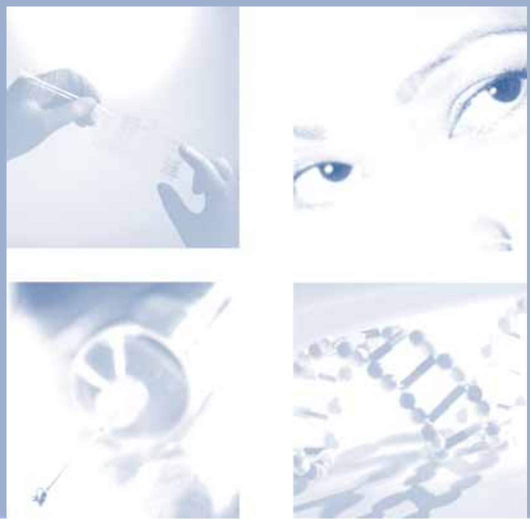

Stem Cell Research

The Young People of Scotland Decide

The
Royal Society
of Edinburgh

Report of a Discussion Forum
for S5 and S6 Students
Thursday 15 June 2006
at Inverness College

The Royal Society of Edinburgh

The Royal Society of Edinburgh (RSE) is Scotland's National Academy of Science & Letters.

An independent body with charitable status, its multidisciplinary fellowship of 1400 men and women of international standing represents a knowledge resource for the people of Scotland. Committed to its Royal Charter of 1783 for the "advancement of learning and useful knowledge" the Society recognises the important role it can play in today's Scotland. Working as part of the UK and within a global context, the RSE seeks to contribute to Scotland's social, economic and cultural wellbeing by:

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- awarding over £1.7million annually to Scotland's top young academics to promote research in Scotland
- enabling leading Scottish-based researchers to collaborate with the best of their international counterparts
- inspiring school children in classrooms from the Borders to the Northern Isles and promoting their interest in science, society and culture
- producing academic journals of international standing

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This Discussion Forum was organised as part of the RSE's programme of events for young people across Scotland, which aims to encourage an interest in science, society and culture. The Discussion Forum was run in partnership with the Scottish Initiative for Biotechnology Education (SIBE).

The role of SIBE is to enhance engagement with biotechnology through interactions with the scientific community, school students, teachers and the general public. SIBE is based in the Institute of Cell Biology at the University of Edinburgh. SIBE's objectives are:

- To support teachers in preparing for biotechnology subject areas in further/higher education or to work in Scotland's bioindustries
- To develop new and innovative practicals and materials for schools with clear applications
- To support the University of Edinburgh's public engagement of science and recruitment activities
- To encourage and support the scientific community to actively engage others with their science

Facts and Issues

Stem cells have the potential to help us treat many serious diseases, but their use raises many contentious issues. What must society consider before this potential is harnessed?

In June 2006, students from throughout the Highlands visited Inverness College to meet with experts in the field, discuss the ethical and scientific issues and formulate opinions on this complex debate.

In the morning the speakers introduced the topic; students then split into workshops to formulate their own opinions on five key issues relating to Stem Cell Research:

- Media and its impact upon our understanding of stem cell research
- Clinical trials
- Public trust
- The use of embryos in stem cell research
- Who pays?

The day concluded with students presenting their views to the conference and an open-floor debate.

This report includes overviews of the speakers' presentations and a of summary of the students' opinions and recommendations.

Stem Cell Research: Exploring the Issues

Dr Neville Cobbe, The Wellcome Trust Centre for Cell Biology, University of Edinburgh

Research with stem cells from different sources is undoubtedly one of the most exciting areas of biomedical research. Regrettably, the public debate over the use of stem cells has often been marred by premature hype, misinformation and a lack of meaningful dialogue between those with contrasting views. In this presentation, an attempt is made to provide some of the necessary background to help interpret many of the issues by discussing four key questions (from the perspective of a biologist not directly engaged in work with stem cells). For further background information, the official National Institutes of Health (NIH) resource for stem cell research (http://stemcells.nih.gov/info/basics/) is recommended.

