Course title: Frontiers in Stem Cell Biology and Regenerative Medicine
Language of instruction: English
Professor: Esteban Hoijman y Gina Abelló
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Course contact hours: 45  
Recommended credit: 3 US credits-6 ECTS credits  
Course prerequisites: There are no prerequisites for this course.

Language requirements: English

Course focus and approach:  
This is a course where the general topics of stem cell and regenerative therapies are explored. From the basis of cell biology to the frontier biomedical applications of these fields, the course aims to bring near the most exciting biotechnological approaches.

Course description:  
Over the past years there was an explosion of the biomedical technologies. Among them, the stem cell applications are in the center of the scene. The course aims to provide students from different backgrounds the essential tools to understand the role of stem cells and regeneration on experimental biomedicine. We will give a comprehensive view starting from basic concepts of cellular and molecular biology. These processes are then applied to stem cell biology and regenerating tissues. Finally, they are integrated in a developmental and biomedical approach that helps to understand the relevance of these fields for human health. The teachers, both experimental researchers, will introduce the frontiers of the present stem cell-related technologies, the future perspectives analyzed and open discussions elaborated in the classes. From tissue regeneration, personalized cell replacement therapies, cell reprogramming, 3D organ printing, mini-organ cultures and many others, the students will be exposed to the current state-of-the-art of these fields.
Learning objectives:
At the end of this course the students:
- will be able to understand the basics of stem cells biology and regeneration.
- will be up to date in the frontier biomedical applications of these fields.
- will be able to recognize the relevance of these technologies for human health.

Course workload:
The course is based on lectures and discussion sessions. Students will read 4 short papers (two-three pages) and write 1 short report (one page) along the course. Students will do a 10-minute oral presentation to the class. There will be a mid-term and a final exam.

Teaching methodology:
The course will be developed in a set of lectures (50%), seminar session (50%).

Lectures are developed in 45 minutes and materials, power point PDFs, will be available in advance. There will be some selected lectures given by guest speakers.

Seminars consist of problem solving, paper discussions, including animations and interactive materials, and general discussions.

It is expected that students contribute with their own background to discussions and works.

Assessment criteria:
Midterm exam: 30%
Final exam: 30%
Class participation: 20%
Report and class presentation: 20%

Final exams consist of an assay with four to five questions or problems to solve.

Report and class presentation. For the Student Talks (STs), students will make an oral presentation to their classmates and teachers. Students will select a topic from a list of offered articles, or they may propose their own before week 5. They have to deliver a report by week 8, when presentations begin. The activity includes: 1) One page report containing the relevant information and three references. A figure may be included if appropriate. 2) A talk of 10 minutes + 5 minutes discussion using i.e. PowerPoint.

Absence policy
After the add/drop, all registrations are considered final and EAP Absence Policy begins to apply. For the academic year 2011-2012, such policy is as follows:
Attending class is mandatory and will be monitored daily by professors. Missing classes will impact on the student’s final grade as follows:

<table>
<thead>
<tr>
<th>Absences</th>
<th>Penalization</th>
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<tbody>
<tr>
<td>Up to two (2) absences</td>
<td>No penalization</td>
</tr>
<tr>
<td>Three (3) absences</td>
<td>1 point subtracted from final grade (on a 10 point scale)</td>
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<tr>
<td>Four (4) absences</td>
<td>2 points subtracted from final grade (on a 10 point scale)</td>
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<tr>
<td>Five (5) absences or more</td>
<td>The student receives an INCOMPLETE (“NO PRESENTAT”) for the course</td>
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The PEHE/HESP attendance policy does not distinguish between justified or unjustified absences. The student is deemed responsible to manage his/her absences.

Emergency situations (hospitalization, family emergency...) will be analyzed on a case by case basis by the Academic Director of the program.

