A Review of Science Outreach Strategies

NORTH AND SOUTH

WITH SOME RECOMMENDATIONS FOR IMPROVEMENT

A REPORT FOR THE STANDING CONFERENCE ON TEACHER EDUCATION NORTH AND SOUTH (SCoTENS)

Kevin Davison, Veronica McCauley, Christine Domegan, William McClune

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Research Team
Dr. Kevin Davison and Dr. Veronica McCauley
School of Education, National University of Ireland, Galway

Dr. Christine Domegan
Marketing Department,
School of Business and Economics, National University of Ireland, Galway

Dr. William McClune
Graduate School of Education, Queen's University Belfast

Consultative Partners
Sally Montgomery
W5 Interactive Discovery Centre, Belfast

Eileen Martin and Emma McKenna
The Science Shop, Queen's University Belfast

Collaborators and Consultants
James J. Browne, NUI, Galway; Tony Hall, NUI, Galway; Aiden Kane and Angela Sice CISC, NUI, Galway; Peter Brabazon and Aoife O'Mahony, Engineers Ireland; Heather Greer, Discover Science and Engineering; James Stewart, W5, Belfast; Brian Trench, Dublin City University; Martin Hynes, Irish Research Council for Science, Engineering and Technology (IRCSET); Margie McCarthy and John Denri, IRCSET; STEPS to Engineering; Gerrard Hastings, University of Stirling; Jane Jerry, Exploration Station; Steve Miller, University College London; Joe Cullen, Tavistock Institute; Hans Persson, University of Sweden; Svein Sjøberg, University of Oslo; Anna Walshe, National Council for Curriculum and Assessment.

Research Assistants
Marianne Mortensen, Gilian Moran, Bonnie Long, Patricia McHugh, Yvonne Costello, Laura Gregg, Julia Doherty

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Foreword

Science outreach is at a crossroads in Ireland. In a time of economic caution and rapid social change, more than ever there is a need to communicate science and engineering to the general public. Building a knowledge-based economy cannot happen without a broader participation in science. This is not news to the people who work as science outreach providers. Those in the science and engineering community share a long history of working with schools and the general public to widen participation in science and to strengthen science literacy in the country. We have created strong partnerships with the education sector, and have implemented a number of successful outreach initiatives aimed at both children and adults alike.

A Review of Science Outreach Strategies, North and South demonstrates the commitment organisations such as Discover Science and Engineering have made to advance science in Ireland. It also provides preliminary data about the scope of the diverse outreach activities so that we can better assess the successes and gaps in our efforts. The report also points out, however, that there is more to disseminating knowledge about science than simply providing information and sparking interest. In order to sustain high levels of participation in science and engineering in Ireland, there is a need to evaluate our collective efforts and to address how we might work together, across the border and inter-institutionally, to create a more coordinated science outreach strategy. The authors of this report recommend that we consider a social marketing strategy that aims to influence voluntary change in people's *behaviour* to allow for a long-term commitment to science in society. The value of this report is that it creates a shift in thinking from a traditional view of science outreach known as 'knowledge transfer' to a more holistic, coordinated effort. This will allow outreach providers to influence individuals' personal relationship with science so that it becomes an enduring part of their lives. As science literacy grows, so does the potential for more people to participate in the knowledge economy in Ireland.

Peter Brabazon
Programme Director, Discover Science and Engineering, Dublin

Executive Summary

This report is the first comprehensive census and examination of science outreach and communication activities on the island of Ireland. The report introduces social marketing theory as an alternative way to think about more effective outreach strategies. Data collected at the first annual Science Communication, Outreach and Public Engagement Research Symposium held in the National University of Ireland, Galway on 24-25 May 2007 will be discussed along with data from the first all-Ireland survey of science communication and outreach providers, practitioners and policy makers. The data gathered show the key challenge facing Irish science communication and outreach stakeholders is the greater integration of multiple partners, from government and state bodies to schools, teachers, NGOs, commercial players and the general public.

The data also suggest that there is a need for a shift away from simply providing information about science or increasing an interest in science, toward an approach that attempts to influence voluntary social behaviour to increase public engagement with the sciences. Furthermore, a more comprehensive evaluation of outreach activities is needed to make the best use of available resources. This report offers science outreach providers and educators a snapshot into the diversity of outreach activities and their scope, and recommends innovative approaches to increase science literacy. Building science literacy and attracting and retaining future scientists is essential to the growth of social and economic development in the new knowledge economy.

Introduction

Science communication and outreach activities engage diverse audiences to increase public awareness of, support for, and participation in science, and to influence school subject, degree, and career choices. They allow children, teachers and parents to experience science in a fun, hands-on, exciting way, to stimulate their interest, and to participate in science as a career option and research avenue. These activities typically include school visits, demonstrations and placements, public promotion of science events such as lectures and exhibitions, and participation by scientists in public debates in the media, organised or facilitated by research institutes, academic departments/faculties and learned institutions.

Communicating science effectively to diverse audiences is central to infusing a greater understanding of science in public discourse and knowledge. In turn, the growth of scientific initiatives drives our knowledge-based societies. Toward this goal, outreach activities are also aimed at addressing the decline in the numbers taking up science courses at secondary and tertiary educational institutions (McCauley, et al, 2006). In this way, a major investment of resources in the promotion of science development is instrumental in anchoring education and knowledge to national growth and prosperity (Beetlestone et al, 1998, McCauley et al, 2006 and Edwards 2004).

Research funders and development agencies in the Republic of Ireland, Northern Ireland and internationally attach great importance to complementing substantive scientific research with such communication and outreach activities, in support of the broad policy effort towards building a knowledge-based society. The science community has responded, accepting the premise that such activities will act as 'agents of change', promoting innovation in society (Edwards 2004). Communication, outreach and public engagement programmes lie at the centre of the European Union's policy to create a knowledge-based economy supported by science literate people who are interested in research and innovation (Gover'Science Seminar, 2006). Behind this science movement is the belief that there are seamless links between interest in and enthusiasm for science, science literacy levels, science careers, and economic and social prosperity (Layton et al, 1993; Beetlestone et al, 1998). However these same assumptions about seamlessness make it difficult to

assess the effectiveness of outreach efforts.

Many of the diverse groups who work in science outreach and communication have not established a systematic evaluation to communicate science to their target audience. While many, of course, evaluate specific outreach activities to ensure the quality of their future work, there is no tool in existence that outreach providers might use to measure the effectiveness of outreach activities to influence science literacy on a long-term basis.

Furthermore, outreach providers do not actively explore different theoretical approaches to effective outreach. As a result, there is a paucity of communication between outreach providers regarding the work they do and how best to do it. Successfully expanding the degree to which science is a part of people's lives may involve more than just creating an interest in science; it may involve examining the social factors that may hinder greater engagement and commitment to science and science careers. There is a recognized need to create a space to bring diverse science outreach providers together to network, share ideas, coordinate efforts, learn about innovative approaches, consider evaluation strategies, and extend the science information reach.
In response, the first annual Science Communication, Outreach and Public Engagement Research Symposium was held at the National University of Ireland, Galway on 24-25 May 2007. It was co-organised by the Departments of Education, Marketing, and the Centre of Innovation and Structural Change (CISC) at NUI Galway, in collaboration with the Graduate School of Education and the Science Shop at Queen's University Belfast, and W5 Discovery Centre in Belfast.

The aim of the symposium was to assemble some of the key* science outreach stakeholders in the Republic of Ireland and Northern Ireland to begin to examine policy, leadership, evaluation strategies, and the critical contribution that inter-disciplinary theories such as social marketing may offer. By drawing together a variety of individuals and groups that ordinarily work independently or in isolation on science outreach activities, the research team hoped to create a clearer picture of the diversity of approaches and the needs of such groups.

* These are organisations/entities/persons whose primary stated goal is science communication, science promotion through fun, active learning or informal education experiences. They include, for example, Discover Science and Engineering and STEPS to Engineering, but exclude the Irish Museum of Modern Art which does some fringe science work.

During the symposium, the research team observed formal and informal discussions, and documented a variety of exchanges between participants. In addition to a general evaluation of the symposium, participants were asked for 'expressions of interest' regarding what information would best assist them to strengthen their science communication and outreach activities. These suggestions were incorporated into a post-conference on-line survey to begin to map outreach activities in Ireland, North and South. Despite different legislation, government priorities, and funding structures, there was an effort made to begin cross-border dialogue and transfer of knowledge regarding science communication and outreach, and to establish a mutually beneficial collaborative relationship between the Republic of Ireland and Northern Ireland.

This report will begin by offering a sketch of outreach activities and actors on the island of Ireland. It will then present the argument for the consideration of a social marketing approach to improve science communication efforts. Central to this report is the discussion of the data from an on-line survey of science outreach providers. This data will be presented and analysed to map and evaluate the current outreach activities so that future efforts are more effective and efficient. By combining the survey data with observation and interview data from the research symposium, we will conclude by offering recommendations regarding science outreach best practice and future collaboration to strengthen outreach strategies across the island of Ireland.

It is hoped that this report will serve as a useful resource for educators, scientists, outreach officers and students interested in promoting science, and for those who are working to create greater integration of science outreach activities across Irish, European, and international borders.

The Context of Contemporary Science Outreach Activities

Introduction

In order to better understand how to improve science outreach strategies on the island of Ireland it is important to become familiar with the social, political, and educational context surrounding outreach activities. Many groups who aim to communicate science to the public tailor their activities to very specific audiences, and in so doing they may be less aware of the multiple external forces at play that may distort and impact on their efforts. Having a better sense of the context as well as knowledge of other science outreach approaches will strengthen the ability to reach a broader public.

The European Union's policy-making regarding science and technology takes a two-pronged approach. Firstly the policy focuses on innovation-oriented research and secondly on protection-oriented research (Felt, 2007). These two prongs represent the two separate roles of science and policy. Science is seen as helping policy-making and bettering society as a whole through advancement, competitiveness, and economic success [innovation-oriented]. Additionally, science is regarded as a dynamic force which requires control, regulation, and management in order to safeguard human rights and public safety [protection-oriented].

At present the European policy on science is governed by the EU's 2000 Lisbon Agenda which includes "the commitment to use scientific research to build the most competitive global knowledge economy by 2010" (Felt, 2007, p.10). The development of a pan-European knowledge economy is an integral part of the Lisbon Agenda and European policy-making regarding science and technology. However this proposed degree of integration requires buy-in at all levels, from scientific experts to the lay public, and across all member states. However achieving this degree of integration and buy-in is fraught with complexities and challenges due to the public's reported unease with and scepticism of science.

Public unease and scepticism

Public unease with science is commonly over-exaggerated. Lay people are concerned with the uncertainty and risk associated with new innovations, a concern which has been heightened of late through debates and news reporting on topics such as genetically modified food, stem cell research, and nanotechnologies. However rather than the public fearing all science, there exists a more selective fear of certain areas of science rather than an all-out trepidation about the

entire subject. In fact, European publics embrace and use many scientific and technological advances in everyday life without hesitation or dread (Felt, 2007).

European policy-making therefore requires broader public engagement with science in order to lessen the uncertainty and risk associated with scientific innovations. European policy is moving towards a stipulation requiring that the public should be included to a greater extent in the creation of scientific and technological innovations. This may reduce the controversies and conflicts surrounding science portrayed in the media. Science experts, policy-makers, and the public working together create the best opportunity for a knowledge economy. This is because "science and innovation are social, cultural, and institutional - as well as technical and specialist activities" (Stirling, 2006, p.7). This shift to a more inclusive distribution of information about science, science research, and science careers creates greater demands on outreach providers to expand their potential reach.

Advances in science and technology, and the policy-making which governs them, are depicted as providing benefits to everyone. Public unease with science and distrust in policy-making are due to the lack of public engagement at the early stages of policy development. "Engagement holds the greatest value when it occurs upstream" (Stirling, 2006, p.8). Including the public at the beginning of the process leading to policy-making ensures there are a diversity of voices considered; and there is a commitment made by policy-makers, society, industry, and the research community to collectively learn from the real opportunities and challenges facing them throughout the innovation process (Stirling, 2006). This leads to a more open, honest and frank discussion where the true benefits of science to everyone are outlined and uncertainty and unease are lessened (Felt, 2007).

Ethics in Policy Making

EU policy on ethics in science aims to protect society through regulation of the science community. Ethics have become a concern for policy-makers due to the advent of major environmental and societal problems such as global warming. EU policy-makers have outlined a number of practical recommendations for the way forward "to move from a somewhat fragmented introspective and reactive preoccupation of science and society, to a more integrated, open and proactive understanding of the inescapable place of science in society" (Stirling, 2006, p. 11).

