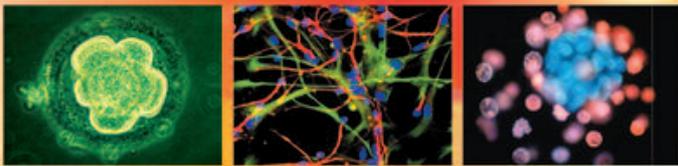


stems cells



embryonic stem cells

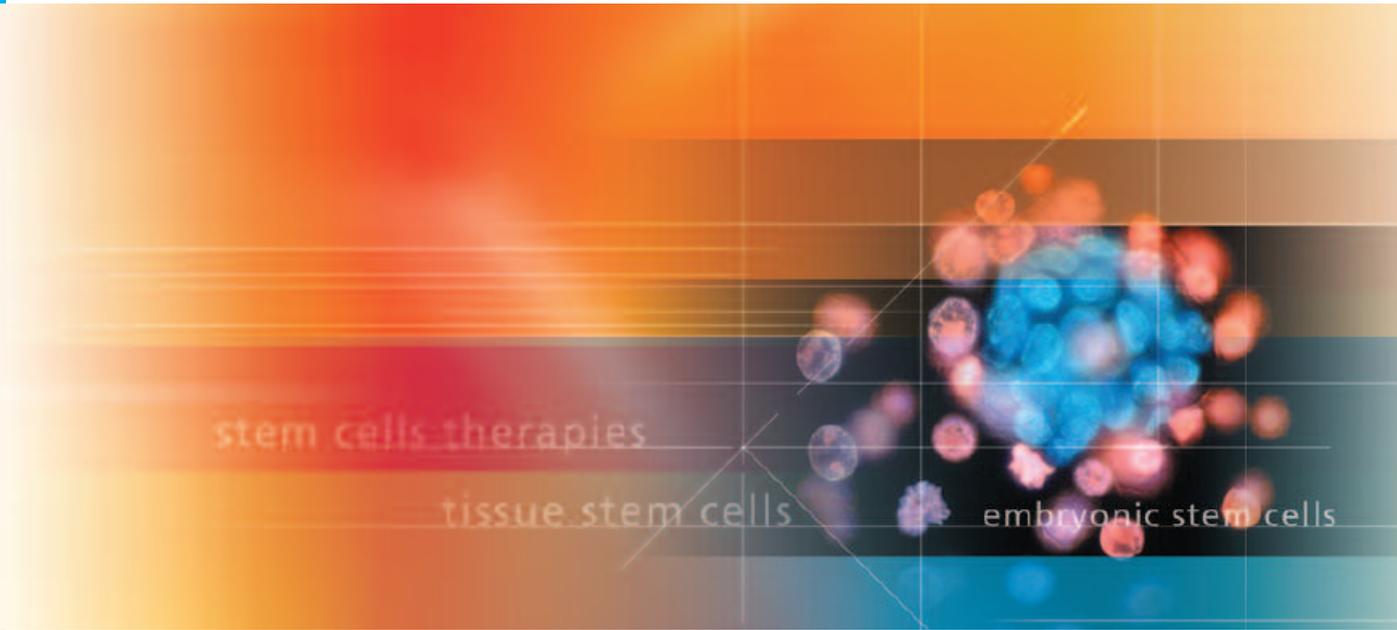
tissue stem cells

stem cells therapies

Research on stem cells from humans and other animals is crucial to advancing our understanding of basic processes in developmental biology and also provides the potential to identify new drugs. Stem cell research may offer hope to those suffering from incurable degenerative diseases such as Alzheimer's, Parkinson's and Motor Neurone Disease. The source of human stem cells can however raise concerns. In the UK human stem cell research is strictly regulated by guidelines and legislation.

- ▶ The Biotechnology and Biological Sciences Research Council (BBSRC) funds non-clinical bioscience research
- ▶ BBSRC has funded stem cell research since its inception. To date, the total investment in this research is approximately £48M. In 2002 BBSRC was awarded an additional £10.6M as part of a £40M government initiative on stem cells
- ▶ BBSRC provides funding for the UK Stem Cell Bank. The bank serves as a repository for several human stem cell lines, enhancing the range and quality of cell lines available for research

What are stem cells?



