

SCRM 513: Stem Cells and Regenerative Medicine (4 units)

Fall 2017 — Monday 1:00-3:00pm/Wednesday 2:00-4:00pm
Broad CIRM Center 1st floor conference room (BCC 101)

Instructor: **Qi-Long Ying, PhD**

Office: BCC 512

Office Hours: Tue/Thur/Fri — 3:00-5:00pm

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Course Description

The course will cover topics on basic biology of embryonic, fetal, and adult stem cells; the tools, methods, and experimental protocols needed to study and characterize stem cells; as well as application of stem cells to treat specific human diseases. The course is intended for upper level undergraduates with a biological science major or minor, masters degree students in any of several biomedical disciplines, and for PhD students in the KSOM Department of Stem Cell Biology and Regenerative Medicine or in other USC schools and departments with an interest in stem cell biology and regenerative medicine.

Learning Objectives

Students are expected to acquire knowledge and understanding of the basic biology of embryonic and tissue-specific stem cells, of the potential application of stem cell for the treatment of human diseases, and of different experimental approaches used to study and characterize stem cells. This course fills a significant gap in, and complements the currently offered classes in the Dornsife College Department of Biological Sciences and in the Keck School of Medicine Department of Stem Cell Biology and Regenerative Medicine.

Prerequisite(s): None

Co-Requisite (s): none

Concurrent Enrollment: none

Recommended Preparation: none

Course Notes

None.

Technological Proficiency and Hardware/Software Required

None.

Required Readings and Supplementary Materials

- *Essentials of Stem Cell Biology*, Robert Lanza and Anthony Altala, 3rd Edition (ISBN-13: 978-0124095038)
- 1-2 papers related to the topic of each class will be uploaded to Blackboard in advance

Description and Assessment of Assignments

Students are required to read the assigned section(s) of the textbook and the manuscript(s) before each class. Students will be expected to participate actively in class discussion and will be randomly called upon to answer questions asked by the instructor. Midterm and final exams will be based on short essay questions related to what the students have learned in the class.

Grading Breakdown

Assignment	Points	% of Grade
Midterm Exam #1	20	20
Midterm Exam #2	20	20
Final Exam	30	30
Class Participation	15	15
Presentation	15	15
TOTAL	100	100

Assignment Submission Policy

No submitted assignments.

Additional Policies

Attendance and reading of the assigned materials prior to each class is expected. Students are expected to participate actively in class and will be called on at random to answer questions posed by the instructor.

Course Schedule: A Weekly Breakdown

Course Schedule-2017		SCRM-513 'Stem Cells and Regenerative Medicine'				
Lecture #	General topic	Specific subjects	Reading	Further reading	Date	Instructor
1	Course introduction	Course introduction Overview of basic and translational research of stem cells	Lanza chapters 1-2 pp 3-18		8/21/2017	Ying
2	Differentiation in early development	Preimplantation development; From implantation to gastrulation	Lanza chapter 10 pp 121-140	Development 136:701-713, 2009	8/23/2017	Ying
3	Pluripotent stem cells I-rodent embryonic stem cells	Origin of embryonic stem cells Properties of embryonic stem cells Embryonic stem cell self-renewal pathways Application of embryonic stem cells	Lanza chapter 3-4 pp 19-38; Lanza chapter 7 pp81-94; Lanza chapter 28 pp399-408	Nature 292:154-156, 1981; Cell 135:1299-1310, 2008	8/28/2017	Ying
4	Pluripotent stem cells II-human embryonic stem cells	Derivation and maintenance of human embryonic stem cells; Human embryonic stem cell self-renewal pathways	Lanza chapter 27 pp 387-398; Lanza chapter 29 pp 409-434	Science 282:1145-1147, 1998; Cell Stem Cell 15:471-487, 2014	8/30/2017	Ying
No class	Labor Day				9/4/2017	
5	Pluripotent stem cells III-Induced pluripotent stem cells	Generation of pluripotent stem cells; Characterization of pluripotent stem cells; Induced pluripotency-the underlying mechanism	Lanza chapter 26 pp375-386	Cell 126:663:676, 2006; Cell 131:861-872, 2007	9/6/2017	Ying
6	Pluripotent stem cells IV-Primordial germ cells and embryonic germ cells	Origin of primordial germ cells and embryonic germ cells; Properties of primordial germ cells and embryonic germ cells; Derivation and maintenance of embryonic germ cells	Lanza chapter 30 pp 435-452	Nature 359:550-551, 1992; PNAS 95:13726-13731, 1998	9/11/2017	Ying
7	Pluripotent stem cells V-Embryonic stem cells in tissue engineering; Amniotic fluid-derived stem cells	Tissue engineering principles and perspectives; Limitations and hurdles of using embryonic stem cells in tissue engineering; Amniotic fluid and amniocentesis; Isolation and characterization of amniotic fluid-derived stem cells	Lanza chapter 39 pp581-594 Lanza chapter 11 pp 141-156	PNAS 109:8705-9, 2012; Nature Biotechnology 25:100-106, 2007	9/13/2017	Ying
9	Cancer stem cells	Cancer stem cell theory; Isolation and characterization of cancer stem cells; Implications for cancer treatment	Cell Stem Cell 14:275-291, 2014	Nature Medicine 3:730-737, 1997; Nature 456:593, 2008	9/18/2017	Ying
8	New technologies for genetic modification in stem cells	Crispr/Cas9 TALENs/ZFN	PMID: 24362028	PNAS 110:15644-9, 2013	9/20/2017	Ying
10	Midterm 1				9/25/2017	
11	Neurogenesis and neural stem cells I	Establishment of neural tissue Molecular basis of neural induction	Lanza chapter 13 pp163-184	Nature 340:471-473, 1989; Cell 156:1072, 2014	9/27/2017	Ying
12	Neurogenesis and neural stem cells II	Neural stem cells in the brain; Pluripotent stem cell-derived neural stem cells	Lanza chapters 13 pp163-184	Genes Dev 22:152-165, 2008; Nature 480:547, 2011	10/2/2017	Ying

