

## Definition: What are Stem Cells?

Stem cells are undifferentiated or 'blank' cells found in the human body that have the potential to develop into many different cell types that carry out different functions. Most cells in the human body are *differentiated*. That means they are built to function in a particular organ system and carry out a specific function. A red blood cell, for example, is designed to carry oxygen, while a white blood cell is designed to fight off disease. These differentiated cells result from the process of cell division, a process that begins with *undifferentiated* stem cells.

Pluripotent stem cells, found in embryos, can give rise to all the cells found in the human body – cells as diverse as those found in the brain, bone, heart and skin.

Multipotent stem cells, found in adults or in babies' umbilical cords, have a more limited capacity. Their development is limited to the cells that make up the organ system that they originated from. For example, a multipotent stem cell in the bone marrow can develop into a red blood cell, a blood platelet or a white blood cell, but not into a skin cell or brain cell.

Researchers believe that stem cells, especially pluripotent stem cells, hold much potential for medical therapies and medical research such as:

- Growing replacement cells or whole replacement organs. Human stem cells can be used to generate specialized cells in a laboratory and then be transplanted to replace damaged cells in the body. These could be used to treat a range of conditions from Parkinson disease to heart failure to spinal injuries. For example, in the case of a spinal injury, neural stem cells could be generated to replace damaged tissue.
- "Patching" organs that don't work properly - like helping a diabetic person's pancreas produce insulin. The newest therapies in research on stem cells and diabetes involve generating islet cells that produce insulin to replace those that a diabetic person's immune system destroys.
- In the study of human development, stem cells could help researchers determine why, in the early stages of development, some cells become cancerous or how genetic diseases develop. This could lead to answers as to how they might be prevented.
- For research purposes, stem cells may be useful as a testing ground for new drugs before they are used on humans. Stem cells may be more accurate for research results than using animal subjects, as well as solve the ethical dilemma of using animals for medical testing.

Stem cell research has the potential to bring new treatment options to patients with Alzheimer's, Parkinson's disease, heart disease, burns, diabetes, and spinal cord injuries.



## Ethical Issues

Research that uses multipotent stem cells (which are found in adults and in umbilical cords) is not generally considered controversial. However, because their ability to differentiate is limited, so is their usefulness in research.



However, research with pluripotent stem cells is controversial because it requires destroying an artificially-fertilized embryo at the 5-14 day stage. Because pluripotent stem cells can differentiate into all the cell types in the human body, they have the greatest application in research for new medical treatments.

Recently, researchers at the biotech company, Advanced Cell Technology, claim to have succeeded in harvesting stem cells from mouse embryos without killing them. If this technique is valid and its reliability improved, it could alleviate many of the ethical problems related to stem cell research.

Whether or not to use stem cells in research or medical therapy raises a number of ethical issues:

- When does a human embryo attain personhood?
- Should we use research methods that destroy human embryos to search for new therapies that could help people in the future?
- Where should the embryos for stem cell research come from?
- Will stem cell research lead to future genetic manipulation of cells? Will we cease to be human if that happens?
- What are we willing to spend on medical research and who should decide what is morally appropriate?
- Are the social, economic and personal costs of the diseases that stem cells have the potential to treat greater than the costs associated with the destruction of embryos? Can we quantify these costs?



## Links

American Society for Bioethics and Humanities

[www.asbh.org](http://www.asbh.org)

Do No Harm: The Coalition of Americans for Research Ethics

[www.stemcellresearch.org](http://www.stemcellresearch.org)

Genetics Science Learning Center (University of Utah): Stem Cells in the Spotlight  
<http://gslc.genetics.utah.edu/units/stemcells/>

National Institute of Health Stem Cell Information.  
<http://stemcells.nih.gov>

President's Council on Bioethics  
[www.bioethics.gov](http://www.bioethics.gov)

University of Minnesota Stem Cell Institute  
[www1.umn.edu/stemcell](http://www1.umn.edu/stemcell)



### Suggested Reading

#### **Online**

The investigation of work by Dr. Woo-Suk Hwang of Seoul National University in South Korea, who announced he had produced the first cloned human embryo and patient-specific stem cell lines, is featured in the story, "Timeline of a Controversy," from Nature, online at <http://www.nature.com/news/2005/051219/full/051219-3.html>. While other recent work was discovered to be fraudulent, Hwang's team was proven to have produced the first dog clone.

