A VISION FOR SCIENCE AND SOCIETY

1 Context

The UK Government Department for Innovation, Universities and Skills (DIUS) recently published a document entitled *A Vision for Science and Society* as part of a public consultation about the development of a new strategy for the UK. The Royal Society of Edinburgh (RSE), Scotland's National Academy, welcomes this timely document and is pleased to respond to it. At the same time, it uses this opportunity to address comments to the Scottish Government, as many of the processes and responsibilities that will need to be engaged by a new strategy lie in the domain of devolved powers. The thesis of the DIUS document, and one with which we concur, is that a healthy and progressive modern society needs to be involved in the process of creating new scientific knowledge, and to be able to use that knowledge in beneficial ways that are consistent with society's values. It argues that for this to be realised, the interaction between society and the scientific process needs to be enhanced, and suggests ways in which this could be done.

2 The relevant roles of the Royal Society of Edinburgh

The Royal Society of Edinburgh exists to stimulate and reward research and scholarship, to encourage and support enthusiasm for science and learning, to provide advice and evidence for public policy and to work through its international programme in supporting international exchange and collaboration. It is unique in the UK in its multidisciplinary Fellowship, consisting of individuals distinguished in their own fields. It utilises its breadth to provide evidence and advice across the whole range of contemporary issues to governments, parliaments and other bodies in Scotland, the UK and Europe. It organises open lectures and conferences, and undertakes extensive engagement programmes, which develop dialogue between specialists and citizens. It provides educational activities for primary and secondary school students throughout Scotland in association with other providers.

The RSE is also a partner in the Edinburgh Beltane Beacons for Public Engagement project, which aims to encourage citizen participation and understanding of areas of research relevant to public policy such as health and life sciences, energy and environment. The RSE is about to launch a major inquiry on the subject of adapting to climate change, which will be associated with an intensive public engagement and dialogue process.

3 Why Science and Society matters

Scientific understanding and the technologies that derive from it have changed, are changing and will continue to change the way we live. Because of these impacts on the lives of individuals and society, it is imperative, particularly in a democratic society, that all are stakeholders in the scientific venture. Science must be a public rather than a private enterprise. Science and the technologies that flow from it offer options and opportunities. How the latter are exploited should be in principle a decision for society. In this interplay, scientists need to engage with fellow citizens and policy makers in explaining the potentials and limitations of their science, whilst recognising the critical importance of social values in determining how scientific understanding should be used. Governments and bodies in civic society need to collaborate in creating the frame within which these interactions can occur.

If these processes fail, there is every prospect that the scientific creativity and understanding that is increasingly required to cope with global problems will not be exploited, that we will fail to realise the potential that science offers in the economy and in support of pubic policy, and that we will be indecisive and ineffectual in the face of the many challenges that confront us.

4 Objectives for a Science and Society Strategy

We therefore believe that the **primary** objectives of a policy for science and society are as follows:

1. To help all citizens understand as much as possible how the science enterprise works, so that they can understand and engage with it.
2. To develop habits and processes that give society a say, possibly in the priorities for science, but certainly in the introduction of potentially disruptive technologies, and how we should respond to global problems.
3. To ensure that mechanisms exist to provide the scientific support that public policy needs.
4. To ensure we have the scientists and engineers needed to support the development of the economy, social services, infrastructure and the development of more sustainable ways of living on the planet.
5. Finally, to recognise that the rationale for science and funding of science is not only utilitarian, as described in the four preceding imperatives. The instinct to understand, to find meaning, and to map the cosmos and ourselves is deeply human; a common pursuit that all societies have shared. Science is a fundamental part of that enterprise and should be encouraged and supported as such.

The approach of the DIUS consultation is to focus on science-related attributes that it would wish to see in society: one excited by and valuing science, confident in its use and with a well-qualified scientific workforce. It then goes on to identify key processes designed to achieve these ends. We broadly agree with this, but also believe that we need a more explicit definition of objectives such as those set out above, to identify priorities for action. We will therefore use the five objectives outlined above to suggest a number of first order priorities for policy, and then go on to answer the specific questions set out in the DIUS consultation.