Let's begin by asking "What is a stem cell?" A stem cell is a relatively undifferentiated cell that can divide to give two daughter cells, at least one of which remains as a stem cell whilst the other may differentiate to yield a more specialised cell type. By suppressing this differentiation, it is theoretically possible to expand stem cells in culture indefinitely. There are two main types of stem cell, known as embryonic and tissue stem cells. Embryonic stem cells give rise to all or most tissues in a developing organism and may be broadly divided into two types. At the earliest stages of development, the cells of an embryo are described as "totipotent", meaning that each cell is capable of giving rise to all tissues required for future development. As the embryo develops further, it forms a hollow ball of around 100 or more cells. This is called a blastocyst embryo and stem cells for use in research may be derived from its inner cell mass. These cells are described as being "pluripotent", as they can produce all or most of the many different tissues found in an adult. However, unlike the totipotent cells associated with the earliest stages of development, pluripotent stem cells do not give rise to the placenta and other tissues required for development in the womb.

The second major stem cell type are tissue stem

cells, which are often more commonly referred to as "adult stem cells". These include not only stem cells from mature individuals but also stem cells found in a developing foetus and cells in the umbilical cord and placenta. Compared to the pluripotent stem cells derived from blastocyst embryos, tissue stem cells generally display a more restricted range of development. However, some rarer tissue stem cells also seem to be pluripotent. For example, some stem cells from bone marrow and fat have been shown by various research groups to be capable of differentiating into different cell types from all three germ layers, whilst certain stem cells derived from testes have recently been shown to be pluripotent in mice.

From a practical perspective, there are various pros and cons associated with the use of different types of stem cells in potential therapies. For example, tissue stem cells may be taken from the same patient to be used in their own treatment, thereby minimising the risk of immune rejection. On the other hand, embryonic stem cells may be rejected unless a large bank of stem cells can be created to create a tissue match for each member of the population. Curiously, embryonic stem cells can sometimes be rejected even if they are derived from a cloned embryo. In addition, embryonic stem cells can form tumours when injected into adults, so it is essential to be able to derive a pure population of differentiated cells before cells can be transplanted into patients. On the other hand, tissue stem cells are currently considered harder to isolate and culture in large numbers, though this is improving as research with stem cells of different types continues. In fact, although only tissue stem cells have been successfully used in clinical treatments so far, studies of embryonic stem cells from different species may in turn lead to a better understanding of the factors needed for proliferation and differentiation, providing more tissue stem cells for study or therapies. In this way, studies of different stem cells may be complementary, rather than simply being competing alternatives.

There are also various pros and cons associated with the use of different types of stem cells from an ethical perspective. Ideally, adult stem cells can be removed with the permission of the patient and minimal risk of lasting harm, thereby ensuring informed consent on the part of all concerned. However, tissue stem cells may also be derived from aborted foetuses or require selection for babies to be a tissue match. In addition, the use of cloning to create embryos needs many eggs from women, leading to risks of exploitation. Lastly, the derivation of most embryonic stem cells requires the destruction of embryos, which raises ethical concerns depending on their moral status. To explore this further, we need to consider the questions of "What is a human being?" and "When does human life begin?"

Dealing with the first of these two questions, a good place to begin is probably the Oxford English Dictionary. This defines a human being as "any man, woman or child of the species *Homo sapiens*". Given the ways in which a child is also defined, one may therefore conclude that any member of the species *Homo sapiens* is a human being. This provides a biological definition of humanity and we have known since the 19th century that a new human life usually begins with a single cell called a zygote (the product of fertilisation). However, not everyone necessarily shares this scientific view, often due to other interests. Many alternative perspectives can be traced back to Aristotle, who described how a "flesh-like substance" becomes animated on the 40th day for a male (but substantially later for a female). In order to accommodate contrasting views, it was decided that embryos should only be used for experimentation prior to formation of the earliest beginnings of the nervous system, at around 14 days after formation of the zygote. This widely-accepted compromise allowed for humane experimentation but embryos should still have a "special status" and should be afforded some protection in law.

Nevertheless, the moral status of embryos remains a highly contentious subject, so a selection of various commonly encountered arguments and counter-arguments are presented. These range from issues surrounding the perceived viability of embryos to various perspectives regarding their relative size or sensitivity. Throughout this discussion, an attempt is made to put arguments into a broader biological perspective and emphasis is placed on the importance of trying to be as objectively consistent as possible in the choice of criteria employed for subsequent moral evaluations. For example, definitions of humanity in terms of consciousness may fail to protect others who are temporarily unaware and one can't exclude the actual or potential consciousness of other species. The discussion of what constitutes a human concludes with brief reference to questions raised by the creation of chimeras for some studies using stem cells. A spectrum of possibilities concerning what might be considered as ethically justifiable uses of human embryos in research are then presented, in order to try and evaluate "What is O.K.?". Finally, an overview of different approaches to addressing ethical problems is discussed, leaving others to draw their own conclusions on the relevant issues.