Embryonic stem cells

Embryonic stem cells (ES cells) are found at the earliest stages of the developing embryo. ES cells can differentiate into the widest variety of specialised cell types and hence currently have the greatest medical potential. As ES cells are harvested from embryos their use raises particular ethical issues.

Tissue stem cells

Tissue stem cells (TS cells) are found in foetal and adult tissue, including bone marrow, blood, the eye, the brain and skeletal muscle. Until recently TS cells were thought to have limited medical potential as it was believed that they could only give rise to the cell types of the tissue they came from. Scientists are now investigating the possibility that TS cells from one tissue, under the right conditions, could give rise to cell types of another tissue ('plasticity'); if TS cells do exhibit such plasticity then this may increase their medical potential.

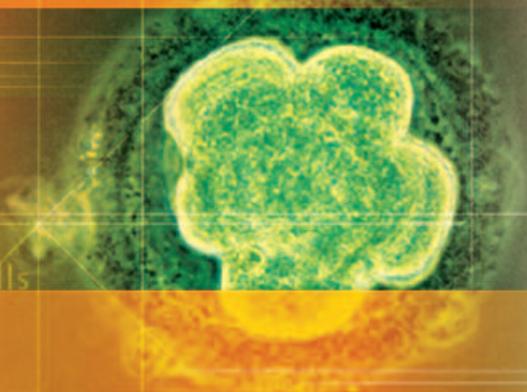
Possible sources of human stem cells	
Embryonic Stem Cells	Tissue Stem Cells
<ul style="list-style-type: none">▶ Unused embryos from <i>in vitro</i> fertilization (IVF) or pre-implantation genetic diagnosis▶ Embryos created exclusively for stem cell research in the laboratory by IVF, using donated eggs and sperm▶ Embryos created exclusively for stem cell research in the laboratory by cell nuclear replacement, using donated eggs and nuclei from adult tissue▶ Embryos created exclusively for stem cell research by activating a human egg without a sperm	<ul style="list-style-type: none">▶ Adult or foetal tissue, such as bone marrow▶ Umbilical cord blood▶ Aborted fetuses

current and potential uses

tissue stem cells

scientific research

embryonic stem cells

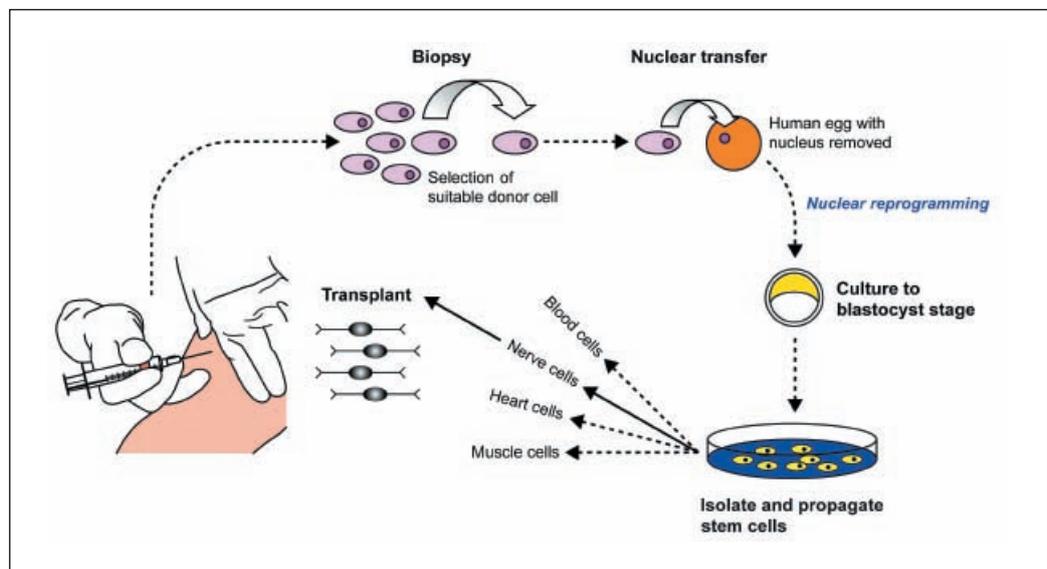


Bone marrow transplants and skin grafting are established examples of stem cell replacement therapies. For example, during a bone marrow transplant stem cells are removed from the bone marrow of a donor and transplanted into the patient to generate new blood cells.