5 Priorities for Policy

5.1 To help all citizens understand as much as possible how the science enterprise works, so that they can understand and engage with it.

a) Science education in school

Good media coverage, science centres, science festivals, engagement and outreach by universities and other groups are all important in enthusing and informing the public. But there is one crucial element that is not dealt with by the DIUS document: the nature of science education in schools. This of course lies beyond the DIUS remit, but the way that Government organises its departments should not inhibit the development of good policy.

Our schools not only prepare those who will go on to a career in science and technology, but also those who will not, and most of these non-scientists need to have some comprehension of how the science works and how it affects their lives. We believe that much science education at school does not prepare these citizens well.

One problem is the widespread misapprehension that science always gives unambiguous and definite answers. The misapprehension is both understandable and unfortunate. Understandable – because the science taught in school is about things we understand very well. Unfortunate – because many innovations in science lie at or beyond the frontiers of what is currently known, which makes it harder to define potential side effects and forecast risks. The consequence is that schooling in science often does not prepare students for the "real world" of science they will meet in later life. For example, they and their parents are confused by conflicting views about nutrition, vaccination, HIV and global warming, and by the cacophony of conflicting certainties and crude characterisations propounded in the media. Part of the challenge for science education should be to familiarise pupils with the concept of uncertainty and the fact that much scientific understanding is provisional, without corroding their confidence in the scientific process.

In Scotland, the development of the new *Curriculum for Excellence*, which has the potential to create more flexible approaches, should be exploited to take these issues into account in the later stages of school education. The intention is to develop cross-cutting, interdisciplinary themes; to address applications and explore real-world relevance; and focus on active learning in open-ended investigations, together with discussion, debate and critical thinking. The phasing of these processes is critical, however. The nuts and bolts of understanding remain the disciplines which have been the means whereby reality is analysed and understood and are still powerful drivers of new knowledge. The integration of these disciplines and intellectual concepts like complexity are advanced skills and should not be introduced at too early a stage. To address these challenges effectively, there needs to be far more opportunities for continuing professional development (CPD), and more support to develop team teaching.

b) The role of informal education

A great deal of informal education takes place within the family. There is much evidence that the relationship between grandparents and grandchildren is one where mutual education takes place more readily than between parents and children. Greater wisdom and concern for the future often comes with age, and as the number of retired people grows, and more of them engage in education and community activity, we have more opportunities to encourage cross-generational engagement in informal education.

5.2 To develop habits and processes that give society a say, possibly in the priorities for science, but certainly in the introduction of potentially disruptive technologies, and how we should respond to global problems.

a) Public engagement and dialogue

The consultation document argues that processes of engagement between scientists, public and policy makers are crucial if society is to value the importance of science to its economic and social wellbeing and to be confident in its use. We agree that greater engagement between scientists, public and policy makers is necessary if society is to consent to and profit from scientific and technological developments. Moreover, there are many areas such as energy policy and climate change where governments are loath to make policy decisions that need to be made about choices because of their concerns about public response. Part of the problem often arises from the issues described in section 5.1. Deliberative dialogue is a means whereby such difficult issues can be addressed.

The purpose of such dialogue would not be to determine policy but to inform it. It is crucial that the questions are posed in such a way that the outcome of the dialogue process has the potential to be useful in policy development, and that Government does not commission dialogue on questions where it has already determined its policy and is simply looking for public agreement. Dialogue is most likely to be fruitful where Government has a coherent view of what it wants from the process, where it is has a blank policy canvas, or where dialogue can change aspects of a pre-existing policy direction. Unlike written consultation exercises, dialogue processes are open and their outcomes readily scrutinized. To be seen to ignore them can undermine the credibility of the policy and the dialogue processes in general. It is also important to assess the circumstances under which "upstream engagement" may be appropriate. Another problem is the difficulty or impossibility of knowing the outcomes or practical applications of emerging science or technology. This may undermine the incentive for public involvement and make it easier for special interest groups to dominate debate and promote their agenda. The timing and framing of dialogue is crucial in avoiding premature foreclosure on emerging technologies. Careful framing of the question could however avoid this outcome whilst uncovering areas of public concern that could beneficially influence the research and development agenda.

