

**Learning Activity 2: Sources of Stem Cells: IVF, PGD Clones, Cybrids, SHEEFs  
Menstrual Blood, Cord Blood, Ovaries, Fetuses, and Fat  
Eggs & Blood: Gifts & Commodities Module**  
*by Katayoun Chamany Updated July 2018*

With new advances in reproductive technology, plastic surgery, and stem cell research, an interesting confluence of ethical controversies has emerged regarding embryonic, fetal, and adult stem cell sources. These advances have created a market where eggs (oocytes) are viewed as a commodity for establishing human embryonic stem cell lines (hESCs) and stereotypical views of bodily tissues associated with reproduction or waste are being challenged. The following articles and video clips allow you to formulate a deep understanding of the techniques and implications associated with each stem cell source.

You will apply this knowledge to create **visual narratives** that integrate the biological, ethical, legal, and social dimensions associated with a specific source of stem cells. Depending on your course, you may be asked to design the narrative for a single source type, or you may be asked to collaborate with your peers on a single source, or generate a narrative for each source over the course of the semester. Additional resources to those listed below each stem cell source are the [Timelines](#) and [PPT Slide Sets](#) at [Stem Cells Across the Curriculum](#).

The activity frames discussion through the generation of *personalized* visual narratives that combine text and images. The narrative should not be a replica of the infographics or animations provided. Instead, you are encouraged to be creative, expressive, and integrative, weaving the biological, ethical, legal, and social issues most important to you and/or a specific community. Additionally, the narrative should pay close attention to the temporal (timing) and spatial (location and movement among spaces) aspects of the process. To help you get started and to imagine how creating visual narratives can illustrate what you find interesting, confusing, or controversial about a topic, see the following website, which contains a database of student-generated drawings to explain a variety of topics: [Picturing to Learn Resources and Site](#). The narrative should address:

1. **The Source:** The starting material for this source of stem cells, the manipulations, and the technologies involved in bringing it to the lab or clinic.
2. **The Process:** The steps involved in procurement of the tissue/cells and any related activities.
  - a. Was any money exchanged? Are there any excess, extra, or by-products, and how are they managed?
  - b. What policies are associated to derive or deliver stem cells from this source?
  - c. The key points at which decisions are made.
3. **Biological Characteristics:** What is useful about this specific source for basic biological research.
  - a. What is the cell fate potential?
  - b. What is the qualitative and quantitative dimension of genetic content for cells from this source?
  - c. Does a diploid nuclear genome exist and, if so, is there both paternal and maternal contribution?
  - d. Are there animal components present?

4. **Scientific Potential:** Characteristics that make this source useful for basic scientific research.
  - a. How can the source expand our knowledge base of human development, disease, etc.?
  - b. How can working with these cells expand our tool kit in scientific experiments?
  
5. **Therapeutic Potential:** Characteristics that make this source useful for biomedicine or future therapies.
  - a. If used for transplant therapy or enhancement would they be universally immunocompatible?
  - b. Are the cells easily retrieved? Are the stem cells plentiful? Do they need to be amplified?
  - c. Is there potential for the development of unwanted outcomes such as tumor formation?
  
6. **Banking and Access:** Where are the potential products stored and how they are used/ administered for scientific research and therapeutic purposes. Are they stable, can they be stored?
  
7. **Public or Private:** Are the cells obtained within the public and private sector, and why relegated to one or the other?
  
8. **Social Views:** The ways that this source may challenge and/or confirm stereotypical views on the role of females in society and tissues and cells associated with female bodies, waste, or reproduction.

**Self-reflection:** In addition to the visual narrative, provide a short reflective self-assessment of how satisfied you are with your visual narrative in terms of conveying the aspects above and where you feel you could improve.