This shift focusing on ethics must, by definition, be more inclusive, because a commitment to ethics at the policy level must involve a broad level of public consent. These recommendations regarding ethics and public accountability will be implemented over time to more substantially combine the views of policy-makers, the scientific community and the public.

The practical recommendations outlined by the EU include:

- Conducting a thorough regulatory appraisal of member state processes
- Developing ways of properly treating uncertainties and using risk management
- Creating scientific advisory committees to make scientists and policy-makers more accountable
- Shifting to plural conditional advice
- Avoid misleading, insensitive public definitions
- Enact and enforce current EU rules
- Value the social distribution of knowledge
- Develop ethical advisory boards within the EU

(Felt, 2007)

European policy-making regarding science and technology is multifaceted. It requires collective engagement of the three main stakeholders: the science community, policy-makers and the lay public. It needs regulation as well as collaboration. The overall aim of science policy in the EU according to the Lisbon Agenda is to create a competitive knowledge economy which can withstand global forces. "The success of these strategies requires the involvement and active participation of citizens in the creation, sharing, and dissemination of knowledge" (European Commission, 2007). It is important to understand the implications of this policy-driven demand for a greater degree of public participation in science in society. The policy that is created at the EU level in turn needs to be reflected in the policy of individual states so that the stakeholders are drawn together toward a common goal of increasing the scope and reach of science promotion activities.

Science Policy in the Republic of Ireland

At the centre of the European Union's policy governing Science and Technology is the creation of a knowledge-based economy supported by science literate people who are interested in research and innovation. This overall policy has many implications and challenges for each and every member state if its goals are to be achieved. Ireland, as a member state, appreciates the

mammoth task ahead, and has developed its own policy, the Strategy for Science, Technology and Innovation (SSTI), together with action plans to bring the Irish economy forward and match it to European standards. "Ireland has fully embraced that challenge and this strategy represents our comprehensive plan to guide us towards that goal" (SSTI, 2006, p.3).

The Republic of Ireland began its foray into science policy development in the 1970s when it founded the National Science Council and the National Board for Science and Technology (SSTI, 2006). This broad stroke initial policy focused more on the governing of science and its limited developments rather than the potential of its innovation capacities. Later Irish policy became permeated by European policy and new standards for innovation and development were set.

Recent policy measures outlined through the National Development Plan have seen the Republic of Ireland thoroughly embrace science, technology, development, and innovation. This has led to the foundation of some major initiatives such as Science Foundation Ireland (SFI) and the Programme for Research in Third Level Institutions (PRTLI). The National Development Plan 2000 – 2006 has seen a definitive growth in research and development in Ireland and has helped towards achieving the major goal of building a knowledge-based society in Ireland.

Following on from the National Development Plan 2000 – 2006 Irish policy is currently governed by the Strategy for Science, Technology and Innovation (SSTI) 2006 – 2013. The main premises of this strategy are:

- To advance the level of research and development activities undertaken in Ireland
- To encourage increased numbers of people entering and completing 'Fourth Level' education in all sectors, especially in science, technology and engineering
- To continue with the creation of a knowledge-based society with greater public interest in and engagement with science
- To create, through innovative means, ways of making Ireland more competitive and sustainable on a global scale.

(SSTI, 2006)

This strategy aims to establish Ireland as a major world player in research and development and to create a centre of excellence in Ireland for innovation and intellectual property. To achieve to this end Ireland must "build a

sustainable system of world-class research teams across all disciplines and to double our output of PhDs" (SSTI, 2006, p.8). In order to build world-class research teams, collaboration and the transfer of knowledge across disciplines is essential. An all-island approach is taken under this strategy which combines work undertaken both north and south of the border. This increases productivity and efficiency and reduces the chance of duplication of research. There is, therefore, a need to meet the challenges of cross-border collaboration arising from different structures of funding, policy and education.

The SSTI also aims to increase the level of knowledge and information transferred from researchers into industry. This sharing of knowledge from experts to industry and onto the lay public is essential to create a science-literate and knowledge-based society. Knowledge transfer requires policy-makers to ensure the infrastructure is present to allow collaboration, so that a sufficient number of research institutions and organisations are aware of and interested in sharing knowledge, and that the process of knowledge transfer is efficient and timely. Knowledge transfer on an all-island basis will lead to the creation of synergy and benefits for the population at large.

The Strategy for Science, Technology and Innovation 2006-2013 governs research into and the development of intellectual property in education, agriculture and food, health, the environment and energy. The policy governing science education and its interaction with society proposes developing children's interest in science at an early age and nurturing this interest throughout their primary and secondary school science curricula. This requires an overhaul of the science syllabus at both levels of education, particularly at second level where syllabus change must be accompanied by retraining of science teachers (Science Communication, Outreach and Public Engagement Conference, 2007). Thus it is critical that education policy, pedagogy and the curriculum in both jurisdictions review the way science is presented to children and young adults in order to counter the fact that, at present, only a slightly higher proportion of students at second level have a positive rather than negative view on science (ROSE Report, 2007).

Science policy, of course, applies to more than just the teaching of science. For example, to date the levels of research and development carried out in Ireland in the agri-food/ agri-business sector is low. Irish science policy aims to develop

a knowledge base in this sector, increase the number of researchers working in it and create a foundation from which Ireland shall become innovative and competitive in agriculture and food (SSTI, 2006).

Continued research and development in the health sector is an additional concern for the SSTI. Currently the Irish health system is inefficient and working at over-capacity. Greater research is therefore a necessity to create and benefit from new technologies and medical innovations. Research into improving the quality of health in the population may well lead to a reduction in the number of people seeking medical treatment and thus increase efficiency.

Irish policy on governing the environment and energy is aimed at making Ireland more sustainable in the future. Research into renewable energy sources is imperative both for reducing reliance on current supplies and for creating a cleaner environment. Ireland is committed to being at the forefront of developing a clean, efficient, renewable energy source in the not so distant future (SSTI, 2006).

In plotting the various implications of science policy, the bigger picture emerges: how political and economic strategies influence policy decisions which, in turn, impact on the way science enters the lives of the general public. The demands of such shifts in science policy depend on the ability of outreach providers to facilitate more effective science communication activities. Therefore it is important to consider the capacities of the outreach providers to meet policy objectives.

Who are involved?

In the Republic of Ireland policy on science, technology and innovation is a broad, all-encompassing strategy aimed at increasing both expert research and public participation in scientific areas. Due to the broadness of the topics covered under this ambitious policy plan, the Irish government has established many sub-committees and affiliated organisations to act as stakeholders, regulators and implementers of the strategy. With more integrated efforts, together they can oversee the achievement of the policy. A brief, nominal introduction to these stakeholders will suffice here, as the key players in science and technology in the Republic of Ireland will be discussed at length later in the report.

Firstly there are three government departments which are associated with the development of Irish scientific policy. While their involvement varies in extent, each has an important part to play in bringing science, technology and

innovation to fruition. They are the Department of Education and Science, the Department of Enterprise, Trade and Employment, and the Department of Agriculture, Fisheries and Food. Various state bodies are included in the development and implementation of Irish strategy such as Enterprise Ireland, the Higher Education Authority (and the Higher Education Institutions), the Office of Science, Technology and Innovation, the Advisory Science Council, the Environmental Protection Agency, the Marine Institute, IDA Ireland, the Health Service Executive and the Energy Research Council. Furthermore, to ensure science research and knowledge is transferred throughout the layers of society, additional governmental agencies have been founded to aid the development and communication of science, technology and innovation. These include Science Foundation Ireland, the Programme of Research in Third Level Institutions, Technology Ireland, Discover Science and Engineering, the Technology Transfer Office, Teagasc and Forfás.

Funding and collaboration

As the Irish economy advances, so does the level of commitment by the Irish government to further develop science and technology initiatives and research. A major factor in building world-class research centres of excellence is funding. Funding for Irish research comes from two main sources. The majority of funding comes from the Irish government. In 2005 the government allocated €658 million to the development of science, technology and innovation, and has earmarked a further €192 million for this initiative until the end of 2008. The Strategy for Science, Technology and Innovation 2006-2013 is very ambitious in its mission and goals and thus requires high levels of finance to see it through to completion. The cost of implementing the strategy is projected at €1.88 billion – however it is estimated that the Irish government will have invested in excess of €2.7 billion by the end of 2008 (SSTI, 2006).

The second source of funding comes indirectly from the industries themselves. Increased investment in research and development at firm level helps to achieve the aims of the government strategy by creating scientific and technological innovativeness, as well as helping to lead to the development of a knowledge-based economy and a science literate public.

As previously noted, Irish science policy encourages cross-border collaborative research with Northern Ireland; facilitating both sets of researchers to benefit from

knowledge sharing, efficiency, synergies, and the elimination of duplication of research. Cross-border cooperation promotes scientific excellence and drives international standards (SSTI, 2006). Ireland is also involved with a number of European science initiatives. "Ireland has benefited greatly from engagement in the international arena under the EU Framework Programme and from our involvement in the European Space Agency" (SSTI, 2006). This provides Irish scientists with the opportunity to grow and develop their knowledge and skills in a variety of areas with international researchers. Techniques and ideas learned through international collaboration may then be applied to the Irish context of research and development, thus aiding innovation. The Republic of Ireland has also recently established research links and collaboration mechanisms beyond Europe, and both the Dublin and Belfast governments are involved with the Ireland – US Research and Development Partnership in the prioritized research areas of diabetes, cystic fibrosis, nanotechnology and sensors.

Science Policy and Planning for the Future

"Ireland by 2013 will be internationally renowned for the excellence of its research, and will be to the forefront in generating and using new knowledge for economic and social progress, within an innovation culture" (SSTI, 2006, p.8).

The Strategy for Science, Technology and Innovation has not yet run a third of its course, but the initial stages have made strides towards its successful completion. Public engagement with science still has much to be desired if the creation of a science literate, knowledge-based population is to be truly realised. While the Republic has increased its output of doctorates in both science and engineering, it remains firmly behind other European nations such as Switzerland, the UK and Finland in terms of doctoral graduates per hundred population (SSTI, 2006).

Persistent engagement with US and collaboration with EU research institutions are also necessary to further the development of world-class research centres on the island of Ireland. There is also a need for ongoing research in various public policy areas such as health, agriculture, the environment and energy to advance the economy and increase active public participation in scientific debates that concern them. "The future strategic direction of research will be able to anticipate and respond to changing circumstances" (SSTI, 2006, p.11).

The Strategy for Science, Technology and Innovation currently governing Irish scientific policy aims to broaden Irish research horizons, encourage enterprise, trade and development, and establish Ireland as a premier location in the research arena. If and when these aims are achieved in 2013, the advantages for the Irish economy (north and south of the border), and for the people of the island, will be enormous. Economic, social, educational and synergistic benefits will be evident throughout industry and the public sphere.

Key Players in Science Technology and Innovation in the Republic of Ireland

Various organisations have been established to undertake the task of helping the public engage and become more science literate. There are six key players driving science communication in the Republic of Ireland: the Department of Education and Science, the Department of Enterprise, Trade and Employment, Forfás, Discover Science and Engineering, Science Foundation Ireland, and STEPS to Engineering. These six key players ensure science is introduced to, and made interesting for, the public – from primary school age up to adults. While each is a separate, independent entity, many of their activities are interdependent and the process of collaboration between them is strong.

It is important to remember that these six groups in the Republic of Ireland have only been active in the last ten years, whereas outreach providers in the United Kingdom and the United States of America been engaged in informal outreach activities since the 1960s. This section will examine the science outreach providers in the Republic, including their mandate and various outreach activities. Following this, outreach providers in Northern Ireland will be examined. There will be less detail on the latter as the activities are more concentrated in three highly developed agencies.

Department of Education and Science

The Department of Education and Science (DES), through its annual budget, funds the delivery of education, and more specific to this report, science education, to the people of the Republic of Ireland. The DES governs education in primary, secondary, and tertiary institutions and thus provides access to education to the overwhelming proportion of the population. The DES is ideally positioned to develop an interest in science among Ireland's youth and to nurture that interest throughout their educational lives, leading to a

science literate population and a knowledge-based economy.

The overriding mission of the DES is to help everyone engage with education in order to succeed in their future careers and to become active participants in Irish society, thus aiding the advancement of the nation (DES, 2007a). This mission is quite broad and therefore prevents the Department from becoming limited to specific areas. The DES has outlined five goals to help it achieve its mission. These goals are outlined as follows:

To promote equity and inclusion, to promote quality outcomes, to promote lifelong learning, to plan for education that is relevant to personal, social, cultural and economic needs, to enhance the capacity of the Department of Education and Science for service delivery, policy formulation, research and evaluation. (DES, 2007a)

With its main focus on formal education delivery, the DES has, by definition, an investment in understanding and implementing successful outreach strategies. Therefore it is well placed to act as an agent of change in the promotion of science. Formal education providers, such as schools, regularly collaborate with external and informal science outreach providers to complement and supplement the existing curriculum. The development and strengthening of a science literate and knowledge-based economy will help the DES in future in the processes of policy-making and regulation.