13	Hematopoietic stem cells	Embryonic hematopoiesis; Hematopoietic stem cell niche; Embryonic stem cell-derived Hematopoietic stem cells	Lanza chapter 16 pp 219-226	Nature 425:841-6, 2003; Genes & Dev 25:1928, 2011	10/4/2017	Ying
14	Cord blood hematopoietic stem cells	Cord blood transplantation; Characteristics of cord blood stem cells; Genomics and proteomics of cord blood stem cells	Lanza chapter 12 pp 157-162	Bone Marrow Transplantation 39:11-23, 2007	10/9/2017	Ying
15	Stem cells in the retina and the inner ear	Sources of stem cells in the retina and inner ear; Properties of stem cells in the retina and inner ear	Lanza chapter 14 pp 185-202	Cloning and Stem Cells 6:217, 2004; Nature 472:51-56, 2011	10/11/2017	Ying
16	Skin stem cells	Skin organization; The bulge as a residence of skin stem cells; Cell signaling in skin stem cells	Lanza chapter 15 pp 203-218	Cell Stem Cell 13:720-733, 2013	10/16/2017	Ying
17	Skeletal muscle stem cells	Sources of skeletal muscle stem cells; Intrinsic regulation of skeletal muscle stem cells; Extrinsic regulation of skeletal muscle stem cells	Lanza chapter 20 pp 267-280	Cell 122:289-301, 2005	10/18/2017	Ying
18	Stem cells in the kidney	The anatomy of kidney development; Sources of kidney stem cells; Characterization of kidney stem cells	Lanza chapter 22 pp 291-308	Cell Reports 2:540-552, 2012; Nature 526:564, 2015	10/23/2017	Ying
19	Stem cells in the liver, pancreas, and intestine	Organization of adult liver and pancreas; Liver/Pancreatic stem cells; Intestinal stem cells	Lanza chapters 23-25 pp 309-374	Nature 459:261, 2009; Nature 494:247-250, 2013	10/25/2017	Ying
20	Midterm 2				10/30/2017	
21	iPSCs for disease modeling	Models of neurological diseases; Models of hematopoietic disorders; Models of cardiovascular conditions; Models of metabolic disorders	Phil. Trans. R. Soc. B 366:2274-2285, 2011	Cell Stem Cell 12:656-668, 2013	11/1/2017	Ying
22	Mesenchymal stem cells	Location of mesenchymal stem cells; Isolation and culture of mesenchymal stem cells; Tissue-engineering with mesenchymal stem cells	Lanza chapter 19 pp 255-266	Nature 418:41-49, 2002	11/6/2017	Ying
23	Use of stem cells to treat diabetes and liver disease	β -cell replacement therapy; Sources of insulin-producing cells; Hepatocyte transplantation; Challenges and future directions	Lanza chapter 33 pp 491-500 Lanza chapter 37 pp 543-5564	Stem Cells 31:1966-1979, 2013. Nature 499:481-484, 2013	11/8/2017	Ying
24	Use of stem cells to treat heart disease	Distribution of stem cells in the heart; Preclinical studies using stem cells to treat heart disease	Lanza chapter 35 pp 515-528	Circulation 126:S54-S64, 2012	11/13/2017	Ying
25	Orthopedic applications of stem cells	Biology of musculoskeletal tissues; Tissue engineering strategies for bone and cartilage defects	Lanza chapter 38 pp 565-580	Journal of Orthopaedic Surgery and Research 2014, 9:98	11/15/2017	Ying

26	Neural stem cells for central nervous system repair	Therapeutic potential of neural stem cells; Cell replacement using neural stem cells	Lanza chapter 32 pp 467-490	PLoS ONE 9(3): e91408. doi:10.1371/journal.pone.0091408	11/20/2017	Ying
No class	Thanksgiving Holiday				11/22/2017	
27	Stem cells for the treatment of muscular dystrophy	Cellular environment of a dystrophic muscle; Myogenic stem cells from embryonic stem cells and inducible pluripotent stem cells; Current stem cell-based therapeutic approaches	Lanza chapter 36 pp 529-542	Cell Stem Cell 10:610-619, 2012	11/27/2017	Ying
28	Regeneration of epidermis	Epidermal stem cells; Stem cells in burn and skin ulcers	Lanza chapter 34 pp 501-514, pp551-560	Nature Medicine 12:1397-1402, 2006	11/29/2017	Ying
29	Final exam				12/6/2017	

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 Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/b/11-00-behavior-violating-university-standards-and-appropriate-sanctions/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct/>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

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 (or to TA) 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. Website and contact information for DSP:

http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, 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.