The potential of stem cell therapies extends beyond current usage. Stem cell transplants could offer potential therapies for degenerative diseases. Stem cells could also be used as a source of healthy human cells for testing the effects and side-effects of potential new drugs, providing an alternative to some animal testing.

Patient-specific stem cell therapy

Stem cell replacements, like other tissue transplants, face the problem of being rejected by the patient's immune system. Patient-specific stem cell therapy could overcome the issue of immune rejection by using DNA from a patient's own healthy cells to make an embryo from which stem cells could be derived and directed to make the required cell type for repair. Making an embryo in this way is known as 'therapeutic cloning'. Unlike so-called reproductive cloning (which led to Dolly the sheep) UK scientists do not intend to produce a cloned individual.



Patient-specific stem cell therapy



scientific research

stem cells therapies

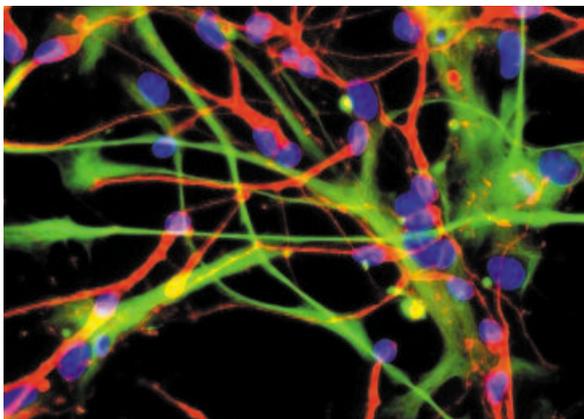
embryonic stem cells

tissue stem cells

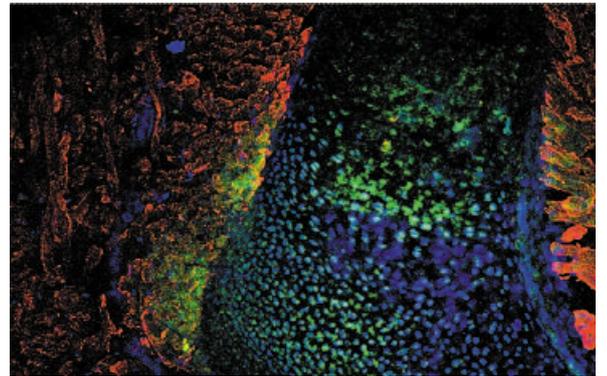
Growing pure stem cells

Researchers at the Universities of Edinburgh and Milan have grown unspecialised brain stem cells in the laboratory that could potentially be used to model diseases of the nervous system, and develop new drugs to treat them. Importantly the approach used by scientists enables them to keep the stem cells pure and unspecialised until they want to take some and convert them into specialised brain cells, such as neurons and astrocytes. The cells will help researchers to identify cellular processes that go wrong in neurodegenerative diseases – a crucial first step in developing effective, safe therapies.

This work was part funded by BBSRC. For more information contact Professor Austin Smith via: external.relations@bbsrc.ac.uk



Brain stem cells Image courtesy of Yirui Sun, ISCR



Neck and shoulder stem cells

Image courtesy of Dr Georgy Koentges, UCL

Stem cell origin of neck and shoulders

Scientists at the Wolfson Institute for Biomedical Research at University College London used a new genetic technique to tag mesenchymal stem cells in the embryo and then trace them to the adult animal. They discovered that instead of one type of stem cells making up the bones of the shoulder and neck and another type making the muscles, mesenchymal stem cells make both the muscles and the point where it joins the skeleton. This research sheds new light on the evolution of the vertebrate neck and on human diseases such as Klippel-Feil syndrome and Chiari Syndrome. Chiari Syndrome is thought to be responsible for a quarter of all cot death cases.

