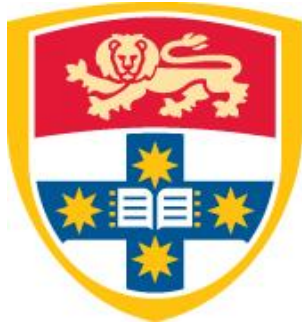


Frontiers in Cellular Physiology

PHSI3009 / PHSI3909 (Advanced)



THE UNIVERSITY OF
SYDNEY

School of Medical Sciences

Discipline of Physiology

Semester 1, 2017
Course Guide

Unit of Study Outline

Welcome to Frontiers in Cellular Physiology PHSI3009 and PHSI3909 (Advanced). Cellular physiology is a vibrant and exciting area of research that probes the increasingly complex molecular basis for how cells function and how individual cellular behaviours contribute to physiological responses at the whole organ level and, ultimately, the body, itself. In essence, it is alterations in normal cellular physiology that initiate and propagate the pathogenic changes that result in disease. Our knowledge is increasing exponentially, however, it is research in cellular physiology that serves to integrate the molecular and biochemical observations to explain the mechanistic basis for the disease and to point to new therapeutic strategies. In this unit of study, you will learn how the physiological responses of “healthy” cells are altered in a diverse range of diseases. In this course, you will explore cellular signalling and pathways by which living cells perceive stimuli, how information is processed and decoded, leading to appropriate end responses.

At the heart of this unit of study are a set of problems that you address working together in groups of 5. There will be two Challenge-Based Learning (CBL) tasks that run over 3 weeks each. You will meet weekly and each CBL challenge will culminate in a group oral or video presentation. The CBL core of the unit of study will be complemented by weekly lectures as well as practical classes. This unit of study will discuss our current understanding of cell signalling systems, key cellular components in cell signalling pathways and their roles in the regulation of cell functions at the molecular level. You will get “hands on” experience with some scientific techniques, data generation and analysis, interpretation and communication. This unit of study is specifically designed to help you to start to develop the skills you need to be an independent scientific professional as you move towards Honours, post-graduate studies or the workplace. This course is ideal preparation if you are considering taking the Honours program offered by the Discipline of Physiology, which is part of the research-intensive Bosch Institute for Medical Research, or any other Honours programs in the broader biomedical-related areas at the University of Sydney.

We strongly recommend that students interested in gaining a Physiology major take PHSI3010/PHSI3910 (Advanced) together with PHSI3009/PHSI3909 (Advanced).

Learning Commitments and Contact Times

Lectures:

Tuesday 12:00-1:00 pm: Sydney Nanoscience Hub Lecture Theatre 4002 (Messel)

Friday 12:00-1:00 pm: New Law School Lecture Theatre 101

CBL: You will be allocated to a CBL group consisting of about 5 students before the first session of each CBL task. There is one two hour CBL session per week at the times indicated. Attendance at your assigned CBL session is compulsory. Failure to attend CBL sessions will result in loss of marks. There will be 2 CBL scenarios. PHSI3909 students will not undertake the second CBL scenario. CBLs start in week 5.

CBL sessions

Monday 2:00-4:00 pm OR 4:00-6:00 pm (weeks 5, 6 & 8 and weeks 10, 11 & 12)

OR

Tuesday 2:00-4:00 pm OR 4:00-6:00 pm (weeks 5, 6 & 8 and weeks 10, 11 & 12)

CBL times and locations will be printed on your personal timetable. Please check Blackboard eLearning because enrolments change during the first two weeks of semester and sometimes we may need to alter group composition and where you will meet. **You must attend your allotted CBL group.**

Practicals: You will be allocated to a practical class on your personal timetable (weeks 3,4 & 9).

Monday 2:00-6:00 pm (Prac group A)

OR

Tuesday 2:00-6:00 pm (Prac group B)

Location: Charles Perkins Centre X-Lab

A detailed timetable for this UoS is linked on Blackboard. Alterations in the timetable may occur at any time during semester. Please check Blackboard regularly after the start of semester for room numbers, late timetable changes, lecture and CBL materials and for practical class notes.

Textbook

Molecular Biology of the Cell 5th edition (Ed. Alberts *et al.*) provides a good theoretical text for both PHSI3009 and PHSI3909. It is not essential that you buy this text.

Learning Outcomes

After completing this unit of study you will be able to:

- Describe intracellular signalling mechanisms that are involved in maintaining cellular functions.
- Describe relationships between dysfunction of intracellular signalling mechanisms and human diseases.
- Describe mechanisms by which small molecules and organic ions are transported across the cell membrane, how ion transport mechanisms are regulated and pathophysiology related to abnormalities of the transport mechanisms.
- Understand the principles underlying commonly used experimental methods in cellular physiology.
- Synthesise relevant findings from original research articles and, as a group, prepare a short oral presentation from a scientific article outlining relevant information to a current problem faced by the group.
- Confidently to communicate scientific findings.