Positive Aspects of Stem Cell Research and its Potential Applications

Dr Matt Dalby, Centre for Cell Engineering, University of Glasgow

A key area likely to be impacted on with our increased understanding and ability to manipulate stem cells is regenerative medicine, specifically tissue engineering.

Unlike mature, highly differentiated cell types, that the body uses to form specialised tissues, stem cells possess the quality of plasticity. Plasticity is the ability to form cell types from a number of different tissues. Adult stem cells, as found in, e.g., bone marrow and hair follicles, can form a wide variety of cell types, e.g., mesenchymal stem cells of the bone marrow, can form cells of the soft tissues, enothelia, epithelia, cartilage, bone and nervous system. It is the job of the haemopoietic stem cells (the other type of stem cell found in the marrow) to form blood cells (e.g., macrophages, leukocytes etc). However, there is very little evidence that either type of stem cell has the plasticity to do the job of the other type, i.e. the adult stem cells' plasticity is limited. Embryonic stem cells, however, have unlimited plasticity.

Tissue engineers aim to use scaffold materials (i.e. materials that support cell growth and specific differentiation) in combination with isolated cells to produce replacements for damaged or diseased tissues or organs in the lab. Stem cells, again, hold many advantages over the use of mature cell types. Firstly, they are highly proliferative and thus are much easier to grow in the lab to the large numbers required for tissue engineering. Secondly, as they can form a number of cell types, more complex organs can be considered (organs tend to be formed from a number of cell types). Again, embryonic stem cells have a number of advantages over adult stem cells. Firstly, they can be grown, undifferentiated, in the lab for long periods of time. This makes them easy to handle and also makes it easy to grow very large cell numbers. Secondly, the now familiar theme of increased plasticity – i.e. there are no limits. Adult stem cells, however, tend to spontaneously differentiate after relatively short times in culture. This problem can, however, be negated by seeding the cells at lower density on the scaffold and using bioreactor culture conditions to allow the cells to grow on the scaffold rather than in cell dishes beforehand.

Bioreactors are used by biologists to give efficient delivery of nutrients to the cells, thus allowing increased cell numbers to be cultured in the lab. A key difficulty, however, is angiogenesis, or the formation of blood vessels within the engineered tissues. In order to produce vessels, endothelial cells need to correct environmental cues to form blood vessels; this can mean that if using mature cells, several cell types may need to be seeded into the construct. This produces many problems with culturing in the lab, as different cell types have different needs. Use of stem cells, however, could get around this problem. A single stem cell type could be seeded and then differentiate into a number of cell types in the lab.

At present, however, tissue engineers are trying to grow new tissues to the point where their own vasculature is becoming a requirement and then

transplanting into the body, where the body's own blood system can invade and support the new tissue.

Key to all this technology is the development of what are described as 'next-generation' materials – i.e. materials that deliver specific cues to stem cells and will firstly control proliferation and differentiation and possibly in future generations allow spatial differentiation. This means stem cells could be seeded on to the material, directed to specific locations and then have cues delivered to them that would allow specific differentiation and hence formation of a more ordered tissue with functionality. For example, osteoblasts producing bone and the ability to simultaneously grow e.g., endothelial cells producing capillaries to supply the new bone with nutrients.

Through increasing our understanding of stem cell response to environmental cues – both chemical and topographical, we are moving closer to producing the next generation material required for successful tissue engineering that will fulfil many goals in regenerative medicine.

Stem Cell Research: Legal, Ethical and Social Issues

Professor Graeme Laurie, School of Law, University of Edinburgh

Introduction: what can law do?

What is the role of law in responding to developments in stem cell technologies? How can law protect embryos used in stem cell research, especially when this work might involve the destruction of the embryos? When so many of us disagree about how we should treat embryos, how can the legal system reflect the range of views that people hold in society? Is it appropriate for the law to regulate science and to encourage commercialisation and exploitation at the same time?

This paper will consider how law attempts to reflect the ethical arguments about stem cell research. It will look at two aspects of the debate: the regulation of stem cell science and the commercialisation of the science through patents.

