

February 2010

SCIENCE FOR ALL

Report and action plan from the
Science for All Expert Group

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This report has been produced by the Science for All Expert Group, an independent group supported by a Secretariat from the Department for Business Innovation and Skills

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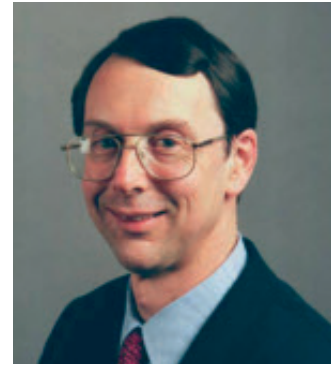
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Introduction from Roland Jackson, Chair

The Science for All Expert Group was asked to develop an action plan, in discussion with Government and other stakeholders in response to the Science and Society consultation, to:

- deliver a shift in cultural awareness, recognition and support for science by building on the Science:[So what? So everything] (SSWSE) campaign*
- develop a co-ordinated public engagement framework which is sufficiently flexible to recognise a range of engagement activity (professional & volunteer, national & local) and creates the conditions for increased participation and debate*
- achieve greater acknowledgement of the importance of public engagement activity supported by increased training and recognition in all sectors*
- ensure public perspectives are sought, recognised and responded to by the scientific and policy communities*



In response to this brief, the Group has produced a vision for a healthy science and society relationship and a substantial set of actions and recommendations which we believe will help achieve the objectives set us and lead towards achieving the vision.

We produce this report and action plan against the background of largely positive attitudes to science in the UK, an increasing commitment to public engagement, and a diverse and innovative range of engagement activities by individuals and institutions which are well respected internationally. Nevertheless, there remains a need to embed these activities, to continue to improve their scope and quality, to bring initiatives together better for greater effect, and to assess their impact.

Process

The work of our Expert Group followed the public consultation on the UK's Science and Society Strategy, which ran between July and October 2008. Given this extensive prior consultation we did not build in any further substantive consultation during our work. We did, however, seek wider input early on through the BIS website, which gave us some useful pointers. We also specifically reviewed all the suggestions which emerged from the consultation itself.

The Expert Group had a total of four full meetings between July 2009 and January 2010. The three main strands of our work, described below, emerged early on. In parallel, seven specific areas of focus became apparent:

- a vision for public engagement;
- understanding the purposes and motivations for public engagement;
- the relationship of the sciences to culture;
- recognition and reward;
- training and development;
- mapping the 'landscape' of public engagement; and
- embedding public dialogue in institutions – later broadened to embedding public engagement overall

At our first meeting we set up seven working groups to cover these areas and I am especially grateful to the chairs of these groups for the work they led; Kerry Leslie (for Alan Thorpe); Paul Manners; Clare Matterson; Lesley Paterson; Kathy Sykes; and Nick Winterbotham.

To inform the development of this report and action plan, we commissioned seven contributing pieces of work, which we provide in full alongside the report and summarise within it. These consist of:

- an academic review of the evidence base surrounding the value of public engagement by scientists;
- a study of the relationship of the sciences to broader culture;
- a mapping of public engagement activity across several sectors;
- a mapping of public engagement competencies;
- a review of the research into reward and recognition for public engagement; and
- two complementary reviews of behavioural change and organisational learning.

A word on definitions

The words 'science' and 'scientist' have different meanings to different people within British culture, and are generally more narrowly defined than in other cultures and languages. We have adopted, for practical purposes, the definition of the sciences on the BIS website, namely encompassing research and practice in the physical, biological, engineering, mathematical, health and medical, natural and social disciplines, and research in the arts and humanities. In consequence, throughout this report we refer predominantly to public engagement with the 'sciences' rather than 'science', and encourage others to do the same.

Likewise we use the word 'scientist' to include researchers and practitioners in these disciplines. This report is therefore aimed not just at research scientists but at everyone involved in the scientific enterprise broadly defined including, purely for illustration, engineers, technologists, mathematicians and doctors.

Indeed, the concepts behind our report and plan are largely generic to public engagement. Although this is outside our remit, many of the principles in this report would equally apply to, for example, the legal or banking sectors. Some would argue that it is time other major sectors examined their relationships with the public in the open way demonstrated by the scientific community in recent years.

Outcomes and future development

Our work has led us to a picture of an interlocking system of public engagement activities and of the organisations involved. Our action plan is directed in two ways. On the one hand, we suggest ways to improve the myriad relationships and processes within this system for greater effect. On the other hand, we seek to identify and influence major external factors which affect the culture and practice of public engagement. There are many purposes and motivations, from institutions and individuals, for public engagement and our report makes these explicit.

We offer this action plan as work in progress, conscious that it now needs challenging and further developing by those with shared interests, and that there may be specific areas (such as informal science education and the excitement of young people about the sciences) that we have not had time to address. We aim to create an open process for widely shared implementation and further development. There are some 60 individual actions and recommended actions in this report, varying from the very specific to the more general and challenging. It is hoped that societal groups will work in partnership with government,

funders, employers and science communication organisations to deliver this action plan. Some actions are already being taken forward by members of the Group and we look forward to other people and organisations joining with us to help realise these actions and others.

Thanks

As Chair of this Group I should like to thank everyone who has contributed to this plan: members of the Group itself; the chairs of working groups, mentioned above; people drawn in to the activities of the working groups; the staff in the Science and Society team in the Department for Business, Innovation and Skills (BIS), especially Stephen Axford, Karen Folkes, Isabel Spence and Martin Harris; and those who produced the commissioned work to extremely tight timescales, namely: Paul Benneworth; Graham Farmelo; Ben Johnson and Graphic Science; Mark Dyball, Suzanne King and People, Science & Policy; Helen Featherstone, Clare Wilkinson and Karen Bultitude; Sara Wolcott and Anasuya Sengupta; and Lindsey Colbourne and Ed Straw for Lindsey Colbourne Associates.

Finally, although it may be invidious to single out particular people when so many have contributed so much, I should like to offer special thanks to Paul Manners and Isabel Spence, whose advice, ideas and practical help I have hugely appreciated throughout.

1. Introduction

Science and its applications are inseparable from society, and the commitment of those involved in this enterprise to engage with society has a long history. While many would date the modern era from the Bodmer Report ('The Public Understanding of Science') of 1985, published by the Royal Society, institutional commitment to public engagement with the sciences goes back at least as far as the founding of the Royal Institution in 1799, which in itself predates the coining of the word 'scientist' in the 1830s at an early meeting of the British Association for the Advancement of Science.

Over time there have been many different social contexts and purposes for public engagement with the sciences¹. A field such as this, with its reach into the political sphere, into ethical issues and into private and public organisations, will always be contested; sometimes with considerable vigour.

Our intention in this report is to provide a snapshot of the current state of public engagement with the sciences, to outline a vision which we believe carries wide support, to make explicit the different rationales and purposes for public engagement and to lay out a roadmap for all of us who are committed to further development. In doing so we recognise that we are building on the ideas and work of many others. This report is not an endpoint, but a series of suggestions for all of us to consider, accept, reject or modify, and work on for the future.

We commissioned a range of research to inform our discussions, which we publish in full alongside this report as well as in short summary form at the end of this document. These reports and summaries reflect the views of the authors of the reports and do not necessarily reflect the views of members of the expert group. We hope that those who wish to explore areas in depth will find these reports as helpful as we did.

1.1 The social and cultural context for public engagement

Alongside our report and action plan we present a detailed review of the evidence base surrounding the value of public engagement by scientists, undertaken by Paul Benneworth (summarised in the Appendix). This review seeks to better understand the current social environment for the sciences and the role public engagement can play in reaffirming the sciences' 'licence to practice'. Drawing extensively on the literature, it identifies four external pressures on public engagement: the loss of authority of scientists; the change in the nature of knowledge production; improved communications; and questions of democracy. The review then describes the current state of public engagement, as reflected in scientific debates and through behaviours and practices. Finally, it offers a model of an interlocking system of types of public engagement which we have found helpful to understand the diversity of activities which take place under the banner of 'public engagement'.

¹ Our definition of the sciences is deliberately wide, encompassing research and practice in the physical, biological, engineering, mathematical, health and medical, natural and social disciplines, and research in the arts and humanities. Likewise we use the word scientist to include researchers and practitioners in these disciplines.