The DES targets its educational activities at children from primary school age, through teenagers in second level education, and on to university students and adult education. It governs the curricula taught at each level of education and provides support materials and learning resources to parents and teachers. The Department arranges course days and training seminars for teachers to help them provide the best education possible to today's Irish students. For example, it has laid on provision for science-based summer courses in regional Education Centres.

New additions and changes to the science curriculum at primary, secondary and tertiary level require an accompanying change in teaching methods, which must be facilitated by the DES in collaboration with third level teacher education institutions. Furthermore, the Department, through its website, helps parents get involved in the education of their children by providing a forum for parents to find out about the curriculum, comment on its implementation, and make

suggestions for the future (DES, 2007b).

Some of examples of DES science-based initiatives include:

Information and Communication Technology (ICT) in First and Second Level Education
This initiative to raise the level of information and communication technology in schools has been running since 1997. Since its inception, the ICT programme has significantly increased the number of computers in schools, trained teachers to develop their own IT skills, and increased the level of ICT in the curricula at both primary and secondary levels. This introduction to technology at an early stage aims to improve children's interest in and familiarity with science and technology, which is necessary for the development of a knowledge-based economy.

Blueprint for the Future of ICT in Education
This initiative ran from 2001 to 2003 and aimed to increase further investment in ICT in schools. It is an extension to the above initiative. The developments made under this strategy increased accessibility of teacher training in local areas, thus encouraging more teachers to adopt more IT in the classroom. It also developed partnerships with industry, the community, and researchers in other EU countries to promote science and technology and to benefit from the knowledge gained through these partnerships (DES, 2002).

Department of Enterprise, Trade and Employment
The Department of Enterprise, Trade and Employment (DETE) is the government department responsible for creating and overseeing national policy on science, technology and innovation. The DES governs the science curriculum and formal education whereas the DETE oversees science research and its applicability to industry in Ireland as well as informal science learning and experiences. In order to manage more thoroughly the government's investment in science and technology and its strategic importance in the development of a knowledge-based, economically beneficial society, the DETE has established a number of sub-agencies. These include the Office of Science, Technology and Innovation [OSTI], Forfás, Science Foundation Ireland [SFI] and the Office of the Chief Scientific Advisor.

The DETE's mission in this area is to develop national policy on science, technology and innovation which will make Ireland more competitive and sustainable in the global economy (DETE, 2005). The Department aims to establish links

between scientists, industry and the national community to develop a science literate population and a knowledge-based economy that will provide the platform from which to create international leadership in innovative scientific research. This ties into the DETE's other missions of facilitating trade and creating employment.

The goals of the DETE are all aimed at creating a more competitive Ireland in terms of workforce, innovation, research and economy. It has outlined a number of key priorities or goals to help it achieve competitiveness in its Statement of Strategy 2005-2007. The goals concerning the development of science, technology and innovation are:

- A commitment to investment in research and development
- The pursuit of economically advantageous migration of researchers and practitioners of science and technology
- To encourage more people to enter fourth level education and pursue lifelong learning
- To further develop national partnership agreements and international collaboration in research on science and technology
- To ensure that high standards of regulation are adhered to.

The primary audience for the DETE's programmes are industry practitioners, researchers, the government, policy-makers and interest groups in the community. There are four agencies set up under the guise of the DETE, each with its own independent function in delivering science and technology developments to its own target audiences. The following is a brief overview of the two agencies with specific science outreach mandates.

Office of Science, Technology and Innovation

This office is responsible for developing national policy on science, technology and innovation and the development of research in these areas. It provides funding and advice on research to practitioners and industry, and aims to increase the number of science literate people in the Irish population. The OSTI promotes awareness of science and innovation and their acceptance in society as well as promoting international collaboration among researchers (DETE, 2007).

Office of the Chief Scientific Advisor

This office was established to advise the government on its policy-making regarding science, technology and innovation. It blends science with public concern and makes recommendations accordingly. The Chief Scientific Advisor to the Irish government is Dr. Patrick

Cunningham, formerly Professor of Animal Genetics at Trinity College Dublin. His role is to assess developments in science and innovation and determine their impact on the public. His recommendations to the government have ramifications for the level of investment provided to various areas of scientific research.

Forfás

Forfás is one of the agencies set up under the umbrella of the Department of Enterprise, Trade and Employment. It was established in 1994 as the advisory board for national policy on science, technology, innovation, trade and enterprise. Forfás provides advice and information to various stakeholders concerned with national policy on science and innovation, and is particularly concerned with the development of future enterprise, research science governance and the delivery of scientific research to support and strengthen Irish enterprise competitiveness. (Forfás, no date, a)

Forfás aims to develop collaboration and partnerships in science leading to greater economic competitiveness and more employment and trade. Its mission is to help foster innovation in Irish companies, thus improving the economy and leading to higher standards of living and a better quality of life in Ireland. (Forfás, no date, b).

Forfás aims to provide high quality, evidence-based recommendations to policy-makers which take into account the opinions and concerns of its stakeholders regarding competitiveness and growth. It sees the potential of collaborating across industry fields to provide a more comprehensive policy using best practice in other disciplines. It also sees the importance of conducting additional research nationally and internationally to spot threats and opportunities in the scientific environment which may help or hinder Ireland's competitiveness and impact upon its economic performance (Forfás, no date, c). Its affiliate companies also target the future of science in Ireland through providing programmes to children, teenagers, parents and teachers.

Forfás acts as a management body and advisory service providing help and support to its many affiliate organisations. Organisations managed by Forfás include Discover Science and Engineering and Science Foundation Ireland, discussed below.

Discover Science and Engineering

Discover Science and Engineering (DSE) was established in 2003 to bring together the various groups which previously aimed to promote

scientific awareness in both the public and private sectors. It is a conglomerate, managed by Forfás, of diverse groups such as the Office of Science and Technology, the Departments of Education and Science and Enterprise, Trade and Employment, FÁS, and the Institute of Engineers of Ireland. Discover Science and Engineering oversees a range of activities aimed at promoting science in society and actively encouraging Ireland's youth to consider future careers in science, technology and engineering.

Central to the goals of DSE is the belief that only through creating an awareness of and interest in science can the public become a science literate population, the foundation on which to build a knowledge economy. The development of such an economy is necessary for Ireland to become a centre of excellence in research and innovation and thus a major world player. Certain core values are at the centre of such a strong mission. These values are the basis for each initiative set up by DSE to encourage science communication:

Curious – capturing the curiosity of youth
Ingenious – resulting in creative solutions
Tuned-In – correct messages and media
Real – connecting to our audience (DSE, 2007, p.4)

The role of the DSE is a broad and ever expanding one. It strives to promote science communication with members of the lay public, coordinate education and initiatives with the needs and wants of its target audiences, and create over time a knowledge-based society and advanced economy. This three-way role requires clear strategic objectives. At its broadest level DSE aims to enable the public to understand scientific innovations and how these innovations benefit the community. Accordingly the number of students studying science must be increased and careers in science, engineering, and ICT must be actively promoted (DSE, 2007). Achieving these goals depends upon critically re-examining science outreach strategies and approaches.

DSE's initiatives are grouped under three headings: primary school science initiatives, secondary school science initiatives and general awareness programmes (separate initiatives are aimed at third level students to promote future careers in science). The primary school initiatives consist of Discover Primary Science and the Greenwave Programme. Secondary school initiatives include Discover Sensors and support for science and career

work in Transition Year. General awareness programmes are SCOPE TV and Science Week. These are detailed below.

Discover Primary Science
Discover Primary Science, aimed at the lower classes in primary schools, is probably the most comprehensive science awareness programme developed by DSE. It educates participating teachers in how to make science fun and interesting for the children, with resources provided by DSE to help motivate teachers to engage with science at this level (DSE, 2007).

The Greenwave Programme
This programme, piloted in 2006-2007, encourages children to become involved in a nationwide experiment to measure and record how fast spring arrives across Ireland (DSE, 2007). It is nature-based and helps children to understand that scientific experiments need not always be confined to the laboratory. It heightens children's awareness of and interest in science as they can see the developments occurring around them. Climate change may not be an enthralling subject matter for children but this initiative teaches children in a very real manner how climate change and other environment movements can affect the world around us.

Discover Sensors
This project, piloted in 2006, is aimed at Junior Certificate students and their teachers. Following a revision of the Junior Cert science syllabus, a more practical learning environment was introduced. Discover Sensors aims to help students and teachers to engage in active learning in relation to science and "places increased emphasis on students' thinking and on their analytical, investigative and problem-solving skills" (DSE, 2007, p.3). It hopes to expand in the future to incorporate Leaving Certificate students and teachers.

Transition Year Support
This programme provides Transition Year students with resources to complete science and technology projects. As Transition Year is the only second level year which caters for project work and unconventional learning, DSE hopes to use this opportunity to encourage students to develop an interest in science and technology and possibly pursue future careers in these areas. Online learning supports and blogs help students with science education in an interesting and innovative manner (DSE, 2007).

Careers
This is another pilot project but is concerned more with technology and engineering than science. It hopes to promote IT and

engineering as viable career paths for students studying science at second level. It aims to increase the number of applicants opting for higher education in computer science, electrical engineering and electronic engineering (DSE, 2007).

Science Week
Science Week is a dedicated week once a year where scientists, science events and exhibitions come into contact with children, teenagers and the public at venues around the country to promote scientific learning and science literacy. These events have been attracting larger crowds every year (DSE, 2007).

SCOPE TV
SCOPE is in its fourth series on Irish television and has increased interest in science for many people through showing scientific experiments and science-related activities taking place on the small screen (DSE, 2007).

Science.ie
This is a web-based educational resource which provides information, advice, links and support for people of all ages with an interest in science.

Discover Science and Engineering hopes to continue expanding its various pilot projects in primary and secondary schools and among the general public. An increase in the number of schools participating in these various pilot projects is a positive sign for the future.

Science Foundation Ireland
Science Foundation Ireland (SFI) was set up in 2000 as a dedicated organisation to build research centres of excellence in science, engineering and technology in Ireland. It became fully functional in 2001 and has spent the past seven years making strides towards developing the Republic of Ireland as an internationally recognised leader in scientific research, with the aim of gaining sustainable economic advantage in the global economy. SFI was established by the Irish government under the management of Forfás, and its funding has increased substantially over the years (€16.6 million in the 2008 Budget). The development of SFI has been a major step towards increasing research and innovation in Ireland. The research under SFI aids collaboration between Ireland and other nations, thus encouraging international researchers to come and work in Ireland (SFI, 2004).

SFI is committed to advancing the development and benefits of the Irish economy through increasing scientific knowledge among the Irish population. Its mission requires investment in people, innovation and collaboration efforts both nationally and internationally. The

areas of most strategic importance to Ireland's economic development need to be identified and funded to achieve this mission. SFI is determined to build world-class infrastructure to generate world-class research (SFI, 2004).

SFI has three main goals and five sub-goals outlined for the achievement of its mission. The three primary goals are to: develop human capital, support strong ideas, and promote partnerships. To develop human capital SFI is prepared to invest in attracting people to science, technology and engineering through developing educational initiatives and infrastructure to enable research into specified strategic areas within these subjects to help create a more competitive Ireland. Supporting strong ideas and providing funding to develop these ideas are prerequisites for innovation. Promoting partnerships both among researchers within the island of Ireland (in educational institutions, in industry and between these sectors) and internationally will help Ireland become more competitive in the long-run (SFI, 2004).

The five sub-goals involve recruiting additional researchers, funding the development of Ireland's research infrastructure, initiating teams to carry out research, supporting research and education of future researchers, and providing support for technology transfer to generate economic benefits. SFI's programmes are aimed at students, both at undergraduate and postgraduate levels, at science teachers and at science researchers. (SFI, 2004).

The initiatives SFI supports include the following:

UREKA: Undergraduate Research Experience and Knowledge Award
SFI is primarily interested in promoting research into the strategic areas likely to advance the economy of Ireland on a long-term basis. UREKA targets undergraduate students of science, engineering and technology, aiming to support them in undertaking research which may form a basis for developing Ireland's competitiveness (SFI, 2004).

STARS: Secondary Teachers Assistant Researchers
This initiative encourages second level science teachers to spend their summers in laboratories carrying out research.

