1. Course Information

Physiology 4510A: Understanding Pluripotency: The physiology of stem cell fate and function

Fall Term 2019

The fundamental goal of pluripotent stem cell biology is to understand how the self-renew and differentiation capabilities of these extraordinary cells are regulated to produce cells capable of differentiating into a wide range of functional cell types. This course will examine a variety of current topics within the field of pluripotent stem cell physiology. In particular, we will focus on the basic biology of embryo-derived stem cells and their potency. We will briefly cover pre- and post-implantation embryo development, focusing on cell fate determination and the cell lines derived from these developmental stages. We will discuss how these embryo-derived cell lines are isolated and tested, what factors allow for their expansion, how they can be genetically manipulated and what intrinsic and extrinsic factors regulate their self-renewal and cellular differentiation characteristics. We will also discuss pluripotent stem cells derived by somatic cell nuclear transfer and cellular reprogramming technologies. An understanding of this physiology will enable students a thorough understanding of stem cell function and cell fate determination to assess whether regenerative medicine is feasible with pluripotent cells along with gaining the ability to critically evaluate the ethical issues that surround this field.

Lectures:
2 hr classes (~1 hr didactic lecture, ~1 hr problem-based learning exercises / informal class discussions and exercises)

Thursdays, 2:30-4:20, Western Active Learning Space (WALS, Room 66 UCC)

Requisites:
Suggested Prerequisite(s): Physiology 3120, 3130Y and Physiology 3140A (or equivalent).

Senate regulation regarding the student’s responsibility regarding requisites: Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Accessibility Statement
Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.
2. Instructor Information

<table>
<thead>
<tr>
<th>Instructors</th>
<th>Email</th>
<th>Office</th>
<th>Office Hours*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Dean H. Betts</td>
<td><a href="mailto:dean.betts@schulich.uwo.ca">dean.betts@schulich.uwo.ca</a></td>
<td>DSB 2022</td>
<td>After Lectures</td>
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<tr>
<td>[Course Co-coordinator]</td>
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<tr>
<td>Dr. Cheryle A. Seguin</td>
<td><a href="mailto:cheryle.seguin@schulich.uwo.ca">cheryle.seguin@schulich.uwo.ca</a></td>
<td>DSB 0035A</td>
<td>After Lectures</td>
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<tr>
<td>[Course Co-coordinator]</td>
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<tr>
<td>Josh Dierolf</td>
<td><a href="mailto:jdierolf@uwo.ca">jdierolf@uwo.ca</a></td>
<td>DSB 2027</td>
<td>After Lectures</td>
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<tr>
<td>[TA*]</td>
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* or by appointment; #TA = teaching assistant

OWL:
Students with OWL issues should see: https://owlhelp.uwo.ca

3. Course Syllabus

Course Objectives:

The main objective of this course is to introduce students to the basic molecular, biochemical and morphological events that regulate pluripotent stem cell biology. Additional objectives are: to improve the students’ ability to read and understand primary scientific literature, to write about science effectively to a lay audience and to provide students with an opportunity to conceptually translate their knowledge of stem cell biology to solve biological problems by designing novel experiments and stem cell based therapies. The course material will include didactic lecturing, but will also utilized a flipped classroom approach for students to conduct in-class exercises to properly examine primary research journal papers, to learn how to write scientific and lay articles and how to properly design hypothesis driven experiments. Students will be expected to come prepared to discuss the content of research articles in class as well as work independently outside the lectures. The lectures will focus mainly on the factors and signalling pathways that govern development of the early embryo, embryo-derived stem cells concentrating on the physiology, utility and ethical issues that surround pluripotent stem cell technologies.
A student who has met the objectives of the course will be able to:

- Explain the basic concepts of stem cell self-renewal and pluripotency and how these features are evaluated in the stem cell field
- Apply their understanding of the basic concepts and fundamental mechanism that regulate pluripotent stem cells as it relates to developmental biology to solve problems/questions
- Navigate, understand and critically evaluate published stem cell research literature
- Debate current ethical issues that surround pluripotent stem cell biotechnologies
- Explain the basic concepts of stem cell self-renewal and pluripotency and how these features are evaluated in the stem cell field
- Explain the basic concepts of stem cell self-renewal and pluripotency and how these features are evaluated in the stem cell field

**Method of Presentation:** The material of the course will be presented in the form of didactic lectures and a partial flipped classroom platform that includes problem based learning exercises and informal class discussions, exercises and debates.