The place of science within our concept of 'culture' in the UK remains ambiguous and contested. We examined this in two ways. We commissioned an investigation into ways by which walls are being broken down between the arts and the sciences, and we explored the importance which major cultural institutions do or do not give to the sciences in their policies, strategies and practices. Alongside this plan we present the evidence gathered to examine these issues, produced by Graham Farmelo (summarised in the Appendix).

1.2 Purposes for public engagement

Part of the challenge of understanding and analysing this field of public engagement is that there are so many different purposes being pursued by institutions (public, private or charitable) and individuals (scientists or other members of the public) in the course of their public engagement activities. These varied purposes may reinforce each other or conflict. In their turn, they depend on different institutional or individual priorities, motivations, and assumptions. It is important for all involved in public engagement to recognise and acknowledge openly what drives their public engagement activities and what assumptions underlie them.

Many, but doubtless not all, of these purposes are shown in Figure 1, with an indication of different motivations underlying them. A substantial proportion of these are concerned with the impact of the sciences in the world, through their contribution to meeting societal needs and to a healthy economy. In the current economic climate it is undoubtedly the case that the sciences and scientists need to demonstrate their case for continued public investment to Government and the wider public on economic and social grounds as well as through their contribution to the growth of scientific knowledge itself.

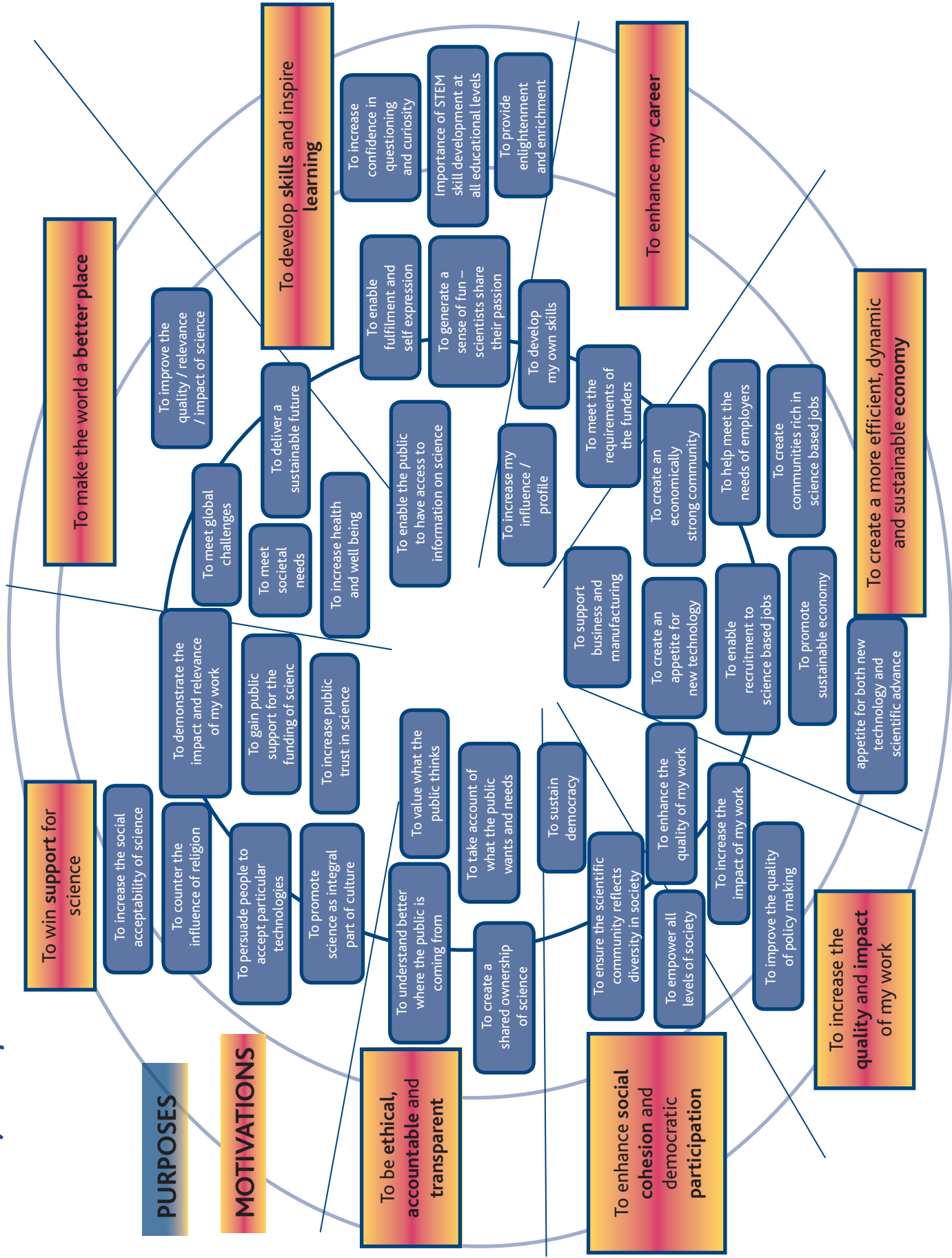
While recognising this diversity of purposes and motivations we nevertheless thought it important to state our own shared vision for public engagement, since it shapes the nature of our actions and recommendations.

Our vision is of all sections of society valuing the sciences and their methods as creative and empowering ways to ask questions, offer solutions and contribute to our understanding and improvement of the world in which we live

In practice, this means:

- those involved in the sciences listen to, engage with, and are informed by knowledge and views from the public, leading to increased learning and mutual respect between scientists, the wider society and policy makers*
- the science communities are accessible and visible, and there is informed and open communication and debate about the findings, practices, directions and implications of science*

Figure 1: A representation of some of the many purposes and motivations for public engagement, developed during the production of this report



Much public engagement activity is driven by institutional² agendas. There are many different ways of describing forms of public engagement from an institutional perspective. For the purposes of the mapping work we commissioned, described below, we defined four forms of engagement to help structure the analysis (summarised in the Appendix).

The accompanying paper by Paul Benneworth (summarised in the Appendix) illustrates the different ways in which scientists, policy-makers and members of the public can interact, the different intensities of those interactions, and the implications this has for all involved. Lindsey Colbourne, in her accompanying paper (also summarised in the Appendix), argues the value of seeking wider consensus on a common way of describing forms of public engagement. It may be that no one set of definitions can do justice to the complexity of public engagement, but we hope the ideas presented will stimulate further productive discussion.

Individual scientists, and members of the public, have their own purposes and motivations for engagement. Significant work has been carried out in recent years to understand the motivations of scientists. This research is reviewed in the accompanying literature review by People, Science & Policy (summarised in the Appendix), which pulls together findings and recommendations from previous studies on recognition of public engagement and its role as a factor in influencing decisions to participate. We also held a workshop to explore the experiences of the Beacons for Public Engagement on reward and recognition mechanisms. This work has helped lead to our recommendations on how to support and recognise public engagement by individuals as well as at institutional level.

The public demonstrate a range of attitudes to engagement with the sciences, which have been explored in several public attitude surveys. Aspects of public motivations and attitudes, based on these surveys, are explored in the paper by Paul Benneworth. However, the surveys generally focus on asking the public about their attitudes, awareness and involvement, rather than on their own purposes and priorities for engagement. These need to be teased out of the research. For example in the 2005 Science and Society survey (OST/MORI) it was concluded that 'there is much wider demand for influence on decision-making about science or scientific research, compared with how much influence people *currently* feel they have'.

1.3 Mapping the public engagement landscape

To gain a better understanding of public engagement, we commissioned a mapping exercise of public engagement activity and the drivers for it, across several sectors. This was structured around four broad forms of engagement which are detailed in the Appendix. This work, carried out by the Science Communication Unit at the University of the West of England is set out in an accompanying paper (summarised in the Appendix). It revealed that public engagement is a field of expertise that draws extensively on other approaches to communicating with, involving and empowering the public. These include communications, marketing, lifelong learning, leisure provision, community development and campaigning.

The mapping also revealed that public engagement now has a distinctive set of institutional purposes and motivations that are broadly shared across all the sectors and that for each one, distinctive approaches are emerging. We imply no value judgement between these; each has its own place, and all contribute in different ways to the developing relationship between science and society. To these are added a variety of purposes and motivations for individuals (scientists and other members of the public) as described above.

2 The term 'institution' covers businesses, public sector and third sector organisations, including professional and academic bodies.

