

### ***Stem Cell Biology and Therapeutics Course (PATH 425) Description:***

This course is intended to teach current understanding of stem cells as it relates to their characterization, function, and physiologic and pathological states. The course will expose students to the current understanding of various types of stem cells, including embryonic and adult stem cells of various tissues and techniques for their isolation and study. Experimental models and potential biomedical therapeutic applications will be discussed. Stem cells will also be discussed in the context of cancer and the use of stem cells for cancer therapies. The course will be taught by faculty of the “Center for Stem Cell and Regenerative Medicine” who are affiliated with multiple departments of Case Western Reserve University, the Cleveland Clinic, and partnering biomedical companies. A significant number of faculty members are also members of the Case Comprehensive Cancer Center.

The lectures will be organized into 5 sections. The first section will give an overview of embryonic and adult stem cells and their basic characteristics. This area will discuss general methods and unifying features of all normal stem cells and lay the foundation for subsequent sections. The 2<sup>nd</sup> section will focus on homeostasis and regulation of hematopoietic stem cells, animal models of transplantation, conventional and potential future use of hematopoietic stem cells as a source of regenerative stem cells. The 3<sup>rd</sup> section will focus on isolation, immunologic properties, and potential therapeutic use of mesenchymal stem cells and multipotent adult progenitor cells from the bone marrow stromal tissue. The 4<sup>th</sup> section will focus on development of neural stem cells and their application in response to brain injury, glial scarring, and neurodegenerative disorders. The final section will focus on stem cell engineering for therapeutics and analysis of their trafficking properties *in vivo*.

Lectures and discussions will be interactive and encourage critical thinking in stem cell biology and biomedical applications of stem cells. Presentation and discussion of journal articles by students is required and students are required to read all submitted materials ahead of class for active participation. Review and journal articles will be provided to students a minimum of 1 week in advance.

Grading: Grading will be based on attendance and participation (25%), journal club presentations (25%), mid-term exam (25%), and final exam (25%). Exams will be taken in class.

Class Location: Wolstein Research Building, 2-136 conference room, 3:30-5pm Mon/Thur

### ***Stem Cell Biology and Therapeutics Course:***

Course Description: This course is intended to provide a comprehensive overview of current understanding of adult stem cells, including their basic properties and interactions within organisms. Stem cell isolation methods, experimental models and potential biomedical therapeutic applications will be discussed. It is a graduate level course that requires a basic background in biology. Introductory biology courses are strongly recommended.

Course requirements: Class seminars and discussions will be interactive and encourage critical thinking in stem cell biology and biomedical applications of stem cells. Class materials will be distributed in advance through Blackboard. These materials will include research and review articles or book chapters related to the topic to be discussed. Students are required to read all submitted materials ahead of class for active participation. Review and journal articles will be provided to students a minimum of 1 week in advance.

Grading: Grading will be based on attendance and class participation (25%), journal article presentations and critiques (25%), mid-term exam (25%), and final exam (25%). Students will be given in-class final exams.

#### Organizers:

Kevin D. Bunting, Ph.D.

Robert Miller, Ph.D.

N	Topic	Faculty	Description
	<b>Stem cell properties</b>	<b>SECTION</b>	
1/12	Introduction – adult and embryonic stem cells, inducible pluripotent stem cells	Kevin Bunting Department of Medicine Division of Hematology-Oncology CWRU	Overview of the course, definition of stem cells, basic characteristics, comparison of embryonic vs. adult
1/15	Signal Transduction	Cheng-Kui Qu Department of Medicine Division of Hematology-Oncology CWRU	Integral intracellular signaling pathways required for stem cell development
1/22	Embryonic Development and Differentiation	Robert Miller Department of Neurosciences CWRU	Overview of embryonic development as it relates to stem cell function
1/26	General Methods in Stem Cell Biology	Robert Miller	Overview of basic assays to distinguish stem cells from progenitor cells
	<b>Hematopoietic stem cells</b>	<b>SECTION</b>	
1/29	Hematopoietic Stem Cell Biology	Kevin Bunting	Hematopoietic stem cells transplantation, engraftment
2/2	Assays for Mouse and Human Hematopoietic Stem Cells	Kevin Bunting	Comparison of in vitro and in vivo assays for hematopoietic stem cells and their progenitors
2/5	Phosphatases in hematopoiesis	Cheng-Kui Qu	Control of hematopoiesis and targeted therapies
2/9	Cancer Stem Cells	Kevin Bunting	Cancer stem cells and use of stem cells for cancer therapeutics
2/12	Student presentations	Bunting, Qu, others	Articles focused on hematopoietic stem cells
	<b>Mesenchymal stem cells</b>	<b>SECTION</b>	
2/16	Multipotent Adult Progenitor (Stem) Cells	Robert Mays Athersys	Isolation, culture and differentiation potential of MAPCs, comparison with MSCs

2/19	Development and Mesenchymal Stem Cells	Arnold Caplan Biology Department CWRU	Mesengensis and the role of MSCs during development and life
2/23	Immunologic Properties of MSCs and Clinical Applications	Jeff Auletta Rainbow Babies and Children's Hospital	Characterization of MSC-T-cell interaction as it relates to transplant immunology
2/26	MSCs and chondrogenesis	Luis Solchaga Case Comprehensive Cancer Center, CWRU	Differentiation of MSCs to make cartilage
3/2	Student presentations	Bunting, Qu, Miller, others	Articles focused on mesenchymal stem cells
3/5	Mid-term exam		
	Spring Break	Spring Break	
	<b>Neural stem cells</b>	<b>SECTION</b>	
3/16	NSC and Brain Injury, Brain Tumors	Robert Miller	Potential use of NSCs to repair traumatic CNS injuries
3/19	Glial scar regeneration and NSCs	Jerry Silver Department of Neurosciences CWRU	Potential use of NSCs to repair glial scarring
3/23	Nervous System Development and Neural Stem Cells	Robert Miller	Biology of NSCs during development and in adults. Where are they, what do they do?
3/26	Neurodegenerative Disorders and NSCs	Robert Miller	Potential use of NSCs and MSCs to prevent or treat immune and degenerative disorders of CNS
3/30	Student presentations	Bunting, Qu, Miller, others	Articles focused on neural stem cells
	<b>Stem cell engineering and trafficking</b>	<b>SECTION</b>	
4/2	Non-invasive Imaging of Stem Cells In Vivo Using Nuclear Medicine Scans	Zhenghong Lee Radiology Department CWRU	Non-invasive real time imaging of genetically-modified stem cells in vivo
4/6	Human Embryonic Stem Cells and Applications	Horst von Recum Department of Biomedical Engineering CWRU	Genetic manipulation of human embryonic stem cells for study of disease and for directed differentiation
4/9	Optimizing MSC differentiation	Luis Solchaga	Development of improved methods for MSC expansion and chondrogenesis
4/13	Student presentations	Bunting, Qu, Miller, others	Articles focused on stem cell engineering
4/16	Final Exam taken in class		