

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

SPRING 2024: January 11 – April 25

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

DMC 157 – in person only

INSTRUCTOR:

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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 genetically modified human beings. What might the future hold? Will we find cures for most if not all diseases? Will we live much longer, healthier lives? Are we entering a new stage of self-directed 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. Interleaved into this will be a discussion of how the reality of stem cell science contrasts with how it has been foretold and 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 uses 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 scientific articles, as well as media articles, science fiction literature, and film. 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 small group workshops.
- 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.
- Grading breakdown: Letter Grade
 - 20% of the grade will be for group presentations of researched material
 - 20% of the grade will be for short, unannounced quizzes (best 4 out of 5 for grade)
 - 30% of the grade will be for the mid-term short story
 - 30% of the grade will be for the final exam

Grading Scale (curve usually applied):

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:

Final exam and quizzes will be short essay questions. The mid-term exam is an original piece of short fiction.

Class Sessions: 1 hour 50 minutes

Week 1 Introduction
Jan. 11 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 Woolly Mammoths and Dinosaurs
Jan. 18 Cloning by Somatic Cell Nuclear Transfer

Class Exercise #1: Groups of students each prepare discussion of how to de-extinct a particular animal. I will assign animals and groups at the end of Week 1 and each

group will come prepared to discuss the advantages and challenges of bringing their animal back from extinction.

Required reading:

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

Week 3
Jan. 25

The Clone Wars
Human Cloning

Novel #1 Discussion: Boys from Brazil by Ira Levin

Required reading:

1. “Yes to Human Cloning” by Rael.

Week 4
Feb. 1

Growing Embryos and People Outside the Mother
Embryonic Stem Cells and Embryoid Bodies

Class Exercise #2: *Groups of students discuss the ethical issues and recent attempts to grow advanced stage animal and human embryos in the lab.*

Required reading:

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

Week 5
Feb. 8

Designer People
Genetic Engineering of Stem Cells and Human Embryos

Class Exercise #3: *Groups of students discuss an application of genetic engineering in humans, such as curing a disease or introducing a new ability.*

Movie Viewing Before Class: *GATTACA* (1997) – 106 minutes

Required reading:

1. CRISPR editing of human babies in China
<https://www.npr.org/sections/health-shots/2018/11/26/670752865/chinese-scientist-says-hes-first-to-genetically-edit-babies>
<https://www.youtube.com/watch?v=th0vnOmFltc>
<http://www.sciencemag.org/news/2018/11/i-feel-obligation-be-balanced-noted-biologist-comes-defense-gene-editing-babies>
2. “Scientists reveal proposal to build human genome from scratch”.
<http://www.sciencemag.org/news/2016/06/scientists-reveal-proposal-build-human-genome-scratch>

Week 6
Feb. 15 Mermaids and Cenotaurs
Human-Animal Chimeras

Class Exercise #4: Groups of students discuss the rationale of and therapeutic potential of different types of human-animal chimeras.

Required reading:

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

Week 7
Feb. 22 Modern Alchemy
Cellular Reprogramming and Transdifferentiation

Class Exercise #5: Groups of students discuss therapeutic applications of cellular reprogramming and transdifferentiation in specific organ systems.

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 8
Feb. 29 Beyond Mommy and Daddy
Altering Heredity with Germline Stem Cells and SCNT

Class Exercise #6: Groups of students discuss potential uses of germline stem cells in changing the concept of heredity and treating infertility.

Required reading:

1. 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
March 7 Growing New Arms and Legs
Epimorphic Regeneration

Class Exercise #7: Groups of students discuss the regenerative abilities of a particular animal and how this knowledge could be applied to humans.

Required reading:

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

***** **Mid-Term Essay - Due March 8, 11:59pm**

Fictional Short Story on Future Impact of Stem Cells and Regenerative Medicine on Society
(5 pages, single-spaced, Arial 11pt, 1-inch margins)

Spring break
March 14

Week 10
March 21 Discussion of Mid-Term Essays – Short in-class synopsis of each story

Week 11
March 28 Stem cell models of brain disease – Louise Menendez, guest lecturer
Neuronal Differentiation in a Dish

Class Exercise #8: Groups of students discuss stem cell-based approaches for modeling neurodevelopmental disorders and disease.

Required reading:

1. TBD

Week 12
April 4 Custom Order Replacement Organs
Cultured Organoids, Biological 3-D Printing, and Organs-on-Chips

Class Exercise #9: Groups of students discuss how to make a particular organ in vitro from stem cells. What are the advantages and particular challenges to bio-engineering such an organ?

Required reading:

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

Week 13
April 11 Ship of Theseus and Immortality
Stem Cells and Aging

Novel #2 Discussion: Oryx and Crake by Margaret Atwood

Required reading:

1. Young Blood Reverses Aging:
http://www.nytimes.com/2014/05/05/science/young-blood-may-hold-key-to-reversing-aging.html?_r=0
2. In vitro meat
<http://www.nytimes.com/2013/05/14/science/engineering-the-325000-in-vitro-burger.html>

Week 14
April 18 Stem Cells in the Clinic
Potential and Limitations of Stem Cell Therapy

Class Exercise #10: Groups of students discuss clinical trials using stem cells to treat a range of diseases.

Required reading:

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

Week 15 Stem Cell Tourism and the New Snake Oil
April 25 **Misinformation and the Media in the Stem Cell Age**

Class Exercise #11: Individual students critique an online stem cell clinic. Does it seem legitimate? What are some of the red flags if not?

Movie Viewing Before Class: “21st Century Snake Oil” – 2 parts

<https://www.youtube.com/watch?v=zupt6RoQgbM>

<https://www.youtube.com/watch?v=njSMTfPRz9g>

Required reading:

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

TBD Review Session for Final Exam

FINAL EXAM

May 2, 4:30-6:30 PM Series of Short Essay Questions

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
eeotix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-3340 or otfp@med.usc.edu

chan.usc.edu/otfp

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.