We would add that although engagement with society about science can bring a wider dimension to policy making, it may also greatly complicate or even paralyse the policy making process. For many of the scientific issues for which engagement is advocated there will be no overall societal consensus and, even if very carefully managed, the process of engagement can lead to polarisation of public opinion and negative attitudes towards new areas of science or innovation which become hard to change. Once such a polarisation has taken place it can be extremely difficult for policy makers to develop policies which retain maximum choice for UK citizens and avoid pandering to minority factional interests.

There are signs the UK Government is developing effective processes for dialogue, but three issues need to be addressed: appropriate horizon scanning processes need to be associated with careful judgments about where dialogue would be appropriate and at which stage of emergence of an issue it should be applied; issues must be framed in such a way that dialogue can influence the development of policy; and a corporate memory of the process must be kept. Dialogue processes are overdue for adoption in Scotland – for example, to deal with issues such as energy, the organisation of health provision and policies for adapting to climate change. The RSE plans to launch an engagement and dialogue process about the latter issue, and this could provide useful experience about further initiatives. Conventional consultation processes are no substitute for deliberative dialogue.

b) Role of the media

For many citizens, the media are the primary source for knowledge and understanding of scientific issues. Whereas they correctly provide healthy scepticism, the treatment is too frequently trivial or erroneous. Frequent sensationalist reporting is unhelpful, inhibits informed dialogue between the scientific community and the public and generates an erroneous stereotype of science and scientists. A search for 'balance' in the media can often result in equal credibility and time being given to irrational, naïve or unscrupulous opponents of rational inquiry. Objective exploration of the issues does not boost readership or audience figures as well as a sensational story. Debates are often confrontational, leaving no room for the middle ground where the truth often lies, and there is little attempt to present reasoned arguments. Such treatment has already damaged public health via the MMR controversy and undermined the prospects for rational discussion of nuclear power.

When major national engagement or dialogue processes are developed, it is possible that local media in particular could provide a valuable forum for debate on issues that resonate locally. We should encourage more scientists to contribute to the media in different ways, not merely by fronting television science programmes. Universities and research institutes could help via training and specialist advice. There is much to be said for universities and research councils requiring a proportion of the articles produced by scientists to be published in the popular media.

5.3 To ensure that mechanisms exist to provide the scientific support that public policy needs.

The implications of modern scientific understanding are so pervasive that there are few areas of Government policy to which they do not apply. At the same time, the direct scientific support for policy within Government is relatively small. In many areas, the direct support has diminished, and the range of expertise needed to underpin policy has greatly expanded. There is a serious need to enlist support for public policy from the science base – particularly from the universities, which contain unique ranges of competence that can be brought together to address complex cross-discipline issues. To achieve this, Government needs to analyse its needs more rigorously and reach out more effectively to the universities. Universities need to recognise and reward the importance of this activity, and both need to discuss the funding basis that would enable this development. The needs of devolved administrations, such as Scotland are not necessarily different to those of the UK Government, in regard to particular issues. It is therefore timely for the devolved administrations to consider how to address their particular needs.

The primary role of scientists in the public domain is to determine the facts as far as we understand them and to indicate the limits and uncertainties of our knowledge. Such evidence informs the choices and decisions that society and government at all levels need to make. The role of scientists is not to make policy but to provide the scientific context in which informed policy decisions can be made as part of wider societal debate. Learned societies such as the RSE have an important role to play in orchestrating independent scientific advice and evidence and posing critical questions.