Linked to the mapping of public engagement activity, we commissioned a mapping of existing public engagement training and continuing professional development provision in the UK, and of public engagement-related competencies that are currently identifiable in four selected sectors: academia; engineering; health; and government. We also conducted in-depth interviews with eight key players across the four sectors. The details of this work, undertaken by Graphic Science, are given in an accompanying paper (summarised in the Appendix).

1.4 Embedding public engagement within institutions

It is still the case that public engagement is not regarded strategically, or as of strategic importance, by many organisations. We therefore commissioned two complementary reviews of behavioural change and organisational learning, which outline what we know about how organisations can change their internal cultures to consider embedding public participation where it is appropriate and relevant. The details of this work, by Lindsey Colbourne and by Anasuya Sengupta and Sara Wolcott, are given in the accompanying papers (summarised in the Appendix).

2. The action plan and recommendations

The picture of public engagement activities and organisations that emerges is that of an interlocking system. There are different but linked types of engagement, described above. These require different intensities of interaction by scientists or policy-makers, and different degrees of involvement by the public.

In response to this, our action plan is directed in two ways.

Many of the actions and recommendations focus on the system itself and on ways to improve the relationships and processes within the system for greater effect. These actions are directed, for example, at better networking, means of embedding activity, and better sharing of learning.

Other actions and recommendations focus on influencing the external environment, and the ways by which it affects the culture and practice of public engagement. These actions are directed, for example, at the roles of funders and employers, and the policies of cultural institutions. There is of course some overlap with the work of other Expert Groups, in particular Science and Trust and Science and the Media. We have highlighted this in places, and have not concentrated on areas which might be expected to fall under our broad remit but which were being picked up elsewhere.

Our discussions and analysis revealed three critical areas where we felt actions could most effectively be focused.

First, public engagement is still a relatively new and emerging field, and our understanding of many aspects is only now developing. For example, we have only partial knowledge of why the public engages, how engagement activities can be most effectively developed and delivered, and what the impact of these events actually is. We therefore felt that a vital focus should be:

- *A wider understanding of why, when and how the public engages with the sciences*

Second, although there are many organisations and individuals working in this area, and much parallel activity in different sectors, we discovered that there was a significant lack of joined-up working and sharing between those who are involved. We identified a further challenge therefore to develop:

- *Supportive networks and mechanisms for increasing effective engagement*

Third, although there is now compelling evidence of the vital role public engagement plays in sustaining a healthy culture for science, there are still significant barriers to individuals who wish to embrace engagement because of institutional cultures which marginalise or undervalue engagement. Our third challenge therefore is to work towards:

- *A professional culture that values, recognises and supports public engagement with the sciences*

We have set out our plan against these three challenges under 19 broad headings, listed below, with more specific actions and recommendations under each; a total of 60 individual actions and suggested actions.

1.0 A wider understanding of why, when and how the public engages with the sciences

- 1.1 Establish a shared framework and vision for public engagement with the sciences
- 1.2 Improve understanding of the relationship between the public, scientific and policy communities
- 1.3 Improve understanding of how the public perceives the place of the sciences in culture
- 1.4 Develop the potential for engagement through social media

2.0 Supportive networks and mechanisms for increasing effective engagement

- 2.1 Achieve better coordination between the many organisations involved in public engagement
- 2.2 Share and apply learning from public engagement activities
- 2.3 Provide accessible information on the sciences (including lay research summaries) via a single web portal
- 2.4 UK cultural institutions take a strategic approach to the sciences in culture
- 2.5 Establish public compacts on national issues
- 2.6 Extend recent developments of collaborations between the arts and sciences
- 2.7 Promote active support for the sciences in broadcasting

3.0 A professional culture that values, recognises and supports public engagement with the sciences

- 3.1 Embed public engagement within institutional structures and processes
- 3.2 Ensure all researchers and practitioners have access to training for public engagement
- 3.3 Include public engagement competencies within continuing professional development frameworks
- 3.4 Improve understanding of mechanisms to recognise public engagement activities
- 3.5 Ensure funders of the sciences have mechanisms in place to support and recognise public engagement
- 3.6 Demonstrate public engagement at an institutional level
- 3.7 Recognise individuals who undertake public engagement
- 3.8 Promote successful knowledge exchange between the sciences, policy and business

3. *Taking this work forward*

Responsibility for taking forward these actions is inevitably widely spread; the current actions and recommendations are variously directed at, for example, government, funders, employers and science communication organisations. Critically, in addition, there will be people and organisations not directly involved in the Expert Group who wish to suggest modifications or additions to this plan, and contribute to a continuing joint effort. It is up to all of us to work together more effectively, and to share responsibility for challenging, developing and taking forward the ideas expressed here, and any that are missing.

We therefore seek to develop an open process for implementation and further development; not a further consultation but an evolving joint activity. There are some 60 individual actions and recommended actions in this report, varying from the very specific to the more general and challenging. It is hoped that societal groups will work in partnership with government, funders, employers and science communication organisations to deliver this action plan. Some actions are already being taken forward by members of the Group and we look forward to hearing from other people and organisations who want to join with us to help realise these actions and others.

We plan to explore ideas for this at the 2010 Science Communication Conference, aiming to co-design a process of coordination and development that carries widespread support and involvement.

4. Detailed Action Plan and Recommendations

Public engagement is a maturing field of activity. Many of our proposed actions and recommendations are evolutionary and incremental, building on the positive developments of recent years. Others are more systemic and challenging such as the idea of the 'public compact' as a means of engaging society in addressing major challenges that require the application of the sciences.

Our actions and recommendations for action are given below. Where an action is preceded by an asterisk * it is already under way.

We identify three key challenges for public engagement, and set out our action plan against each one:

- *A wider understanding of why, when and how the public engages with the sciences*
- *Supportive networks and mechanisms for effective engagement*
- *A professional culture that values, recognises and supports public engagement with the sciences*

1.0 A wider understanding of why, when and how the public engages with the sciences

1.1 Establish a shared framework and vision for public engagement with the sciences

Rationale: We need to be explicit about the range of different purposes for public engagement, by institutions and individuals, and seek if possible to create a shared vision that embraces them.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
*open up the action plan to others and develop new partnerships to develop and take it forward	Follow-up group, with support from BIS
use existing research and practice (including SSWSE) to move beyond reaching the 'usual suspects', helping to ensure that public engagement activities take account of diversity issues	SSWSE, Science Centres, Science Festivals
develop a common framework to describe types/purposes of engagement	Follow-up group

1.2 *Improve understanding of the relationship between the public, scientific and policy communities*

Rationale: It would be helpful to agree how we assess the relationship between the public, scientists and policy-makers.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
develop a set of indicators which would act as a basket of measures of the health of the relationship between society and the scientific and policy communities, building on public attitudes surveys, the attitudes of scientists and policy makers, and including measures of diversity	BIS support to develop, Association of Science and Discovery Centres (ASDC)
produce an integrated analysis of what public attitudes research over the past 10 years tells us (quantitative and qualitative)	BIS and others

1.3 *Improve understanding of how the public perceives the place of the sciences in culture*

Rationale: For the place of the sciences in culture to be discussed meaningfully, it is essential to know how the word is understood in the UK, and other countries.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
include a set of questions exploring the extent to which the sciences are regarded as part of culture in the next wave of the DCMS 'Taking Part' Survey	BIS/DCMS
compare UK perceptions of culture with other European countries by including a question in the next Eurobarometer on Science and Technology	BIS
ensure questions relating to this are included in the next Public Attitudes to Science Survey to be conducted during 2010	BIS

1.4 *Develop the potential for engagement through social media*

Rationale: The area of social media (blogs, social networking, interactive gaming, etc) is growing fast and organically – with considerable science content and discussion taking place across many different boundaries with particular appeal to young people.

An interesting and bold innovation at Channel 4 was its decision to transfer its entire science budget for young people to on-line since it was failing to reach this audience through broadcast media. This is clearly an area of huge potential with considerable scope for science engagement. These social media interactions are usually outside 'official' organisations and there is some concern that those organisations are 'behind the curve' in this key area.

To get there we need to:

Action

Suggested lead

explore and promote the role of social media as a mechanism for engagement with the sciences

BIS

2.0 Supportive networks and mechanisms for increasing effective engagement

2.1 *Achieve better coordination between the many organisations involved in public engagement*

Rationale: The field of public engagement is extremely diverse, which makes coordination difficult given individual agendas and limited resources, and partnerships difficult to sustain.

