania</i> and <i>Trichomonas</i> .
Wellcome Trust/Cancer Research UK, Gurdon Institute, University of Cambridge	Developmental biology and cancer biology.
Wellcome Trust Centre for Human Genetics, University of Oxford	Bioinformatics, cardiovascular disease, genomics, immunity and inflammation, metabolism, neurogenetics, statistical genetics, and transgenics.
Wellcome Trust Centre for Stem Cell Research, University of Cambridge	The fundamental properties of embryonic, fetal and adult stem cells.
Centre for Gene Regulation and Expression, University of Dundee	Using quantitative approaches to study gene expression, particularly live cell imaging and proteomics.
Wellcome Trust Centre for Neuroimaging, UCL	How thought and perception arise from brain activity, and how such processes break down in neurological and psychiatric disease in relation to all aspects of higher cognitive function including vision, memory, language and reasoning, emotion, decision making, and motor control.
Wellcome Trust Sanger Institute	Understanding the role of genetics in health and disease; discovery of the basis of genetic and infectious disease and provision of results that can be translated into diagnostics, treatments or therapies that reduce global health burdens.
The Francis Crick Institute, London	This new institute, due to open in 2015, has a distinctive vision of how medical research should be conducted. In particular, it will aim to generate new knowledge about the biological mechanisms controlling cell, tissue and body function. It is a partnership that includes the Wellcome Trust, the Medical Research Council, Cancer Research UK, UCL, King's College London and Imperial College London.
Diamond Light Source	By accelerating electrons to near-light speed, Diamond generates brilliant beams of light from infrared to X-rays that are used for academic and industry research and development across a range of scientific disciplines, including structural biology, physics, chemistry, materials science, engineering, and earth and environmental sciences.

Study days and workshops

Some of the centres run workshops or study days for students from local schools. In one centre these are targeted at A-level students and are run in partnership with the local museum, which hosts the event in its laboratory. A second centre runs practical sessions in biology as part of a university-wide initiative to provide hands-on experiences for potential students. Another centre, as part of its contribution to National Science and Engineering Week, runs a programme for primary schools that involves an initial talk by a researcher – given in the school to set the scene – followed by a visit to the centre, where the children carry out a series of experiments. This centre has recently been successful in obtaining a Royal Society Partnership Grant to fund a programme of work with two local secondary schools. Several centres are exploring links between science, art and other media to make links with schools directly or indirectly. Examples include the production of films, the development of a programme in which dance is used to explore ideas in science with primary-aged children, and the use of comics to explain topics.

The centres also engage with young people of school age by contributing to other events, including:

University open days

Many of the centres contribute to their host university open days for prospective students and/or the general public. Open day activities might include a tour of the centre, contributions to a programme of talks or simply an exhibition stand in a central location.

Science festivals and events

Several centres made significant contributions to their local annual science festival by providing an exhibition stand, a hands-on activity or lectures. One centre, initially through the contact of an individual member of staff, provides a programme of science activities for a local one-day event aimed at primary children.

Work experience opportunities

All the centres report having requests, often from family or personal contacts, for young people to do work experience in the centre. Although there are examples where this has been arranged, the health and safety regulations relating to people aged under 18 working in the laboratories are seen as a barrier. In some centres younger students are taken on in other capacities (e.g. working in an administrative role). In most of the centres, work experience is not arranged through the public engagement team.

Continuing professional development (CPD) for teachers

The majority of centres work directly with young people, but two centres explicitly provide CPD opportunities for teachers – usually through a third party, such as the National Science Learning Centre in England or the Scottish Science Education Resource Centre in Scotland.

Current practice: an analysis

Overall, the range of activity undertaken by the centres is engaging and impressive. Furthermore, there seems to be a willingness to do more to increase both the quality and the quantity of the programmes in public engagement generally and for schools in particular. With some variation, this is an attitude that is broadly shared by directors, group leaders, researchers, postgraduates, technicians and administrative staff. However, as one senior manager expressed it, “we need to move from public engagement [including school links] being a cottage industry to being a mainstream activity”.

To address this issue, this study used visits to centres and interviews with researchers to explore five questions:

1. To what extent do engagement programmes that involve schools form part of the strategic objectives of the centres?
2. Which factors encourage or hinder the development of engagement programmes that involve schools?
3. Which mechanisms are and could be used to strengthen links with schools?
4. Which conditions need to be put in place to encourage, support and sustain relationships and programmes?
5. Which types of advice and support would be welcomed to improve the effectiveness and impact of links with schools?