### Resources For Different Stem Cell Source Types:

#### IVF Embryos

1. **Infographic:** Chamany, K. et al. 2013. Embryo.IVF. Extranumerary ZoomGraphic. Stem Cells Across the Curriculum. [Link](#)
2. **IVF Animation:** Vidali, A. April 3 2011. IVF Procedure. A Simple Explanation of the In Vitro Fertilization Cycle. [Link](#)
3. **IVF SCR Review Article:** Kiessling, A. Oct 2007. Human Eggs: The Need, The Risks, And The Politics. *Burrill Stem Cell Report*. 38-45. [Link](#) *This article is good for biology students who can make connections to the cell cycle and reproductive biology.*
4. **Research Article:** Roberts, C., & Throsby, K. 2008. Paid to share: IVF patients, eggs and stem cell research. *Social Science & Medicine*. 66(1):159-169. [Link](#)
5. **Bush Vetoes Surplus IVF Embryo Bill Video:** Rosary Films 2009. Stem Cell Research Policy of President Bush/Adult Versus Embryonic Stem Cells. Youtube. [Link](#)
6. **Bill to Use Surplus IVF Embryos for SCR Video:** MSNBC. March 9, 2009. Rep DeGette on MSNBC's Hardball with Chris Matthews (11:34 min) [Link](#)
7. **IVF SCR Review Article:** Gearhart, J. et al. Jan 7, 2011. In vitro fertilization, the Nobel Prize, and human embryonic stem cells. *Cell*. 8:12-15. [Link](#)
8. **Op-Ed.** Darnovsky, M. & Fogel, B. Sept 3, 2013. California Controversy: Let's Not Expand the Women's Market in Women's Eggs. *Huffington Post.com*. (1 pg) [Link](#)
9. **Committee Opinion:** Ethics Committee of the American Society for Reproductive Medicine. June 2013. Disposition of abandoned embryos: A committee opinion. *Fertility and Sterility*. 99 (7):1848-1849. [Link](#)

10. **News:** Lewin, T. June 17, 2015. Industry's Growth Leads to Leftover Embryos, and Painful Choices. *New York Times*:A1. [Link](#)
11. **Clinical Report:** Shroff, G. 2015. Human embryonic stem cell in the treatment of Spinocerebellar Ataxia a case series. *Journal of Clinical Case Reports*. 5 (1): 1-5. [Link](#)
12. **Qualitative Research Article:** Goedeke, S., et al. 2017. The fate of unused embryos. *Qualitative Health Research*. 27(10):1529-1540. [Link](#)

### Research Embryos

13. **Infographic:** Chamany, K. et al. 2013. Embryo. IVF. Research ZoomGraphic. Stem Cells Across the Curriculum. [Link](#)
14. **News:** Josefson, D. 2001. Embryos created for stem cell research. *British Medical Journal*. 323(7305): 127. [Link](#)
15. **News:** Toma, T. July 19, 2001. Custom-made human embryos for medical research. *The Scientist*. [Link](#)
16. **Research Article:** Lanzendorf, S. et al. 2001. Use of human gametes obtained from anonymous donors for the production of human embryonic stem cell lines. *Fertility and Sterility*. 76 (1):132-137. [Link](#)
17. **Article:** Egli, D. et al. 2011. Impracticality of egg donor recruitment in the absence of compensation. *Cell Stem Cell*. 9(4):293-294. [Link](#)
18. **Comment Article:** Fiore, R. & Hirsch, K. 2011. Oocytes for research: reevaluating risks and compensation. *The American Journal of Bioethics*. 11(9):42-43. [Link](#)
19. **Committee Statement:** Haimes, E. et al. 2013. ISSCR: Committee Forum. Position statement on the provision and procurement of human eggs for stem cell research. *Cell Stem Cell*. 12 (3):285-291. [Link](#)
20. **Dissertation Summary:** Yoon, H. Oct 13, 2015. Gender and Stem Cell Research in South Korea: A review of Science, Nation, and Women's Bodies: Economies of Reproductive Tissues and Stem Cell Research in South Korea, by Yeonbo Jeong. *DissertationReviews.com*. [Link](#)