To get there we need to:

Action

Suggested lead

develop, subject to some limited resourcing, a strategic and operational alliance between those organisations, nationally and regionally, which are responsible for the majority of the networks and support for public engagement with the sciences. We envisage this to be an *ad hoc* alliance, without formal constitution or bureaucracy, to share information and practice, enhance collaboration and seek more efficient use of resources

Informal follow-up group to take all this work forward. It would need a coordinator with basic office costs, web dialogue system, and a small allowance for meetings – British Science Association

explore how to encourage and support better local and regional networking for public engagement

ASDC/ NCCPE/ Science cities, RDAs STEMNET, British Science Association and Local Authorities

develop and extend the mapping work of public engagement across a variety of sectors, including identifying the key national and regional support systems and networks, assessing their impacts and highlighting any gaps in provision

Follow-up group

2.2 Share and apply learning from public engagement activities

Rationale: This challenge is regularly highlighted by the public engagement community.

To get there we need to:

Action	Suggested lead
develop better systems for defining and measuring quality, impact and reach of engagement	Follow-up group
*develop an evaluation database to share findings and methodologies	Follow-up group, supporting the work by the British Science Association
highlight and support 'social activist' grass roots approaches, such as DIY engineering at recent Climate Camps, Transition Towns, and Guerrilla Science at Arts and Music Festivals	Festivals – arts/science/music

2.3 Provide accessible information on the sciences (including lay research summaries) via a single web portal

Rationale: Reliable, publicly-accessible and searchable information is vital to underpin discussion about science-related issues, and to enable the public and journalists to be readily informed.

The Science and Media group has made a similar recommendation which we endorse.

To get there we need to:

Action	Suggested lead
develop the Science:[So what? So everything] website as a portal to reliable and publicly accessible information on science generally and on the science behind topical issues in particular. The process for selecting resources signposted should be transparent and open to challenge. The signposting should include clear links to public engagement websites (which are the subject of the following action)	SSWSE
review and pull together information on public engagement websites/portals and explore ways of improving the links between them ³	Follow-up group
ensure that all scientific research papers with any public interest dimension have a plain English summary giving context and implications, for public and media consumption. In addition we commend the Royal Society report of April 2006 'Science and the public interest' ⁴ , and propose that it be revisited to develop further concrete recommendations	Wellcome Trust, Royal Society, RCUK

3 Examples include:

- National Coordinating Centre for Public Engagement: <http://www.publicengagement.ac.uk/>
- psci-com: <http://www.intute.ac.uk/psicom/>
- British Science Association: <http://www.britishsociety.org/>
- Association for Science and Discovery Centres: <http://www.sciencecentres.org.uk/>
- STEMNET: <http://www.stemnet.org.uk>
- ISOTOPE: <http://isotope.open.ac.uk/>
- Connecting Science: <http://www.connectingscience.org/>
- Sciencewise-ERC: <http://www.sciencewise-erc.org.uk/>

4 Royal Society report: Science and the public interest: communicating the results of new scientific research to the public

2.4 UK cultural institutions take a strategic approach to the sciences in culture

Rationale: Few influential figures in the administration of culture would publicly oppose the notion that science is part of our culture. However, the manifestation of this into the fabric of these institutions and their activities is patchy – shown, for example, by the lack of science in the City of Culture competition.

To get there we need:

<i>Action</i>	<i>Suggested lead</i>
publicly funded national cultural institutions and DCMS to demonstrate their commitment to recognising science as part of our culture, by embedding it in their mission statements and follow-through actions and activities	DCMS/National cultural institutions e.g. British Museum
boards of these institutions to have representation from the scientific community and boards of scientific bodies to have representation from wider society	DCMS/National cultural institutions, British Museum, Science Museum
scientific organisations that engage with politicians and civil servants to stress the importance of science engagement as part of the cultural dialogue in the UK	Scientific organisations

2.5 Establish public compacts on national issues

Rationale: There is a need for concerted action by the public, government, business and others to address major science-related challenges.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
set up a pilot 'public compact', to enable concerted action on national issues by government, public sector bodies, businesses and members of the public ⁵	Public sector to fund a pilot, e.g. on climate change
consider and promote ways of prioritising key issues needing public participation and/or tackling some emerging technologies together	GO-Science Horizon Scanning Centre

⁵ With acknowledgement to Joe Hayman who has been developing this idea. The compact might be initiated by a nucleus of citizen groups, government and business. It would outline how each individual and sector could play a role in a solution to the collective problem, and how their actions would relate to and enable the actions of other sectors of society. Negotiating this kind of compact might start with iterative dialogue between representatives from all sectors and a representative sample of members of the public acting as a 'citizen's jury' on the issue, and such mechanisms should be explored. This concept could be applied to science-related challenges such as climate change, where coordinated, complementary actions undertaken by members of the public, businesses and all branches of government are essential if an effective national response is to be achieved.

2.6 *Extend recent developments of collaborations between the arts and sciences*

Rationale: Traditionally there have been public institutions that portray the arts and others that portray the sciences. In the UK over the last 10 years, a range of approaches has emerged as these institutions have explored new interactions between the arts and sciences. In the past 3 years a small number of institutions have been established with the core purpose of bridging these disciplines, most notably the Wellcome Collection, London and the Science Gallery, Dublin. There is evidence that these interactions are attracting new audiences to science and also providing a space for the public to challenge and debate scientific issues.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
build mechanisms to share more extensively the outcomes, best practice and evaluations of science and arts collaborations	Wellcome Trust, British Science Association, ASDC, Museums and Libraries Association (MLA), DCMS
provide funding for science-arts interactions, and do more to enable particularly strong exhibits to be presented in different places across the UK	Follow up group – develop case for funders built on the action above
implement a more joined-up approach across Government departments (BIS, Department for Children, Schools and Families (DCSF), DCMS) to support informal science engagement, in particular the cultural dimensions of science, in ways that are coherent	BIS

2.7 *Promote active support for the sciences in broadcasting*

Rationale: We believe that the sciences are well served by the UK's broadcasters that receive public funding and reach mass audiences. However, we recognise that there continue to be major differences in culture and perception between broadcasters and scientists about what makes good television, and criticisms of 'dumbing down' – sometimes creating unnecessary tensions.

We endorse the recommendations from the Science and Media group which complement and extend these recommendations

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
provide publicly-funded broadcasters (BBC/Channel 4) with continued support as a priority for public access to high-quality science broadcasting in the UK	DCMS
establish mechanisms to bring together scientists and broadcasters to bridge the gap between them and to recognise the requirements and skills of each sector, building on the proposal to develop a BBC 'Buddy Scheme'	BIS/BBC
work with the BBC College of Journalism to develop science training for journalists	BBC/SMC and others

3.0 A professional culture that values, recognises and supports public engagement with the sciences

3.1 Embed public engagement within institutional structures and processes

Rationale: Until public engagement becomes an integral part of institutional practice its benefits will be limited.

To get there we need to:

Action	Suggested lead
* produce an overview of good practice in embedding public participation in organisations including suggestions of possible impacts, case studies and research papers based on learning from the workshop on embedding public participation and literature reviews on organisational change	Sciencewise-ERC
develop a toolkit of approaches to organisational development and public engagement	Follow-up group, NCCPE
*organise a workshop at the Science Communication Conference 2010, and at the Beacons and National Coordinating Centre for Public Engagement (NCCPE) conference in Dec 2010, to consider how the findings of our research may inform their toolkits, manifesto, framework and other resources	NCCPE, British Science Association
improve mechanisms to share, promote and embed good practice in using public participation to inform decision-making across and within government departments, agencies, funding bodies, academia, business and charities	Sciencewise-Expert Resource Centre (Sciencewise-ERC) lead/ Research Councils UK (RCUK) to share learning from its panels
create a forum for business to support, incentivise, build on and share existing good practice in the way business is involved in public participation and dialogue on key issues	Confederation of British Industry (CBI), Federation of Small Businesses, and/or Royal Academy of Engineering
ensure greater commitment from government and other stakeholders to act on the results of public engagement activities and be transparent about the way in which issues raised are being addressed	BIS/Government Office for Science (Go-Science)
ensure Sciencewise-ERC builds on and continues to support government departments and agencies in making effective use of public dialogue to inform decision-making, through: <ul style="list-style-type: none"> • having greater bite, profile and impact • continuously monitoring public perceptions and attitudes around emerging scientific issues • improve capturing of outcomes and learning from public dialogue and increase sharing of these with other sectors including on organisational change and embedding public participation in decision-making • improve capturing and sharing evidence on impact of public participation in decision-making across departments and sectors 	Sciencewise-ERC
encourage funders/government/policy makers to embed public engagement in their own activities	BIS / RCUK / NCCPE

