**MEDS 380: Stem Cells: Fact and Fiction (2 units)**

SPRING 2015: January 12 – April 26

Tuesday 4:00 – 5:50 pm, 1 hour 50 minutes contact time per week

**Room VKC207**

INSTRUCTOR:

* Gage Crump, Ph.D., Associate Professor of Stem Cell Biology and Regenerative Medicine, Keck School of Medicine of USC
* Office Address: 1425 San Pablo St, BCC 406, Los Angeles, CA 90089-2821
* Office Phone: (323) 442-2693
* Office hours by appointment: please contact Gage Crump at gcrump@usc.edu

**Introduction and Purpose**

Stem cells have captured the imaginations of scientists, physicians, and the general public for their ability to revolutionize not only how we treat diseases but the foundations of life itself. This course discusses how stem cells and regenerative medicine have been portrayed in culture, the scientific underpinnings of what is currently possible, and visions into the future of this field.

In the timescale of humanity, the biological revolution is very much in its infancy. Yet many concepts that were strictly the realm of scientific fiction have now become, or on the verge of becoming, reality. Driven by genetic engineering and stem cell technology, we have brought extinct animals back to life, conceived embryos from three biological parents, synthesized the genetic blueprint of organisms from scratch, and transformed blood into neurons. What might the future hold? Will we find cures for most if not all diseases? Are we entering a new stage of evolution? Are we changing the very essence of what it means to be human?

A special emphasis will be placed on the scientific basis of stem cell biology and regenerative medicine. How does the reality of stem cell science contrast with how it has been portrayed in literature, film, and media?

Upon successful completion of this course, the student should be able to demonstrate a
working knowledge of:

* The history of stem cell science
* The biology of stem cells
* The use of stem cells in regenerative medicine
* Non-medical applications of stem cells in animal conservation and for-profit companies
* The portrayal of stem cells in culture and media

**Course Requirements and Grades**

* Textbook: Stem Cells: Scientific Facts and Fiction by Mummery, Christine et al. Second Edition (2014). Elsevier Press. ISBN 978-0-12-411551-4
* Course materials include a selection of articles from the peer-reviewed scientific literature, as well as media articles and science fiction literature. These required readings are listed below under Class Sessions.
* The course will consist of one 110 minute meeting each week, which will involve a dynamic combination of lecture, videos, class discussion and special guests.
* Prior to each class meeting, students will receive communication with material to read, listen to, and/or watch in preparation for the session. Students will be expected to be able to discuss the material during class.
* After each meeting, students will receive an email with questions involving material from the session. These questions will not be graded, but will instead act as practice questions for the final examination.
* Grading breakdown: Letter Grade

30% of the grade will be for attendance, participation, and short quizzes (~5 total)

35% of the grade will be for the mid-term examination

35% of the grade will be for the final exam

**Grading Scale (curve will likely be used):**

A 94-100

A- 90-93

B+ 87-89

B 83-86

B- 80-82

C+ 77-79

C 75-76

C- 74-70

D+ 69-67

D 66-64

D- 63-60

F 59-0

Examinations:

Exams will be short essays on topics selected in consultation with the instructor and will be based on research of literature.

Class Sessions: 1 hour 50 minutes

Week 1 Introduction

Jan. 12 **What are Stem Cells?**

 Viewing of Film “Stem Cell Revolutions: Visions of the Future” – 71 minutes

Required reading:

1. Chapter 3 of StemCells: SFF. “What are Stem Cells?”

Week 2 From Dolly the Sheep to Bringing Back Wooly Mammoths and Dinosaurs

Jan. 19 **Cloning by Somatic Cell Nuclear Transfer**

Required reading:

1. BBC Future – Will we ever clone a mammoth?

http://www.bbc.com/future/story/20120601-will-we-ever-clone-a-mammoth

2. For $100,000, You Can Clone Your Dog

http://www.businessweek.com/articles/2014-10-22/koreas-sooam-biotech-is-the-worlds-first-animal-cloning-factory

3. Chapter 6 of StemCells: SFF. “Cloning: History and Future Applications”

Week 3 The Clone Wars

Jan. 26 **Human Cloning**

Required reading:

1. Boys from Brazil by Ira Levin

2. Chapter 4.1-4.5 (pp. 69-89) of StemCells: SFF. “Of Mice and Men: The History of Embryonic Stem Cells”

Week 4 Designer People

Feb. 2 **Transgenesis**

Required reading:

1. GFP Bunny by Eduardo Kac

http://www.ekac.org/gfpbunny.html#gfpbunnyanchor

2. Movie Viewing: *Gattaca* *(1997) – 106 minutes*

Week 5 Growing Embryos Outside the Mother

Feb. 9 **Embryonic Stem Cells and Embryoid Bodies**

Required reading:

1. Chapter 4.6-4.9 (pp. 93-100) of StemCells: SFF. “Of Mice and Men: The History of Embryonic Stem Cells”

Week 6 Modern Alchemy

Feb. 16 **Cellular Reprogramming and Transdifferentiation**

Required reading:

1. Takahashi, K., and Yamanaka, S. (2006). Induction of pluripotent stem cells from mouse embryonic and adult fibroblast cultures by defined factors. Cell *126*, 663-676.