**Methods of Evaluation (Students will be expected to):**

- Actively participate in regular classroom discussions and debates
- Read assigned scientific papers *prior* to class
- Utilize current scientific literature in preparing assignments
- Prepare a scientific lay article
- Apply their learned basic science knowledge of the stem cell field to propose experiments to solve scientific problems/questions
- Write, in short answer essay format, on quizzes, the mid-term and final examinations
Course Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Demonstrate a detailed knowledge and critical understanding of key concepts and regulatory mechanisms governing pluripotent stem cell function by describing concepts, applying and integrating ones' knowledge, and critically evaluating and reflecting upon major theories, practices and ethical issues in the field.

2. Demonstrate a strong understanding of the scientific methodologies behind pluripotent stem cells by formulating hypotheses, designing experiments, analyzing and interpreting data and making reasoned conclusions and improvements in experimental design in light of published work.

3. Interpret figures and proper figure descriptions along with identifying the strengths and weaknesses of information and the various research techniques used.

4. Perform literature searches and be able to evaluate and critique current literature in pluripotent stem cell physiology to generate a clear and concise written layperson article.

5. Explain and apply different stem cell models and technologies (e.g. knockout vs. knock-in, genome editing approaches etc.) with varying experimental procedures (Western vs. real time RT-qPCR etc.) to interpret the scientific literature encompassing the pluripotent stem cell field.

6. Demonstrate the ability to critically evaluate, manage, reflect on, integrate and apply their pluripotent stem cell knowledge in solving problem based learning exercises and examination questions.

7. Develop convincing arguments to effectively debate complex ideas and relevant scientific and / or ethical issues to be made aware of that scientific knowledge changes, has different interpretations and that ethical issues are not always simple choices between two differing views.
**Physiology 4510**  
*Understanding pluripotency: The physiology of stem cell fate and function*

**Lecture Schedule**  
Thursdays, 2:30-4:20 Western Active Learning Space (WALS, Room 66 UCC)

<table>
<thead>
<tr>
<th>DATE</th>
<th>TOPIC (Instructor)</th>
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<tbody>
<tr>
<td>5 Sept.</td>
<td>Course Introduction; Fundamental principles of “stemness”; pre- and post-implantation embryo development as it relates to embryo-derived stem cells and cell fate determination (Betts)</td>
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<tr>
<td>12 Sept.</td>
<td>Cell Differentiation/Lineage Restriction (Séguin)</td>
</tr>
<tr>
<td>19 Sept.</td>
<td>Embryonic Stem Cells and Pluripotency (Séguin)</td>
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<tr>
<td>26 Sept.</td>
<td>Extracellular Signals to Direct Stem Cell Differentiation (Séguin)</td>
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<tr>
<td>3 Oct.</td>
<td>Intracellular Signals to Direct Stem Cell Differentiation (Séguin)</td>
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<tr>
<td>10 Oct.</td>
<td>Somatic Cloning and Epigenetic Reprogramming in Mammals (Betts)</td>
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<tr>
<td>17 Oct.</td>
<td>Induced Pluripotent Stem Cells (Betts)</td>
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<tr>
<td>31 Oct.</td>
<td>Systems Biology Approaches (e.g. RNA-seq; ChIP; microarray; proteomic)/Genetic manipulation of pluripotent stem cells (e.g. genome editing, knockdown, transgenic approaches) (Betts/Tobias)</td>
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<td>14 Nov.</td>
<td>Ethical Issues Surrounding Pluripotent Stem Cells (Betts), In class activity to play “decide” ethics kit on stem cells</td>
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<td>21 Nov.</td>
<td>“Jigsaw” readings and presentations of important pluripotent stem cell papers (Betts and Séguin)</td>
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<td>28 Nov.</td>
<td>Cell-Based Therapies from Pluripotent Stem Cells (Betts)</td>
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<tr>
<td>5 Dec.</td>
<td>Design your own pluripotent stem cell based therapy (Betts) and Course Review (Betts and Séguin)</td>
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*Select journal papers and study notes for these lectures will be made available on the course OWL site at least the week prior to each lecture*
4. Course Materials

Copyright Statement:
Course material produced by faculty is copyrighted and to reproduce this material for any purposes other than your own educational use contravenes Canadian Copyright Laws.