3.2 *Ensure all researchers and practitioners have access to training for public engagement*

Rationale: Since public engagement is seen as important regardless of where scientists and practitioners work, training and development opportunities should be available to all and build on educational courses that include an appropriate element.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
promote engagement training as part of continuing professional development for scientists	RCUK/ASDC/ Professional bodies
encourage Professional Bodies to recognise and adopt public engagement skills and competencies into their frameworks and then to provide the appropriate training	Follow-up group/ Professional Bodies
explore the establishment of a qualification for evaluation of public engagement (e.g. a Diploma)	Follow-up group

3.3 *Include public engagement competencies within continuing professional development frameworks*

Rationale: A competency-based framework would result in public engagement skills and training becoming embedded across academia, public sector and business.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
*develop a list of public engagement skills, knowledge and experiences required	Follow-up group
organise an event to bring key people together to review findings of the desk research and to consider next steps	Follow-up group
Work with Vitae to incorporate attributes and competencies for public engagement into the Researcher Development Framework (due to be launched in April 2010) that complements the concordat described in 3.5;	Vitae/RCUK/NCCPE
Develop a competency framework for public engagement, and explore how these competencies might be embedded into existing or developing professional development frameworks e.g. Modernising Careers' (DH) and CEng (Engineering Council)	Follow up group
advocate that all undergraduate and postgraduate studies in the sciences, together with early career training, contain an element on public engagement/ communication/ ethics, and that these should build on GCSE, A-level, Diploma and other vocational courses in the sciences which should all contain an appropriate element	Follow-up group/ ASDC/ DCSF/ BIS/ National Science Learning Centres/ RCUK/ Engineering Professors Council

3.4 *Improve understanding of mechanisms to recognise public engagement activities*

Rationale: There is a need to develop the evidence base. The literature review identified a number of knowledge gaps, particularly in recognition of public engagement in the private sector and in academic researchers outside STEM disciplines.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
commission research to build a better understanding of motivations, rewards and barriers for public engagement in business and how they relate to the third/public sectors	Follow-up group, possibly led by Royal Academy of Engineering (RAEng)/BIS
commission in 2010 a representative study of all academic researchers (all disciplines) to investigate the motivations, rewards, barriers and training needs of individual researchers involved in public engagement	Follow-up group, possibly led by RCUK
commission in 2014 a follow-up representative study of all academic researchers, to look at the impact of new policies such as changes to the Research Excellence Framework (REF); this could then be repeated every four years to track attitudes	Follow-up group, possibly led by RCUK

3.5 *Ensure funders of the sciences have mechanisms in place to support and recognise public engagement*

Rationale: In developing reward and recognition systems, funders, government and the wider public engagement community should continue to engage with moving public engagement from a voluntary to an integral part of professional culture.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
*to develop an RCUK-led public engagement concordat for funders of research to clarify expectations and improve coherence and impact	RCUK
funders of the sciences to consider how grant applicants can demonstrate that public engagement activity associated with their research is consistent with their institution's policy and practice	RCUK and other funders of the sciences
all funders to include public engagement as an eligible cost (including staff time) within grants	Follow up group
funding councils to include public engagement within research assessment (i.e. at Unit of Assessment level)	Higher Education Funding Council for England (HEFCE) and other funders
research funders to explore potential unintended consequences of formalising public engagement to inform the implementation of the previous action	Higher Education Funding Council for England (HEFCE) and other funders
all government R&D contracts and grants to the private sector to require delivery of an appropriate plan for public engagement	Any Govt Dept that contracts with or provides grant funding to businesses

3.6 *Demonstrate public engagement at an institutional level*

Rationale: The literature review highlighted the value of institutional awards for public engagement. In addition we recognise that structural changes to improve reward and recognition should go hand-in-hand with measures to encourage cultural change (as seen in the Beacons for Public Engagement), particularly concerning recognition of the merit and value of public engagement as integral to a scientific career.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
members of the research, higher education (HE) and wider scientific communities (including businesses of all sizes) to consider how they can embed public engagement so that it is recognised as an integral part of a scientific career	Funders of the sciences/follow-on group
funders of the sciences to encourage and support HE and research institutions in receipt of funding to develop their own public engagement strategies	RCUK lead/HEFCE/All funders

3.7 *Recognise individuals who undertake public engagement*

Rationale: Within institutions, personal rewards (benefits that researchers felt they had accrued through involvement in public engagement) are also motivators for participation in public engagement.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
employers of researchers and staff who participate in public engagement activities (such as Higher Education institutions, research institutes and industry), to consider how to include public engagement within professional advancement of their staff through promotion and recruitment criteria and provide support for implementation	Follow-up group/UUK
professional bodies to accredit the skills acquired through public engagement within the criteria for obtaining professional status (e.g. Chartered Chemist)	Follow-up group/Professional Bodies
*the NCCPE to disseminate the findings from a workshop held by the Recognition Working Group on learning from the Beacons for Public Engagement on reward and recognition mechanisms and the results from an Economic and Social Research Council (ESRC)/NCCPE research synthesis on academic promotions criteria	NCCPE
*RCUK to publish a brochure aimed at researchers demonstrating the benefits of public engagement to themselves and their research	RCUK

3.8 *Promote successful knowledge exchange between the sciences, policy and business*

Rationale: There is useful and varied experience in different contexts that is not necessarily shared at present.

To get there we need to:

<i>Action</i>	<i>Suggested lead</i>
review existing best practice in buddy schemes in public engagement (such as the Engineering and Physical Sciences Research Council (EPSRC) Partnerships for Public Engagement mentors and NCCPE Ambassadors programme) and the support service provided by the NCCPE, and explore need for a national/ regional buddy scheme for public engagement ⁶	NCCPE/STEMNET
use secondments, job shadowing, consultations and workshops more extensively to facilitate the transfer of people, information and ideas between the sciences, policy-making and business communities	Follow-up group

⁶ career issues were also highlighted at the 2009 Science Communication Conference

Glossary

ASDC	– Association for Science and Discovery Centres
BIS	– Department for Business, Innovation and Skills
DCMS	– Department for Culture, Media and Sport
DCSF	– Department for Children, Schools and Families
EPSRC	– Engineering and Physical Sciences Research Council
HE	– Higher Education
HEFCE	– Higher Education Funding Council for England
NCCPE	– National Co-ordinating Centre for Public Engagement
NERC	– Natural Environment Research Council
PSP	– People Science & Policy
RAEng	– Royal Academy of Engineering
RCUK	– Research Councils UK
RDA	– Regional Development Agency
SMC	– Science Media Centre
SSWSE	– Science: [So what? So everything]
Sciencewise-ERC	– Sciencewise Expert Resource Centre for public dialogue in Science and Innovation
STEMNET	– Science, Technology, Engineering and Mathematics Network
WIST-2	– Wider Implications of Science and Technology

Appendix – Summary of Commissioned Research

Seven pieces of research were commissioned by the Science for All Expert Group to feed in to this report. Summaries of the research can be found in this Appendix and the full research reports can be downloaded at:

<http://interactive.bis.gov.uk/scienceandsociety/site/science-for-all/>

These reports and summaries reflect the views of the authors of the reports and do not necessarily reflect the views of members of the expert group.

1	A review of the evidence base surrounding the value of public engagement by scientists Paul Benneworth	26
2	Aspects of science in UK culture Graham Farmelo	28
3	Public engagement map Helen Featherstone, Clare Wilkinson and Karen Bultitude	30
4	Reward and recognition of public engagement People Science & Policy	33
5	Informing the development of a competency framework for public engagement Ben Johnson	35
6	Learning for change in public, educational and other science organisations: embedding greater public engagement Sara Wolcott and Anasuya Sengupta	38
7	Organisational learning and change for public engagement Lindsey Colbourne and Ed Straw for Lindsey Colbourne Associates	39

1. *A review of the evidence base surrounding the value of public engagement by scientists*

This review highlights changes in society which have made it more important for scientists to engage with the public. It then offers some ways of understanding public engagement and what it can be expected to achieve in practice. Finally, it suggests a model for understanding and encouraging engagement by scientists and the public.

