

BICD 112

Stem Cells and Regeneration

Spring 2024
CENTER 222

TTH 3:30 – 4:50 PM

Professors: Dr. Kim Cooper and Dr. David Traver

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Course Description: Stem cells maintain homeostasis of nearly all organ systems and the regenerative capacity of certain organisms. Over the past decade, the study of stem cell biology has exploded, in part due to the remarkable discovery that adult somatic cells can be easily reprogrammed to become induced pluripotent cells, which are capable of differentiating into any cell type in the body. This finding has promise for a new field of regenerative medicine, where it will soon be possible to generate patient-specific cell types that can be used to remedy disease states without the complications of genetic mismatching that result using current cellular replacement therapies. It is therefore essential to understand the native characteristics of stem cells, their role in regeneration, and the natural barriers to regeneration in many species, including humans. This course explores the paradigm of the tissue-specific stem cell, the cellular mechanisms of tissue regeneration, the evolution of stem cells and regenerative capacity over time, the basis of induced pluripotency, and how these basic processes can inform new approaches to human health.

Class Structure and Philosophy: Evidence-based approaches to science and medicine are built on a foundation of understanding peer-reviewed literature. The state of a particular field is rapidly changing with new findings every year. This class is therefore based on review of the primary literature in order to stay current and to provide opportunities for you to learn to critically evaluate the literature.

Lectures: The purpose of lecture is to provide essential background information for you to understand the state of the field at the time a paper was published and for an introduction to unfamiliar methods and concepts that will aid your understanding of the paper. Pre-readings and videos will give you an introduction to this material before class. Peer instruction questions in class and during discussion will be graded based on participation (see below).

Sections: Two sections are offered: W, 3:00 – 3:50 in CENTER 217B, F, 1:00 – 1:50 in CENTER 217B. Sections are run by our IA, Ali Dragozova and are designed to reinforce what is presented in class. In particular, sections are a great place to discuss questions you are having with assigned papers, including exam papers. Sections are not required but highly recommended as they will help you understand the complex material.

Papers and Discussions: Each lecture will be followed by one or two paper discussions. Online pre-discussion quizzes will guide your reading in preparation for the discussion. Papers will be annotated to help you understand challenging aspects. You are not expected to understand details of the entire paper - focus on understanding the questions and annotated concepts. During class discussions, you will be grouped into teams, and your team will be randomly assigned a figure or component of the paper to discuss and present to the class. After class, a post-reading quiz will be posted on TritonEd that contains short answer questions (similar to what you will see on exams) that will be graded.

Exams: There are three exams. You will be given a paper to read in advance of each exam and a series of questions during the in-class exam. The exam is short answer and open note, and questions will be similar in style to your post-reading questions. Communicating with your peers in any format is not allowed. **There will be NO MAKE-UPS for missed exams**, so confirm now that you are able to make all exam times. Since this is a ‘skills-based’ course and you can have demonstrated mastery of the literature early or late in the quarter or encountered challenging circumstances at any time, **we will drop the lowest exam grade**.

Grading:

Attendance (mandatory; will be counted via iClicker check-in at class start)	30 points
iClicker questions in lecture and discussion (participation-based, see below)	45 points
Pre-discussion questions (multiple choice on Ted, graded)	45 points
Post-discussion questions (short answer on Ted, graded)	180 points
Exam I (4/25/24, in class)	100 points
Exam II (5/16/24, in class)	100 points
Final Exam (6/10/24, Room TBD)	<u>100 points (lowest exam dropped)</u>
	500 Points Total

The class is graded on a “hybrid curve”. The top 5% of the class will be normalized to 100%, and letter grade cutoffs made at 12.5% point intervals, e.g. 87.5-100%=A, 75-87.5%=B, etc. Everyone in this course **could** therefore get an A....

iclicker Grading: You will be graded on your in-class participation using iclickers, NOT on having the correct response. The purpose of these questions is to stimulate discussion.

If you answer:

> 70% of clicker questions	you will receive	45 points
> 60% of clicker questions		20 points
> 40% of clicker questions		15 points
> 20% of clicker questions		10 points

Canvas: Lecture notes in PDF form will be available on Canvas by 10 pm the day preceding each lecture.

Pre-discussion quizzes will be available on Canvas 48 hours before each discussion and will close at the start of each discussion.

Post-discussion quizzes will be available on Canvas at the end of each discussion and will close at 11 PM on the second day (after 60 hours).