Specific learning objectives are available with each lecture PowerPoint on Blackboard eLearning

Learner Preparation

The prerequisite units of this unit of study are Intermediate Physiology PHSI (2005 or 2905), PHSI (2006 or 2906). For BMedSc students, the prerequisites are BMED (2801 and 2803).

Learning Modes

Lectures: This unit of study covers three main themes: Cell Signalling, Intracellular Trafficking and Membrane Transport of Small Molecules. Each theme has a series of lectures. The themes Cell Signalling and Membrane Transport of Small Molecules are also associated with CBLs and practicals. The lectures will illustrate key concepts related to the study themes to broaden your knowledge in cellular physiology at the molecular level. Lecture content is essential for other learning modes offered in this unit. It is expected that you will apply the content of the lectures in undertaking the CBL learning tasks and in practical sessions.

Challenge-based learning (CBL): The aim of the CBL sessions is to get you to work in groups to develop innovative solutions to complex challenges in biomedical science. These are authentic and complex challenges that we, as researchers, currently face. You will use the in-depth knowledge that you gain from the lectures and practicals together with literature searches to address each challenge. These tasks will help you develop skills in problem solving, reasoning, interpretation of current research papers, critical reflection, team/group work and communication across a number of modes.

There are two CBL topics for PHSI3009. PHSI3909 students will not attend the second CBL topic. Each CBL topic will consist of a 2 hour session per week for 3 weeks. CBL times and locations will be printed on your personal timetable. **You are required to attend all CBL sessions and engage in group discussion. Your attendance is compulsory. Active engagement in group discussion and preparation of group presentation forms the basis of the assessment for this part of the course.**

Please note: In the event of repeated non-attendance without an acceptable Special Consideration, or repeated failure to actively participate in CBL sessions, a student will not be credited with the shared group-presentation mark.

The assessment for both CBLs will be:

- Group presentation: Each group will give an oral presentation at the last session of a CBL Topic and submit a short video presentation at the last session of the other CBL Topic.
- Individual video critique

Marking criteria and detailed instructions will be provided during semester before the CBLs commence. Additional information regarding tips for presentations and creating videos will be also provided as required.

CBL Topics:

CBL1 – Insulin Secretion:

The secretion of insulin from the pancreatic β -cells in response to glucose requires a complicated series of signal transduction events. One very attractive way of treating Type 1 diabetes is to develop “artificial” or “synthetic” cells that are capable of behaving in the manner of pancreatic beta-cells.

You are a team of young post-docs who are looking to crowd-source a project to create a synthetic insulin-secreting cell that can be implanted into people living with Type 1 diabetes. Your job is to create a “pitch” that outlines the physiological challenges you face, what the key features are that you want to build into your cell and how you might go about it. Remember, the investors are looking for a novel angle !

CBL 2- CFTR:

You are working as a senior drug developer in a large pharmaceutical company. Your Director has just returned from a conference on global challenges during which she had dinner with the CEO of an international not-for-profit cystic fibrosis organisation. At the end of the dinner, she made a commitment that the company would seek to create a program for innovative CF treatments focused on targeting the CFTR protein in one of the classes of mutations.

Based on your expertise in human cellular physiology and ion channels, your team has been asked to prepare a presentation to pitch to the company board for possible strategies for a CF treatment development program. In order to do this, you will need to do literature searches to present a current state-of-play and decide on one possible therapeutic approach based on a strong literature base and a backup approach that can be more speculative.

The broad aim of this CBL is for you to develop a deeper understanding of the processes underlying epithelial ion and fluid transport and how mutations in a single ion channel can have catastrophic effects across multiple organs. Central to this is how a comprehensive knowledge of ion channel structure and function can lead to the design and discovery of innovative therapeutic interventions. This CBL will also give you a chance to practice presentation skills in a “corporate” scenario.

CBL Structure:

Before the start of the first session of each CBL topic, you should refresh your knowledge of the key subject areas. Check Blackboard eLearning for instructions for each CBL.

Session 1:

- Introduction of “CBL topic”
- Work in groups of 4-6 (will be pre-allocated) to start to formulate a strategy to address the problem

Between Sessions 1 and 2 you are expected to plan your project and allocate tasks and start to refine the focus of the project.

Session 2:

- Plan and decide structure and prepare materials for the project with assistance from academic tutors

Between Sessions 2 and 3 you are expected to work with your group members to prepare a group presentation.

Session 3:

15-minute group presentations with 5 min questions from students. Marked by staff and students.