Textbook: None required

Suggested Textbooks:


Supplemental Information: Published journal articles will be provided for downloading from OWL as required reading for lectures. Students are encouraged to peruse the scientific literature and read review and/or primary research articles in the stem cell biology field. Examples of such journals: Cell Stem Cells, Cellular Reprogramming, Current Stem Cell Research, Development, Journal of Cell Science, Journal of Biological Chemistry, Nature journals, Proc Natl Acad Sci U S A, Science, Stem Cells, Stem Cell Reports, Stem Cells and Development.
5. Evaluation:

A detailed and comprehensive set of regulations concerning the scheduling of tests, assignments, etc. is available at:  
[http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=]

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<tr>
<th>Component</th>
<th>Date</th>
<th>% of Final Mark</th>
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<tr>
<td>Assignment 1 - Ethics Cartoon</td>
<td>Sept. 20(^{th}), 2019</td>
<td>5%</td>
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<tr>
<td>Assignment 2 - Layperson Article</td>
<td>Oct 18(^{th}), 2019</td>
<td>10%</td>
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<tr>
<td>Mid-term test (based on first 7 lectures)</td>
<td>Nov. 14(^{th}), 2019 (7-9 pm; room: TBA)</td>
<td>30%</td>
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<tr>
<td>Jigsaw Presentations and group work</td>
<td>Nov. 21(^{st}), 2019</td>
<td>10%</td>
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<tr>
<td>Design your own therapy (in class)</td>
<td>Dec. 5(^{th}), 2019</td>
<td>5%</td>
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<tr>
<td>Final Exam</td>
<td>TBA (Dec. 8(^{th}) - 19(^{th}), 2019)</td>
<td>40%</td>
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<td><strong>Total Marks</strong></td>
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<td><strong>100%</strong></td>
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The mid-term (2 hours) and final exam (3 hours) will consist of short answer essay questions developed from lectures, assigned readings/exercises and other presented material. There will be a few practice exam questions provided before the midterm and final exams. The 3 hr final exam will be cumulative, with emphasis on the second half of the course.

Policy on the Rounding and Bumping of Marks:

Across the Basic Medical Sciences Undergraduate Education programs and within the department of Physiology and Pharmacology we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement.

**Final grades** on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g., 74.4 becomes 74, and 74.5 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g. a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved and the mark assigned; requests for mark “bumping” will be denied.
6. Additional Information/Statements

Statement on Academic Offences

“Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following website:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Statement on the use of Cell Phone and Electronic Devices

The Schulich School of Medicine and Dentistry is committed to ensuring that testing and evaluation are undertaken fairly across all our departments and programs. For all tests and exams, it is the policy of the School and the Department of Physiology and Pharmacology that any electronic devices (e.g. cell phone, tablet, camera, watch, smart watch, ipod, ear buds, headphones) are strictly prohibited. These devices MUST be left either at home or with the students bag/jacket at the front of the room and MUST NOT be at the test/exam desk or in the individuals pocket. Any student found with one of these prohibited devices will receive a grade of zero on the test or exam. Non-programmable calculators are only allowed when indicated by the instructor. The Department of Physiology and Pharmacology is not responsible for stolen/lost or broken devices.

Statement on Discussion of Grades

The Department of Physiology and Pharmacology is committed to fair assessment of student work and encourages students to discuss course content and graded work with their peers in an effort to improve learning.

For Students: While all students have the right to question their grade should they feel it’s inaccurate, this exercise should be undertaken in a respectful manner. Professionalism and respect should be demonstrated in all interactions with instructors and peers. When discussing a grade or exam question with a professor or teaching assistant, the discussion should focus on your individual concern. Students should remember that some forms of assessment or specific questions are designed to be more challenging than others. In this situation, there may be several students that don’t receive the correct answer and this does not necessarily mean that there is a problem with the question or assessment. Concerns from one student that indicate that they are communicating on behalf of a larger group of peers (mob/crowd mentality) will not be considered. Concerns with an assessment should be communicated to the instructor and should reflect your individual concern. Threats of any sort will not be tolerated and will be considered a violation of the student code of conduct. It is a requirement that you treat your instructors with respect and you should expect the same respect returned to you by your instructor.

For Professors and Teaching Assistants: All professors and teaching assistants should keep an open mind when discussing graded work with students. Make an effort to listen to students and try and see their point of view. If there was ambiguity in a
question or multiple correct answers that a student brings to your attention, you should revise the grade. If the student concern is not adequately justified, explain your reasoning. Students that have concerns regarding an exam question or graded assignment deserve to be treated with respect. Treat with them with the same respect that you expect from them. That being said, concerns from one student that indicate that they are communicating on behalf of a larger group of peers (mob/crowd mentality) should not be considered.