5.4 To ensure that we have the scientists and engineers needed to support the development of the economy, social services, infrastructure and the development of more sustainable ways of living on the planet.

We suggest that there are two principal sets of processes that are likely to influence this issue. Firstly, scientific careers should be seen to be attractive and important. Science programmes on television, reporting of exciting scientific discoveries in the media and the existence of role models are important aspects. Learned societies and universities also have important roles to play in targeting, encouraging and supporting such opportunities. One particular issue is to ensure that school careers advisers are themselves well-advised about patterns and opportunities of employment for scientists. For example, whereas it is clear that study of the law prepares students for employment in the law, it is less self-evident how physicists are employed. In reality, there is a strong and diverse demand for physicists, and careers advisers need to be aware of this. Secondly, the school experience is vital. As described in 5.1a, science tuition needs to be clear, well conceived and related to current issues that are important for society. Support for teachers and schools in this regard is essential.

5.5 We must recognise that the rationale for science and funding of science is not only utilitarian, as described in the four preceding imperatives. The instinct to understand, to find meaning, and to map the cosmos and ourselves is deeply human; a common pursuit that all societies have shared. Science is a fundamental part of that enterprise and should be encouraged and supported as such.

Whereas the preceding discussion stresses the utility of science to society, the discoveries of science and the rational basis for its operation have profoundly influenced our culture and perceptions of human identity. It is important that one discourse does not drive out the other, but that both are recognised as two sides of the same coin. When a Government minister speaks of introducing five hours of culture a week into schools, why is science and the perspectives that arise from the scientific enterprise not included? It is a travesty of cultural history and cultural perspectives, to which Galileo, Newton, Darwin and Lovelock have made fundamental contributions.
The exclusion of science from this domain in official announcements and initiatives tends to strengthen the parody of science as a narrow technical specialisation, lacking the creativity of the arts and humanities, and fit only for "nerds". This must change, because it is this perception that also helps to undermine the attractiveness of science for students. Initiatives that recognise the creativity and cultural relevance of science are of great importance. The celebration of Darwin's anniversary will be an opportunity to do this.

6 The roles of universities in the science and society agenda

In the previous section and the responses to specific questions which follow, the actual and potential role of the universities is repeatedly invoked. The universities' great strength is the enormous reservoir of knowledge and creativity represented by their staff and students, which is increasingly being tapped to address the science and society agenda, but which could contribute even more. The fundamental question is what are the roles of the universities and how are they funded to address those roles? Universities are paid formulaically for the students they teach, but as student numbers are capped or the per capita resources diminish, it is not generally a means whereby they can increase their income. Success relative to other universities in the Research Assessment Exercise (RAE) is a principal means whereby universities can increase their income, and it is one that appeals more than other approaches such as increasing overseas student recruitment, because of their historical commitment to research. "Knowledge transfer" funding is an increasing source of university income, and can in theory be applied to the science and society agenda, whilst the increasing availability of science and society funding is another welcome move.

The essential step however is a change in culture whereby societal engagement is rediscovered as a major function of the universities and regarded as a natural extension of their research function, as well as one which permits them to promote their research into the public domain. One way to facilitate this culture change would be to recognise initiatives in terms of promotion and pay. The research councils could also strengthen the requirement for societal engagement in research programmes. We are sceptical that another stream of funding is called for. To stratify university activity into an excessive number of specific streams that are individually funded as if they were not part of the same educational and research enterprise would be counter-productive. The funding for societal engagement should be embedded in existing funding streams.

7 Responses to the specific questions in the DIUS consultation

7.1 General comments

The general tenor of the consultation document verges on the complacent. The essence of scientific arguments is often difficult to grasp. Careful thought and analysis is required to enable the dialogue between science and society to evolve in a positive direction.