The analysis of current practice that is presented in this section draws principally on the responses to questions 1, 2 and 3. The section ‘Developing a strategic view’ (page 15), considers the findings from questions 4 and 5. It should be noted that despite examining the specific matter of links with schools, many of the issues raised in the interviews applied to public engagement more generally.

Six themes are used to present the analysis of current practice.

1. Attitudes towards, and recognition of, engagement programmes that involve schools

The importance of creating the right attitudes towards public engagement activities in general, and work with schools in particular, cannot be overestimated. Despite the generally high levels of commitment and enthusiasm in the centres, significant concerns exist under the surface. Predominant among these is that “there is no personal benefit to researchers [and it is not considered justified] in terms of the research grant”. Put more succinctly, “there are no Brownie points for doing it”.

Participation is mainly the decision of the individual, but on occasions they feel they have to withdraw because of pressure from research leaders. In a small number of situations, there is “suspicion and scepticism as to whether this is a valuable use of time”. The lack of formal recognition reinforces the view that public engagement activity lies outside peoples’ contractual obligations and, for many individuals, it is thought to have implications for their career prospects.

Everyone fully accepts that the top priority for individuals and the centres overall is to make progress in their research; therefore, recognising contributions in other areas is not straightforward. It is particularly problematic for individuals who take on coordinator roles, for whom steps must be taken to avoid this becoming “a second-class career route”.

Being mindful of these issues, several of the centres have developed informal ways of giving public recognition to individuals for their contributions to public engagement programmes (e.g. prizes for public engagement). Several centres are considering introducing an expectation that staff contribute to public engagement, by including it in job descriptions and reviewing it as part of the appraisal process.

The importance of changes in the external environment is also recognised by many of the centres. The establishment of the Beacons for Public Engagement (www.publicengagement.ac.uk/about/beacons/) was highlighted during some of the interviews, along with some funding bodies now requiring public engagement activities. The impression in most centres is that this whole area of work is becoming increasingly valued locally, regionally and nationally. Work with schools is high on most people’s priority lists.

2. Purpose and objectives of working with schools

It is an expectation that all centres undertake public engagement activity; for some sources of funding, it is a requirement. However, meeting such requirements is not in itself an indicator that the activity has a clear purpose beyond minimum compliance. Only two centres had a written strategic plan for public engagement that included work with schools, but two others were in the process of developing one to guide their work over the next three to five years. Notwithstanding the lack of written plans, most centres did articulate objectives (not necessarily shared with or by all staff) when asked, which included:

- to raise the importance, and to some extent the accountability, of the work we do in science
- to improve the image of science and scientists
- to make the experience useful for scientists and increase their interaction to raise aspirations of young people
- to provide support and resources for staff to make public engagement accessible for both staff and customers.

The lack of clear direction seems to result in some frustration, and for some researchers it results in a sense that they have to “waste” time finding out what they have to do and then “pulling something together”. Increasingly the centres are giving their programmes more structure and developing greater consistency in what they do. This may be in terms of the content, the audience or the type of event, or a combination of all three. Developing a focus for activities seems to be contributing to greater acceptance, especially when it builds on the strengths of the research being carried out. For some researchers this is seen to be adding value in promoting the main priority of the centre (i.e. doing research in their field).

Those centres that had, or were moving towards, a strategic plan saw it as an important step in developing a more sustainable approach to the work with schools. However, this is not without its challenges.

3. Leadership, management and staffing

After the support of the director of the centre, identifying individuals with specific responsibility for coordinating engagement activities is seen as the key element in establishing sustainable, quality programmes for schools.

At a practical level, the tasks that need to be done to put on an event – even something as simple as an external talk – take time. If these arrangements have to be made by individual researchers, this takes them away from their research and can make them less willing to contribute. Almost all the designated coordinators in the centres said that they had set themselves the objective to minimise the time researchers had to be away from the bench. In doing so, they were able to maximise the benefits of the experience for both the researcher and the ‘customer’.