Practical Classes

There are three practical class topics for PHSI3009, ie. Tissue Culture and Aseptic Technique, Cell Signalling and Epithelial Transport. The class times and locations will be shown on Blackboard eLearning. All PHSI3009 and PHSI3909 students are to attend and engage in all practical classes. **Attendance is compulsory and will be recorded. Failure to attend without the granting of special consideration will adversely affect your mark.**

Tissue Culture and Aseptic Technique Practical (A/Prof Day): This practical will teach you the most fundamental technique used in research in cell physiology. You will be introduced to aseptic technique and have hands-on experience maintaining animal cells in culture conditions. Check Blackboard eLearning for instructions.

Cell Signalling Practical (Prof Poronnik): You will learn of some important methods used to measure cell signaling based on the activation of G-protein coupled receptors (GPCR). You will use cells in culture to measure changes in intracellular calcium in response to receptor activation. Check Blackboard eLearning for instructions.

Epithelial Transport practical (A/Prof Dinudom): In this practical, you will work in a group of 3-4 to learn how to use an Ussing chamber to investigate Na⁺ transport activity of the toad skin epithelium. Online instructions will be provided in Kuracloud. A week before starting the practical session you must read the “Background on Ion Transport in the Toad Skin Epithelium” and “Student’s Guide for Epithelial Transport Practical Classes” which are available on Blackboard eLearning.

Before attending the first practical session you must complete the online CPC X-Lab induction if you have never done so during your second year. The induction is linked on Blackboard.

Only students that complete the induction and comply with the X-Lab dress code will be allowed to enter the CPC X-lab.

Record keeping: During your practical, you will record information electronically and/or in a separate lab notebook. The record will include results, analysis and interpretation of results from practical sessions. It is expected that the protocols are summarised in a flow diagram and that any changes are recorded. Accurate record keeping will help you to explain your data fully, especially if your observations are not as predicted. Your demonstrators will give you feedback during the practical class on how clearly you have recorded your data and how logically it is presented. You may also record any interpretations of the data.

Practical classes involving animal tissue

The Epithelial Transport practical involves students working with tissue dissected from toads. The toads are first humanely killed and the tissue dissected by a skilled technician under a protocol approved by the University of Sydney Animal Ethics Committee. If you have ethical objections to participating in such practical classes you should either change your enrolment now (before the end of week 3) or do all of the following: 1) go to the Physiology office to complete a form certifying your ethical concerns; then 2) contact the unit of study coordinator to obtain an alternative assessment task; and 3) complete and submit the alternative assessment task as instructed.

Practical class assessment: Practicals will be assessed by MCQ and a report. The group work in practical classes allows you the opportunity to engage in scientific inquiry and develop deeper understanding through discussion with your peers. It is an opportunity to work collaboratively and learn to be a supportive and responsible group member. In addition, there may be specific criteria that you must address. Instructions will be found at the end of your practical notes or on Blackboard eLearning. The report structure will be outlined in each case by the academic in charge.

Written reports

A dropbox for submitting the Practical Report and Video Critique will be created on the Blackboard eLearning website for PHSI3009/3909 two weeks before the submission deadline. All written reports will be screened by Turnitin for plagiarism and academic dishonesty. By submitting the report you are accepting that you are aware of The University of Sydney's policy relating to [Academic Honesty in Coursework 2015](#).

Any plagiarism detected will be reported to the Discipline and Faculty, and the report will be marked zero.

Late submission of reports without special consideration will attract a 10% penalty per day.

PHSI3909: Research Project

As part of PHSI3909 (Advanced), you are required to identify an appropriate research topic with an academic mentor and submit a 2,000 word (or equivalent) research report. The objective of this research project is to develop your skills in scientific investigation and presentation of research topics in cellular physiology. Your project may be a library-based topic or a research-based topic. The report is worth 25% of your final mark.

It is each student's responsibility to contact an academic mentor for a project. Only students with academic approval will be accepted into research projects.

How to choose your research topic?

1. Visit the Google doc to learn more about [research topics available](#).
2. Indicate preferences via the [poll](#) before the end of Week 1.
3. When instructed, discuss projects of interest with academic mentors and obtain permission to join a project.
4. After being accepted to a project, we will add your name to the project in the Google doc.

