

## Molecular Medicine

### COURSE SUMMARY

*My aim is to introduce you to university-style education and major principles of modern biological research. This involves asking the right questions and identifying the tools to answer them. I hope you will gain a better understanding of the bidirectional interplay between fundamental and translational research and how relevant Stem Cell Biology and Epigenetics are for studying and fighting human disease.*

### COURSE AIMS

- Gain an understanding of how to critically read and analyse scientific literature, ask relevant questions, formulate and test hypotheses. Students will start learning to identify suitable techniques to answer specific biological questions related to molecular medicine.
- The aim of this course is to give an overview of the state of the art in stem cell biology and its implications for regenerative medicine, drug screening, as well as for modelling normal development and disease.
- In addition, students will be introduced to the concept of epigenetic regulation, which is a major player in controlling cell fate transitions. We will also touch upon how impaired regulation of gene expression may lead to tumorigenesis and whether stem cells are involved in the onset of cancer. My goal is also to ensure my students realise that, at least for now, stem cells are not a panacea for all ills, but they do offer unprecedented opportunities to study and tackle many human diseases.

### READING LIST

- 1) Essentials of Cell Biology  
<http://www.nature.com/scitable/ebooks/essentials-of-cell-biology-14749010/contents>
- 2) Essentials of Genetics  
<http://www.nature.com/scitable/ebooks/essentials-of-genetics-8/contents>

### SET WORK

- Week 1: Essay reviewing the main concepts discussed in week 1
- Week 2: Essay on the differences between embryonic and adult stem cells and their amenability to regenerative medicine purposes.

COURSE OUTLINE

	Day	Type of tutorial	Time	Topic	Areas of Discussion (including activities)	Possible Preparatory Reading	Homework (if different to preparatory reading)
<b>WEEK 1</b>	<b>Monday</b>	Preliminary group tutorial	09:15 - 10:45	<b>Course welcome. Introduction to Stem Cell Biology</b>	<b>Introduction to our summer course plan. Historical overview of stem cell research. Definition of a stem cell. Stem cell potency. Embryonic and adult stem cells.</b>	<a href="http://www.nature.com/scitable/spotlight/stem-cells-6969855">http://www.nature.com/scitable/spotlight/stem-cells-6969855</a>  (no need to read everything, but a useful reference throughout the course)	

<b>Tuesday</b>	Group tutorial	09:15 - 10:45	<b>Epigenetic regulation of differentiation and reprogramming</b>	<b>Cell fate decisions and epigenetic memory. Introduction to epigenetics. Epigenetic reprogramming and induced pluripotent stem cells (iPSC).</b>	<a href="http://www.nature.com/scitable/topicpage/epigenetics-fundamentals-26099600">http://www.nature.com/scitable/topicpage/epigenetics-fundamentals-26099600</a> <a href="http://www.nature.com/scitable/topicpage/chromosomes-14121320">http://www.nature.com/scitable/topicpage/chromosomes-14121320</a> <a href="http://www.nature.com/scitable/topicpage/gene-expression-14121669">http://www.nature.com/scitable/topicpage/gene-expression-14121669</a> <a href="http://www.nature.com/scitable/topicpage/epigenetic-influences-and-disease-895">http://www.nature.com/scitable/topicpage/epigenetic-influences-and-disease-895</a> <a href="http://www.nature.com/scitable/topicpage/turning-somatic-cells-into-pluripotent-stem-cells-14431451">http://www.nature.com/scitable/topicpage/turning-somatic-cells-into-pluripotent-stem-cells-14431451</a>	
<b>Wednesday</b>	Group tutorial	09:15 - 10:45	<b>Tissue-specific stem cells: roles in homeostasis and upon injury. Stem cell niche</b>	<b>Haematopoietic stem cells (HSC): the paradigmatic adult stem cells. Do all tissue-specific stem cells form a hierarchy as in the hematopoiesis?</b>	<a href="http://www.nature.com/scitable/topicpage/cell-differentiation-and-tissue-14046412">http://www.nature.com/scitable/topicpage/cell-differentiation-and-tissue-14046412</a>	