In addition, several interviewees considered that planning programmes involving resources and activities that can be reused or shared in some form maximises the return on the time and effort needed to work up presentations and practical activities. Two of the coordinators also pointed out that “[the researchers] all don’t need to do talks” – coordinating the activities helps to spread the load and involve researchers in different aspects of the work by, for example, writing blogs, leading tours around the centre, responding to questions via emails, and producing safe protocols that model the experiments carried out in the laboratory.

In the centres that have a coordinator, their time allocation varies from 10 per cent to 80 per cent of the individual’s time. Clearly, having dedicated time available strengthens the position of both the individual and work with schools. Just as importantly, coordinators who have been given extended appointments (more than one year’s duration) felt they were able to plan ahead and focus on embedding relationships, which was considered particularly important in working with schools.

Coordinators have restrictions on their time because they are often researchers with dual priorities or are on restricted contracts. A frustration affecting most individuals in these roles is that this responsibility rarely forms part of their appraisal, especially when the time allocation is low.

Administrative support is also important. In one centre an administrator has some designated time to support work with schools. This has a significant positive impact on the level of activity and, it would seem, on the willingness of researchers to get involved. In the majority of centres, such support relies on goodwill and is not necessarily seen as part of the administrator’s job.

Staff training

All the centres recognise the need for training staff involved in public engagement activities and argued strongly that undertaking such activities enabled researchers to develop their wider communication skills. Indeed, this was generally presented as a major selling point for getting individuals to contribute to the programmes. The training opportunities were seen as particularly valuable to postgraduate and postdoctoral researchers. The lack of recognition for such training is considered a drawback, but some centres are exploring the possibilities for certification.

The models for training provision range from dedicated courses at the centre and the use of external provision to informal mentoring and advice. Much of the training is generic, but for those working with schools there is a demand for material that is specific to matters concerning current curriculum requirements for different age groups. In particular, many researchers want advice on how to make their research relevant to the needs of the students.

4. Communicating with schools

All of the centres had contact with schools, but the closeness of their relationships varied enormously. Many were one-off talks that had been requested. Other relationships had built up over several years as the schools made repeated visits to the centre and/or received speakers on a regular basis. The two most common forms of initial contact with schools are through personal links (members of centre staff or close friends) and direct approaches from schools looking for a link with a local scientist. For the most part, contact with other schools has increased through word-of-mouth recommendations from teachers to their colleagues.

Some of the centres have taken steps to make contact with schools using their links with the host university and, to a lesser extent, through other science-focused organisations. This was driven in part by concerns that the centre was only working with a restricted number of schools and in part by a wider desire to raise the profile of science and the centre. Some centres have also built up their own databases of contacts with individual teachers and are taking a more proactive approach to establishing links.

It is interesting that no centre has contact with local authorities, but several have established links with other science-focused organisations that support enrichment activities for young people nationally (e.g. STEMNET) or locally (e.g. Science Oxford). Participation in schemes such as STEM Ambassadors is sporadic.

Although there is a desire to extend their reach, all of the centres have limited capacity to respond to requests for talks in schools or visits to the centre. This is principally down to the availability of staff, but accommodation, resources, time, and health and safety regulations all add to the constraints. For many centres the potential for expansion is currently seen to be limited.

In a few centres, discussions are taking place about how to reach a wider range of schools by using web-based materials. Although all the centres have their own websites, which refer to their public engagement work with schools, only a minority have sites devoted specifically to resources to support their links with schools. It is also thought that the use of web-based material and other media could strengthen relationships with particular schools, help teachers clarify the outcomes they would like from their interaction with a centre, prepare pupils better and help researchers to link their research to the needs of the students more effectively.

On a more practical note, several centres expressed concern that schools, often unwittingly, created disincentives for centres to engage with them. One particular frustration is the difficulty of contacting not simply the school but the right person in the school. This is time consuming but can also lead to misinformation, differences in the expectations of the two parties and the potential cancellation of sessions, to the disappointment of everyone. Researcher-presented talks in schools are relatively easy to organise, but making arrangements for groups of students to visit the centre is not always straightforward for the centre or the school. Transport costs, the timing of visits and risk assessments cause particular difficulties.

Finally, it should be noted that discussions on communication with schools addressed issues of logistics almost exclusively. With only one exception, no references were made to the involvement of teachers in the

development of programmes or the design of activities. Although some ideas are gleaned informally during general conversations with teachers, no centre has a formal mechanism in place for consulting teachers as part of the planning process.