A more strategic approach to public engagement is required that cuts across the administrative boundaries that Government creates in managing its business. Many current debates on major issues such as energy, food security and climate change, are held in isolation from one another, and can both underestimate the complexity of the issues and at the same time miss simpler underlying principles.

There are enormous benefits to be gained, particularly in terms of societal well-being and economic performance, from a society that is confident in the use of science – a society that understands science-based concepts and how these can be utilised for society's benefit. While general awareness of science may have improved in recent years, knowledge of the scientific method has not – i.e. people do not generally understand basics such as analysis of evidence, statistics etc. Scientists have an important role in terms of data analysis and improving understanding of the scientific method. The key role of scientists in the public domain is to determine the facts as far as we know them. The evidence informs the choices and decisions that have to be made and enables a society that understands science to pose the testing questions required. The role of scientists is not to make policy but to provide the scientific context in which informed policy decisions can be made as part of wider public engagement and debate. Bodies such as the RSE also have an important role in being able to form and pose the critical questions.

The consultation focuses primarily on the UK, with little reference to the global dimensions of science. This is a serious omission in view of the global relevance of many scientific issues. At the very least, the UK should be seeking out good practice elsewhere in the world, and should ideally be working in partnership with bodies such as the European Commission.

7.2 Responses to specific questions

Q. What steps can we take to co-ordinate better or streamline science and society activity to make it more effective?

Science and society activities are delivered through a variety of means and by a variety of providers. It is important to discriminate between engagement designed to inspire, educate and inform and deliberative engagement focussed on specific public issues. The former can be facilitated through both outreach from and visits to science centres, through festivals and other specific events, but an important part of the vision should be to make science engagement of both types accessible throughout the UK. There is a recognition that science engagement needs to be available to pupils in schools, to teachers as part of their CPD and to communities. The Government-funded network STEMNET, which aims to inform young people in the UK about science, technology, engineering and mathematics, could have a role as regional (national) facilitators, bringing science centres, the universities, festivals and other science engagement providers, towards a more connected framework of delivery which is both cost effective and practical. Providing outreach events to school pupils liberates teachers to engage in CPD and the presence of science communicators provides opportunities for community engagement. This sort of collaboration requires a regional forum for science engagement (possibly provided through STEMNET), resources to sustain the collaboration and an evaluation framework to assure quality. What is delivered needs to be relevant to the modern world and to stimulate informed dialogue on issues that are underpinned by science.

We keenly await the Science Engagement Forum (expected in early 2009) which will explore the future of science engagement in Scotland with funders and providers. This could be an important step in creating an overall framework to prevent duplication and to focus effort efficiently.

The quality of public engagement is important, and only those initiatives that have credibility with the public and the support of scientific community should be supported.

Q. How can scientists further improve and professionalise engagement with the public?

We recognise the improvement made to date by the scientific community in engaging with the public. Communication is already regarded as a key aspect of the work of scientists, who regularly provide lectures, organise seminars, meetings and demonstrations. Academics have long recognised this as a responsibility, but on a personal basis. The latter should continue to be encouraged, but the orchestration of effort as discussed in response to the preceding question, is now an important priority.

Scientists need to recognise and understand the frame within which they communicate with the public, which commonly requires them to address issues in a broader context than they typically cover in their specialised research. Experienced academics are very familiar with this requirement, as are professional science communicators. Universities in particular should take responsibility for helping young scientists to acquire these skills. This is particularly important as young scientists are able to engage with the young and their peers in ways that are much more difficult for older scientists, and they also have greater potential to act as role models for the young. We applaud the initiatives taken by the RCUK in encouraging engagement of university researchers with the public through the "Beacons for Public Engagement" programme. However, we also recognise that there is still some way to go in assuring that all universities have appropriate training programmes in place for their researchers.

