

CASE TEACHING NOTES

for

“Stem Cells: Promises to Keep?”

by
Lauren E. Yaich
Department of Natural Sciences
University of Pittsburgh at Bradford

INTRODUCTION / BACKGROUND

The field of stem cell research is a slightly confusing one at this time.

—Price and Williams, 2001

This quotation aptly summarizes the current state of stem cell research. Nevertheless, despite the challenges of handling a still evolving topic in the classroom, it is a fascinating area to explore with college students. The fact that both the ethics and the science of stem cell research are still in a state of flux and controversy makes it a valuable learning tool. It gives students a chance to realize that scientists don't have all the answers yet and that there are very different views about stem cell biology that are currently being hotly debated. Students will learn that the scientific process is a lively one, and not as dull and dry as they might have supposed.

Objectives

- To discuss the concept of the “stem cell.”
- To learn about differences between embryonic stem cells and adult stem cells.
- To discover what types of adult stem cells exist.
- To discuss biomedical applications for stem cells.
- To debate ethical dilemmas posed by stem cell use.

DETAILED CASE ANALYSIS

Detailed case analysis is provided in a separate file that is password-protected. To access this information, go to the [detailed case analysis](#). You will be prompted for a username and password. If you have not yet registered with us, you can see whether you are eligible for an account by reviewing our [password policy and then apply online](#) or write to answerkey@sciencecases.org.

CLASSROOM MANAGEMENT

This case was designed for use in an undergraduate upper-level cell biology or developmental biology class. The instructor should provide the students with relevant readings prior to the class session or alternatively (and perhaps more desirably, given the fast-moving nature of this field) have the students locate recent articles on stem cells.

In this case study, the first half of the class would be spent discussing the biology of stem cells and the potential biomedical uses for them. This could be done either by having the instructor lead the discussion with the entire class or by having the class break-up into smaller groups to come up with answers to key questions followed by a wrap up with the entire class. The second half of the class would

involve a debate focused on the ethics of stem cell use. The class could be split into two sides, with one side explaining the reasons for Samantha's views and the other side explaining the reasons for Brad's beliefs. The instructor would function as a moderator for the debate.

Since many of the ethical issues surrounding embryonic stem cell use revolve around the destruction of embryos for therapeutic purposes, many students are likely to feel very emotional about this topic, particularly if they have strong views about the abortion issue. Therefore, an effort should be made by the instructor before the debate begins to encourage the participants to exercise classroom civility, and to demonstrate a respect for free speech, which may lead to a discussion of viewpoints that differ dramatically from their own. Additionally, if the participants representing each side are chosen randomly, which is probably the most desirable way to run this exercise, it should be made clear to the students that they should not assume that the views stated by a given "side" in the debate are necessarily representative of the personal beliefs of each individual member.

Potential Questions for the Students

- What are stem cells?
- Some stem cells are unipotent, while others are multipotent or pluripotent. What do these descriptions mean?
- Why are embryonic stem cells not considered totipotent?
- What do we mean when we refer to a cell as differentiated?
- What does dedifferentiation mean?
- What does transdifferentiation mean?
- What is meant by stem cell plasticity?
- From which part of the embryo are embryonic stem cell lines derived?
- Where can stem cells be found in an adult mammal?
- What is known about the regulation of stem cells?
- Brainstorm! What types of human disorders and diseases might be treatable using stem cells?
- What scientific obstacles still exist in the quest to develop stem-cell based therapies for human diseases?
- Why is the maintenance of a stable karyotype a critical feature for any stem cell line that will be used for therapeutic purposes?
- In what way are the ethical dilemmas associated with the use of embryonic stem cells different than those posed by the use of adult stem cells?
- Could the full range of biomedical benefits be obtained from stem cells without the destruction of embryos?
- Should donors of either eggs or adult stem cells receive financial compensation?

REFERENCES

Note that our understanding of this field is currently in an extremely fast-moving phase, with many of the major concepts and "facts" in a state of flux. Therefore, it will be essential for the instructor and students to locate and use the most recent articles as possible. This reference list is only intended to be a starting point.

Print

- Anderson, D.J., *et al.* 2001. Can stem cells cross lineage boundaries? *Nature Medicine* 7:393-395.
- Antoniou, M. 2001. Embryonic stem cell research—The case against.... *Nature Medicine* 7:397-399.
- Asahara, T., *et al.* 2000. Stem cell therapy and gene transfer for regeneration. *Gene Therapy* 7:451-457.