What is law about?

Red light signals

Most of the time when people think about the law, they think about the criminal law: Law tells us what we can and cannot do and punishes us if we don't act accordingly. We all understand, and generally agree, that it is wrong to steal and wrong to kill and accept that there are very serious consequences if we do so. When law works in this way, it gives us a "red light" signal: STOP! Do not proceed! Applied to stem cells, this legal response might be considered appropriate by some, especially if you believe that the human embryo is a human person. An argument might be that to destroy the embryo would be to kill a person. Some countries have, in fact, adopted an outright ban on stem cell research, possibly in light of this view. Examples include Austria and Italy, where any form of research on embryos is illegal. The position in Italy, and other countries like Ireland, is heavily informed by religious views about when life begins and what sort of respect we should give to embryos.

The law in the UK does not treat the embryo as a person. Embryos do not have legal rights. We only have legal rights once we are born. So does that mean that the law allows us to do whatever we want with embryos, including using them in stem cell research that leads to their destruction?

Green light signals

Law in modern society has to be made – usually in parliaments or in the courts – and there are many areas where law is absent or silent. In this sort of circumstance, the approach in many western societies is to say: ‘if it is not prohibited, it is not illegal’. This is a libertarian approach – we are free to do as we want unless we are told otherwise. In this sense, we might have a green light to proceed, and in the context of stem cells there are numerous countries which have not yet passed laws to regulate the science. But the UK is not one of these countries. None the less, in some respects the UK takes a “green light” approach to stem cell technologies because we allow the creation of embryos for research purposes. Sweden and Belgium have done the same, although most countries are far more cautious. These “green light” laws are facilitative: that is, they are designed to encourage a certain sort of behaviour because it is considered to be in the public interest. “Green light” laws are often used to encourage businesses to locate in a particular country or region, for example, by giving tax breaks. An important “green light” area of law is patenting. A patent is given to an inventor if s/he can show s/he has produced something that has never existed before and has some form of social value. A patent gives the inventor the right to a monopoly of the market for 20 years, that is, only s/he can exploit the invention during this time – anyone who copies the invention can be stopped by court action and can be made to pay compensation. It is claimed that patents are very important for stem cell research because funders will not invest in the field unless there is the “green light” of a patent at the end.

Amber light signals

The “amber light” message is: Proceed with Caution! This is probably the best way to sum up how most European countries now approach the regulation of stem cell research. We want to proceed because of the considerable promise which seems to lie in stem cell technologies. We need to exercise caution, however, because we are proceeding in an area which is fraught with moral and ethical difficulties. For example, although we do not recognise the embryo as a ‘person’ with legal rights in the UK, we do provide it with some protection in law.

Baroness Mary Warnock was the Chair of the *Inquiry into Human Fertilisation and Embryology* which was established after the birth of Louise Brown in 1978 – the first person born using *in vitro* fertilisation (IVF). The 1984 Warnock report recommended legislation to regulate the entire field of artificial reproduction and embryo research. In particular, the Warnock Committee considered that the human embryo has a ‘unique moral status’ which deserves respect. The law is the *Human Fertilisation and Embryology Act 1990* which allows the creation of embryos for research, research up to 14 days development but no further, and the practice of therapeutic cloning. A clear “red light”, however, is found in the *Human Reproductive Cloning Act 2001* which is: “An Act to prohibit the placing in a woman of a human embryo which has been created otherwise than by fertilisation.”

A key question for the seminar will be to ask, have we struck an appropriate balance? Should we be more or less cautious in our approach?

Commercialisation

As we have seen, it is frequently argued that valuable research will not get done unless investors can recoup their Research & Development costs through the development of useful products or processes from the research and by commercialising them for profit. Patents facilitate this by giving an inventor a monopoly of the market – and the prospect of a patent is therefore a strong incentive to carry out research. But inventors have to qualify for patent protection. Among other things, they must show in Europe that their invention is new, and that they have been inventive, and that the commercial exploitation of their invention would not be immoral. But what does this last point mean? Is it immoral to carry out stem cell research using human embryos which are destroyed in the process? Is it immoral to give patents over this kind of research? If European countries do not give stem cell patents, will the scientists go elsewhere? Are such economic considerations relevant?

I am grateful to my colleague, Professor Roger Brownsword of King’s College, London for the traffic light analogy.