It is also important for academics and scientists to be proactive in engaging with and influencing the media in the ways suggested in 5.2b. There is a role for coordinated media campaigns in science. According to Eurovision, (who provided the feed to stations world-wide) over one billion people saw the start-up of the Large Hadron Collider (LHC), with the potential to enliven interest in particle physics. It important to follow up this spark of interest by exploring the reason for the LHC and following its progress, and maintaining a sense of excitement and anticipation.

Q. How should high quality engagement be recognised and rewarded?

Part of the incentive for individuals to undertake public engagement is the overt importance of the activity, but sustained and effective engagement does depend upon the recognition and importance with which their institutions regard this activity. The universities are the greatest reservoir of capacity for public engagement. But their priorities are driven to an excessive degree by the financial consequences of the research assessment exercise, and sustained efforts elsewhere are regarded as marginal activities. It would help greatly in creating operational flexibility if this were not so – for example, by not permitting universities to submit more than 60% of their staff for the RAE. Although the grants increasingly becoming available for public engagement are enhancing motivation for this activity, much would be gained by creating greater flexibility in relation to RAE pressures. It should also be explored whether delivery of meaningful public engagement should be a condition of research funding.

Q. How can the scientific and policy communities make science more interesting for the public and particularly for those difficult to reach groups?

We have addressed this issue in 5.1 and 5.2b. We recognise that it is a major challenge to make science more interesting for the "difficult to reach" groups. They are those who are alienated from the rationalist basis of science, and who are unlikely to change that position. It is vital to prevent the growth of that group by improving the quality and relevance of science education as suggested in 5.1a and supporting the deep cultural dimensions of science.

They are also groups that lie out with the economic mainstream of society, whose children are less likely to benefit from education and who are unlikely to engage with public issues. We have no particular insight about how this might be done. A way forward would be to seek advice from social scientists, community officers and local schools about whether for example "Beacon" activities could be funded to explore how engagement might work in such areas.

Q. What contribution can science centres make to the science and society agenda?

Science centres throughout the UK are magnets for the public in inspiring both children and adults with science by making it fun and exciting. They often occupy buildings that provide an inspirational setting for people of all ages to engage with science. They are catalysts for a wide range of activity which can include outreach into communities and schools. Interacting with exhibits in a "science as fun" environment is what science centres do best. They can play an outreach role in reaching groups not able to attend a science centre, often in association with university or other professional groups. Science centres need to be regarded as strategic partners in the delivery of engagement and need to be funded appropriately. For best effect, they need to operate collaboratively, developing strong networks and partnerships, sharing good practice, developing complementary programmes and diversifying income streams.

It is anomalous that many of the great Victorian museums and art galleries are funded to provide free admission whereas, science centres, arguably the modern equivalents of the former, must charge. It is a step forward that entry to the Science Museum in London is free, but this trend needs to be more widespread.

Q. How can the media better support society's need for balanced information that accurately portrays the nature of science and improves scientific literacy?

Part of this issue is addressed in 5.2b. This question is also usefully re-phrased as how can scientists and the media find issues of common interest? Scientists should "infiltrate" the media to give presenters a better grounding in scientific issues. Greater emphasis could also be placed on training science correspondents for the media. The media view that professional presenters rather than scientists should front science programmes distances the scientist from the audience as someone who needs interpretation because they are incapable of communicating directly with laymen. It is a challenge to scientists to show that this need not be so. Given the opportunity, excellent presentations by scientists are not rare, and there is a growing realisation amongst scientists of the importance of such work.

We applaud the work of the Science Media Centre in London, and would like to see a similar development in Scotland.

"Balance" is often a lazy excuse to create conflict. We would urge interviewers to challenge the supporting evidence brought to a debate by interviewees where claims are not supported by good evidence.

Q. How can the lack of quantity and breadth of science television on terrestrial and other channels be addressed?

We question that there is a lack of quantity and breadth. The move to digital systems in particular has created a significant quantity and breadth of science on television. The real challenge here is that television is now only one of a number of sources of information and influence. Fragmentation of the media means that any attempt to use the media today has to take account of more and more outlets. Exploring the potential to use innovative media should be a priority.