5. Funding and resources

Although the level of funding is not seen to be a major issue for ongoing activities, there are concerns at two particular levels.

The first is the lack of a core budget. In all but three of the centres, funding for school activities came from the Director's discretionary fund. While acknowledging the overall support for these activities, it is thought that the lack of a dedicated core budget made it difficult to plan ahead because decisions are generally made on a case-by-case basis. This has implications for the way in which the activities are seen as part of a centre's work and reinforces the idea that public engagement and work with schools is an optional extra.

The second is the cost of staff time. Most of the current activities do not involve significant cash outlay but have a major cost in people's time, which is unaccounted for. This reinforces the view that these activities are done in one's own time.

Although having an explicit core budget is regarded as being important, coordinators recognised that additional funding would be required if they wished to undertake further activities to stimulate new initiatives. Centres that had already taken advantage of additional funding from the Wellcome Trust and other bodies expressed the view that gaining such funding raised the profile of the work internally and externally. From a researcher's point of view, having funding to buy out their time was felt to legitimise developing and delivering such activities. Additional funding is also able to overcome other, more practical, barriers such as the transport costs for getting schools to come to a centre.

6. Accountability, monitoring, evaluation and impact

It is fair to say that the majority of the time spent during the interviews and visits focused on descriptions of the different "things we are doing". Although centres do have evidence to show, for example, the number of visits and talks they do in a year, the processes for monitoring and evaluating the activities are generally minimal. As one interviewee stated, "even getting a list together for the annual report is a chore".

Centres evaluate their events and gain feedback using what one interviewee described as "the happy sheet" to find out the level of satisfaction with a particular experience and to identify ways in which it might be made a better product. All the centres recognise that this is not sufficient, and they are at different stages in trying to develop more rigorous approaches.

Evidence of impact is almost entirely informal and drawn from conversations with centre staff who have been involved, participants and teachers. There are examples of changes in pupil behaviour and attitude following a visit to a centre, as supported by the interviews with teachers in this study (see page 17). When such evidence is not gathered systematically and only rests in the heads of coordinators, it risks being lost.

In terms of accountability, only two centres have formal governance arrangements in place that relate specifically to public engagement including work with schools: one is an internal group and the other an advisory group involving external parties. For most of the centres, public engagement activity is agreed on a one-to-one basis with the director with no formal reporting lines. Although everyone values the support of the director, there is some concern that the lack of transparent lines of communication and accountability undermines the status of the programmes and reinforces the sense that public engagement remains a "hobby".

To summarise

Despite the overall enthusiasm and personal commitment to working with schools, the majority of centres have yet to fully incorporate these activities into their planning. As a group, the centres are on an evolutionary continuum regarding their work with schools; there is a pattern of increasing integration of the activities into the overall work of the centre, and all of the centres recognise that there is much to do. The next section discusses ways in which work with schools might be strengthened.

Developing a strategic view

This study seems to have been timely: the majority of centres seemed very receptive to the questions about developing their work with schools. All centres recognised that they had made progress but that much of the development had been reactive rather than proactive. Although this organic growth has been successful to some extent, there seems to be a strong view that to take things forward requires planning that is integrated with the overall strategy for the centre.

The steps for each centre would be different but, drawing on the responses to questions 4 and 5 in particular, consideration needs to be given to:

- clarifying the purpose of work with schools and establishing clear objectives for it
- planning for development over an extended timescale – say three to five years – in line with the core grant
- dedicating time, responsibilities and recognition for contributions to the activities
- ensuring transparency in monitoring, accountability and evaluation
- incorporating mechanisms for improving sustainability, which might include introducing robust governance structures, succession planning for staff, managing partnerships, and the effective use of digital and social media.

There is an important caveat. Much of the exciting work with schools' outreach has been done by enthusiastic and committed individuals. This is still clear across the centres and must be kept and encouraged; thus, reporting suggestions for improved forward planning does not imply there is no scope for innovation and improvisation. On the contrary, the necessary space and time needs to be created at all levels and a 'can-do attitude' encouraged.

As new ideas are proposed and developed, they can be brought into the main programme as required and shared with other colleagues for wider use. Coupled with these developments is the need to identify opportunities to test out ideas and to keep up to date with what is happening elsewhere in the field.

Although centres intend to continue with their own plans, additional forms of support were identified during the interviews.