1.1 *Societal changes*

The review argues that the changes listed below have made it more important for scientists to engage with the public.

The loss of expertise and authority of scientists. At various times, a suspicious public has rejected expert advice on, for example, genetically-modified food. The public must be allowed to exercise some sort of accountability over scientific decision-taking. This must happen without science and scientists becoming a lightning rod for public dissatisfaction stemming from a failure to take consultations seriously, and political disenchantment more generally.

A change in the nature of knowledge production. Knowledge production now involves increasing interaction and networking between partners within potentially closed 'innovation networks'. This risks creating closed cliques between scientists, engineers and entrepreneurs which exclude the wider public, and which create little public accountability around decisions which can profoundly change national ethical and moral landscapes.

Improved communications and a proliferation of sources of information. As a consequence, scientists are in an increasingly competitive global marketplace of ideas. Scientists may be forced to compromise their basic principles to be able to sell their knowledge in this market-place, meeting media outlets' demands for certain, quick answers at odds with the slow back-and-forth of the scientific process. Yet, failing to make these compromises raises the spectre of lobbyists and pressure groups, who may lack a commitment to science's steady and step-wise creation of knowledge, becoming more powerful.

The democratic deficit: the challenge to the mass-party system, with the emergence of single-issue pressure groups and closed, populist movements. Legitimacy is increasingly dependent on the possession of knowledge or funds to contribute to solutions to contemporary social problems, which places science in something of a quandary. Should scientists exploit their knowledge through participation in elite decision-making structures, or should they instead try to inculcate wider society with the scientific norms and behaviours that underpin progressive societies more generally?

1.2 *Public engagement*

Engagement is an important means to resolve these various tensions. The review highlights a number of generalisations, below, which have emerged from the literature. These offer some ways of understanding public engagement and what it can be expected to achieve in practice.

Generalisations:

- There is no reasonable prospect of encouraging engagement which threatens to stop scientists pursuing interesting avenues of research.
- There is a limit to the amount of engagement which scientists can sensibly undertake. Different types of engagement are appropriate to different kinds of situation, and there is no simple 'one size fits all' solution.
- Activities such as consultations are seldom the best way to increase engagement. The risk with these sorts of initiatives is that they are not connected to the institutions which actually take decisions which influence the societal guidance of science. Nor are they skilled in knowing how to take forward the results of engagement in practice.
- Engagement allows the public and scientists to discuss scientific issues, but it also helps both parties to become better at discussing those issues. The most effective forms of engagement are the ones which emphasise and accentuate that learning process.
- Engagement only really works if its outcomes have an influence, as judged by public policymakers. Making public engagement part of normal business means creating more ways for engagement to routinely influence public policy, away from the pressures of urgency, conflict and crisis, where consultation and engagement usually occur.

1.3 *Model for engagement*

The model presented in the paper represents the relationships between the public and scientists, between forms of engagement, and between those forms and the policy process. It makes use of a systems approach. Forms of engagement are described as 'dissemination', 'conversation', co-inquiry' and 'co-governance'. Relationships between people, forms of engagement and policy makers are regarded as manifestations of systemic connections between these groups. Improving engagement outcomes then becomes a question of improving the performance of the system, by improving the amount of input, system connections and connectivity, and by identifying and removing blockages in the system.

In the UK, there seems to be much engagement activity at low levels of intensity, such as traditional dissemination of information, but less than might be expected at higher levels, such as co-governance of research programmes by the public and users. One explanation for this might be that there are blockages at lower levels of the system.

If these blockages were addressed, and there were more interactions between scientists and the public at lower intensities, allowing both groups to learn and develop, then this would increase the overall scope and impact of public engagement.

This is not a plea for funding engagement networks. Rather it is an argument that, in a time of budgetary stringency, it is necessary to develop a suite of light-touch activities that build on what is already present.

2. Aspects of science in UK culture

The brief for this report was to discuss, using case studies, how the walls perceived to exist between the sciences and the arts can be broken down, and to investigate the extent to which leading UK cultural institutions and initiatives embrace science within their respective remits.

It concludes that there is a clear case to be made that science is under-represented (and under-resourced) in UK culture. However, this under-representation is not universal and is rarely blatant. For example, the Heritage Lottery Fund and the British Library do give an appropriate weighting to science activities, and the BBC's science is on the whole of very good quality. On the other hand, it is argued that that science is a poor relation in the Department of Culture, Media and Sport (DCMS) and the British Council.

2.1 Science-art projects

There is a strong tradition of imaginative science-art projects in the UK, but there appears no single place where evaluations of their effectiveness (for example in reaching new audiences) can be readily accessed.

All the UK's top-class centres which explore the interactions between science and art appear to be in London, which is as well served in this respect as any city in the world.

There is a good deal of scope to increase the support for science-related activities in these centres, for example by targeting grants on them, and by facilitating links with local science researchers.

It seems that many strong science related artworks disappear from public view in the UK after a single display.

The high proportion of visual art in science-art initiatives in the UK invites the question of why other types of art are so much less popular. Why is music, the most popular art form, so poorly represented?

In the past two years, resources for the Science Book Prizes have dropped markedly, leading to the dropping of the children's award and much less publicity after the announcement of the winner. At the time of writing, funding for the 2010 prize has not been secured.

2.2 Science in culture

For the place of science in culture to be discussed meaningfully, it is essential to know how the word is understood in the UK and how people react to the idea that culture includes science. There seem to be no currently valid research data on this.

It appears that DCMS accepts that science is part of culture, but judging by the implementation of the Cultural Olympiad and the UK City of Culture, DCMS seems to have failed to give significant weight to the role of science in major cultural projects.

In the UK Government, the administration of science appears to be structured primarily around the need to fund scientific research and innovation, and to fund formal science education.

The reach of the BBC (TV, radio and online) is such that the quality of its science provision is a critical factor in the Science for All agenda in the UK. All things considered, science on many BBC media channels appears to be as good as one could reasonably hope in the current age of rapid change in the media.

However, there are some important gaps in the provision of science in radio (notably audiences who favour Radios 1 and 2 and the commercial radio stations) and in television (those who habitually turn to ITV and cable channels). It is reasonable to speculate that at least half the adults in the UK get minuscule amounts of science from television and radio, apart from news items.

There is a problem with inclusion (or otherwise) of scientists in discussion programmes on the media. Apart from a few shows on Radio 4, there is a paucity of opportunities for scientists to demonstrate that they know – or are concerned about – anything apart from science. This reinforces the stereotypical image of the narrow-minded, dull scientist. Radio 4 is currently seeking to address this.

There is continuing pressure on the BBC licence fee and, in 2013, the Charter is up for renewal. If that renewal is not granted, or even if there is a double-digit decrease in the real value of the licence fee, the quality of science broadcasting in the UK could fall precipitously.

The belief persists that science is a neglected part of national culture and that this is partly due to the lack of science-trained (or at least science-savvy) people in high places, including Parliament, the senior Civil Service and the governing bodies of national cultural institutions. This cause has been popular for at least 150 years, yet there appears to be no audit of science-savvy 'people in high places' in the UK, nor guidelines that ensure a reasonable proportion of science-supporting trustees on the boards of leading cultural organisations in the UK.

2.3 Web 2.0

UK-based science engagement websites have been slow to move towards much increased audience involvement. These sites may well look dull and unappetising to young people, who are used to much sharper and more involving web technology. The root of this problem may be that the people who make the decisions about communication strategies are not *au fait* with modern trends, especially in ways of attracting young people.

3. Public engagement map

The map provides a snapshot of the extent and scope of current engagement in industry, academia, and public and cultural life in the UK. It presents a tool to identify gaps and opportunities for increased coordination. Four forms of public engagement were defined and used in the mapping: 'telling', 'sharing', 'involving' and 'consulting'. These categories were used solely to help focus the mapping of public engagement and of training and development (paper 5). They do not necessarily reflect the definitions of public engagement provided by BIS or by individual organisations represented in the Science for All Group. There are many different ways of categorising forms of public engagement, and it may now be helpful to seek broad agreement on a common way of describing them.