Students' Views

Media and its impact upon our understanding of stem cell research

Students carried out a short review of the media coverage of stem cell research. Students felt that the relationship between the media and public understanding of issues like stem cell research is a problematic one. The media's nature, i.e. need to generate profit and influence of personal opinion on reporting, must be considered by the public reacting to information provided in the media.

They identified three main groups accountable for controlling communication between science and the public: scientists; journalists; and the public themselves. Students also noted that the BBC has great impact in this area as a trusted public information resource.

They suggested that journalists must retain the right to a free press because it is untenable to attempt to control what they say. Thus scientists should work with the media to provide accurate and accessible information.

Students proposed that scientists should provide a reliable central point of information for the public on stem cell research, e.g. a website, where users could be sure they were receiving clear and unbiased information.

Students felt that government also has a responsibility to keep their 'publics' informed on such issues, but again in a clear and unbiased manner. It was suggested that the government should also carry out more discussion with the public on scientific matters, e.g. ballots, so the public's views can be clearly shown.

The students stressed that all members of the public have a right to their own opinion, but also have a responsibility to form it responsibly and not rely on single sources of information

Clinical Trials

Students agreed that Clinical Trials will be a key factor in the development of new treatments using stem cell research. However, they highlighted three key issues which they propose must be carefully considered prior to any trial taking place:

- ***Consent***: Risks associated with clinical trials should be assessed and minimised by scientists before the question of consent arises. Any person consenting to trials should be made fully aware of this process, and the potential for unknown risks, so that their consent is as informed as possible. Students felt the question of treatment of childhood disease is key in the discussion of consent, questioning whether it is right for adults to consent on behalf of their children and at what age children should be able to make such decisions themselves.
- ***Liability***: Students raised the question of liability. If a trial does result in physical damage to the patient, who should pay or compensate for this damage and subsequent treatments? For example, if a patient has consented to the treatment fully aware of the risks should they be responsible for costs; or should the company producing the treatment be responsible as a sign of good will?
- ***Payment***: Students felt that the issue of payment for participation in clinical trials was a problematic one, with many questions to consider. Firstly, should payment simply cover costs or should it be more? If payment is in excess of costs, can it be said to be too persuasive; and is it thus at risk of clouding people's judgement or putting people at risk of exploitation?

Thus students concluded that although clinical trials are integral to the development of new treatments, they also raise many questions; therefore alternative techniques should be considered where applicable.

Public trust of scientists

Students were asked to rank different groups in society according to how trustworthy they perceived them to be. Scientists ranked in the lower middle of this group (doctors, judges and teachers being ranked as most trustworthy and journalists, business leaders and politicians as least). Students ranked different members of society in this way because they felt that the groups they identified as most trustworthy were generally unbiased and might be expected to put the interests of others ahead of their own interests, i.e. they have no hidden incentives. By contrast, the group felt that those identified as least trustworthy might have vested interests in promoting their story, getting rich or maintaining power.

Students were asked to consider ways scientists could encourage public trust, and whether the general public should be involved in determining research policy, such as stem cell research.

Students suggested that the public should not be able to simply dictate what scientists can or cannot do as they do not have relevant expertise. However they also felt that that scientists should not be completely unrestricted in their research, as some students felt that scientists are at risk of being too focused on their own work to consider its potential impact upon society.

Students agreed it is important to decrease what they perceive as the mystery surrounding scientists and their work and the negative images associated with scientists. They suggested a number of ways in which this could be done, for example:

- Direct contact, e.g. talks in informal settings; laboratory open days
- Greater media coverage, e.g. websites; accessible magazines etc
- Distribution of free information resources to homes, e.g. leaflets, newspapers; questionnaires
- Communication on ethically complex issues should be initially provided by a scientist perceived as expert but unbiased, e.g. not directly involved in the research discussed
- Communication which explains the benefits and problems of potential research.

Students acknowledged that there are problems in communicating with the public, for example the public tends to have a short-term interest in issues like stem cell research and looks for clear answers quickly, which science cannot necessarily provide. Many members of the public also have very little knowledge of science, but this should not deter scientists from enabling them to learn about something new.

Students concluded that there should be an ongoing dialogue between scientists and the public which should tackle the twin aims of encouraging public trust of scientists and providing information for the public on issues of importance.