1. Continued efforts to raise the status and profile of public engagement activities

In the context of science research centres, the perception of work with schools is still very much that it is a "hobby" and not part of the main job. Although it is recognised that the situation has improved significantly, continued efforts are needed to raise the status and profile of such activities. This might include formal recognition (and reward) in job descriptions, as well as more informal acknowledgements through awards and prizes.

The development of a training package for researchers was also suggested and has several benefits: encouraging researchers to take advantage of the opportunities, contributing to personal and career development, and improving the quality of the work done with schools.

2. Opportunities for networking with other centres and organisations

The idea of getting together with other people "doing this bizarre job" was proposed by all those with some responsibility for coordinating activities. One coordinator admitted to feeling "isolated", and all of them indicated that opportunities for exchanging ideas, developing relationships and possibly exploring joint activities would offer significant benefits.

Many of the centres were unaware of things that were going on elsewhere, which posed a problem if they got a request they were unable to fulfil. It was indicated that a mechanism for sharing information about what other centres offer might be of value so that requests could be passed on. This specific suggestion was in addition to requests for advice on ways in which the wider world of developments in science education might be accessed.

3. Access to small grants to support additional activity

Although the issues of budgets and funding were not dwelt upon, requests for access to small grants (up to £5000) were made on several occasions. Grants of this size could be used, for example, to fund the

development of new activities to facilitate trials (and extensions of existing ones), to involve an increased number of schools at events or to build up an equipment bank that could be used on- or off-site.

4. Advice on ways to improve evaluation and impact measurement

For many centres evaluation and impact measurement was a major issue. Although all the centres indicated that they attempt to evaluate their activities, they also recognised they were only scratching at the surface and would welcome support and advice on ways in which they might improve their evaluation to increase the quality of the activities and programmes.

To summarise

Based on the evidence from the interviews, key elements in helping centres to raise the profile and impact of their work with schools include: individual commitment, particularly from the director, to such activities; the appointment of a coordinator with dedicated time; agreement of strategic objectives and medium-term goals; incorporation into the governance arrangements; allocation of a core budget; and establishing monitoring and impact measures for reporting and improvement purposes. Importantly, consideration needs to be given to the timescale for the changes, which need to become embedded in the culture of the centre as they do not happen overnight.

The schools' perspective

Although the principle aim of this study was to consider the way in which the Wellcome Trust-funded centres worked with schools, it was important to gain an insight from the schools' perspective. Interviews were therefore conducted with ten teachers. Their responses, which are reported in this section, help to triangulate the findings from centre visits and give an indication of the impact the activities have on students and teachers.

The enthusiasm of the teachers interviewed for the work of the centres is very clear. They all appreciated the time and effort the researchers and administrators at the centre put in to provide their students with a positive experience. This reaction from the teachers was not unexpected because they had been identified by the centres and, by agreeing to be interviewed, were self-selecting. Attempts were made to involve schools that had, for example, approached a centre but withdrawn from the activity or event; unfortunately, these efforts failed.

All the teachers had used at least one centre once, and some had used them for several years. The majority based their responses on taking groups of students on visits to the centre. Two had been involved in a project that involved centre staff working in school, and two others had taken groups of students to events arranged and run by a centre.

Benefits of engaging with a centre

The teachers identified a range of benefits coming from involvement with the centres. Although everyone referred to the need for the activity to be relevant to the curriculum in some way, this is not seen as the main value for the students or the main reason why the teachers organised the activity. The responses fall into five categories.

1. Bringing science alive

All of the teachers are committed to finding ways of bringing science alive for their students in a way that is not possible in school. What the activities with the centres provided was described in many ways, including: "it gives the wow factor", "it provides reference points for what we do in school", "pupils hear a different voice" and "they get it from the horse's mouth". Being able to experience experiments that are not possible in school (even though the students were not necessarily able to perform them) added to the interest.

2. Showing scientists are human

Meeting 'real scientists' and young researchers is seen as a major benefit in helping students realise that "[scientists] are real human beings". In some cases, the contact with researchers continued after the visits via email.

3. Career possibilities

Many of the teachers valued the opportunity for students to see scientists in their own environment and to get a feel for what working as a scientist might be like. At least two of the teachers stated that one of their reasons for visiting such centres is to give their students 'a wider perspective beyond medicine and dentistry', which are, too often, seen as the career routes for those doing science A levels.