Telling

The underlying purpose here is to promote a particular point of view or course of action, so that the public is convinced of a particular message or course of action. Typical mechanisms would include communications and PR campaigns, recruitment campaigns and behaviour change initiatives.

Sharing

The underlying purpose here is to enhance the public's understanding and appreciation through effective, accessible and relevant communications, so that the public's curiosity, interest and needs are met by receiving accessible information. Typical mechanisms would include festivals, open days and events programmes, web-based portals providing relevant and accessible information, and the generation of ongoing accurate media coverage.

Linked to this, though it was not explicitly included in the mapping work, is the concept of 'empowering': presenting alternative views and ethical dilemmas on controversial areas of science, so that the public are able to participate in debate and make informed choices.

Involving

The underlying purpose here is to improve the quality and impact of core activities/ services/ products by actively involving the public in their delivery / execution, so that public involvement increases the effectiveness of policy and service delivery and the quality and relevance of products. For example, in the health sector, 'Participation Works' enables organisations to effectively involve children and young people in the development, delivery and evaluation of services that affect their lives.

Consulting

The underlying purpose here is to increase public ownership, support and understanding of emerging policy by actively involving them in informing its direction, so that deliberation with the public improves the quality of decisions and enhances democracy. Examples here would include specific consultations, Citizens' Juries and similar processes and supporting initiatives such as the Sciencewise-ERC.

These are consistent with the similar forms of engagement described in the paper, 'A review of the evidence base surrounding the value of public engagement by scientists.'

3.1 Industry

For much of the science industry, there appear to be two key drivers for public engagement: ensuring a future supply of scientists and ongoing financial growth.

The science industry invests time and money on the provision of classroom support and raising company profiles. Science industry organisations also increase their profile in an area by supporting community projects and encouraging staff volunteering.

However, for the health-related sector, classroom and community support are not enough to ensure ongoing financial growth. If Pfizer is typical of its sector, public engagement also incorporates a more consultative approach.

3.2 Academia

The academic sector has economic, policy and cultural motives for undertaking public engagement. The Research Councils and universities generally stress economic and policy reasons, and the learned institutions emphasise cultural ones.

There is a strong emphasis on 'telling' and 'sharing' activities, but also a significant amount of 'consulting' going on particularly in the biological, health and physical sciences.

There are institutional and financial drivers for researchers to undertake public engagement through the funding schemes of the various Research Councils. However the rewards and recognition are not well understood, and work is currently underway to identify these.

3.3 Public sector

The reasons cited by the public sector for undertaking public engagement were economic, policy-related and democratic. The improvement in policy and policy-making and increasing confidence in regulation were drivers for the public sector particularly those where government policy has to respond to a rapidly changing environment.

There appears to be some discrepancy between what is said and what is done within the public sector. The bodies reviewed here make explicit statements about undertaking public engagement to influence policy, but they do not always seem to translate into practice. This may be because these bodies' main concern is to link themselves to policymakers rather than to citizens.

Personal development is seen as a significant component of reward for doing public engagement in the public sector.

3.4 Cultural sector

The cultural sector's drivers for undertaking public engagement are largely cultural, as would be expected, and democratic. They take the form of 'telling' and 'sharing' activities, but also include 'involving' activities. 'Sharing' and 'involving' are largely funded on a case-by-case basis by the Research Councils, charitable funds and industry. These activities target families, schools and independent adults and are biased towards the physical, biological sciences and engineering.

Cross-cutting themes and further research

3.5 Activity

From the map, a picture begins to emerge. The natural, physical and biological sciences are active, while the social sciences and humanities are less obviously undertaking public engagement.

This study has not made any attempt to judge the quality of the public engagement being

undertaken. Further work could usefully be undertaken to identify the key characteristics of good quality public engagement. Nor has this study made any attempt to map the impact of public engagement, despite there being many and varied potential and actual impacts on all parties involved.

There is a significant amount of work funded through the Research Councils and many charitable bodies. This study has not addressed the impact the funding regimes have on the type and content of public engagement. Further work could usefully explore this influence.

3.6 Motivation

The cultural sector's primary motivation for undertaking public engagement is to enhance the profile of science as a cultural entity and for democratic reasons. Industry and academia undertake public engagement largely for economic reasons, which are most relevant to their needs and stakeholders. It would be interesting to explore how the different sectors could share their expertise, to see for example whether industry could learn from the cultural sector and contribute to public engagement being undertaken for largely cultural reasons.

3.7 Enablers

Networks and partnership working are significant enablers of public engagement. The support they provide is evident across all sectors reviewed here. This study has not been able to study them in great depth. Further work could explore these networks to reveal the key features that institutions and individuals value.

3.8 Rewards

The rewards for undertaking public engagement are not clear, but when they are cited they are largely couched in terms that relate to the personal development of the individual delivering the activity, rather than to improved decision-making or quality of research.

3.9 Gaps

The creation of maps allows gaps to be made visible. There are numerous examples of public engagement being undertaken for policy reasons, but it should be stressed that this research is not comprehensive and can only within its time constraints scratch the surface of the current public engagement field in the UK.

The framework developed alongside this study was used to shape the data collection and the reporting. The framework is still in development and this study has demonstrated that some changes are necessary to reflect the current situation accurately.

More extensive and detailed information should be commissioned to map, both quantitatively and qualitatively, public engagement across a variety of sectors.

4. Reward and recognition of public engagement

This review explores what motivates researchers to undertake public engagement, with a particular focus on the rewards – whether financial, personal or career enhancing. It also considers the barriers to public engagement. The review mainly focused on the academic sector as this is where the data was available.

4.1 Personal motivation

Motivation was defined as those factors that could lead researchers to become involved in public engagement.

The strongest motivating factor seemed to be researchers' sense that participating in public engagement was a duty that was in essence part of their role, especially if they received public funding. Duty implies an internal compulsion to act.

A second influential motivating factor for individual researchers is the perception that an external agency requires them to participate. This requirement may be from funders or from their employers. The review suggests a disjuncture. Many in academia believe that public engagement is part of their role and others, including research funders, expect them to treat it as such. However, public engagement is rarely recognised formally as part of an academic job.

There are, and have been, a number of funding schemes to promote involvement in public engagement. However most, if not all, of these grant schemes did not provide funding for staff time. This may have contributed to the feeling in the research community that running public engagement activities is a voluntary activity.

Personal recognition does not seem to be a strong motivating factor, reflecting the strong sense that public engagement is a duty. Individual awards and prizes seem to be relatively weak motivators.

4.2 Personal rewards

Personal rewards were the benefits that researchers felt they had accrued through involvement in public engagement. Promulgation of these benefits could act as motivators for other researchers considering participation in public engagement. The principal benefits cited were professional advancement, improved research skills, enhanced communication skills, enjoyment and satisfaction.

4.3 Barriers to individuals

The review has also found barriers to participation in public engagement:

Throughout academia there is a sense that research is the most important activity for academics, and any other task that competes for an academic's time is given less priority. Some researchers also reported a lack of appropriate skills. Allied to this is their perception that they need additional support, for example from a wider framework for public engagement within which they can operate. All of these barriers are multiplied for more junior researchers who are in less secure positions than their more senior colleagues.

Within academia, public engagement has developed as a largely voluntary activity in the UK. If it is as important as research funders, and many researchers themselves, seem to believe, then continuing to rely on a voluntary system is inappropriate. Competing pressures within academia will always squeeze the time available for voluntary activities and this will certainly have adverse impacts on the quantity of public engagement work, and possibly on its quality.

4.4 Institutional motivation

This review has found that individual academic institutions can be motivated to foster public engagement to advance institutional objectives such as recruitment of students and establishment of community relations.

Research has found little evidence of the motivating factors for those private sector organisations that become involved in public engagement. Yet many private sector organisations and their employees are involved, so there must be some core factors at play.

Within the research community there is a belief that it is inappropriate to expect all researchers to participate in public engagement and that those least well equipped to contribute should not be expected to. This leads to the conclusion that the institution should take responsibility for an effective public engagement programme.

4.5 Institutional rewards

One of the main motivating factors for individual academic researchers that has been identified is the winning of rewards for their institution.

In order to achieve this, many researchers believe that public engagement should be recognised in research quality assessment. However, there are concerns about the nature of measurement systems and whether these would simply lead to lip service being paid to public engagement; also to a greater focus on the quantity of public engagement rather than its quality.