### PGD Embryos

21. **Infographic:** Chamany, K. et al. 2013. Embryo.IVF. PGD ZoomGraphic. Stem Cells Across the Curriculum. [Link](#)
22. **PGD Savior Sibling Video:** Thirteen/Education Broadcasting Corporation (Producer.) April 2, 2010. Religion and Ethics Weekly: Embryonic Stem Cell Controversy. [Link](#)
23. **PGD Review Article:** Handyside, A. 2010. Preimplantation Genetic Diagnosis. *Obstetrics, Gynecology, and Reproductive Medicine*. 21(3):68-79. [Link](#)
24. **PGD and SCR Policy Article:** Theodosiou, A. & Johnson, M. 2011. The politics of human embryo research and the motivation to achieve PGD. *Reproductive Biomedicine Online*. 22(5):457-471. [Link](#)
25. **PGD and SCR Policy News:** Wadman, M. June 15, 2010. Disease cells fail to win approval. *Nature News*. [Link](#)
26. **PGD and SCR Policy Response:** Yovich, J. 2011. Invited commentary: The politics of human embryo research and the motivation to achieve PGD. *Reproductive Biomedicine Online*. 22(5):408-409. [Link](#)
27. **Extranumerary Embryos News:** Lewin, T. June 17, 2015. Industry's Growth Leads to Leftover Embryos, and Painful Choices. *New York Times*:A1. [Link](#)

### Parthenotes, Clones, and Cybrid Embryos

28. **Infographic:** Chamany, K. et al. 2013. Embryo.Genetically Modified Embryo ZoomGraphics (Parthenote, SCNT, Cybrid). Stem Cells Across the Curriculum. [Link](#)
29. **Animation:** University of Michigan. Nuclear Transfer Animation. Stem Cell Explained. [Link](#) *Animation of the process of somatic cell nuclear transfer in the context of stem cell research.*
30. **Video Microscopy:** HHMI. Somatic Cell Nuclear Cloning. [Link](#) *Real time and videomicroscopic overview of somatic cell nuclear cloning and link to animation below.*

31. **Op-Ed:** Vogelstein, B. et al. Feb 12, 2002. Please don't call it cloning. *Science*. 295(5558):1237. [Link](#)  
*This article suggests new nomenclature for stem cell research that does not invoke the concept of reproductive clones.*
32. **Op-Ed:** O'Mathuna, D. 2002. What to call human cloning? *EMBO Reports*. 3 (6): 502-505. [Link](#) *This article is in response to the Vogelstein et al. article and states that ethical issues can not be skirted by changing the vocabulary*
33. **UK Hybrid Embryos Licensed Video:** Walsh, F. April 8, 2008. UK's First Hybrid Embryos Created. *BBC News*. Text and Video. [Link](#) ; downloadable from [Link](#)
34. **Research Article:** Baylis, F. 2008. Animal eggs for stem cell research: A path not worth taking. *American Journal of Bioethics*. 8(12): 18-32. [Link](#)
35. **Research Article:** Egli, D. et al. 2011. Impracticality of egg donor recruitment in the absence of compensation. *Cell Stem Cell*. 9(4):293-294. [Link](#)
36. **Research Article:** Tachibana, M. et al. 2013. Human embryonic stem cells derived by somatic cell nuclear transfer. *Cell*. 153(6):1228-1238. [Link](#)

### Ovarian Stem Cells

37. **Infographic:** Chamany, K. et al. 2013. Sources of Stem Cells Radial Infographic. Stem Cells Across the Curriculum. [Link](#)
38. **Video Animation:** Dolgin, E. Feb 26, 2012. Stem cell discovery puts women's reproduction on fertile ground. NatureVideo. Spoonful of Medicine. 5 min video. Produced by Erin Olsen, narrated by Rebecca Hersher, and animation and artwork by Katherine Vacari. MacMillan Publishers. [Link](#)
39. **News Article:** Weintraub, K. April 2012. Egg Stem Cells. *MIT Technology Review*. [Link](#)
40. **News Article:** Gura, T. November 15, 2012. Reproductive biology: Fertile mind. *Nature*. 491:319-320. [Link](#)
41. **Research Article:** White, A. et al. 2012. Oocyte formation by mitotically active germ cells purified from ovaries of reproductive age women. *Nature Medicine*. 18(3): 413-422. [Link](#)
42. **Research Article:** Woods, D. and Tilly J. 2013. Isolation, characterization and propagation of mitotically active germ cells from adult mouse and human ovaries. *Nature Protocols*. 8: 968-88. [Link](#)
43. **Science News:** Couzin-Frankel, J. 2015. Eggs unlimited. *Science*. 350(6261):620-624. [Link](#)
44. **Science News:** Servick, K. Feb 8, 2018. These lab-grown human eggs could combat infertility- if they prove healthy. *ScienceMagazine News*. [Link](#)