4. The impact back in school

When asked whether they saw any impact on students that lasted beyond the visit, the majority of teachers gave examples of students in whom they had seen a significant change in attitude towards their studies. This was particularly the case with post-16 students basing their Extended Project Qualifications on something they had seen or done during the centre visit and referencing the visit in their personal statements on university application forms.

5. Inspiring teachers

Several of the teachers emphasised that their links with the centres inspire them as teachers, as well as their students. They noted that visits help them to keep up to date with particular topics and rekindle their own enthusiasm for their subject.

Barriers to developing links with centres

Without exception, the teachers pointed out that setting up visits and arranging talks or other activities is not without its problems. The most common issues are related to funding for transport and supply cover, the logistics of getting students to and from centres, and obtaining permission from senior management

teams; even when senior managers are broadly supportive, there is still a requirement for the visit to be justified on educational grounds (i.e. it must support the curriculum in some way).

Other reservations concerned limitations on group sizes imposed by the centre, which make it impossible to include all the students in a particular year group. This was less of a problem for post-16 students because their teaching groups are smaller and their timetables are more flexible. Schools also found the timing of visits difficult in relation to when particular topics were being studied or when examinations were held.

Despite acknowledging the barriers, none of the teachers felt they were insurmountable – indeed, they had all demonstrated it was possible to overcome the problems they faced. However, the view was expressed that things are not getting better, so ‘anything a centre can do to make it easier for teachers’ would be appreciated.

Awareness of centre activities

Schools most commonly found out about a centre through personal contacts – via family or friendship links to centre staff, through PGCE tutors or fellow teachers who had used the centre, by attending CPD courses that included someone from the centre, or through a recommendation from the course leader.

Despite one teacher stating that they ‘don’t get as many leaflets as you might think’, mailings into schools were not referred to directly. Related comments included “the information we get is filtered” and “leaflets that come into school are unlikely to get through to me”. It seems clear that mailshots into schools have a low impact, but no one had any suggestions about how centres might raise their profile with more schools.

Several of the teachers explained they had found the centre via a web search or through the Wellcome Trust website or a direct link to the centre website. The teachers who raised the issue of websites were generally positive about the material they had been able to access but were also concerned that it was not particularly clear what was available for schools. In turn, they believed this made it difficult for teachers to decide whether making a link with the centre would be beneficial; the implication here is that some teachers do not go any further and look elsewhere.

Improving the experience

Two of the teachers said they could not think of anything that could have improved their visit to the centre. The others also praised the experience they had with the centre but made some suggestions about how things might be improved.

The suggestions most commonly related to logistics and funding. They included travel bursaries to cover the cost of a coach, a menu of preset programmes for schools to choose from that could be presented to senior managers, pre-prepared risk assessment *pro forma*, and a room where students could leave their bags and coats and eat their packed lunches.

Of the suggestions relating to content, the main one was for the provision of materials about the centre and pre- and post-visit activities for students. Specific resources available on the centre website would be particularly useful here. More generally, centres were encouraged to ensure that what they offered enhanced the curriculum.

A minority of the teachers requested courses for teachers at the centres. They argued that these would not only inspire them as individuals but also enable them to become more comfortable with the science before doing it with their students. In addition, as indicated above, courses for teachers could act as a stimulus for increasing school links with a centre.

Problems with communication between the schools and centres were mentioned. Several teachers said how difficult it can be to finalise arrangements for a visit or activity but could not suggest a solution that would guarantee the problems would be removed.

To summarise

The teachers interviewed were very positive about the experiences they and their students had with the centres and emphasised the positive way in which researchers interacted with young people. Building up the relationships over several years was considered to enhance their value further.

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Appendix I: Interview template for research centres