Science Foundation Ireland also has various other multi-annual funding programmes aimed at research centres and individual researchers both nationally and internationally who participate in research in Ireland. Such programmes include Centres for Science Engineering and

Technology (CSET), Research Frontiers Programme (RFP) and President of Ireland Young Researcher Award (PIYRA). Outreach in science and technology is inherent to these initiatives, with policy, education, and funding coming together to support not only scientific innovation, but also the public communication of science. In its relatively short existence SFI has already built a recognised reputation for developing research centres of excellence in Ireland and is dedicated to driving future research in Ireland (SFI, 2004).

STEPS To Engineering

STEPS to Engineering was founded in 2000 but adopted its current name in 2005. Managed by Engineers Ireland, STEPS is supported by the Department of Education and Science, FÁS, Forfás, as well as a number of engineering employers, and is a key element in the Discover Science and Engineering programme. It was initially conceived as a means of promoting engineering as a future career for students. However it has since expanded its focus to include teaching children and teenagers about engineering in general and how it can be fun, interesting and relevant to their lives. STEPS reaches out to parents, teachers, children, and teenagers to promote an interest in engineering as an essential element in a science literate society, and uses innovative programmes to try to change the preconceived notion that careers in science and engineering are boring and difficult (ROSE Report, 2007).

STEPS aims to target children and young people and build their interest in engineering so that more and more of them choose to pursue the various engineering courses offered in third level institutions. The longer-term aim is to secure the supply of engineers which will be needed in the future to aid Ireland's economic development.

STEPS' mission requires a number of goals to move people along each step of the process: from building an interest in engineering to pursuing it as a career. These goals are to:

- Raise awareness amongst students about engineering as a career choice
- Encourage a positive attitude towards careers in engineering, science and technology
- Promote a greater understanding of the role/contribution of engineering in society and how engineering is relevant to our everyday lives,
- Highlight the advantages, diversity, opportunities and excellent rewards offered by a career in the engineering profession,
- Introduce students to science

and show the links with engineering
(STEPS, no date a).

STEPS targets both primary and secondary schools with initiatives to keep engineering at the forefront of their minds right up until they enter third level education. It also promotes its programmes to teachers and it offers teacher support to help them deliver STEPS initiatives in schools. It also uses the media to promote its programmes to parents thus helping to generate a greater awareness of engineering.

STEPS initiatives include:

Magical Science and Engineering Show
This show brings science and engineering to life for primary school children by bringing experiments into the classroom. Children can learn about the two subject areas and develop an interest in engineering as it is made fun, interesting and relevant to their lives.

K'NEX Challenge and K'NEXperience
The K'NEX Challenge and K'NEXperience actively bring engineering to the classroom as children are given the freedom to demonstrate their engineering and creative abilities using material supplied by STEPS in pursuit of awards in a national competition.

Engineering Seminars
STEPS offer an introductory evening in secondary schools around the Republic of Ireland by inviting local engineers to provide an insight to their work and into careers available through engineering. These informational seminars are designed to encourage secondary school students to study engineering at third level.

Engineered! Week of Wonder
This is an annual celebration of all things engineering which sees activities run across the Republic of Ireland to promote the profession. Engineering and third level institutions get involved during this week to provide exhibitions of engineering aimed at increasing the numbers entering the profession.

Future Outreach in the Republic of Ireland
Scheduled to open in 2010 in Dublin, the **Exploration Station** will be the first interactive science centre in the Republic. It will be a living laboratory that will connect to the national primary science curriculum and will reach out to schools and parents through travelling exhibits. A part of its mandate also includes sponsoring visits to the new museum for disadvantaged children, as well as travelling educational

'kits' for those further away from Dublin.

An impressive 'new kid on the block', the Science Gallery at Trinity College Dublin, offers a shopfront interactive science presence for youth and the general public. Its changing exhibits blur the line between art and science, and technology and culture. The Science Gallery has initiated a number of partnerships between industry and the community to deliver stronger science and technology outreach activities to the public. Its diverse and eclectic exhibitions aim to build a community of interest in science and technology.

Each of the various government-founded organisations above has their individual agenda on how to increase public participation in science, technology and innovation; yet they are all connected by the overriding goal of achieving the mission of the Strategy for Science Technology and Innovation 2006-2013. The Irish government needs to ensure the collaboration of these organisations, avoid duplication in activities and promote interdependence among them in pursuit of the SSTI'S goals. Although it is tempting to assume success will follow from the activities such a range of science outreach providers, the absence of an overarching evaluation instrument prevents us from identifying a model of best practice that will lead to long-term science literacy.

Key Players in Science and Technology in Northern Ireland

Science outreach work in Northern Ireland is mainly conducted by three main actors: the ***W5 Interactive Discovery Centre***, Belfast; the ***Science Shops in Queens University Belfast and the University of Ulster***, and the ***Armagh Planetarium***. Given the smaller population and geographic area of Northern Ireland much of the science communication needs can be met by these three players.

W5 Interactive Discovery Centre opened in March 2001 as the first major science museum on the island of Ireland. It is located in the new Odyssey entertainment complex beside the River Lagan and near Belfast Central railway station. It offers permanent and temporary science-related exhibits, as well as daily science demonstrations aimed at visitors of all ages, from very young children to adult learners.

W5's aims promote science to a broad range of the general public from Northern Ireland, Republic of Ireland and internationally. W5 caters to schools by connecting to the science curriculum in both jurisdictions and offers a range of workshops that include notes for teachers. Its programmes have been developed to reflect the Republic's curriculum from Primary to Leaving Certificate, and it is recognized by the Department of Education and Science as a Discovery Primary Science Centre.

Furthermore W5 offers programmes and resources that help visitors to connect with the community and environment. Events and competitions at W5 attempt to engage visitors with science and technology so that their very participation provides direction for outreach activities. The Centre carries out ongoing evaluation and focus groups with visitors, schools, local communities, universities and industry to evaluate the service they provide.

The Science Shops at Queen's University Belfast and the University of Ulster create connections between members of the community, voluntary organizations, students and researchers at the universities. Facilitating diverse partnerships between university students and the community promotes active collaboration enabling the advancement of science among the general public. Since its establishment in 1988, the Science Shop at Queen's University alone has facilitated over 1500 research partnerships for community organisations in Northern Ireland. The University of Ulster Science Shop was established in 1996 in partnership with Queen's.

The Science Shops in Northern Ireland are connected to an international network of Science Shops, participate in a number of international research projects and regularly attend International Science Shop conferences.

In addition to its daily tours and astronomy shows, the Armagh Planetarium offers a number of outreach programs for primary and post-primary students, as well as a particular programme that caters to students with special education needs. Furthermore, the Armagh Planetarium also has a mobile 'SkyDome', a portable planetarium that it brings to science festivals in both Northern Ireland and the Republic of Ireland.

Because the United Kingdom has formulated policy on science communication and been actively engaged with science outreach activities since the 1960s, the degree of activity in Northern Ireland appears to be better focused and coordinated. The Republic of Ireland, in contrast, appears to have a multiplicity of initiatives established in the last ten years or less as a response to the rising concern over science enrolments in schools and universities. Partly because of this longer tradition of outreach, along with the concentrated outreach activities in Northern Ireland outlined above, there were fewer Northern responses to this project's survey and therefore the data for outreach providers in Northern Ireland are less detailed.

Social Marketing – Voluntary Behavioural Change and Science Communication

In collaborating across disciplines, and across borders, the research team intentionally aimed to introduce alternative ways of thinking about how science might be promoted more effectively on the island of Ireland. For the first annual Science Communication, Outreach and Public Engagement Research Symposium in May 2007, two of the four keynote speakers were invited to speak about how theories of social marketing might be applied to science outreach.

Social marketing may be defined as the systematic application of marketing principles alongside other concepts and techniques to achieve specific behavioural goals for a social good, and in this way to bring about social change: e.g. reduce litter, improve citizens' health, conserve energy, or promote careers in science and engineering. A fundamental principle of social marketing is that *programmes to influence actions will be more effective if they are based on an understanding of the target audience's own perceptions and beliefs.* Another key principle is based on the recognition that the marketplace is constantly changing; as a consequence, programme effects must be regularly monitored, and programme managers must be prepared to be flexible with strategies and plans in order to adapt to shifts and changes. Monitoring and research-based evaluation are critical activities in social marketing (based on material from Social Marketing Institute, Washington DC).

The application of social marketing to issues that concern societies, such as smoking, drink driving, exercise for young children, teenage drinking, and leprosy demonstrate that its techniques can be effectively employed to achieve the goals of science communication and outreach (Andreasen, 2006; Rothschild et al, 2006; Kotler and Lee, 2008 and Hastings, 2007). Just like the decision to stop smoking, engagement with science requires a change in social behaviour so that people commit to becoming more literate in science. Thus science communication and outreach initiatives capture the essence of social marketing: the central role of voluntary behavioural change for the betterment of the individual and society. At the micro level, primary and secondary school children, their teachers and their parents constitute different target audiences with different social and economic needs. At the macro level, relationships between community groups and regional bodies facilitate the exchange process, with national

agents at the top end of the value co-creation chain shaping the context for such exchanges to occur. Therefore it can be argued that, by necessity, these particular social relations demand an analysis that is best facilitated by a social marketing approach.

It is widely recognised that advertising and communication alone have not resulted in much sought after science behavioural changes in this area, i.e. an increase in science literacy and in science graduates, both deemed desirable and beneficial for society (Evans and Durant, 1995; DETE, 2006). The Republic of Ireland, in a recent Eurobarometer report (Europeans, Science and Technology Eurobarometer 2008) demonstrates this very potently, reporting the lowest levels of stated interest in in-depth scientific information in the media; in obtaining information in the specialised press; in obtaining information on traditional websites, and in having scientific news presented in dedicated newspaper sections. Ireland also had the highest 'don't know' responses on factors mattering most in news about scientific research (e.g. ease of understanding, usefulness, objectiveness).

The results of the Relevance of Science Education (ROSE) survey completed by 688 students from 29 second-level schools in Ireland signal that the great majority of students do not want 'to become a scientist' or 'to get a job in technology' (55% of students chose the extreme 'disagree' option for the former statement and 44% for the latter statement). "The Irish students respond in a similar way to students in the other industrialised countries, but not with such a marked gender difference. They share the general trend - an aversion to 'becoming a scientist'" (Matthews, 2007). Understanding this reluctance to engage with science as an 'aversion' helps us to grasp that change cannot happen by simply inspiring greater interest in science. The aversion needs to be challenged at the level of behaviour.

Social marketing, even within the broader discipline of marketing, has historically been defined in multiple ways (McDermott et al, 2005). Since Wiebe (1951-52) penned the phase "selling brotherhood the way we sell soap," and Kotler and Zaltman in 1971 defined the term social marketing as selling "ideas". Social marketing in the 1980s and 1990s was about interventions and programmes to improve the quality of life. Classically, this early social marketing made use of subsidised brands/targeted vouchers and extensive distribution, and was heavily donor based (Ramlow, 2008). This view of social

marketing, now referred to as 'tell and sell' marketing, is the more traditional understanding of the concept (NSMC, 2006).

Social marketing in the 21st century delineates its domain around voluntary behavioural change (Kotler and Lee, 2008, Andreasen, 2002; Hastings, MacFadyen and Anderson, 2000 and Hastings, 2007; Smith 2000 and Smith 2007). Levy and Zaltman (1975) identify three dimensions in society that are affected by the voluntary behavioural change sought in social marketing campaigns: micro level, group level and macro level - as displayed in Table 1.

The application of social marketing at all three of these levels results in a conceptual maturing towards the 'market with' and 'relational' approach (Hastings, 2003; Hastings and Saren, 2003; Lusch and Vargo, 2006; Gronroos, 2007; Wilkie and Moore, 2003). This 'market with' approach of social marketing embraces upstream stakeholders, partnerships, multiple exchanges and the co-creation of value at all levels including that of the whole system – a macro society level constituting those who control the social context influencing the other two units (Brenkert, 2002). This is attributable to the fact that individuals influence, and are influenced by, those surrounding them, thereby requiring this three-tiered approach to the exchange process, building upon both economic and social dimensions. This multiple exchange process results in social marketing having an

Table 1: Types of social change, by time and level of society

Change	Micro level (individual)	Group level (group/ organisation)	Macro level (society)
Short term Example:	**Behaviour change** Attendance at stop-smoking clinic	**Changes in norms/ Administrative change** Removal of tobacco advertising from outside a school	**Policy change** Banning of all forms of tobacco marketing
Long term Example:	**Lifestyle change** Smoking cessation.	**Organisational change** Deter retailers from selling cigarettes to minors.	**'Socio-cultural evolution'** Eradication of all tobacco-related disease.

Source: McFadyen, L., Stead, M., and Hastings, G. (1999) A synopsis of social marketing. Available at: http:// www.social-marketing.com.html, pp. 4.

extensive constellation of co-creating value stakeholders and relationships to satisfy and manage.