Students highlighted that it is important that such communication is on an appropriate level, e.g. jargon-free and easy to understand. Students also highlighted that there is a delicate balance between ensuring you get the relevant information to as many people as possible and this becoming an unwelcome intrusion for those who may appear disinterested.

The use of embryos in stem cell research

Students identified two key issues which they suggested should be considered in the discussion of the use of embryos in stem cell research: The definition of when life begins and the type of embryo.

Students demonstrated a number of different opinions on how life can be defined and agreed that this is a contentious issue with no easy answer. However they agreed on three defining factors which they felt should be considered in any discussion or decision relating to the use of embryos in stem cell research:

- ***Physiology:*** the physiological development of an embryo. For example, can life be said to have developed after one cell? (Single-celled organisms like the amoeba are classified as living) Or does human life begin when more complex physiology has developed, e.g. the central nervous system? Linked to physiology is the issue of awareness and sensation. It was suggested by some students that the ability to be aware of your environment and feel pain is the deciding point in defining a life.
- ***Religion:*** students acknowledged that there are many different religious perspectives on the point at which human life begins. They felt all must be considered in the development of any future legislation on the use of embryos in Stem Cell Research.
- ***Potentiality:*** Students felt that the potential embodied in any embryo is key in this debate. They suggested that from the moment of conception, an embryo has the potential to live a full and rewarding life. Thus they questioned our right to destroy this potential.

  Considering all of the perspectives above, students agreed with the current UK ruling that research can only be carried out on embryos of less than 14 days development.

  Students also discussed three different types of embryos potentially used in stem cell research, discussing the advantages and disadvantages of each.

- ***Embryonic stem cells from spare or discarded embryos from IVF treatments:*** Students felt that the use of discarded embryos from IVF treatments was a useful application of something that would otherwise be wasted, suggesting that parents might be interested in contributing their spare embryos because of the potential contribution to society they would be making. Further, many IVF embryos are not able to develop info full-term foetuses, but do contain stem cells which can be applied to research. However, students highlighted that if an IVF embryo is used for research it cannot be donated to another family unable to conceive.
- ***Embryonic stem cells from embryos created specifically for research:*** Students suggested that embryos could be created specifically for the purpose of stem cell research. In this scenario, embryos would be donated voluntarily and a large number could be created with relative speed, thus ensuring that an adequate resource was available for research purposes. However, students felt that under such a system there was a great risk of exploiting women, who would be asked to donate eggs, an invasive procedure, for example the risk of a donor agreeing for financial incentives and not understanding the consequences was highlighted.

  For both of the embryo types above, students highlighted that the embryos used would be at a stage of development at which they would not have central nervous systems, thus the ethical question of physiology would be satisfied. However, they also noted that if the issue of potentiality is applied to this situation, it can be said to have been wasted.

- ***Tissue stem cells from aborted foetuses:*** Students agreed that this source had different issues to the two types identified above.

  They noted that it would concern more fully developed foetuses, rather than embryos at an early stage of development. Thus tissue stem cells and not embryonic stem cells would be

utilised in research. Students felt that this process would make use of a life that has already been discarded, however they highlighted that the foetus has rights and questioned whether the use of such foetuses for research purposes might contravene such rights.

Students concluded that this was a complex debate with no easy answer; however, the general consensus was that it is best to continue using embryonic stem cells, as a single embryo holds the potential to contribute to the development of a treatment that might save thousands of people. However, it was also suggested that research into the plasticity of tissue cells should be furthered as there are far fewer ethical concerns in their use.

Who pays?

Students noted that the current UK healthcare budget is £60 billion, and the budget for stem cell research is £31 million (with the potential to rise to £104 million over the next 10 years). They noted that as research and development was being carried out by both private and public labs, both public and private funding is currently funding the development of stem cell research.

Students also discussed controls on research, notably patents and regulations. Students felt that patents were in general a good thing as they prevent exploitation and support the economy. However, they did question whether patents have the potential to limit research in negative ways too. The students felt that regulations for research were essential. They suggested that such regulations should be developed using as broad a range of opinions as possible (e.g. the public) and that regulations should be under continual review to ensure they are up to date with advances in research and technology. Students were in favour of a regulatory model for stem cell research which starts with strict controls upon research and is continually reviewed and relaxed as more is discovered in the field.

It was agreed that the current system of funding from both public and private sources was appropriate. Students felt that a greater focus on partnership would help the economy and suggested that this would also ensure strict government regulations regarding funding were also applied to private companies.