Preparation and submission of PHSI3909 research project report

- The report must be in Word format.
- The word limit is 2,000 excluding the abstract, figure legends and references.
- An abstract is not compulsory. If you do choose to write an abstract, however, it must be no longer than 200 words.
- The format of your final report may vary depending on whether you have done a library project, or have performed research in a laboratory. The academic mentor will determine whether your format is appropriate for your specific project. Please discuss the final format with them before submitting your report.
- Before submitting your report, please make sure that the file name of your report has been saved as indicated;
PHSI3909_yoursurname_supervisors_surname2016.docx
- A dropbox for submitting PHSI3909 research project reports will be created on the Blackboard E-Learning website for PHSI3009/3909 two weeks before the report submission deadline. All written reports will be screened by Turnitin for plagiarism and academic dishonesty. By submitting the report you are accepting that you are aware of The University of Sydney's policy relating to [Academic Honesty in Coursework 2015](#).
Any plagiarism detected will be reported to the Discipline and Faculty, and the report will be marked zero.
- The report must be submitted by **4:00 pm, 9 June 2017**. Any report submitted on that day after 4:00 pm will be considered one day late and marks will be deducted from the total.

Lecturers and lecture topics

A/Prof Margot Day:

- Function and regulation of K⁺ channels
- Ca²⁺ channels
- Organic ion transporters and diseases

A/Prof Anuwat Dinudom: **Course Co-ordinator**

- Principles of cell communication
- Signalling via small G-proteins
- Epithelial Na⁺ channels

Dr Stuart Fraser:

- Signalling via growth factors
- Anion transporters in health and disease

Prof Phillip Poronnik:

- Signalling via G protein-coupled receptors
- Intracellular Ca²⁺ signalling
- CFTR and cystic fibrosis
- Cl⁻ channels and fluid secretion
- Maximizing transport efficiency

Prof Peter Thorn:

- Regulation of intracellular trafficking
- Endocytosis and Exocytosis
- Mechanisms for insulin secretion

ASSESSMENT SCHEDULE for PHSI3009

Assessment	Assessment type	Due Dates	Weight of whole semester
CBL 1	Group Presentation	3 rd session (oral) OR 12 May 2017 (video)	10% 15%
CBL 2	Group Presentation	3 rd session (oral) OR 9 June 2017 (video)	10% 15%
CBL	Individual video critique	26 May 2017	5%
Practical 1 Tissue Culture and Aseptic Technique	MCQ	Mid-semester Exam 28 April 2017	5%
Practical 2 Cell Signalling	Individual report	24 April 2017	5%
Practical3 Epithelial Transport	MCQ	Final Exam	5%
Lectures 1-10	MCQ	Mid-semester Exam 28 April 2017	15%
Lectures 1-22	MCQ	Final Exam	40%

ASSESSMENT SCHEDULE for PHSI3909

Assessment	Assessment type	Due Dates	Weight of whole semester
CBL 1	Pre-CBL assessment	CBL 1 st session	Formative assessment
	Group Presentation	12 May 2017 (video)	15%
	Individual video critique	26 May 2017	5%
Practical 1 Tissue Culture and Aseptic Technique	MCQ	Mid-semester Exam 28 April 2017	Formative assessment
Practical 2 Cell Signalling	Individual report	24 April 2017	Formative assessment
Practical 3 Epithelial Transport	MCQ	Final Exam	Formative assessment
Lectures 1-10	MCQ	Mid-semester Exam 28 April 2017	15%
Research report	Individual essay	9 June 2017	25%
Lectures 1-22	MCQ	Final Exam	40%

GENERAL LEARNING RESOURCES:

Information on essay writing, report writing and referencing can be found in Blackboard eLearning. It is extremely important that you read the instructions as marks will be deducted if the guidelines are not followed.

ACADEMIC CONTACT INFORMATION:

Before making any enquiry about the course, please review the [Frequently Asked Questions](#) (FAQ) page.

If you still have a question, you should send it to the PHSI3009/3909 email address: PHSI3009.questions@sydney.edu.au. **Do not send your email questions directly to course academics. Our academics will not answer any enquiry sent to their personal email address.**

This [email](#) should also be used to contact your course co-ordinator, A/Prof Anuwat Dinudom.

ADMINISTRATION:

All student enquiries, including relating to lecture notes, submission of assessments, CBL and practical group/schedule and marks should only be sent to Dr Craig Campbell via the [PHSI3009/3909 email address](#).

It is important to note that you must (1) inform and (2) get permission from the course coordinator, before moving to a different CBL or practical group from that which you were assigned. Failure in doing so will result in an inaccurate recording of your mark and grade.

All other enquiries should be directed to the Physiology Student Liaison office (Louise Harrison) at louisejh@physiol.usyd.edu.au).

Submission of written reports and other assessment items:

In line with University policy, all written reports must be submitted electronically as a Word or other text-based document via Blackboard to be screened for similarity to previously submitted or published text through Turnitin.

Copying the work of others is considered academic misconduct (plagiarism). In writing essays and reports you must be aware of The University of Sydney's policy relating to [Academic Honesty in Coursework 2015](#).

Applications for Special Consideration and Special Arrangements are to be submitted through Sydney Student. Information is available in [Coursework Policy](#) and [Assessment Procedures](#)