Cheating: Don't do it. We rely on you to be honest, to work hard, and to accept the grade that is the outcome of your hard work. Students are expected to do their own work, as outlined in the UCSD Policy on Academic Integrity. Academic misconduct is broadly defined as any prohibited and dishonest means to receive course credit, a higher grade, or avoid a lower grade. Academic misconduct misrepresents your knowledge and abilities, which undermines the instructor's ability to determine how well you're doing in the course. Please do not risk your future by cheating. Those caught cheating will be reported to the Academic Integrity Coordinator, which reports

directly to the Dean of the student's college. For the Academic Integrity policy at UCSD, see here: <http://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Appendices/2>.

Exams will be timed in such a way to make it difficult to use resources outside of your own understanding. We will also periodically check websites known to support 'contract cheating' (e.g. Chegg) for evidence that assignments have been posted, and we will report findings to the Office of Academic Integrity. Students suspected of AI violations on exams will be invited to Zoom follow-up meetings where they will be asked to (in real time and recorded on video) justify their answers before the graded exams or solutions are released. If we are not convinced during the meeting that the student has achieved a level of understanding that matches their performance on an exam, or if the student refuses to participate, we will report the student for AI violations.

OSD students: If you need testing accommodation for this class, please work with the Office for Students with Disabilities (OSD). Students requesting accommodations and services due to a disability for this course need to provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD), prior to eligibility for requests. Receipt of AFAs in advance is necessary for appropriate planning for the provision of reasonable accommodations. OSD Academic Liaisons also need to receive current AFAs. For more information, contact the OSD at (858) 534.4382 (V); (858) 534-9709 (TTY); osd@ucsd.edu, or <http://osd.ucsd.edu>. **You will need to coordinate scheduling of exams with the instructors. All of these arrangements should be made within the first two weeks of the quarter.**

Enrollment questions: Administrative, advising, or registration questions should be submitted via the Virtual Advising Center (vac.ucsd.edu).

SESSION TOPICS

#	DATE	PRESENTER	TOPIC	PAPERS
1	04 / 02	COOPER LECTURE	Welcome, logistics, how to read a paper	
2	04 / 04	COOPER LECTURE	History of Regeneration / Methods	
3	04 / 09	PAPER 1 DISCUSSION (DT)	Regeneration of planarians with a single cell.	Wagner, Wang and Reddien, Science 2011.
4	04 / 11	JENNIFER SIMKIN	Vertebrate Regeneration Lecture	
5	04 / 16	PAPER 2 DISCUSSION (KC)	Regeneration in the Spiny Mouse	Simkin et al. eLife 2017;6:e24623.
6	04 / 18	PAPER 3 DISCUSSION (DT)	Axolotl Limb Regeneration	Kragl et al., Nature 460: 60-65, 2009.
7	04 / 23	TRAVER LECTURE	History of Stem Cells / Methods	
8	04 / 25	-	MIDTERM 1	TBD
9	04 / 30	PAPER 4 DISCUSSION (DT)	Hematopoietic Stem Cells	Taya et al., Science 354: 1152-5, 2016.
10	05 / 02	COOPER & TRAVER	Niche Review Article	Fuchs and Blau, Cell Stem Cell 27: 532-56.
11	05 / 07	PAPER 5 DISCUSSION (KC)	Skin Stem Cells	Shwartz et al., 2020, Cell 182, 578–593.
12	05 / 09	PAPER 6 DISCUSSION (DT)	Intestinal Stem Cells	Sato et al., Nature 459: 262-5, 2009.
13	05 / 14	WILLERT	Embryonic Stem Cells and Pluripotency	
14	05 / 16	-	MIDTERM 2	TBD
15	05 / 21	PAPER 7 DISCUSSION (DT)	Yamanka iPSC Paper	Takahashi and Yamanaka, Cell 126: 663-76.
16	05 / 23	COOPER & TRAVER	Clinical Outlook Review Article	Vandana et al., Cell Stem Cell 30: 571-91.
17	05 / 28	PAPER 8 DISCUSSION (KC)	Use of Organoids to Model Disease	Ouchi et al., Cell Metabolism 30: 374-84.
18	05 / 30	COOPER LECTURE	Course Recap and Stem Cell Fraud	
19	06 / 04	PAPER 9 DISCUSSION	Future Outlook	TBD
20	06 / 06	COOPER & TRAVER	Q & A Session	
21	06 / 10	3PM-6PM	FINAL EXAM	Paper TBD