Students suggested that there were many potential benefits that make the contribution of public funds to such research worthwhile, for example the development of treatments for diseases such as Parkinson's, Leukaemia and Diabetes. However, they did query whether some of this money should be spent on improving existing treatments, which might bring quicker results. Students also questioned whether the potential benefits offered by stem cell research outweigh the need to divert funds to other areas of government expenditure, e.g. humanitarian welfare worldwide.

Summary of Students' Recommendations

- The public has the right to their own opinion regarding stem cell research, but also has a responsibility to form this opinion conscientiously.
- The media and scientists have a responsibility to provide clear, accessible and unbiased information on stem cell research to ensure the public has the opportunity to learn from reliable sources.
- There should be ongoing communication between scientists and the public to encourage public trust in stem cell research and the scientists conducting it.
- It is important that such communication is on an appropriate level in terms of both content and volume to avoid becoming off-putting or an unwelcome intrusion.
- Clinical trials are a key factor in the development of treatments using stem cell research. However, students felt that issues of consent, liability and payment are problematic and thus alternative techniques should be considered where viable.
- The use of embryos in stem cell research is a complex issue. Most students agreed that embryonic stem cells should be used in research, as a single embryo holds the potential to contribute to the development of a treatment that might save thousands of people.
- The current UK ruling that research can only be carried out on embryos of less than 14 days development was supported by the students.
- Research into the plasticity of tissue cells should be furthered as there are far fewer ethical concerns in their use.
- Stem cell research should continue to be funded from both public and private sources. However, students felt that this process should have greater focus on partnerships to encourage a successful economy.
- Students favoured a regulatory model for stem cell research which has strict controls upon research at the outset but is continually reviewed and relaxed as our knowledge in the field expands.

Speakers & Chair

Chair: Professor Mary Bownes FRSE

Professor Mary Bownes is a Professor of Developmental Biology at the University of Edinburgh and Vice-Principal, with widening participation and community relations in her remit. She is Director of the Scottish Initiative for Biotechnology Education. Mary has been actively involved in science communication and teacher development for many years.

Dr Neville Cobbe

Dr Neville Cobbe is based at the University of Edinburgh where his research focuses on genetics and cell biology. He has been interested in various aspects of communicating science and its relevance to society. He has contributed to exhibitions for the Edinburgh International Science Festival and participates in workshops for young people or adults on a variety of bioethical issues. He has also given both oral and written evidence to the House of Commons Science and Technology Committee.

Dr Matt Dalby

Dr Matt Dalby is a BBSRC David Philips Fellow, based at the University of Glasgow. The Fellowship enables his development as a young, independent researcher and focuses upon tissue engineering of bone using topography. Dr Dalby has recently been awarded a BBSRC follow-on grant to help him pursue the commercialisation of ideas that have been submitted to patent arising from his Fellowship. He works in a multidisciplinary environment composed of chemists, physicists, engineers and biologists.

Professor Graeme Laurie

Professor Graeme Laurie is a member of the School of Law at the University of Edinburgh and Co-Director of the Arts and Humanities Research Council (AHRC) Research Centre for Studies in Intellectual Property and Technology Law, also at the University of Edinburgh. He works in the fields of medical law and intellectual property law. He has spent several years looking at the law's response to stem cell technologies, and he has worked closely with bodies such as the Scottish Stem Cell Network and EuroStemCell.

Dr Jan Barfoot

Jan Barfoot did her PhD in cancer biology at the University of Edinburgh. After this she moved into the field of science communication and is now deputy director of the Scottish Initiative for Biotechnology Education (SIBE) at the University of Edinburgh. Here, she facilitates engaging hands-on/brains-on biotechnology and bioethical workshops for school students and the public and is heavily involved in training science communicators. Dr Barfoot created the support activities for the Discussion Forum and her support is gratefully acknowledged.

Participating Schools

Lochaber High School, Fort William

Portree High School, Isle Of Skye

Ullapool High School, Ullapool

Inverness Royal Academy, Inverness

Invergordon Academy, Invergordon

Fortrose Academy, Fortrose

Gordonstoun School, Elgin

Lossiemouth High School, Lossiemouth

Acknowledgements

Support for this event from the Darwin Trust of Edinburgh is gratefully acknowledged.

Photos by Alan Wylie, Cactus ID.

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ISBN 0 902198 99 8