Q. How can business better engage with society and policy makers about the development and use of science in everyday life?

There is a tendency for businesses to engage with society and policy makers only when it is vital for them to do so, or when their business interests are threatened. Such attitudes encourage the accusations of self-interest and dishonesty. Business must recognise that public engagement is a means of enhancing the public capacity to make rational judgements based on improved understanding. It should take a longer-term view. Industry Associations are well placed to do this, provided they are able to create credibility and do not merely reflect the financial interests of their members. In this regard, universities might consider that their outreach activities should also be directed to industry.

Q. How can policy makers better engage with society about the development of science?

We address this in section 5.3.

Q. How can we embed and communicate the principles of responsible scientific practice and ethics?

We support the principles of the Universal Ethical Code for scientists produced by the office of the UK Chief Scientific Adviser. The code could also make explicit its relevance to all editors, whether of scientific publications or for the news media, who handle scientific information. It is important for the code to have "bite" and to this extent perhaps it could be taken into consideration in the awarding of research funding and for employment contracts. There is also much to be said for the code to be part of the graduation ceremony of scientists, analogous to the Hippocratic Oath taken by graduating medical doctors. The seriousness of such an event during an important rite of passage would be a memorable event for many.

Q. What more can the education community do to develop scientific literacy in young people?

We have addressed this issue in section 5.1. Given the diverse patterns of educational experience in the different parts of the UK, there is ample opportunity to learn from one another in adopting good practice.

Q. How can we ensure policy makers understand the benefits of engagement with society on science in bringing a wider dimension to policy making?

We address this in section 5.2a.

Q. How can good practice in public dialogue be embedded across government?

It is important that Government departments routinely consider the dialogue option as issues emerge or are anticipated where dialogue could be appropriate. We have set out some of the principles for effective dialogue in section 5.2a, but the rapid turnover of staff in the civil service mitigates against the retention of a corporate memory. Under these circumstances, the principles of dialogue processes and memory of former processes should also be embedded in the Expert Resource Centre under the auspices of Sciencewise, routine reference for the Centre should be made to gain advice.

Q. What additional mechanisms should be put in place to enable scientists to better interact with policy makers?

It is crucial that policy makers have access to the best available scientific evidence and proactively seek to engage with the science community. Interaction between scientists and policy makers can be strongly influenced by the ethos of the particular Government department, with some being particularly good at recognising the need to have access to outside scientific expertise. However, there are some departments that do not recognise this need. In Whitehall, these have largely been addressed through the appointment of Chief Scientists in all departments. There is as yet no clear process where all directorates of the Scottish Government can access necessary scientific advice, or even in some cases understand where it might be necessary. This should not be difficult in Scotland, thanks to its small size and the excellence and relatively large size of the Scottish science base. But it should be a priority. At the UK level, perhaps consideration should be given to making greater use of Green Papers and Royal Commission Reports.

Q. How is good practice by scientists engaging with policy makers celebrated and rewarded?

We address this in section 5.3.

Q. What additional mechanisms should be put in place to enable policy makers to better interact with scientists?

See previous two answers.

Q. What further support do teachers need to help young people understand how science works, how government works and how the media work?

We address the first question in section 5.1a. In relation to the latter two, it is important that teachers are not burdened with yet another responsibility without being given support. We argue that there is a very strong case for a much greater support for teachers through the opportunity to undertake high-quality CPD as a means of perennially inspiring their approach to the curriculum and the vitality of its delivery. Although the availability of CPD has increased in recent years, it still falls far short of what is required to sustain the developments in education that we seek. Successful introduction of the Curriculum for Excellence in Scotland, for example, will depend fundamentally on Government recognising this imperative.