					etic system? Examples of intestinal, muscle and brain stem cells.		
<b>Friday</b>	Group Tutorial	09:15 - 10:45	<b>Pluripotent stem cells</b>	How similar are iPSC and embryonic stem cells? Are we ready to use pluripotent stem cell-derived cells for regenerative medicine purposes? Ethical issues in stem cell research.	<a href="http://www.eurostemcell.org/resource/stemcellshorts-what-are-induced-pluripotent-stem-cells">http://www.eurostemcell.org/resource/stemcellshorts-what-are-induced-pluripotent-stem-cells</a>  <a href="http://www.eurostemcell.org/resource/stemcellshorts-what-are-induced-pluripotent-stem-cells">http://www.eurostemcell.org/resource/stemcellshorts-what-are-induced-pluripotent-stem-cells</a>	<p>1) Our course focuses on mammalian stem cells. However, it is exciting to explore the biology of stem cells in other organisms as well. Please read the following article:  <a href="http://www.nature.com/scitable/topicpage/stem-cells-in-plants-and-animals-14164783">http://www.nature.com/scitable/topicpage/stem-cells-in-plants-and-animals-14164783</a>  and write a brief summary comparing stem cells identified in plants and animals.</p>	
<b>Saturday</b>	1-2-1 Tutorials	30 mins per	<i>I will try to recapitulate previous tutorials asking students relevant thought-provoking</i>			SET WORK* 1	

			student	<i>questions to identify areas that need more explanation.</i>			
		Subject-specific afternoon				I would like to arrange a visit to a local Stem Cell laboratory, for example at the Oxford Stem Cell Institute. I would aim to show students live stem cells in culture, such as mouse and human embryonic stem cells, underscoring the differences in morphology and culture requirements	
	Sunday	Group tutorial	09:15 - 10:45	Methods in Stem Cell Biology	How can we prove that a given cell in a true stem cell? Methods to study self-renewal and differentiation <i>in vivo</i> and <i>in vitro</i> .		
WEEK 2	Monday	Group tutorial	09:15 - 10:45	Cancer stem cells	Cancer stem cell hypothesis: evidence and controversies.	<a href="http://stemcells.nih.gov/info/Regenerative_Medicine/pages/2006chapter9.aspx">http://stemcells.nih.gov/info/Regenerative_Medicine/pages/2006chapter9.aspx</a>	

					Potential risks of tumorigenesis after stem cell therapies		
<b>Tuesday</b>	Group tutorial	09:15 - 10:45	<b>Implications of stem cells in regenerative medicine and cancer</b>	<b>The use of stem cells for development and disease modelling, drug screening and in regenerative medicine.</b>	<a href="http://www.isscr.org/home/publications/patient-handbook">http://www.isscr.org/home/publications/patient-handbook</a>  <a href="http://www.mprnews.org/story/2008/11/03/bmt_anniversary">http://www.mprnews.org/story/2008/11/03/bmt_anniversary</a>  <a href="http://stemcells.nih.gov/info/basics/pages/basics6.aspx">http://stemcells.nih.gov/info/basics/pages/basics6.aspx</a>	Have you ever come across terms “stem cells”, regenerative medicine”, “cure for cancer” etc. being misused by the popular press? Please provide the examples and explain why the use of these terms was inappropriate. Alternatively, have you heard of any popular myths and misconceptions about stem cells? Why do you think they are wrong?	
<b>Wednesday</b>	Group tutorial	09:15 - 10:45	Review of the entire course				
<b>Friday</b>	1-2-1 Tutorials	30 mins per student	<i>discuss the differences between embryonic and adult stem cells and their amenability to regenerative medicine purposes. I will ask the students to address the</i>			SET WORK* 2	

				<i>risks and challenges of both approaches</i>		
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