Statement on Appeals:
The Department of Physiology and Pharmacology follows the Western University student academic appeals policy (http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#SubHeading_181). All appeals to individual graded course components must be submitted to the course instructor within 3 weeks of the grade being released. All final course grade appeals must be received by January 31 (1st term classes) or June 30 (2nd term half classes and full year classes). You must first appeal to the course manager. If this appeal is rejected, then you can appeal to the Undergraduate Chair of the Department of Physiology and Pharmacology. If this appeal is rejected, you may then appeal to the Associate Dean of the Bachelor of Medical Sciences Undergraduate Education Committee.

You must have suitable grounds for appeal which may include: 1) appeal on medical or compassionate grounds; 2) appeal based on extenuating circumstances beyond your control; 3) appeal based on bias, inaccuracy or unfairness. All appeals must be accompanied by a detailed explanation along with supporting documentation. You should submit your appeal as an e-mail with a single attachment. If you have multiple supporting documents, you should merge them into a single document.

Absence from course commitments

Medical/Compassionate Relief Program Policy
It is current policy that students who are unable to write a test or examination or other form of course evaluation are required to obtain a medical certificate that is taken to the Academic Counseling Office, NCB 280 (for Science and Basic Medical Science students) or to your appropriate Home Faculty Counseling Office. In the case of an unexpected absence on compassionate grounds, documentation is also requested. Such documentation must be submitted by the student directly to the Academic Counseling office and not to the instructor. An academic counselor in that office will review and either approve or deny the accommodation request. It will be the Academic Counseling office that will determine if accommodation is warranted. This policy applies to all forms of assessment, including evaluations that are less than 10%.
A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Record’s Release Form (located in the Dean’s Office) for visits to Student Health Services. The form can be found at: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

A. Absence for medical illness:

Students must familiarize themselves with the Policy on Accommodation for Medical Illness for Undergraduate Students, located at: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/appealsundergrad.pdf

The policy is also accessible from the Medical Accommodation Policy link at http://www.uwo.ca/arts/counselling/procedures/medical_accomodation.html

Statement from the Academic Counselling Office, Faculty of Science (for Science and BMSc students): If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Academic Counselling Office as soon as possible and contact your instructor immediately. It is the student’s responsibility to make alternative arrangements with their instructor once the accommodation has been approved by the Academic Counselling Office and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Academic Counselling Office immediately. For further information, please see: http://www.uwo.ca/arts/counselling/procedures/medical_accomodation.html

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Record’s Release Form (located in the Dean’s Office) for visits to Student Health Services. The form can be found at:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

B. Absence for non-medical reasons

Appropriate documentation must be submitted by the student directly to the appropriate Faculty Dean’s Office and not to the instructor for non-medical absences from quizzes, assignments and the final exam is required. It will subsequently be the Dean’s Office that will determine if accommodation is warranted. The accommodation will be in the form of a make-up assignment, make-up quiz, make-up exam or re-weighting, which may involve written exams being replaced by oral exams.

C. Special Examinations

A Special Examination is any examination other than the regular final examination, and it may be offered only with the permission of the Dean/Academic Counselling Office of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents.
A Special Examination must be written at the University or an Affiliated University College no later than 30 days after the end of the examination period involved. To accommodate unusual circumstances, a date later than this may be arranged at the time permission is first given by the Dean/Academic Counselling Office of the Faculty. The Dean/Academic Counselling Office will consult with the instructor and Department Chair and, if a later date is arranged, will communicate this to the Office of the Registrar.

If a student fails to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean/Academic Counselling Office in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered. When a grade of Special (SPC) or Incomplete (INC) appears on a student’s record, the notations will be removed and replaced by a substantive grade as soon as the grade is available.

This link [http://www.uwo.ca/univsec/pdf/academic_policies/exam/definitions.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/exam/definitions.pdf) includes a table of the Special Exam dates and clearly indicates that if an exam is missed it is deferred until the scheduled date of the final exam the next time the course is offered.

**Support Services:**

RegISTRARIAL Services: [http://www.registrar.uwo.ca](http://www.registrar.uwo.ca)

Academic Counselling (Science and Basic Medical Sciences): [http://uwo.ca/sci/counselling/](http://uwo.ca/sci/counselling/)

USC Student Support Services: [http://westernusc.ca/services/](http://westernusc.ca/services/)

Student Development Services: [http://www.sdc.uwo.ca](http://www.sdc.uwo.ca)

Student Health Services: [http://www.shs.uwo.ca/](http://www.shs.uwo.ca/)

Students who are in emotional/mental distress should refer to Health and Mental Wellbeing: [http://www.uwo.ca/health/mental_wellbeing/index.html](http://www.uwo.ca/health/mental_wellbeing/index.html) for a complete list of options about how to obtain help.