FDA approves first brain stem cell transplant. Associated Press. October 20, 2005.  
<http://www.msnbc.msn.com/id/9767034/from/RL.4/>.

Human Stem Cells: An Ethical Overview  
Published by the Center for Bioethics-University of Minnesota and available online at [http://www.ahc.umn.edu/img/assets/26104/Stem\\_Cells.pdf](http://www.ahc.umn.edu/img/assets/26104/Stem_Cells.pdf).

Little Cells, Big Issues.  
Kahn, Jeffrey P. CNN.com/HEALTH.  
<http://www.cnn.com/HEALTH/bioethics/9901/stem.cells/template.html>

CNN.com has an In-depth Special on The Stem Cell Debate. Find links to issues, politics and analyses and recent news surrounding stem cells at:  
<http://www.cnn.com/SPECIALS/2001/stemcell/>

#### **Articles**

Little, Melissa, Wayne Hall and Amy Orlandi. "Delivering on the promise of human stem-cell research. What are the real barriers?" *EMBO reports* 7, 12, 1188–1192 (2006).

Blastomere Blowup: A novel way to harvest stem cells intrigues and inflames.  
Choi, CO. *Scientific American*. 295 (5): 18, 20, 22, 2006 Nov.

Stem Cells: an alternative to organ transplantation in chronic, degenerative and infectious diseases?  
Gennero L. Mortimer P. Sperber K. Carloni G. Ponzetoo A. *New Microbia*. 29 (3): 151-67, 2006 July.

Ethical issues in embryonic stem cell research.  
Dresser R. *JAMA* March 2001; 285(11):1439-1440.

Stem cells profile: a man in a hurry.  
Alpher J. *Science* March 1999; 283(5407):1434-1435.

The ethics of funding embryonic stem cell research: a Catholic viewpoint.  
Doerflinger RM. *Kennedy Institute of Ethics Journal* June 1999; 9(2):137-150.

Ethics Issues in Stem Cell Research. *International Stem Cell Forum Ethics Working Party et. al.* *Science* 312, 366 (2006).

Corrigan, Oonagh, Kathleen Liddell, John McMillan, Alison Stewart and Susan Wallace. "Ethical, legal and social issues in stem cell research and therapy: A briefing paper from Cambridge Genetics Knowledge Park". Online at [http://www.cgkp.org.uk/resources/pdf/stem\\_cell\\_paper2.pdf](http://www.cgkp.org.uk/resources/pdf/stem_cell_paper2.pdf)

### **Books**

Becoming Immortal: Combining Cloning and Cell Therapy.  
Stanley Shostak; State University of New York (2002).

Bringing Embryos into Existence for Research Purposes.  
Carol Tauer. In: *Contingent Future Persons*. N. Fotion and J.C. Heller, eds.; Dordrecht: Kluwer Academic Publishers (1997).

Cloning and the Future of Human Embryo Research. P. Lauritzen, ed.; Oxford University Press (2001).

My Detour on Life's Highway: The Story of a Stem Cell Transplant Survivor.  
Rosemary Champagne; Glacier Publishing (2001).

The Stem Cell Controversy: Debating the Issues.  
M. Ruse and C. Pynes, eds.; Prometheus Books (2002).

Biomedical Ethics Reviews: Stem Cell Research. Humber JM, Almeder RF, eds. Totowa, NJ (2004).

The Center also offers a Bioethics Overview on the topic of Stem Cells which may be found [here](#).



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## Facts & Statistics

- Human pluripotent stem cells found in embryos were first isolated in 1998 by two teams of scientists, working independently, at the University of Wisconsin and at Johns Hopkins University.
- Since August, 2001, the U.S. Government only funds stem cell research that uses stem cells taken from an approved cell line. This list can be found on-line at [stemcells.nih.gov](http://stemcells.nih.gov)
- Stem cells can divide repeatedly to replicate themselves over and over again without error. Other cells in the human body can only replenish themselves a certain number of times before they begin to break down.