### Menstrual Blood Stem Cells

45. **Infographic:** Chamany, K. et al. 2013. Adult. Adult Cell Source. Blood Stem Cells ZoomGraphic. Stem Cells Across the Curriculum. [Link](#)
46. **Video:** Briganti, Chelsea. 2010. Mademoicell Design Process. Stem Cells from Menstrual Cells. [Link](#)
47. **News:** Aug 19, 2008. Limbs Saved By Menstrual Blood Stem Cells. *ScienceDaily.com* [Link](#)
48. **Blog:** Rowland, T. 2009. Stem Cells Discovered in Menstrual Blood: Endometrial Regenerative Stem Cells. *All Things Stem Cell*. (2 pages) [Link](#)
49. **Market Regulations News:** Robbins, S. Feb 28, 2009. New Developments in Umbilical Cord Blood Technologies:Consolidation of U.S. Family Banks. *Life Sciences World.com*. (10 pages) [Link](#)
50. **Scientific Review Article:** Houry, M. et al. 2014. The promising potential of menstrual stem cells for antenatal diagnosis and cell therapy. *Frontiers of Immunology*. 5 (Article 205): 1-8. [Link](#)
51. **Research Article:** Famarzi, H. et al. Jan 2016. The potential of menstrual blood-derived stem cells in differentiation to epidermal lineage: A preliminary report. *World Journal of Plastic Surgery*. 5 (1): 26-31. [Link](#)

### Cord Blood & Perinatal Stem Cells

52. **Infographic:** Chamany, K. et al. 2013. Adult. Adult Cell Source. Blood Stem Cells ZoomGraphic. Stem Cells Across the Curriculum. [Link](#)

53. **Video on Cord Blood Banking:** Australian Stem Cell Centre. How Can They Be Used: Cord Blood Banking. Stem Cell Channel. [Link](#) (7':09"). Also Available from the [Link](#) under How Can They Be Used.
54. **Review Article:** Kurtzberg, J. et al. 2005. Untying the Gordian knot: policies, practices, and ethical issues related to banking of umbilical cord blood. *Journal of Clinical Investigation*. 115(10):2592-2597. [Link](#)
55. **Law Article:** Mohapatra, S. Fall 2013. Cutting the Cord from Private Cord Blood Banking: Encouraging Compensation for Public Cord Blood Donations After Flynn v. Holder. *University of Colorado Law Review* 84(4): 933-983. [Link](#)
56. **Book Chapter:** Dickenson, D. 2013. Your Birthday Gift: Banking Cord Blood" In *We Medicine, Me Medicine: Reclaiming Biotechnology for the Common Good*. Columbia University Press. 84-112. Google Books. [Link](#)
57. **Clinical Review Article:** Shenoy, S. May 2013. Umbilical cord blood: An evolving stem cell source for sickle cell disease transplants. *Stem Cells Translational Medicine*. 2 (5):337-340. [Link](#)
58. **Review:** Munoz, J. et al. 2014. Concise review: Umbilical cord blood transplantation: Past, present, and future. *Stem Cells Translational Medicine*. 3(12):1435-1443 [Link](#)
59. **Review Article.** Petrini, C. 2014. Umbilical cord blood banking: From personal donation to international public registries to global bioeconomy. *Journal of Blood Medicine*. 4(5): 87-97. [Link](#)
60. **Qualitative Research Article:** Jeong, Y. 2014. Scientific motherhood, responsibility, and hope: Umbilical cord banking in South Korea. *New Genetics and Society*. 33(4):1-35. [Link](#)
61. **Editorial to Special Issue:** Sleeboom-Faulkner, M. and Chang, H-C. Aug 2016. The private, the public and the hybrid in umbilical cord blood banking.- a global perspective. *New Genetics and Society* 36(5): 223-227. [Link](#)
62. **Review:** Ballen, K. May 2017. Umbilical cord blood transplantation: Challenges and future directions. *Stem Cells Translational Medicine*. 6(5):1312-1315. [Link](#)