2. Chapter 4.6-4.9 (pp. 93-100) of StemCells: SFF. “Of Mice and Men: The History of Embryonic Stem Cells”

3. Have iPS cells diffused ethical debates regarding stem cells?

http://www.vox.com/2014/12/15/7384457/stem-cell

Week 7 Mermaids and Cenotaurs

Feb. 23 **Human-Animal Chimeras**

Required reading:

1. Oryx and Crake by Margaret Atwood

2. Solter, D. (2010). Viable rat-mouse chimeras: where do we go from here? Cell *142*, 676-678.

3. Article on in vitro meat

http://www.nytimes.com/2013/05/14/science/engineering-the-325000-in-vitro-burger.html

Week 8 Beyond Mommy and Daddy

March 1 **Altering Heredity with Germline Stem Cells and SCNT**

Movie Viewing and Discussion: “Ethics of three-parent babies”

http://www.closeupresearch.com/mitochondria\_replacement\_ethical\_considerations.html

Required reading:

1. Check, E. (2005). Gene study raises fears for three-parent babies. Nature *438*, 12.

2. Human eggs and sperm made from stem cells

http://www.nature.com/news/rudimentary-egg-and-sperm-cells-made-from-stem-cells-1.16636

Week 9 Mind without a Body

March 8 **Neuronal Differentiation in a Dish**

Required reading:

1. Miniature Human Brains In a Dish http://www.nature.com/nature/journal/v501/n7467/full/nature12552.html

2. Modeling Neurodegenerative Diseases In a Dish

http://www.nature.com/nbt/journal/v32/n8/full/nbt.2977.html

***\*\*\*\*\*\*\* Mid-Term Examination Due – March 8***

Short Fiction Story on Future Use of Stem Cells in Health & Technology (10 pages max)

*Spring Recess*

*March 15*

Week 10 Ship of Theseus and Immortality

March 22 **Stem Cells and Aging**

Required reading:

1. Never Let Me Go by Kazuo Ishiguro
2. Heterochronic Parabiosis

http://onlinelibrary.wiley.com/doi/10.1111/acel.12065/full

1. Young Blood Reverses Aging:

http://www.nytimes.com/2014/05/05/science/young-blood-may-hold-key-to-reversing-aging.html?\_r=0

Week 11 Growing New Arms and Legs

March 29 **Epimorphic Regeneration**

Required reading:

1. Simon, A., and Tanaka, E.M. (2013). Limb regeneration. Wiley interdisciplinary reviews Developmental biology *2*, 291-300.

Week 12 Custom Order Replacement Organs

April 5 **Cultured Organoids and Biological 3-D Printing**

Required reading:

1. Fessenden, M. (2013). A baby breathes easier. Scientific American *309*, 22.
2. Print Thyself

http://www.newyorker.com/magazine/2014/11/24/print-thyself

3. Chapter 13 of StemCells: SFF. “Human Stem Cells for Organs-on-Chips: Clinical Trials without Patients?”

Week 13 Cyborgs

April 12 **Cell-Machine Interfaces**

Required reading:

1. Do androids dream of electric sheep? by Philip K. Dick

2. Chapter 13 of StemCells: SFF. “Human Stem Cells for Organs-on-Chips: Clinical Trials without Patients?”

Week 14 Stem Cells for the Rich?

April 19 **Potential and Limitations of Stem Cell Therapy**

Required reading:

1. Chapter 7 of StemCells: SFF. “Regenerative Medicine: Clinical Applications of Stem Cells”

2. How the Wealthy Are Paying To Be Guinea Pigs in Clinical Trials That Will Cure Us All

http://www.telegraph.co.uk/health/11189163/How-the-wealthy-paying-to-be-guinea-pigs-ini-clinical-trials-could-help-cure-us-all.html

Week 15 Stem Cell Tourism and the New Snake Oil

April 26 **Misinformation and the Media in the Stem Cell Age**

Required reading:

1. Chapter 11 of StemCells: SFF. “Stem Cell Tourism”

2. Movie Viewing: *Whistle Blower* *(2014, Korean w/ English subtitles) – 114 minutes*

FINAL EXAM

May 10, 4:30-6:30PM

 A Series of Short Essay Questions

**Statement for Students with Disabilities**

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

**Statement on Academic Integrity**

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one’s own academic work from misuse by others as well as to avoid using another’s work as one’s own. All students are expected to understand and abide by these principles. *Scampus,* the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>..

**Emergency Preparedness/Course Continuity:**

In case of emergency, and travel to campus is difficult, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies. Instructors should be prepared to assign students a "Plan B" project that can be completed at a distance. For additional information about maintaining your classes in an emergency please access: <http://cst.usc.edu/services/emergencyprep.html>