In order to identify whether public engagement activities are high quality, it is important that there are appropriate metrics and a commitment to evaluation.

4.6 Knowledge gaps

This review has uncovered two main knowledge gaps. Little appears to be known about the mechanisms that operate within the private sector to support or reward individuals participating in public engagement; and almost all of the research to date has focused on the views of academic researchers within the science, technology, engineering and mathematics (STEM) disciplines.

5. *Informing the development of a competency framework for public engagement*

Recognition and adoption of public engagement skills and competencies as a part of the personal and professional development of researchers and practitioners is vital if public engagement training provision is to become embedded and widespread. Research was therefore conducted to gather evidence to inform the development of a competency framework for public engagement. This research used the four purposes of public engagement, which were utilised for the larger public engagement mapping activity (see page 30).

A preliminary piece of research was initially undertaken that demonstrated that some public engagement-related competencies and skills were currently recognised at undergraduate and postgraduate degree level and in some professional standards and development frameworks, with the appropriate training provision, but that this varied widely across the four selected sectors: engineering; academia; health; government.

Graphic Science Ltd undertook additional research to explore recognition of public engagement related skills and competencies and provision of public engagement training by conducting in-depth interview with 8 representatives in the four selected sectors.

A summary of their findings is provided below:

5.1 Public engagement activity

The organisation of public engagement activity varies across the different sectors and it is difficult to harmonise the sectors since individual organisations have different foci, different approaches and different needs. In the case of engineering and academia, public engagement seems to be something carried out by individuals on an ad hoc basis and through enthusiasm and a desire to take it on as an additional activity. Whereas in the health and government sectors public engagement is much more formalised and is considered to be an intrinsic part of the roles of many players within organisations. The engineering sector seems to have a greater focus on engaging with schools via enrichment programmes whereas the government and health sectors have a greater focus on consultation.

The four way classification of public engagement (telling, sharing, involving and consulting) as identified as part of the mini-mapping exercise, proved to be well received by each of the interviewees, each of whom were able to recognise these headings as appropriate for the activities carried out in their sector.

There would appear to be a distinct step up in the level of requisite skills for consultation. While there is a clear progression in the skills needed to move along the spectrum from telling through sharing to involving, involving might represent a ceiling beyond which it is not feasible to expect professionals to possess the pertinent skills.

5.2 Public engagement skills

The only sector which formalised and set an expectation on skills acquisition was the civil service. Across all sectors, where these skills are in place, they tend to be acquired practically as opposed to through a theory based training programme.

Public engagement skills did not tend to receive recognition across any of the sectors explored, apart from the civil service's competency framework which linked appraisal and professional development to skills acquisition.

A number of interviewees warned that any competency framework should avoid making PE skills mandatory, and indeed that training should not be offered to everyone. It was felt that to some degree, people involved in public engagement required a certain level of natural ability. Drawing on the example of performing arts, it was suggested that people with some natural ability could be trained to develop public engagement skills up to a point but that there would be a number of colleagues who would not progress very far.

5.3 Competency framework

Sectors as a whole, rather than individuals, are to be encouraged to develop public engagement skills. It will therefore be necessary to draw up frameworks of competence which can apply across sectors. It was suggested that we should be careful about the language used in these frameworks. We should draw upon examples that employees are comfortable with, so that they do not feel as though they have such a hill to climb.

5.4 Organisational responsibility

While support should be given to those who have the potential to develop public engagement skills, it should not default to a few within each organisation. Every research group, in every department, should be required to produce champions of public engagement. In this way public engagement becomes embedded into the portfolio of a department and the actual practice of researchers, while remaining close to the daily work of the organisation. This means that those who do not possess the necessary skills do not feel that they are required to develop them but those who do possess some natural ability can be nurtured and at the same time receive recognition of the value of these skills within their role, as opposed to in addition to their role.

5.5 Self-reflection

There was some discussion about the value of self-reflection. One interviewee from the academic sector noted that, in her experience, self-reflection and taking on board feedback could only be developed after a great deal of experience. There were many who could not move forward. There was a link between those who could undertake reflection and those who could progress from 'telling' to 'sharing'.

It may be that some are expected to take on the mantle of presenters, whereby they participate in 'telling' and 'sharing', while others, with more skills of reflection, go on to lead on 'involving' and 'consulting'.

5.6 Training provision and accreditation

Support from the professional bodies could be key to embedding public engagement skills into the wider community. If the framework and the training itself came from the professional bodies, as opposed to the employees' institutions and line managers, then this might help to make public engagement skills a broader prerequisite for the sector as a whole. In this way, a national, coherent infrastructure could be established without imposing on the autonomy of individual organisations (such as Universities and PCTs).

Furthermore, if the training offered were to be accredited by the professional bodies this would assist with recognition of the public engagement skills developed. The individual professionals would not themselves be accredited (thereby avoiding the conflicts and hesitation arising from mandatory expectations) but the training in which they participate would be accredited, making it a far more worthy addition to their curriculum vitae.

5.7 Existing competency frameworks

We discovered four competency frameworks in various stages of development:

- The Civil Service's Professional Skills for Government Framework
- The Sanger Institute's Professional Development Framework for Scientists Involved in Public Engagement Work
- Vitae's Researcher Development Framework
- The Department of Health's Modernising Careers

It seems very likely that there are a number of other similar frameworks under development in different sectors concerned with public engagement. It would be prudent to bring as many of these together under the aegis of the science for all group as early as possible.

6. Learning for change in public, educational and other science organisations: embedding greater public engagement

We find critical challenges and lessons on two interconnected levels. The first, on the macro level, is to enable greater public engagement with science. The second, on the micro level, is for enabling change within organisations through meaningful learning.

6.1 Science and public engagement

There needs to be clarity of goals for public engagement in science. We also need to be clear about who is defining 'science', 'the public' and the appropriate space for public engagement.

The culture of science remains removed from the public, limiting the potential of public engagement. Science continues to be treated as of greater value than other types of knowledge. We need a broad, systemic cultural shift which recognises and values the valid knowledge of non-traditional experts – in addition to greater humility in admitting the incompleteness of 'expertise' – to create appropriate solutions to our shared problems.

Higher education (HE) is embedded in the larger scientific community, which in turn has the responsibility of fostering and training sections of the public as future scientific communities. Higher education institutions have simultaneously failed to create scientists who are able to engage with the increasing concerns that citizens have, thereby trapping both HE and science in a supposed scientific neutrality.

6.2 Organisational learning for change

There are a multitude of approaches to organisational learning and change. Learning takes place both on an individual and group level. Changing an organisation's culture necessitates articulating its values.

Resistance can arise from differences about goals and ideologies or threats to people's identities. These barriers to change need to be recognised. Resistance is normal and can illuminate schisms in the organisation which can point the way to further change.

Organisational learning is enabled by certain factors and attitudes. It is helpful to measure change over years rather than weeks; to take time at the beginning of the process to decide what the goal is; to have good leadership; to design programmes for change appropriately; to put in place structures for supporting public engagement; and to create a learning culture.

Enabling attitudes are respect (including respecting resistance), humility, patience, persistence and reflectivity.

7. Organisational learning and change for public engagement

7.1 The five overarching messages of this report are:

- *Public engagement remains counter-cultural* to the ethos of most public and educational institutions, the civil service and scientific research. Over the last ten years, public engagement has been encouraged; yet the ethos of expert leadership and one-way communication still predominates.
- *Public engagement comes in several distinct forms.* The first step in any action plan for public engagement is to decide what is to be achieved and to select the applicable form of engagement. There is a need for the various components of the Science and Society programme to co-design a typology of the forms of public engagement and the benefits and requirements of each one for science and society.
- *There are as many different cultures as there are organisations.* Understanding the nature of a particular organisation is an essential precursor to introducing public engagement to it successfully. Rather than try to change a culture, it is pragmatic to build on its strengths and compensate for its weaknesses.
- *The potential to change an organisation* depends on both its readiness to change and to the powers available to change it. In practice, organisational change has often depended on waiting for the organisation itself to see the need or opportunity, rather than on any external stimulus or force. However, some persuasion may help; and government has powers that could be used to promote public engagement, if it wishes to use them.
- *Experience can be packaged into a toolkit* of approaches to lead and support organisational change for public engagement. Both theory and practical experience have generated many diagnostics, tools, approaches and insights.