### **Breast & Fat Stem Cells**

63. **Infographic:** Chamany, K. et al. 2013. Adult Stem Cell Source. Fat Stem Cells ZoomGraphic. Stem Cells Across the Curriculum. [Link](#)
64. **Magazine Article:** Begley, S. 2010. All Natural: Why Breasts Are the Key to Regenerative Medicine. *Wired Magazine*. (8 pages) [Link](#)
65. **Fat Stem Cells Video:** Rodriguez, R. 2010. Stem Cells From Your Own Fat. New Frontier of Plastic Surgery. Vimeo. [Link](#)
66. **Fat Stem Cells Video.** Photoactivation of Adult Stem Cells Derived from Adipose Tissue. Adistem. [Link](#)
67. **Breast Stem Cells Video.** Berry, D. et al. Breast Stem Cells. Youtube/ Walter and Eliza Hall Institute of Medical Research. [Link](#)
68. **Review Article:** Eun-*hee*, K. and Heo, C. 2014. Current applications of adipose-derived stem cells and their future perspectives. *World Journal of Stem Cells*. 6(1):65-68. [Link](#)
69. **Research Article:** Ra, J. et al. 2011. Safety of intravenous infusion of human adipose tissue derived mesenchymal stem cells in animals and humans. *Stem Cells and Development*. 20 (8): 1297-1308. [Link](#)
70. **Review:** Bora, P., & Majumdar, A. S. 2017. Adipose tissue-derived stromal vascular fraction in regenerative medicine: A brief review on biology and translation. *Stem Cell Research & Therapy*. 8:145. [Link](#)

### **Fetal Stem Cells**

71. **Infographic:** Chamany, K. et al. 2013. Fetus. Fetal Tissue ZoomGraphic. Stem Cells Across the Curriculum. [Link](#)
72. **Scientific Report:** Lindvall, P. et al. 1990. Grafts of Fetal Dopamine Neurons Survive and Improve Motor Function in Parkinson's Disease. *Science* 247(4942): 574-77. [Link](#)

73. **Review Article:** Anonymous. Oct 26, 2011. Tissue-bank shortage: Brain child. *Nature* 478 :4242-443 . [Link](#)
74. **Editorial.** Anonymous. Oct 27, 2011. A priceless resource. *Nature*. 478:427. [Link](#)
75. **Science News:** Wadman, M. June 26, 2013. Medical research: Cell division. *Nature*. 498:422-426. [Link](#)
76. **Review Article:** Barker, R. et al. 2013. Fetal Dopaminergic Transplantation Trials and the Future of Neural Grafting in Parkinson's Disease. *The Lancet Neurology* 12: 84-91. [Link](#)
77. **News:** Storrs, C. July 17, 2015. How Exactly Fetal Tissue is Used in Medicine. CNN.com. [Link](#)
78. **Scientific Review Article:** Gerrelli, D. et al. 2015. Enabling research with human embryonic and fetal tissue resources. *Development*. 142:2073-3076. [Link](#)
79. **News:** Zimmer, C. Sept 10, 2015. A Pregnancy Souvenir: Cells That Are Not Your Own. *The New York Times*. [Link](#)
80. **Scientific Report:** Boddy, A. et al. 2015. Fetal microchimerism and maternal health: A review and evolutionary analysis of cooperation and conflict beyond the womb. *BioEssays*. 37 (10): 1106-08. [Link](#)

### **Synthetic Stem Cells and Synthetic Embryos (SHEEFs)**

81. **News:** Zimmer, C. March 22, 2017. A New Form of Stem-Cell Engineering Raises Ethical Questions *New York Times*. A20. [Link](#)
82. **News:** Kwon, D. June 2017. Synthetic stem cells. *The Scientist*: 25. [Link](#)
83. **Feature Article:** Aach, J. et al. March 21, 2017. Addressing the ethical issues raised by synthetic human entities with embryo-like features. *eLife*. 6: e20674. [Link](#)
84. **Research Articles:** Shahbazi, M. et al. 2016. Self-organization of the human embryo in the absence of maternal tissues. *Nature Cell Biology*.18(6):700-708. <https://www.nature.com/articles/ncb3347>
85. **Research Article:** Luo, L., et al. 2017. Fabrication of synthetic mesenchymal stem cells for the treatment of acute myocardial infarction in mice novelty and significance. *Circulation Research*. 120(11):1768. [Link](#)
86. **News:** Shen, H. 2018. The labs growing human embryos for longer than before. *Nature*. 559:19-22. [Link](#)