Thus science outreach providers need to be simultaneously active and engaged at all levels with customers, communities and policy makers. This, in turn, achieves synergy between the multiple change agents to bring about the desired behavioural change to benefit the individual and society (NSMC, 2006). Typically, it incorporates a new characteristic for social marketing – the direct contracting by government of services from private providers. In many cases, this contemporary form of social marketing represents a move away from products towards services. While as far back as 1975 Bagozzi referred to this co-creation of value as a "complex marketing exchange", where more than three parties are involved in a network of relationships without "the simple quid pro quo notion characteristic of most economic exchanges", we are only now witnessing it to its full extent in practice with the emerging wave of modern social marketing (MacKay 2008; Ramlow, 2008).

Social marketing is a value co-creation process that works throughout an entire holistic system of relationships (Vargo and Lusch, 2008; NSMC, 2006). The 'pre' and 'post' exchange circumstances, processes and participants are as important as (if not more) than the activities *in the exchange itself*. Behaviour and relationships are socially as well as economically determined (Maiback and Cotton, 1995; Hastings 2007; Quelch and Jocz, 2007). In social marketing, partnerships manifest the social context of complex multiple exchanges. Science outreach providers, therefore, need to be aware of the degree to which individuals' understanding of, and relationship to, science is influenced by the social context, both macro and micro.

According to Morgan and Hunt (1994), partnerships occur at five levels: (1) intrapersonal/individual; (2) interpersonal (family and friends lend social support); (3) institutional/organizational; (4) community (local or regional social networks more distant from family and friends), and (5) public policy. Outreach providers would do well to position their activities so that they reach the public at the various points where science intersects the social. Downstream partners are concerned with creating and distributing the interventions (Wallack et al, 1993). Upstream partners are concerned with changing the environment and barriers that prevent individuals from altering their behaviour. They also have responsibilities for policies

affecting the target audiences, with the objective of such policies being to encourage and support the required individual behavioural change.

While upstream partners aim to engage the public, the media and policy makers (Andreasen and Herzberg, 2005; Andreasen, 2006; Hastings 2007), they tend to be time-consuming and expensive (Haytko, 2004). The best social marketing strategies advocate approximately campaigns of ten years duration. Concurring with this, Lusch and Vargo (2006) explain that lengthy time frames for adaptive learning and flexibility are necessary for some marketing practices. The ability to adapt and learn from the community of partnerships and exchange parties is the result of extensive formative, impact and process evaluation in social marketing (Weinreich, 1995; Hastings, 2007). However becoming science literate is not an overnight process any more than the process of changing people's behaviour in other areas. If science literacy is a long-term strategy for socio-economic growth, then the investment in the application of social marketing principles over time is a complementary approach.

Applying social marketing to the goals of science outreach involves a thorough evaluation of and strategic engagement with this complex social field. Influencing behavioural change requires an understanding that people make choices for a variety of different social reasons, and that different choices are made available to people depending on the way they are marketed. Successfully expanding the degree to which science is a part of people's lives may involve more than just creating an interest in science. Rather, science outreach strategies need to find ways to market science to people so that they see the value in integrating science and scientific theories into their lives. Doing this requires a greater engagement with theories, such as social marketing, that have had success in affecting voluntary change in social behaviour.

Research Methodology

Introduction
This research aimed to examine the 'big picture' of what is currently going on in relation to science outreach on the island of Ireland and with this information assess how we might go about improving outreach activities. Data was collected by employing two methodological approaches and quantitative and qualitative research instruments. In the first phase, an exploratory research design was used: an interdisciplinary and inter-institutional research team was assembled to attempt to explore the literature and to have informal conversations with outreach providers in order to begin to understand the barriers to science outreach.

Key outreach stakeholders in the Republic of Ireland and Northern Ireland were invited to participate in the first annual Science Communication, Outreach and Public Engagement Research Symposium held in the National University of Ireland, Galway on 24-25 May 2007. The exchanges and conversations between the speakers and participants at symposium workshops were observed and recorded by the researchers and research assistants who were participant observers there. These notes were analysed by drawing out themes, commonalities, and contradictions, using a constant comparison method. The symposium data informed the purposeful sampling approach with the aim of selecting a sub-sample of key stakeholders at the symposium to participate in in-depth interviews. The common themes which emerged from the participant observation included resource allocation, types of programmes and intervention strategies, target audiences and partnerships, objectives, evaluation, and perceived needs for future development.

The second phase of the research involved a quantitative approach in the form of an on-line survey of the diversity of outreach activities on the island of Ireland. The survey was informed by the existing literature on science communication and social marketing and by contributions from outreach providers attending the research symposium. During the symposium delegates were informed about the forthcoming online survey and were asked to suggest areas of interest and questions that could be included in the web survey that would benefit their own outreach activities, or to provide any other information which they felt was important to gain an all-inclusive synopsis of science outreach and communication in Ireland. These

suggestions were, where possible, incorporated into the survey design.

After two pre-tests, invitations to participate in the online survey, consisting of 38 questions - both multiple choice and open ended (see Appendix A) - were sent to 165 outreach providers in the Republic of Ireland and Northern Ireland. The online survey was active for two months, during which time participants were sent three personalised reminder notices. One hundred and ten surveys were returned, indicating a response rate of 67%. The high response rate is reflective of the interest in the need for such a comprehensive mapping exercise to begin to document the breadth, depth and scope of science outreach and communication activities on the island of Ireland. This approach was chosen so that the findings could identify effective approaches to science outreach in the future and to move beyond a simple description of current practice.

Sampling Frame

Through discussions with research symposium participants and through the pilot survey, a comprehensive sample of science outreach providers who might be solicited to participate in the research was identified (see appendix B). The initial sampling frame consisted of those persons invited to the first annual Science Communication, Outreach and Public Engagement Research Symposium. This list included government policy makers, science teachers and people from museums and aquaria, and primary school science centres. It was complemented synthesizing a number of existing professional categories drawn from public sector education, communication, local authorities, and industry (from, for example, the Discover Science and Engineering and www.universityscience.ie websites).

The sampling frame was expanded further by including the Deans of Science, Engineering and, where applicable, Mathematics from all the higher education institutions of Ireland. Also included were the Directors of the thirteen full-time and nine part-time Education Centres in the Republic of Ireland since they are often on the 'front line' of outreach work connecting science policy and curriculum to students. In addition, individuals associated with science outreach in all the museums, zoos and planetaria in Ireland were included. A search of the multiple science links on the governmental website www.science.ie provided the remainder of participants.

Our aim was to reach any person or group that had a mandate to promote science to the general

public. As such, the reach of the survey extended beyond the select stakeholders who attended the initial research symposium. Those responding were therefore not simply providing us with predictable mandates to promote science, but rather drew together a variety of individuals and groups acting independently in order to create a clearer picture of the diversity of approaches and needs of such groups. To our knowledge, this was the first comprehensive census of science outreach activities on the island of Ireland.

The following section reports on some of the findings of the in-depth interviews and the online survey, and begins to connect the contemporary science outreach activities in Ireland to the theory of social marketing.

Findings

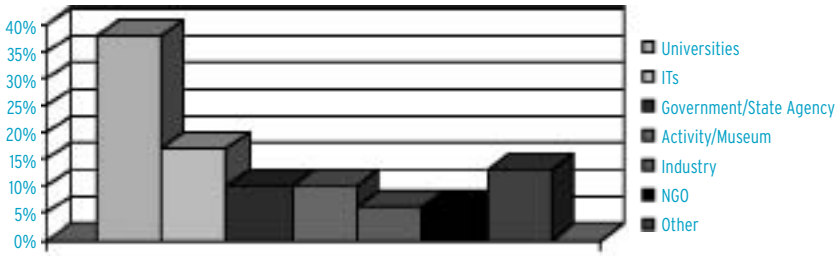
The online survey illustrated that science outreach in Ireland is dominated by educational providers, with third level institutions accounting for 54% of all science communication and outreach work. Industry, in particular multinationals, contribute to 12% of outreach activities (see Table 2).

Table 2: Organisational Profile
While it is not surprising to find that universities and industry make up the bulk of outreach work, what is striking is that the commitment to investing in outreach is fairly recent. The majority of science communication and outreach providers were established since 1998, with 22% having no full-time staff, and 36% having one or two full-time staff. The outreach units average one part-time staff member, with 10% having five or more volunteers. All of this is in keeping with an emerging informal education support mechanism, similar to patterns in the USA.

Outreach aims arising from the survey can be described as mainly traditional: promoting and stimulating awareness of science. 47% of providers report their aims as "generalized work" and 30% focus upon sectoral issues. In their words, they are "mainly education orientated and broadly defined, dealing with the general public/community to inspire future generations".

Annual income for the majority of providers who responded to the survey ranges from €100,000 to €3.8 million. While all are dependent upon multiple income sources, in the Republic the Government (through Science Foundation Ireland

Table 2: Organisational Profile



and Discover Science and Engineering) is the key funder. This funding characteristic has direct implications for the areas of focus, with Irish science communication heavily weighted in favour of four areas: (1) Biological, physical and computing sciences; (2) Education sciences (Social sciences, including economics, history, geography, psychology etc); (3) Health and biotech sciences, and (4) Topical social and environmental issues.

The implications of these profiling results confirm the *deficit model* as the dominant logic behind science communication and outreach in Ireland. This is based on the belief that significant sections of the public lack knowledge of science, and in response, outreach providers attempt to address this deficit with the provision of science-based information. 24% reported that their first aim was to increase the number of science students and 22% reported that their main aim was to increase positive attitudes to science. Thus the aim of science communication appears to be focused on *awareness* about science issues rather than *behavioural change*, as advocated by social marketing approaches. Therefore there is a need to expand the aims of traditional science outreach strategies beyond providing information toward a strategy that also targets the particular understanding and social behaviour that influences decisions about science learning and careers.

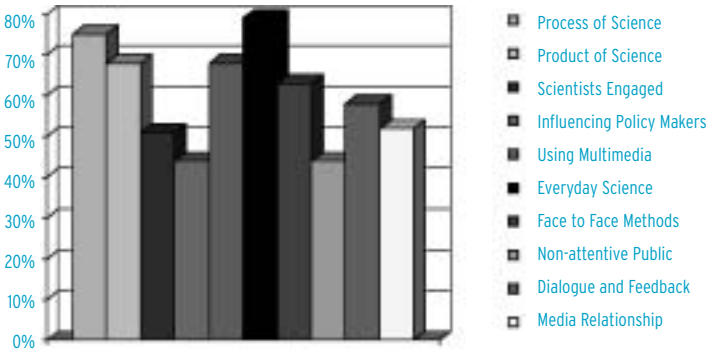
The delivery mechanisms utilised by science communication providers include, in rank order: science weeks and festivals; lectures and open days; public talks; printed media; teacher curriculum; and one day workshops. The main target audiences were teachers and pupils in the upper years of primary schools; secondary teachers and students in Transition Year (15-16 year olds in the Republic of Ireland); and the general public.

The implication of this finding is that targeting these specific audiences again relies on the deficit model: there is an assumption that something is missing – information, resources, or something to attract people to science. While there may indeed be a lack of information or resources in some areas which outreach providers attempt to fill, the data is not available to suggest that delivering information to address a deficit in this way has any long-term impact on future participation in science. Furthermore, it is striking that there is a significant absence of collaboration and integration between some key stakeholders: the media, cultural groups, policy makers.

Further insight is revealed in the reported use of summative evaluation. Only 34% of those surveyed consciously measure change in knowledge, and fewer measure change in beliefs – only 19%. Formative evaluation is undertaken more often, with 58% regularly measuring awareness of programmes and 63% assessing audience satisfaction. Again, the traditional science communication strategy of raising awareness used from the 1960s to the 1990s in the United Kingdom and the United States is the primary approach utilized in much current Irish outreach work. This research has illustrated that there is not a shortage of information about science, nor a shortage of outreach providers to deliver the message about science. However approaching science communication as if one's goal is to simply fill a gap in knowledge is a limited strategy because it assumes that only information is needed for change to occur. As we have seen in AIDS prevention work, the availability of information alone does not affect change. There is a need to connect with the social and contextual reasons why people behave in particular ways. This is a step beyond simply creating an interest in science. Outreach activities must begin actively to change beliefs about science in people's lives in order to sustain interest in science over time.

Respondents were asked about the hallmarks of good science communication practice to benchmark existing practices against international guidelines (www.nist.gov/public_affairs/bestpractices/conf_summary.htm), as displayed in Table 3 below. The table

Table 3: Hallmarks of Good Science Communication Practice



below shows that the strengths of good practice lie in their focus on the Process of Science and Everyday Science, which are clearly the main focus of schools and teachers.