- Bianco, P. and P.G. Robey. 2001. Stem cells in tissue engineering. *Nature* 414:118-121.
- Bjornson, C.R.R., *et al.* 1999. Turning brain into blood: A hematopoietic fate adopted by adult neural stem cells *in vivo*. *Science* 283:534-537.
- Blau, H.M., *et al.* 2001. The evolving concept of a stem cell: Entity or function? *Cell* 105:829-841.
- Brustle, O., *et al.* 1999. Embryonic stem cell-derived glial precursors: A source of myelinating transplants. *Science* 285:754-756.
- Clarke, D. and J. Frisén. 2001. Differentiation potential of adult stem cells. *Current Opinion in Genetics and Development* 11:575-580.
- Donovan, P.J. and J. Gearhart. 2001. The end of the beginning for pluripotent stem cells. *Nature* 414:92-97.
- Fuchs, E. and J.A. Segre. 2000. Stem cells: A new lease on life. *Cell* 100:143-155.
- Gage, F.H. 2000. Mammalian neural stem cells. *Science* 287:1433-1438.
- Geiger, H., *et al.* 1998. Globin gene expression is reprogrammed in chimeras generated by injecting adult hematopoietic stem cells into mouse blastocysts. *Cell* 93:1055-1065.
- Goodell, M.A. 2001. Stem cells: Is there a future in plastics? *Current Opinion in Cell Biology* 13:662-665.
- Kind, A. and A. Colman. 1999. Therapeutic cloning: needs and prospects. *Seminars in Cell and Developmental Biology* 10:279-286.
- Lenoir, N. 2000. Europe confronts the embryonic stem cell research challenge. *Science* 287:1425-1427.
- Ling, K.-W. and E. Dzierzak. 2002. Ontogeny and genetics of the hemato/lymphopoietic system. *Current Opinion in Immunology* 14:186-191.
- Lovell-Badge, R. 2001. The future for stem cell research. *Nature* 414:88-91.
- Lumelsky, N., *et al.* 2001. Differentiation of embryonic stem cells to insulin-secreting structures similar to pancreatic islets. *Science* 292:1389-1394.
- Marshak, D.R., *et al.* (eds.) 2001. *Stem Cell Biology*. Cold Spring Harbor Laboratory Press: Cold Spring Harbor, NY.
- Marshall, E. 2000. The business of stem cells. *Science* 287:1419-1421.
- McKay, R. 2000a. Mammalian deconstruction for stem cell reconstruction. *Nature Medicine* 6:747-748.
- McKay, R. 2000b. Stem cells—Hype and hope. *Nature* 406:361-364.
- McLaren, A. 2001. Ethical and social considerations of stem cell research. *Nature* 414:129-131.
- Orlic, D., *et al.* 2001. Bone marrow cells regenerate infarcted myocardium. *Nature* 410:701-705.
- Orkin, S.H. 2000. Diversification of haematopoietic stem cells to specific lineages. *Nature Reviews Genetics* 1:57-64.
- Pera, M.F., *et al.* 2000. Human embryonic stem cells. *Journal of Cell Science* 113:5-10.
- Perry, D. 2000. Patient's voices: the powerful sound in the stem cell debate. *Science* 287:1423.
- Price, J. 2001. Neural stem cells—Where are you? *Nature Medicine* 7:998-999.
- Price, J. and B.P. Williams. 2001. Neural stem cells. *Current Opinion in Neurobiology* 11:564-567.
- Reya, T., *et al.* 2001. Stem cells, cancer, and cancer stem cells. *Nature* 414:105-111.

- Robertson, J.A. 2001. Human embryonic stem cell research: Ethical and legal issues. *Nature Reviews Genetics* 2:74-78.
- Shambloott, M.J., *et al.* 1998. Derivation of pluripotent stem cells from cultured human primordial germ cells. *Proc. Natl. Acad. Sci. USA* 95:13726-13731.
- Siegel, A.W. 2001. Neutrality and consensus: Towards a viable policy on human stem cell research. *Molecular Aspects of Medicine* 22:171-181.
- Slack, J.M.W. 2000. Stem cells in epithelial tissues. *Science* 287:1431-1433.
- Slack, J.M.W. and D. Tosh. 2001. Transdifferentiation and metaplasia-switching cell types. *Current Opinion in Genetics and Development* 11:581-586.
- Spradling, A., *et al.* 2001. Stem cells find their niche. *Nature* 414:98-104.
- Strain, A.J. and H.A. Crosby. 2000. Hepatic stem cells. *Gut* 46:743-745.
- Temple, S. 2001a. Stem cell plasticity—Building the brain of our dreams. *Nature Reviews Neuroscience* 2:513-520.
- Temple, S. 2001b. The development of neural stem cells. *Nature* 414:112-117.
- Thomson, J.A., *et al.* 1998. Embryonic stem cell lines derived from human blastocysts. *Science* 282:1145-1147.
- Van der Kooy, D. and S. Weiss. 2000. Why stem cells? *Science* 287:1439-1441.
- Vogel, G. 2000. Can old cells learn new tricks? *Science* 287:1418-1419.
- Watt, F.M. and B.L.M. Hogan. 2000. Out of Eden: Stem cells and their niches. *Science* 287:1427-1430.
- Weissman, I.L. 2000a. Stem cells: Units of development, units of regeneration, and units in evolution. *Cell* 100:157-168.
- Weissman, I.L. 2000b. Translating stem and progenitor cell biology to the clinic: Barriers and opportunities. *Science* 287:1442-1446.
- Winston, R. 2001. Embryonic stem cell research—The case for... *Nature Medicine* 7:396-397.
- Wobus, A.M. 2001. Potential of embryonic stem cells. *Molecular Aspects of Medicine* 22:149-164.
- Wurmser, A.E. and F.H. Gage. 2002. Stem cells: Cell fusion causes confusion. *Nature* 416:485-488.
- Young, F.E. 2000. A time for restraint. *Science* 287:1424.

Websites

- NIH Stem Cell Information—The National Institutes of Health (NIH) maintains a website with extensive links to administration statements and congressional testimony about stem cell research. It also has a very thorough report summarizing the current state of science in stem cell research. <http://www.nih.gov/news/stemcell/index.htm>

Acknowledgments: This case was developed with support from The Pew Charitable Trusts.

Date Posted: 07/09/02 nas

Originally published at http://www.sciencecases.org/stem_cells/stem_cells_notes.asp

Copyright © 2003 by the [National Center for Case Study Teaching in Science](#). Please see our [usage guidelines](#), which outline our policy concerning permissible reproduction of this work.