This work was part funded by BBSRC. For more information contact Dr Georgy Koentges: g.koentges@ucl.ac.uk

the law

scientific procedures

stem cells therapies

embryonic stem cells

Human reproductive cloning in the UK is illegal. The Human Fertilisation and Embryology Act 1990, and its subsequent amendment in 2001, strictly regulates the isolation of stem cells from human embryos for stem cell research. The use of embryos in stem cell research can only be carried out with permission from the Human Fertilisation and Embryology Authority (HFEA).

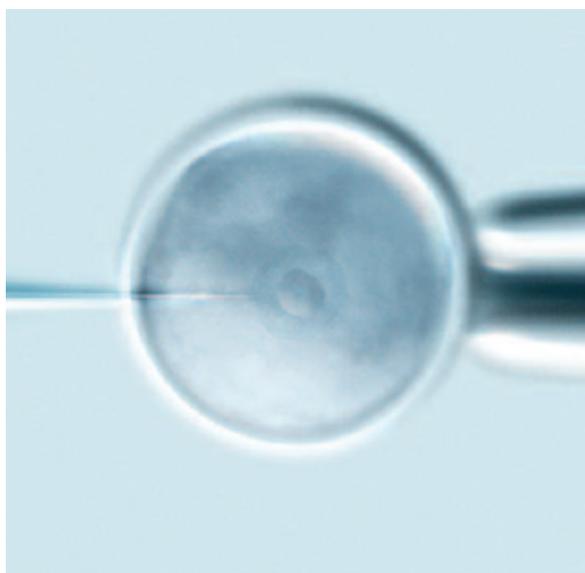
Stem cells from non-human animals

Much of the basic understanding of stem cells has been learned from studying them in animals. The use of animals in research in the UK is strictly regulated by law, under the Animals (Scientific Procedures) Act 1986 and associated legislation. Scientists using animals in their research have to obtain licenses both for themselves and for the particular project they want to undertake. More details about BBSRC's position on the use of animals in research can be found on the website or in our leaflet, 'Scientific Procedures, Animals and BBSRC'.

Key facts

- ▶ Only embryos up to 14 days old can be used for research
- ▶ Research can only take place on embryos created in the laboratory, that is, embryos that have developed from eggs fertilised outside the body
- ▶ 'Surplus' embryos created for use in IVF treatments can only be used with full consent of the parents

Further information about the regulation of stem cell research in the UK is available on the HFEA website at www.hfea.gov.uk



BBSRC's position

ethical issues
stem cells therapies
scientific research

The Biotechnology and Biological Sciences Research Council (BBSRC) is one of eight Research Councils sponsored through the Government's Office of Science and Technology.

BBSRC annually invests over £260M into the UK biosciences community. Our mission is to fund internationally competitive bioscience research, to provide training in the biosciences, to encourage opportunities for knowledge transfer and innovation and to engage the public and other stakeholders in dialogue on issues of scientific interest.

BBSRC supports the use of human and animal stem cells in research in accordance with UK legislation and guidelines. Scientists wanting to conduct research using human embryos must ensure that they have the correct licenses from the HFEA before starting research. We also require that any BBSRC-funded research conducted overseas conforms to UK legislation.

All grant applications submitted to BBSRC are subject to a strict peer-review process that assesses the

scientific validity and likely benefits from the research. In addition, reviewers consider any ethical and social issues the project might raise. Applications that raise ethical issues are passed to BBSRC's Bioscience for Society Strategy Panel, whose membership includes bioethicists, social scientists, educationalists and those with expertise in environmental, animal welfare and diversity issues. The Panel can make recommendations about the proposal or enter into dialogue with the applicant as appropriate.

We appreciate that the use of stem cells raises public aspirations and concerns and welcome constructive debate with all sectors of the community about the research we fund. We try to encourage funded scientists to talk about their work, by providing specialised media and communications training. We also require that grant-holders spend 1-2 days per year on some form of public engagement, and provide funding for particular activities.

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www.bbsrc.ac.uk

The information contained within this leaflet has been adapted from: *Stem Cells: science and ethics 2nd edition*

Copies of this leaflet are available at
www.bbsrc.ac.uk/society/issues/position/