The weaknesses illustrated above are the lack of focus on non-attentive science publics, and the lack of comprehensive engagement with scientists and policy-makers. By not attending to those with the least connection to science, and by having limited engagement about outreach with those most directly connected to science, it becomes easy to fall back on the traditional deficit model of science outreach. Science communication and outreach stakeholders are more concerned with the "sell and tell" of science information, and less concerned with the focus of behavioural change. 66% of survey respondents said that "influencing policy makers" is not applicable to them. This lack of upstream engagement, central to social marketing, is further compounded by views such as the following, expressed by one respondent:

Understanding among science communication and outreach policy makers of the issues and the approaches related to different forms of science communication remains low – this results in fragmented efforts, and in some cases programmes which are much less effective than they might be.

Staying with the upstream theme and social marketing's relational approach, participants recognized that working closely with the media is important. It is understood that the media have their own interests and aims, and science and science communication cannot simply be 'imposed' on them. Therefore the media must be seen as an interested partner to be included in the broadening of coordination efforts. While 52% of our survey respondents reported a strong relationship with the media, more telling were the 48% who reported no strong media relationship, or said that the media was not applicable to them. It is limiting to continue to view the media only as a vehicle to report on local and regional science-related activities. Instead, science outreach providers might work to create more inter-dependent partnerships with the media, as one way to reach the public and begin to influence behavioural change with people who have limited exposure to science.

The need for upstream engagement resonates with another survey finding concerned with communication. 58% of survey respondents reported using dialogue, two-way communication and feedback. However 42% said they do not use dialogue, but rather a one-way communication approach or even no communication. This was

captured by one comment: "The main difficulty is trying to get my research colleagues involved in communicating their science to the public".

This is also evident when respondents were asked about the barriers to their work. One-way communication was raised as an operational difficulty at the level of programme or intervention evaluation. "More specific areas of evaluation to be covered; models of good practice; measuring and communicating the efficiency of programmes" were repeated comments from in-depth interviews, supporting the claim that the area of communication had too little attention paid to it. Progress depends on greater dialogue between practitioners and their various stakeholders from a wide number of fields. Communication *between* practitioners and communication *with* target audiences and stakeholders is vital, and a means of fostering such an expansion of communication is urgently needed. Within communication, evaluation must be considered throughout the programme design and implementation periods, since the 'process' of evaluation is frequently as important as the evaluation results themselves, provided it is recycled into decision making. There is a greater need to examine whether the broader outreach strategy is successful rather than simply evaluating the individual enjoyment of a specific intervention.

Conclusions

Merging the quantitative and quantitative research findings has allowed us to recommend the following actions that outreach providers might consider to improve the effectiveness of their actions and raise the level of scientific literacy of Ireland:

1. **Strategic focus:** It is critically important to evaluate and identify where there is potential for change in order to enable successful science communication and outreach strategies. Recognizing enabling factors and those with leverage over key target groupings is fundamental. In promoting science and technology in Ireland, North and South, it is essential to be strategic about the focus, coordination of activities, and budgetary allocation.

2. **Evaluation:** Identifying the potential for change and the creation of strategic initiatives needs to arise from a broad programme of evaluation. Evaluation must be considered throughout the programme design and implementation periods. The *process* of evaluation is frequently as important as the evaluation results themselves, provided it is recycled into the programme design and management activities. While evaluation is an additional expense, the cost may be justified if programmes are designed on sound principles. To this end, there is a need for further development of evaluation processes, methodologies and techniques. Social marketing concepts and principles can provide a solid foundation for the evaluation approaches adopted.

3. **Social marketing approach:** The symposium research has demonstrated that social marketing principles can improve communication and promotion of science to the public in a wide range of contexts: from general science and technology awareness to campaigns based on scientific research results such as health promotion and the promotion of science and engineering as interesting and rewarding career options. In particular, the following aspects of social marketing are important:

- Programmes and campaigns work best when based on a sound theoretical and research base, allowing for much more in-depth awareness of the issues facing the audience(s) for the campaign.

- A multi-disciplinary approach, involving professionals such as social psychologists, science communicators, educators, sociologists, anthropologists, marketers and science/engineering professionals themselves, leads to a much more effective programme of communication.
- It is vital to utilise reliable and effective principles from marketing in the business sector, as well as to consider theory and practice from other disciplines.

4. **Tools and frameworks:** There is a need for practical tools that can easily be used by professionals in the field of marketing/promotion/communication of science and engineering/technology. As an example, how should a professional go about developing a strategic marketing plan as a basis for developing, implementing and evaluating an effective science and technology communication programme?

5. **Policy integration:** Understanding among policy makers of the issues and the approaches related to different forms of science communication remains low. This results in fragmented efforts, and in some cases programmes that are much less effective than they might be. Thus there is a need for a stronger, more integrated policy framework that includes the diversity of science outreach in Ireland. This can only be achieved through regular dialogue and collaboration between policy makers and diverse outreach providers.

6. **Media partnerships:** Working closely with the media is important. However the media have their own interests and aims, and science and science promotion cannot simply be 'imposed' on them. Therefore the media must be seen as an interested partner and included in the broadening of coordination efforts.

7. **Audience assessment:** Given that so many of the issues to be communicated in science, technology and engineering are of vital importance to society (improving citizens' health; understanding of central concerns such as climate change and energy issues; promotion of careers in science and engineering), there is a need to recognise the breadth of the audience and to be specific about the target of communication in order to ensure the greatest return on the investment.

8. **Network building:** Progress depends on greater dialogue between practitioners from a wide number of fields. Communication *between* practitioners is vital, and a means of fostering that communication is urgently needed. There is a need to employ cross-sectoral strategies including the education community, the business sector and relevant professional bodies and public agencies. A central body will be needed to provide leadership and evaluation; to support and coordinate a social marketing approach; to provide a centralised resource clearing house and database; to provide research expertise, and to develop national and international networks regarding best practice of science communication and outreach activities.

9. **All-island approach:** While recognizing differences in some structures, policies and processes between the two jurisdictions, science communicators are interested in establishing a platform to facilitate an all-island approach to the transfer of knowledge and to learn about what has and has not worked in the Republic of Ireland and Northern Ireland.

10. **Additional strategies:** Future networking possibilities might also include: publishing an e-zine or email-based discussion group; organizing topical and strategic small workshops intended to explore different aspects of promoting science and technology; the development of comprehensive databases; the establishment of various steering groups to coordinate topical outreach activities; the organization of workshops to develop practitioners' understanding of social marketing principles/approaches; developing of relevant skills in graduate training; and forging strong links with the education sector.

11. **Future conferences:** The initial 2007 symposium was followed up by a second *Science in Society: International Perspectives and Experiences in the Irish Context* conference held at Engineers Ireland in Dublin on 23 May 2008. It is anticipated that these annual conferences will be hosted at a different location in Ireland each year, and will continue to draw together key stakeholders to network with and learn from local and international speakers about trends in and strategies for science outreach.

The findings of this report signal challenges for outreach providers and point to the need for the integration of a social marketing approach. For deep engagement to happen with science and technology in Ireland, it is essential to be strategic about the focus and coordination of activities, and budgetary allocations for them. This study shows there is a need for a stronger, more integrated policy framework that includes the diversity of science outreach in Ireland. In the words of one respondent: "I believe there is a need for a more systematic approach at a national level to the area of outreach and public engagement".

This framework needs to go beyond the traditional deficit model associated with science communication, where the assumption is that there is a lack of information and/or interest in science that must be 'topped up'. Employing the theories of social marketing may help outreach providers to take account of societal learning and the socio-educational factors involved in peoples' lives that influence the way they take up science as a part of lifelong learning.

The key challenge facing Irish science communication and outreach practitioners and policy makers alike is to effect a greater integration of the myriad of stakeholders – a total market approach. If science communication is to help deliver the promise of continued economic development, value for society, and improved standards of living, it will be necessary to consider social marketing as a theoretical framework for identifying the most appropriate way to navigate and influence social engagement with science in society.

Future avenues for applying social marketing to science communication research, and addressing the concern for low science enrolments in second and third level education, lie in identifying new ways to address the aversion to "becoming a scientist" (Matthews, 2007). This research has to go beyond simply encouraging greater interest in the career choices of teenagers to consider behavioural modifications and change. It has to uncover and understand how value is co-created on both the economic and social levels through social marketing.

Another fertile vein for research concerns the application of sociological and pedagogical theories and the light they may shed on new ways to rethink how science is taught and experienced as a social act. Drawing theories

from other disciplines may offer innovative approaches to examining why people choose to invest in science and scientific information.

A third avenue for research looks to innovation indicators, which are urgently needed for a complex social and economic system in order to support change and the growth of a knowledge society on the island of Ireland.

The first national science outreach symposium demonstrated that there is a high level of interest among practitioners in improving the standard and effectiveness of the various programmes through which science, technology, and engineering issues are communicated to the public, whether it is the general public, school students, teachers, or other target groups. There was also an expressed need among participants to develop a much stronger network of professionals in order to facilitate learning and greater effectiveness.

In conclusion, it is critical to the success of the island of Ireland's economic development and improved standard of living that there should be greater communication between science outreach providers, as well as the adoption of innovative and interdisciplinary outreach and communication strategies that reach beyond merely creating an interest in the subject towards creating long-term personal investment in science.

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Appendix A – Survey Instrument

1. Survey of Public Engagement with Science

Survey of Public Engagement with Science:
A Project to Map Science Communication and Outreach in Ireland
Undertaken by Centre of Innovation & Structural Change (CISC)at the National University of Ireland, Galway
August 2007

CISC
Centre for Innovation & Structural Change
at the National University of Ireland Galway

National University of Ireland, Galway
Ollscoil na hÉireann, Gaillimh

Dear Participant,

Thank you for taking the time to participate in the first all-Island survey of science communication and outreach activities. The survey should take you no more than 15 minutes to complete.

Arising out of the Public Engagement with Science Conference at the National University of Ireland, Galway, May 2007, the aim of this survey is to map the extent of science communication and outreach activities in Ireland to better understand the impact of such activities and to improve their design and management.

A report will be made available to all participants. Our aim is to strengthen the ability of diverse providers to work together towards a common goal of improving science communication strategies in Ireland... North and South. This research will also be used to construct an on-line database that may assist science communication and outreach providers in their future work.

By clicking on the button below you offer your consent to voluntarily participate in the survey. If you have any questions, concerns, or technical difficulties with the survey, please e-mail kevin.davison@nuigalway.ie.

With kind regards,

Dr. Veronica McCauley and Dr. Kevin Davison, Department of Education,
Dr. Aidan Kane, Department of Economics,
Dr. Christine Domegan, Department of Marketing.

2. Section A: Identification of the Respondent(s)

1. Your name

2. Job Title

3. Organisation

4. Science communication and outreach unit (if any)

5. Year Established

6. Address

7. Telephone

8. Email

10. Which of the following best applies to your organisation?

- ☐ Higher Education (University)
- ☐ Higher Education (Institute of Technology)
- ☐ Private Enterprise/Industry
- ☐ Government Body/State Agency
- ☐ Representative Association/Professional Body
- ☐ Non-profit/Voluntary Organisation
- ☐ Museum/Interactive Activity Centres
- ☐ Other (please specify)

11. Please indicate how many people are involved in science communication outreach in either your organisation or unit for 2006:

Number of paid full time employees (whole organisation)	
Number of paid part time employees (whole organisation)	
Number of volunteers (whole organisation)	
Number of paid full time employees (unit)	
Number of paid part time employees (unit)	
Number of volunteers (unit)	

12. For the substantive/major outreach services that you have/are currently working on, please indicate the service name:

Major service 1	
Major service 2	
Major service 3	

13. Please select the various stage that each of your major services is at:

	Major service 1	Major service 2	Major service 3
Pilot project	☐	☐	☐
In start-up phase	☐	☐	☐
Early days	☐	☐	☐
Peak activity	☐	☐	☐
Post completion	☐	☐	☐

3. Section B: Focus on Science Communication Outreach

Please answer the remainder of this questionnaire, addressing your responses towards your particular division/unit/sector/department//branch/centre/programmes with science communication.

14. In your own words, please describe the aims of your science communication and outreach.

15. a) Please indicate the objectives of your science communication outreach activities (select ALL that apply).
and
b) Please indicate the single objective that best applies to your science communication outreach (select ONE):

	select ALL that apply	select ONE
To create awareness of science	☐	☐
To create (positive science attitudes) among the general public	☐	☐
To increase the number of science students	☐	☐
To increase the number of people choosing science careers	☐	☐
To increase the number of scientific researchers in Ireland	☐	☐
To increase scientific literacy	☐	☐
To provide support to teachers	☐	☐
To influence changing science curricula	☐	☐
To support recently revised science curricula	☐	☐
To improve the quality of life (environmental/medical etc.)	☐	☐
To host public debates (enhance the democratic process)	☐	☐
To build public trust and credibility in science (ethical and moral debates)	☐	☐
To maximise media attention/coverage	☐	☐
To encourage industry-institution collaboration	☐	☐

16. What barriers/difficulties do you experience in providing science communication outreach? Please feel free to address to a range of issues (e.g operational/strategic; design, delivery, evaluation; resource constraints; support and organizational issues.)