Questions	Prompts	Comments
Section 1: To explore the degree to which engagement programmes which involve schools are a priority and form part of the overall objectives of the centre.		
<ul style="list-style-type: none"> Does public engagement form part of the overall strategic plans for the centre? To what extent is developing links with schools a priority in the centre plans for public engagement? Is there a key objective for developing links with schools? How is this area of activity managed? What is the impact of such activities? 	<p>Why is it /isn't it important? Is there a policy? Who are is involved? Who makes decisions? Processes for monitoring / evaluation; measures of impact.</p>	<p>It is recognised that the main purpose of the centre is to do research but within that context public engagement is considered important for a range of reasons.</p>
Section 2: To identify the factors which encourage such activity and the barriers which hinder it in the centre.		
<ul style="list-style-type: none"> What do you see as the barriers to engaging with schools? What do you think could be done to overcome some of these? What do you think are the factors which encourage / support effective engagement? 		<p>Need to push beyond the general responses such as 'time', 'funding' etc.</p>
Section 3: To describe the mechanisms by which links with schools are made.		
<ul style="list-style-type: none"> What mechanisms /channels are used by the centre to engage with schools? Who are the key people / gatekeepers in the process? Do you think different models of engagement more effective in some circumstances than others? To what extent do you think the models of engagement vary according to the type and scale of activity involved? 	<p>Use of existing databases Outreach officer of University Widening Access Other organisations and networks e.g. STEMNET.</p>	<p>Try to identify ways in which workloads/time demands might be minimised.</p>
Section 4: To explore possible mechanisms and factors that enable programmes and relationships to be developed, expanded and sustained.		
<ul style="list-style-type: none"> How might your engagement activities be scaled up to involve increasingly large numbers of schools? In what ways can engagement activities be made more sustainable/ self-sustaining? What do you think are the opportunities for, and threats to, improving the mechanisms for engaging with schools in the future? 	<p>Partnerships. Issues of quality Changes of personnel. Support from funders and other organisations including government / research councils.</p>	<p>Some centres may not wish to expand level of activities so the emphasis needs to be gauged accordingly.</p>
Section 5: To identify the types of advice and support that would be welcome to improve the effectiveness and impact of links with schools.		
<ul style="list-style-type: none"> What kinds of thing would help you in supporting the development of links to schools? 	<p>Guidelines Case studies Possible networks Sharing of good practice.</p>	<p>Open question</p>

Appendix 2: Interview template for schools

Section 1: To explore the degree to which engagement programmes which involve science research centres are a priority and form part of the overall objectives of the school. What are the benefits?

Questions	Prompts	Comments
<ul style="list-style-type: none"> Do links with organisations such as research centres form part of the overall strategic plans for the school? To what extent is developing links with research centres a priority in the plans of the school / science department? Is there a key objective for developing links with external organisations such as research centres? How is this area of activity managed? What is the impact of such activities? 	<p>Why is it /isn't it important? Is there a policy? Who are is involved? Who makes decisions? Processes for monitoring / evaluation; measures of impact.</p>	<p>It is recognised that engaging in links with external bodies is not specifically part of the curriculum but that there are benefits to the over all education of young people.</p>

Section 2: To identify the factors which encourage such activity and the barriers which hinder it in the school and more widely.

<ul style="list-style-type: none"> What do you see as the barriers to engaging with such centres? What do you think could be done to overcome some of these? What do you think are the factors which encourage / support effective engagement? 		<p>Need to push beyond the general responses such as 'time', 'funding' etc.</p>
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Section 3: To describe the mechanisms by which links with schools are made and which ones the school responds to and why.

Questions	Prompts	Comments
<p>What mechanisms /channels are used to engage with schools? Who are the key people / gatekeepers in the process? Do you think different models of engagement more effective in some circumstances than others? To what extent do you think the models of engagement vary according to the type and scale of activity involved? Which approaches do you tend to respond to and why?</p>	<p>Mailshots Personal contacts Recommendations Networks e.g. STEMNET.</p>	<p>Try to identify ways in which workloads/time demands might be minimised. Try to tease out what makes an approach attractive and what doesn't.</p>

Section 4: To explore possible mechanisms and factors that enable programmes and relationships to be developed, expanded and sustained.

Questions	Prompts	Comments
<p>How might your engagement activities be scaled up to involve increasingly large numbers of pupils?</p>	<p>Partnerships. Issues of quality Changes of personnel.</p>	<p>Some schools may not wish to expand level of activities so the emphasis needs to be gauged</p>

In what ways can engagement activities be made more sustainable/ self-sustaining? What do you think are the opportunities for, and threats to, improving the mechanisms for engaging with external organisations in the future?

Support from funders and other organisations accordingly. including government..

Section 5: To identify the types of advice and support that would be welcome to improve the effectiveness and impact of links with schools.

Questions	Prompts	Comments
What kinds of thing would help you in supporting the development of links with other organisations?	Guidelines Case studies Possible networks Sharing of good practice.	Open question