Classroom norms:
- No food or drink is permitted in class
- Students will have a ten-minute break after one one-hour session

Weekly schedule

**WEEK 1. Introduction to the course**

Session 1. Course description I
Seminar 1. First day questionnaire, TED talk and discussion.

**WEEK 2. What are we made of?**

Session 2. The cell. Visualizing real cells in action
Seminar 2. From genes to proteins: Models of transcription-translation.

Reading Assignment:
- The Universal Features of Cells on Earth
- The Chemical Components of a Cell

**WEEK 3. Development and Stem Cells**

Session 3. Early steps of development (cell proliferation, cell differentiation, cell potentiality, fertilization, morula, cloning, stem cell biology)
Seminar 3. Article discussion

Reading Assignment:
http://www.ncbi.nlm.nih.gov/books/NBK10077/
http://www.ncbi.nlm.nih.gov/books/NBK9968/
- http://www.hhmi.org/biointeractive:
  http://www.hhmi.org/biointeractive/differentiation-and-fate-cells
  http://www.hhmi.org/biointeractive/somatic-cell-nuclear-transfer-animation
  http://www.hhmi.org/biointeractive/somatic-cell-nuclear-transfer-video
-NIH webpage http://stemcells.nih.gov/info/basics/Pages/Default.aspx

WEEK 4. Stem cells and Therapies

Session 4. Stem Cell therapy (Blood and Immune System disorders; bone, skin and corneal injuries and diseases)
Seminar 4. Article discussion

Reading Assignment:
http://www.intechopen.com/books/embryology-updates-and-highlights-on-classic-topics/stem-cell-therapies
http://www.intechopen.com/books/pluripotent-stem-cells-from-the-bench-to-the-clinic/induced-pluripotent-stem-cells-for-clinical-use

WEEK 5. Genes and Therapy

Session 5. Gene therapy (Types of gene therapies, gene delivery carriers, modes of delivery, limitations of gene therapy, approaches to overcome these limitations).
Seminar 5. CRISPR and Cancer Therapy.

Reading Assignment:

WEEK 6. Future directions I

Seminar 6. TED talk and discussion

Reading Assignment:
http://www.huffingtonpost.com/entry/3d-printed-human-heart_us_56ca3f41e4b0928f5a6c54f6

WEEK 7. Stem Cells and Cancer

Session 7. SC and cancer (Hematopoietic SC and leukemia)
Seminar 7. Article discussion
Reading Assignment:

**WEEK 8. Regeneration and reprogramming**
Session 8. Introduction to regeneration (types, species)
Seminar 8. Discussion: From science fiction to the real laboratory

Reading Assignment:
- The Molecular and Cellular Choreography of Appendage Regeneration, Cell 165: 1599 (2016).

**WEEK 9. Future directions II**

Session 9. Tissue engineering (biomaterials, organoids)
Seminar 9. Frontiers and limitations in tissue engineering

Reading Assignment:
Modeling Development and Disease with Organoids, Cell 165:1587 (2016)

**WEEK 10. Student Oral Presentations and General Discussion**

Session 10. Student Oral Presentation

**WEEK 11. Final Exam**

**Recommended bibliography:**

Books of stem cells and regeneration:


Further reading (following the order of the course):

  - The Universal Features of Cells on Earth
  - The Chemical Components of a Cell


- http://www.hhmi.org/biointeractive:

- NIH webpage http://stemcells.nih.gov/info/basics/Pages/Default.aspx


- The Molecular and Cellular Choreography of Appendage Regeneration, Cell 165: 1599 (2016).


  - http://www.intechopen.com/books/embryology-updates-and-highlights-on-classic-topics/stem-cell-therapies


- Modeling Development and Disease with Organoids, Cell 165:1587 (2016)


- http://www.huffingtonpost.com/entry/3d-printed-human-heart_us_56ca3f41e4b0928f5a6c54f6

- http://www.els.net/WileyCDA/ElsArticle/refId-a0005223.html

4d http://thetechnologicalcitizen.com/?p=1022