4. Section C: Classifying your Science Communication Outreach

Please answer the remainder of this questionnaire, addressing your responses towards your particular division/unit/sector/department/branch/center/programmes with science communication.

17. Please select all the areas that apply to your current science communication outreach:

	Mathematics	Computer and Information Sciences	Physical Sciences	Chemical Sciences	Earth and Related Environmental Sciences	Biological Sciences	Other Natural Sciences
Natural Sciences	○	○	○	○	○	○	○

18. Please select all the areas that apply to your current science communication outreach:

	Civil Engineering	Electrical Engineering	Electronic Engineering	Mechanical Engineering	Chemical Engineering	Materials Engineering	Medical Engineering	Environmental Engineering	Nanotechnology
Engineering and Technology	○	○	○	○	○	○	○	○	○

19. Please select all the areas that apply to your current science communication outreach:

	Basic Medicine	Clinical Medicine	Health Sciences	Medical Biotechnology	Other Medical Sciences
Medical and Health Sciences	○	○	○	○	○

20. Please select all the areas that apply to your current science communication outreach:

	Agriculture, Forestry, Fisheries	Animal and Dairy Science	Veterinary Science	Agricultural Biotechnology	Other Agricultural Sciences
Agricultural Sciences	○	○	○	○	○

21. Please select all the areas that apply to your current science communication outreach:

	Psychology	Economics and Business	Educational Science	Sociology	Law	Political Science	Social and Economic Geography	Media and Communications	Other Social Sciences
Social Sciences	○	○	○	○	○	○	○	○	○

22. Please select all the areas that apply to your current science communication outreach:

	History and Archeology	Languages and Literature	Philosophy, Ethics and Religion	Arts	Other humanities
Humanities	○	○	○	○	○

23. Please specify any social or topical issues that are the subject of your current science communication outreach:

24. Please indicate the geographical remit of your science communication outreach:

- ☐ Local (city and county)
- ☐ Regional (Province)
- ☐ Northern Ireland
- ☐ Republic of Ireland
- ☐ All Ireland
- ☐ International

25. Please select all the science communication outreach programme types that you provide:

- ☐ One day workshops
- ☐ 2+ days workshops
- ☐ Public talks/debates
- ☐ Lectures, research seminars
- ☐ Traveling exhibits/kiosks
- ☐ Science Festival
- ☐ Teacher Curriculum-based information

- [ ] Open Days
- [ ] Science Week
- [ ] Printed Media: Newsletters, magazines, newspaper supplements
- [ ] Specialised Media e.g. cartoons, TV programmes, radio show, podcasts, virtual spaces
- [ ] Internet
- [ ] Science Shops
- [ ] Citizens' Panels
- [ ] Deliberative Polls on public opinion

Other (please specify)

26. Please select which best describes your science communication outreach:

- [ ] Generalised work accompanying challenges faced by society e.g. sustainable development
- [ ] Addressing broad sectoral issues in particular fields e.g. biotechnology, nanotechnology
- [ ] Tackling specific issues/questions e.g. ageing, stem cell research

27. Please indicate the approximate number of direct beneficiaries of your programmes/services in 2006:

Number of Organisations

Number of individuals

28. Please explain the basis upon which you make your estimates (number of direct beneficiaries).

5. Section C (cont): Classifying your Science Communication Outreach

29. Please indicate who or what your organisation helps at pre-school and primary levels

	Late/wait for infants	1st/2nd class	3rd/4th class	5th/6th	Teachers	Principals
Primary schools	☐	☐	☐	☐	☐	☐

Other (please specify)

30. Please indicate who or what your organisation helps at post-primary level

	1st /2nd years	Junior Certs	Transition year	Leaving Certificate	Teachers	Career Guidance	Principals
Secondary Schools	☐	☐	☐	☐	☐	☐	☐

Other (please specify)

31. Please indicate who or what your organisation helps in the community

	General public	Disadvantaged	Minority/ethnic groups	Asylum seekers	Unemployed/Low income	Travellers	Elderly/Retirement Groups
Community	☐	☐	☐	☐	☐	☐	☐

Other (please specify)

32. Which partnerships are important to you in (a) providing your services and (b) funding your services? Please select all that apply.

	Services	Funding
Universities	☐	☐
Institutes of Technology	☐	☐
Government bodies/state agencies	☐	☐
Representative associations/professional bodies	☐	☐
Private enterprise/industry	☐	☐
Primary schools	☐	☐
Secondary schools	☐	☐
Community/voluntary groups	☐	☐
Arts/culture entities	☐	☐
Museums/interactive activity centres	☐	☐

Other (please specify)

6. Section C (cont): Classifying your Science Communication Outreach

33. Please indicate whether the following elements are part of your science communication and outreach policies:

	Yes	No	Not applicable
Demonstrating both the process and product of science	○	○	○
Comprehensive engagement with scientists	○	○	○
Assessing political climate and/or involves policy makers	○	○	○
Using multimedia/illustrations/interactivity	○	○	○
Relating science to the everyday environment	○	○	○
Delivering the topic from the audiences point of view, not the institutions'	○	○	○
Using face to face methods (rather than virtual or other)	○	○	○
Reaching the science non-attentive public	○	○	○
Using dialogue, two-way communication and feedback	○	○	○
Providing information to the commercial media in easy usable form	○	○	○

Other (please specify)

34. What, if any, are the forms of reporting and monitoring that you undertake on a routine basis?

	Yes	No	Not applicable
External reporting/auditing	☐	☐	☐
Internal evaluation	☐	☐	☐
Situational analysis	☐	☐	☐
Target audience analysis	☐	☐	☐
Outcome measures	☐	☐	☐
Process measures	☐	☐	☐
Formative evaluation	☐	☐	☐
Summative evaluation	☐	☐	☐

Other (please specify)

35. Do you routinely measure the following?

	Yes	No
Awareness of programme initiatives	○	○
Responses to programme initiative elements	○	○
Audience satisfaction levels	○	○

Changes in knowledge	○	○
Changes in attitudes	○	○
Changes in beliefs	○	○
Changes in behaviour intent	○	○
Changes in behaviour	○	○
Media coverage	○	○
Staff Cost	○	○
Dissemination of materials	○	○
Participation and contributions from outside sources	○	○
Reach of promotional material	○	○
Frequency of promotional material	○	○
Website hits for outreach	○	○
Changes in policies or infrastructure	○	○
Assessment of implementation of programme/initiative	○	○

Other (please specify)

36. Are your science communication outreach activities linked to the Department of Education and Science (RoI) or Department of Education (NI) science curricula?

○ Yes
○ No

If yes, in what ways?

7. Section D: Financial Investment in Science Communication and Outreach in Ir...

37. Please estimate (to the nearest thousand) the amount of total income for your following financial years:

2004

2005

2006

38. Please estimate the percentage share of your unit's income arising from each of the funding sources for the financial year 2006:

Government department %

State body %

National research funder %

EU %

Philanthropy sponsorship %

Corporate donation %

Corporate contract %

Fees, Charges, Sales etc. %

39. If there are other income sources, in addition to those listed above, please describe them and their % contribution:

40. Please estimate the percentage share of your unit's expenditure allocated to each of the following for your financial year 2006:

Direct staff costs %

Operational costs %

Capital costs %

41. If there are other costs, in addition to those listed above, please describe them and their % expenditure:

8. Thank You

THANK YOU FOR CONTRIBUTING TO THIS RESEARCH PROJECT.

42. Would you like a summary of the results?

- Yes
- No

If yes, please enter your email, and the results will be forwarded to you in due course:

Appendix B – Survey Participant List

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Caroline	Ang		Dublin Molecular Medicine Centre,	UCD
Seamus	Bannon	The Expert Group on Future Skills Needs	ForFas,	Wilton Park House, Dublin
Jeremy	Bird		Department of Science,	Institute of Technology, Sligo,
Peter	Brabazon	Director	Discover Science & Engineering,	ForFas,
Catherine	Buckley		Alimentary Pharmabiotic Centre,	University College Cork,
Richie	Byrne	Galway Science & Technology Festival	Galway Education Centre,	Galway
Tom	Casey		CIRCA,	62 Kenilworth Square, Dublin
Peter E.	Childs		Chemical & Environmental Science Department,	University of Limerick,
Lindsay	Cody		REMEDI,	NUI Galway.
Pete	Coxon	Dean	Faculty of Science	TCD
Anne	Cronin	Science Promotion Officer	College of Science & Engineering,	University College Cork,
Sally	Cudmore		Alimentary Pharmabiotic Centre,	University College Cork,
Patrick	Cunningham	Chief Scientific Adviser to the Government	Wilton Park House,	Wilton Place, Dublin
Tom	Cunningham		Centre for Telecoms Value-Chain-Driven Research,	Trinity College Dublin,
Siobhan	Daly		Physics Department,	Dublin Institute of Technology,
Mike	Devane			
Lynsey	Davis			
Kevin	Davison	Lecturer & Research Co-ordinator	Department of Education,	NUI Galway.
Deirdre	de Bhailis	Electrical & Electronics Engineering Promotion Officer,	University College Cork,	Cork.
Ethna	Diver	Head of Department of Science	Letterkenny Institute of Technology,	Port Road,
Christine	Domegan	Head of Department,	Department of Marketing,	NUI Galway.
Sheila	Donegan		CALMAST,	The Walton Building,
Orla	Donoghue		Centre for Synthesis & Chemical Biology,	University College Dublin,
Andrea	Doolan		Alimentary Pharmabiotic Centre,	University College Cork,

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
David	Dowling	Head of Science,	Institute of Technology, Carlow,	Kilkenny Road,
Sean	Duke	Editor	SPIN Magazine,	5 Serpentine Road, Dublin
Julie	Ennis		Lero, Irish Software Engineering Research Consortium,	University of Limerick,
Leo	Enright	RTE	Donnybrook,	Dublin 4.
Odilla	Finlayson		Castel Research Group,	CASTeL, DCU
Patrick	FitzPatrick	Head of College of Science		NUI Cork
Andrew	Flaus	Lecturer	Dept of Biochemistry	NUI Galway
Cathy	Foley	Project Executive	Discover Science & Engineering,	ForFas,
Patrick	Fottrell	Chairperson	Science Foundation Ireland,	Wilton Park House, Dublin
Frank	Gannon	Director	Science Foundation Ireland,	Wilton Park House, Dublin
Aideen	Gaynor		Dundalk Institute of Technology,	Dublin Road,
Heather	Geer		Discover Science & Engineering,	ForFas,
Carol	Gibbons	Deputy to the Chief Science Advisor		
Eoin	Gill		CALMAST,	Waterford IT
William	Golden	Director	Centre for Innovation & Structural Change	NUI Galway.
Maria-Alejandre	Gonzalez-Perez	Researcher	CKI,	NUI Galway.
Michael John	Gorman	Director	Science Gallery	Trinity College Dublin,
Liam	Greenslade		Academic Theme Leaders Office,	Dublin City University,
Marnie	Grier		Letterkenny Institute of Technology,	Port Road,
Gillian	Hastings			
Patricia	Hegarty		Tyndall National Institute-Photonics Theory Group,	UCC
Martin	Henry		Castel Research Group,	CASTeL, DCU
Peter	Hetherington	Director	Technical Services,	Pfizer Ringaskiddy API,
Sharon	Higgins	Director	IBEC/Irish Medical Devices Association,	Dublin 2
Aideen	Hodgins		Institute of Technology, Blanchardstown	Blanchardstown Road North,
Ian	Hughes		Discover Science & Engineering,	ForFas,