Q. What more do schools need to enhance the science curriculum to make it more exciting and relevant?

We address this issue in relation to the curriculum in section 5.1a. However, this is an opportunity to create a community of science teachers whether they are in school, college or university, that would in particular benefit school education and the standing of school teachers as well as benefiting the articulation between school, college and university education. Utilisation of university and college facilities could make a significant contribution. At the moment there are tremendous resources of knowledge and capacity in the universities that are under-utilised by the schools. There exists a real willingness within universities and academics to contribute to school science education. If schools were able to create a network of links with businesses, colleges and universities, where these external partners were prepared to put real resources into the relationship, this could significantly enhance learning and experiences. Realistically, there are probably few companies, particularly given the current economic climate, able to maintain a sustained commitment of this sort, but it should be possible for universities and colleges. Some of the principles that should govern university and college involvement in this and other issues are discussed in section 6.

Q. What can the science and business communities do to tell young people about the careers opportunities that a science education opens up in all work areas?

The preceding is relevant. We have commented in 5.4 on the need for fully informed, good quality careers advice within schools that can engage young people on the career opportunities that a science education can provide. It is also important that the science and business communities strike up personal links with young people, where more use could be made of the Ambassador Scheme. Contact with working scientists could be particularly important and all schoolchildren would benefit from the opportunity to see and question people working in research and development. Undergraduates can also play an important role given that their experiences and expectations are closer to those of young people whom they engage with. Once again, outreach and inreach activities can have a prominent role here.

Q. Do these areas and questions provide a suitable framework for addressing the challenges we have identified?

Generally speaking the recent creation of DIUS and DBERR has been positive for UK policy making. However, it is important that their activities are well integrated in issues which cut across them, such as the science and society issue. It is often the case that members of the public are relatively disengaged from science per se, but become involved in a strongly pro-active way when that science moves into the business arena and products are developed or new processes introduced. In such cases, engagement can take the form of demands for strong regulation, often on a precautionary basis, resulting in unnecessary over-regulation of new technology and serious inhibition of innovation in a whole sector.
It is thus very important that the science and society issues discussed in this consultation paper are not seen as solely within the remit of DIUS, but that both give equal attention to such issues and that they are as 'joined-up' as possible between DIUS and DBERR.

Additional Information and References

This submission represents the views of an expert Working Group of Fellows and non-Fellows.

In responding to this consultation the Society would like to draw attention to the following Royal Society of Edinburgh responses which are of relevance to this subject:

- The Royal Society of Edinburgh's submission to the House of Lords Science and Technology Committee's Inquiry *Science and Society* (June 1999) http://www.rse.org.uk/govt_responses/1999/sci&soc.htm
- The Royal Society of Edinburgh's response to the Council for Science and Technology on the role of a *Universal Ethical Code for Scientists* (November 2005)
- The Royal Society of Edinburgh's submission to the Scottish Executive *Science and Innovation Strategy for Scotland* (December 2006) http://www.rse.org.uk/govt_responses/2006/science_innovation_strategy.pdf
- The Royal Society of Edinburgh's submission to the House of Commons Science and Technology Inquiry *Funding of Science and Discovery Centres* (June 2007)

  http://www.rse.org.uk/govt_responses/2007/Response_ScienceCentres.pdf
- The Royal Society of Edinburgh's submission to Learning and Teaching Scotland on *Curriculum for Excellence - draft experiences and outcomes for numeracy, mathematics and science* (April 2008)

  http://www.rse.org.uk/govt_responses/2008/CfE_science_maths_numeracy.pdf
- The Royal Society of Edinburgh's submission to Learning and Teaching Scotland on *Curriculum for Excellence - draft experiences and outcomes for Literacy and English, for Expressive Arts and for Social Studies* (June 2008)

  http://www.rse.org.uk/govt_responses/2008/CFE_literacy.pdf

Any enquiries about this submission and others should be addressed to the RSE's Consultations Officer, Mr William Hardie (email: evidenceadvice@royalsoced.org.uk).

Responses are published on the RSE website (www.royalsoced.org.uk).

October 2008