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Tom	Hyland	Galway Science & Technology Festival	Galway Education Centre,	Galway
Martin	Hynes		IRCSET,	Brooklawn House,
Ruth	Hynes	Researcher	CKI,	NUI Galway.
Gemma	Irvine	Manager Research Programmes	Higher Education Authority,	Dublin 4
Ruth	Jarman	Lecturer in Science Education	School of Education,	Queen's University Belfast,
Jane	Jerry	Executive Director	Exploration Station,	Digital Hub, Dublin
Kate	Johnson	Outreach & Research Project Officer,	Research Office,	Royal College of Surgeons in Ireland,
Aidan	Kane	Lecturer	Department of Economics,	NUI Galway.
Maria	Keeney		School of Science,	Sligo Institute of Technology,
Mary	Kelly		Science Foundation Ireland,	Wilton Park House, Dublin
Tom	Kennedy	Editor,	SPIN Magazine,	5 Serpentine Road, Dublin
Donna	Kilmartin	Project Manager	ECI, NUI Galway	Room 103 ECI
Bernard	Kirk	Director	Galway Education Centre,	
Sarah	Knight	Communications and Outreach Officer	Environmental Change Inst	NUI Galway.
David	Knowles		Conway Institute,	University College Dublin,
Breda	Kyne		REMEDI,	NUI Galway.
Gobnait	Loughman	Group Co-ordinator	Irish Universities Promoting Science	
Mairead	Loughman	Administrative Officer	University College Cork,	Faculty of Science/College of Science, Engineering and Food Science
Bernard	Mahon	Dean	Faculty of Science	NUI, Maynooth
Tracy	Maloney		STARS,	Science Foundation Ireland,
Eileen	Martin		Science Shop,	QUB
Margie	McCarthy		Engineers Ireland,	STEPS to Engineering Manager,
Edel	McCauddend			
Veronica	McCauley	Lecturer	Department of Education,	NUI Galway.
Billy	McClune	Lecturer in Science Education	School of Education,	Queen's University Belfast,
Emer	McHugh		Applied Optics Group,	Department of Experimental Physics, NUI Galway
Brian	McKenna	Principal	College of Life Sciences	UCD

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Emma	McKenna		Science Shop,	QUB
Gabrielle	McSharry		Department of Science,	Institute of Technology Sligo,
Helen	McVeigh		Institute of Biopharmaceutical Sciences,	RCSI,
Oonagh	Meighan			Forfas
Steve	Miller			
Sally	Montgomery	Chief Executive	W5 @ Odyssey,	Belfast
Mattie	Moran	Director	PharmaChemical Ireland Directorate,	IBEC, Dublin 2
Gerry	Morgan	Dean,	Science Faculty,	NUI Galway.
Patrick	Morgan		Department of Biochemistry,	NUI Galway.
Jerome	Morrissey	Director	National Centre for Technology in Education,	Dublin City University,
Henk	Mulder		Science Shop,	Chemiewinkel, Jijksuniversiteit Groningen,
Seamus	Mulconroy			
Ronnie	Munck		Academic Theme Leaders Office,	Dublin City University,
Una	Murphy		Applied Optics Group,	NUI Galway.
Keelan	Murphy		Centre for Research on Adaptive Nanostructures & Nanodevices,	Trinity College Dublin,
Ita	Murphy		REMEDI,	NUI Galway.
Maire	Ni Beilliu			UCD
Claire	Nadkar		Cork Institute of Technology,	Rossa Avenue,
Pat	Nolan		S & T Unit (Office of Science & Technology),	Department of Enterprise Trade & Employment
Thomas Eric	Nordlander			
Mairead	O Driscoll			
Brian	O Gallachoir		Department of Civil Engineering,	University College Cork,
David	O'Beirne	Dean	College of Science	University of Limerick
Emma	O'Brien	Education & Outreach Manager	National Centre for Sensor Research,	Dublin City University,
Cliona	O'Farrelly			UCD
Feilim	O'Hadmaill		Applied Social Studies	University College Cork,
Aoife	O'Mahoney		Engineers Ireland,	STEPS to Engineering Manager,

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Catherine	O'Mahoney	Science Communication & Policy Researcher	Genetics & Biotechnology Lab, LM 2.10	NUI Cork
Stephanie	O'Neill	Manager	STI Awareness Programme,	ForFas,
Elaine	Quinn	Communications & Education Officer	UCD Conway Institute of Biomolecular & Biomedical Research,	University College Dublin,
Sara	Retief		Discover Science & Engineering,	ForFas,
William	Reville	Public Awareness of Science Officer	University College Cork,	Cork.
Ita	Richardson		Lero - the Irish Software Engineering Research Centre,	Department of Computer Science & Information Systems,
James	Ring	Educational Officer	IBEC,	84-86 Lower Baggot Street, Dublin 2
Jim	Ryan	Director	CIRCA, Group Europe	4 Spencer Villas, Dublin
Kevin	Ryan		Irish Software Engineering Research Consortium,	University of Limerick,
Lynn	Scarff	Education & Outreach Manager	Science Gallery	Trinity College Dublin,
Yvonne	Shields			
Julia	Sigwart		Collections-based Biology in Dublin,	University College Dublin,
Brendan	Smith		DERI,	NUI Galway.
Malcom	Smyth	Dean	Science and Health	DCU
Charlie	Spillane		Department of Biochemistry,	University College Cork,
James	Stewart	Senior Educator	W5	Belfast
Penny	Storey		Centre for Telecoms Value-Chain-Driven Research,	Trinity College Dublin,
Keith	Sullivan	Head of Department	Education Department,	NUI Galway.
Gertie	Taggart	Head of School of Science,	Letterkenny Institute of Technology,	Port Road,
Claire	Taylor		National Centre for Sensor Research,	Dublin City University,
Paul	Tomkins	Head	School of Science,	Athlone Institute of Technology,
John	Treacy		Physics Department,	Institute of Technology Tralee,
Brian	Trench	Lecturer	Science Communication,	Communications Department, DCU
Claire	Twomey		Centre for Synthesis & Chemical Biology,	University College Dublin,

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Paul	Van Kampen		Castel Research Group,	DCU
Marie	Walsh		Limerick Institute of Technology,	Department of Applied Science,
Mark	Watson	Education & Outreach	Dublin Molecular Medicine Centre,	UCD
John	Fitzpatrick	Dean	Faculty of Engineering	Trinity College Dublin
Emmanuel	Buffet	Head	School of Maths	DCU
Charles	McCorkell	Dean	Faculty of Engineering	DCU
Padraic	O'Donoghue	Dean	Faculty of Engineering	NUIG
Jonh	Hinde	Head	Department of Maths	NUIG
Jurgen	Berndt	Head	Department of Maths	NUIM
Huw	Lewis	Dean	Faculty of Engineering	UL
Cyril	Burkley	Dean	Computer Science	UL
Austin	Hanley	Dean	School of Engineering	AIT
Richard	Gallery	Head of Department	School of Engineering	Insitutue of Technology Blanchardstown
Larry	McNutt	Dean	School of Infomatics and Engineering	Insitutue of Technology Blanchardstown
David	Denieffe	Head	School of Engineering	IT Carlow
Liam	McDonnell	Head	Department of Applied Physics	Cork Institute of Technology
Hugh	McGlynn	Head	Department of Biological Sciences	Cork Institute of Technology
John	Wood	Head	Department of Chemistry	Cork Institute of Technology
Kevin	Kelly	Head	Department of Maths	Cork Institute of Technology
Des	Walsh	Head	Department of Civil, Sturctural, and Environmental Engineering	Cork Institute of Technology
Irene	Sheridan	Head	Department of Electronic Engineering	Cork Institute of Technology
Daithi	Fallon	Head	Department of Maunfacturing, Biomedical, and Facilities Engineering	Cork Institute of Technology
Matt	Hussey	Director	Faculty of Science	DIT
Mike	Murphy	Director	Faculty of Engineering	DIT
Eugene	Roe	Head	School of Engineering	Dundalk IT
Gerry	Gallagher	Head of Department	Department of Computing and Maths	Dundalk IT
Des	Foley	Head	School of Science	GMIT

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Gerard	MacMichael	Head	School of Engineering	GMIT
Denis	MCFadden	Head	School of Engineering	Letterkenny IT
Paschal	Meehan	Head	School of Science	Limerick IT
Bert	Geraghty	Head	School of Science	IT Sligo
Brendan	McCormack	Head	School of Engineering	IT Sligo
Kenneth	Carroll	Head of Department	Department of Science	IT Tallaght
Pat	McLaughlin	Head	School of Engineering	IT Tallaght
Seamus	O'Shea	Head	School of Science and Computing	IT Tralee
Kevin	Lynch	Head	School of Engineering and Construction	IT Tralee
Jonhn	Griffith	Head of Department	Chemical and Life Sciences	Waterford IT
Micheal	OhEigeartaigh	Head of Department	Computing, Maths, and Physics	Waterford IT
Denis	Moran	Head	School of Engineering	Waterford IT
Richard	Miller	Dean	School of Engineering	University of Ulster
Hugh	McKenna	Dean	Faculty of Life and Health Sciences	University of Ulster
W.I	Montgomery	Head	School of Biological Sciences	Queens University, Belfast
Bert	Rima	Head	School of Biomedical Sciences	Queens University
R	Burch	Head	School of Chemistry and Chemical Engineering	Queens University
Robert	Fleck	Head	School of Mechanical Engineering	Queens University
Francis	Keenan	Head	School of Maths and Physics	Queens University
Frank	Walsh	Director	Education Centre	Athlone
Seamus	O'Canainn	Director	Education Centre	Blackrock
Padraig	Griffin	Director	Education Centre	Carrick-on-Shannon
Kyran	Kennedy	Director	Education Centre	Clare
James	Mulcahy	Director	Education Centre	Cork Institute of Technology
Sally	Bonner	Director	Education Centre	Donegal
Eileen	O'Connor	Director	Education Centre	Dromcondra
Gerard	McHugh	Director	Education Centre	Dublin West
Paul	Fields	Director	Education Centre	Kilkenny
Tony	Mahon	Director	Education Centre	Laois
Seamus	Toomey	Director	Education Centre	Limerick IT
Denis	O'Boyle	Director	Education Centre	Mayo
Jimmy	McGeough	Director	Education Centre	Monaghan
Bernadette	McHugh	Director	Education Centre	Navan
Lorna	Gault	Director	Education Centre	Sligo
Caitriona	Ní Chullota	Director	Education Centre	Tralee

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Harry	Knox	Director	Education Centre	Waterford IT
Kathleen	Lowney	Director	Education Centre	West Cork
Paula	Carolan	Director	Education Centre	Wexford
Seamus	Walshe	Director	Education Centre	Carlow
Sean	Hanly	Director	Education Centre	Cavan
Eilin	Uí Luing	Director	Education Centre	An Daingean
Noreen	Breathnach	Director	Education Centre	Connemara&Arainn
Frank	Grennan	Director	Education Centre	Dundalk IT
Phyl	O'Connor	Director	Education Centre	Ghort a Choirce
Sean	O'Tuama	Director	Education Centre	Thurles/Tipperary
Catherine	Ferris	Director	Education Centre	Tarbert
Billy	Hannon	Director	Education Centre	Tuam
Gill	Madden	Spokesperson	BT Young Scientist	
Astrid	Brennan	Spokesperson	BT Young Scientist	
		Editor	Nanotechnology Ireland Association	
Dawn	Carroll	Embark Initiative	IRCSET	Irish Research Council for Science, Engineering and Technology
Geraldine	van Esbeck	Editor	Irish Scientist Yearbook	
Eric	Donald	PR	Teagasc	
Partick	Buckley	Executive Secretary	Royal Irish Academy	
Pauric	Dempsey	PR	Royal Irish Academy	
J	Power	Director General	Engineers Ireland	
Diarmuid	Mac Mathuna		Science CommunicationsBlog	
Natasha	Kalves		Sonairte Ecology Centre	
Lynn	Mooney		School Science Bus	DCU
William	Reville	Professor	Understanding Science	UCC
			Greenwave	DSE
			Ready Set Bio	REMEDI
			Ingenious Ireland	
			Science Council	Forfas
Edel	Dineen		Lifetime Lab	Cork
Sharon	Carroll		Armagh Planetarium	Armagh
Pat	Corrigan		North Bull Island	Dublin City Council
Pat	O'Suilleabhain		National Sealife	Bray
Deirdre	Power	Education Outreach officer	National Museum of Country Life	Mayo
Sarah	Miller		Ballymun Rediscovery Centre	
Máire	O'Shea		Dingle Oceanlife Aquarium	
Mary	Houlihan		Lismore Heritage Centre	Waterford

FIRST	NAME	POSITION	ADDRESS 1	ADDRESS 2
Emer	Singleton		National Environmental Education Centre	Co. Wicklow
Una	Smyth		Dublin Zoo	

Published by the Centre for Cross Border Studies
39 Abbey Street
Armagh BT61 7EB
Northern Ireland

Tel: (028) 3751 1550
Fax: (028) 3751 1721
(048 from the Republic of Ireland)
Email: crossborder@qub.ac.uk
Web: www.crossborder.ie

Designed by LSD Ltd
Arbor Building
71-75 Donegall Pass
Belfast BT7 1NR

Tel: 028 9022 4455
Email: info@l-s-d.com
Web: www.l-s-d.com