



**UNSW**  
THE UNIVERSITY OF NEW SOUTH WALES

FACULTY OF MEDICINE  
SCHOOL OF MEDICAL SCIENCES  
DEPARTMENT OF PHYSIOLOGY

NEUR3121

# **MOLECULAR AND CELLULAR NEUROSCIENCE**

SESSION 1, 2010

# CONTENTS

COURSE INFORMATION.....	1
COURSE CONVENER AND TEACHING STAFF .....	1
Teaching Staff (Lecturers / Tutors).....	1
OBJECTIVES OF THE COURSE .....	1
Approach to Learning and Teaching .....	2
Learning outcomes .....	2
ASSESSMENT .....	2
ACADEMIC HONESTY AND PLAGARISM .....	3
What is plagiarism?.....	3
SCHEDULE.....	4
RESOURCES.....	4
Prescribed Textbook .....	4
Recommended textbooks .....	5
Other Resources.....	5
COURSE EVALUATION AND DEVELOPMENT.....	5
ADMINISTRATIVE MATTERS.....	5
Honours .....	6
Postgraduate Research Degrees .....	6
Attendance Requirements.....	6
Computing Facilities.....	6
Special Consideration .....	6
Medical Certificates.....	7
Equity and Diversity .....	7
Official Communication by Email.....	7
Grievance Officer .....	7
CLASS TIMETABLE S1, 2009.....	8

## COURSE INFORMATION

Molecular and Cellular Neuroscience is a stage three course worth six units of credit (6 UOC) and usually undertaken upon successful completion of Physiology 1A (PHSL2101 / 2121). The course can contribute to a major or minor study plan in Physiology, Neuroscience and/or Pharmacology for the Bachelor of Science or Bachelor of Medical Sciences.

The content of the course provides an understanding of the way excitable cells function and communicate with each other, how this may be manipulated in the experimental situation and altered in disease. Hence, this provides a strong foundation to the study of many areas in neuroscience. This course is a useful forerunner to Neurophysiology (PHPH3131). Students will also find that this course complements Molecular Pharmacology (PHAR3102).

### COURSE CONVENER AND TEACHING STAFF

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Course convener: Dr. Trevor Lewis ([t.lewis@unsw.edu.au](mailto:t.lewis@unsw.edu.au))  
School of Medical Sciences, Samuels Building, room LG14  
Tel: 9385 1102

Consultation times: Tuesday 2pm to 3pm or by appointment.  
Outside of the consultation times, email is the best method for communicating with the course convenor.

#### **Teaching Staff (Lecturers / Tutors)**

Dr. Andrew Moorhouse ([a.moorhouse@unsw.edu.au](mailto:a.moorhouse@unsw.edu.au))  
Senior Lecturer, School of Medical Sciences, Department of Physiology

Dr. Trevor Lewis ([t.lewis@unsw.edu.au](mailto:t.lewis@unsw.edu.au))  
Lecturer, School of Medical Sciences, Department of Physiology

EProf. Peter Barry ([p.barry@unsw.edu.au](mailto:p.barry@unsw.edu.au))  
Emeritus Professor, School of Medical Sciences, Department of Physiology

AProf. Jamie Vandenburg ([j.vandenberg@victorchang.unsw.edu.au](mailto:j.vandenberg@victorchang.unsw.edu.au))  
Victor Chang Cardiac Research Institute  
Laboratory Head, Electrophysiology and Biophysics Program and School of Medical Sciences

Dr. Angela Finch ([angela.finch@unsw.edu.au](mailto:angela.finch@unsw.edu.au))  
Lecturer, School of Medical Sciences, Department of Pharmacology

Prof. Gary Housley ([g.housley@unsw.edu.au](mailto:g.housley@unsw.edu.au))  
Head of Department, School of Medical Sciences, Department of Physiology

Note: Communication with the teaching staff is most appropriate via email.

### OBJECTIVES OF THE COURSE

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This course aims to provide students with an integrated approach to understanding cellular neuroscience, including current research and techniques. It looks at the key molecules that underlie the processes of signalling in neural cells, the behaviour of neural cells and how these may be manipulated experimentally to understand function. Given the variety of molecules involved in neural signalling and the continued accumulation of scientific knowledge in this field, students will be introduced to some key online database tools that provide links between genes, the gene product and functional information that is relevant to cellular neuroscience. The ability to use such online databases and search the scientific literature are key elements of this course. The course also aims to develop skills in analytical thinking and problem solving in the context of electrical signalling in neurons. This requires an understanding of the fundamental electrical properties of excitable membranes. Communication is also a key element, as this course aims to develop skills in expressing reasoning and integration of information, rather than just conveying an 'answer'.

## ***Approach to Learning and Teaching***

The learning activities used in the course are varied and aim to create an active learning environment that interests, challenges and inspires students. Lectures provide knowledge of the core material and insights into techniques and recent research. The course material is presented by several lecturers, each with expertise in the field. Tutorials are designed to develop student expertise in using simple mathematical and physical principles to solve biological problems and develop analytical skills. The tutorials will provide opportunities for expressing your reasoning or thinking and will support your understanding of the course material presented in the lectures. Practical classes are a combination of computer modelling / simulation of neuronal signalling, that allow testing ideas that cannot easily be done by other means, and classes with biological materials that provide some insight to experimental techniques in real systems.

## ***Learning outcomes***

The Faculty of Science has compiled a list of graduate attributes that students should develop during the program of study for a degree. These provide a context for the UNSW graduate attributes. This course will explicitly contribute to:

1. Research, inquiry and analytical thinking abilities
  - a. Understanding how the electrical properties of membranes underpin signalling in neurons.
  - b. Understanding how different ion channels, transporters and receptors are able to contribute to electrical and chemical signalling in neurons.
  - c. Ability to apply basic mathematical and physical properties to biological problems and concepts of neuronal signalling.
  - d. Ability to formulate and explain the reasoning for a solution to a problem.
  - e. Understand how molecular biology techniques can be applied to manipulate the function of neurons.
2. Effective communication
  - a. Ability to formulate and explain the reasoning for a solution to a problem.
  - b. Ability to integrate and combine information from a variety of different sources.
  - c. Ability to interpret and summarize scientific ideas.
  - d. Planning and organising as a member of a team.
3. Information literacy
  - a. Ability to use the scientific literature to find appropriate information.
  - b. Ability to search and collate information from online databases relevant to molecular and cellular neuroscience.

## **ASSESSMENT**

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Practical books	10%
Group assignment	20%
Progress exams	20%
End of session exam	50%

The practicals are provided to support the lecture material and to practice applying analytical skills to biological problems. The mark will be based on attendance at the practical classes and on the completion of the exercises and questions set in the practical class. The answers to specific questions will be judged more on whether there is clear reasoning behind the answers provided or a thoughtful answer that indicates an approach for solving the problem and (for calculations) the process that was followed. Therefore, students should always show their working and provide reasoning in their answers. The completed exercises for the practical

classes on membrane potentials (MemPot and ArtMem; wk 3) and voltage responses to membrane currents (MemCable;wk 4) must be submitted by the end of week 5 (before mid-semester break). Practical books are to be kept by all students to record the details of each practical class and the answers to the exercises. These must be submitted for assessment to the School's office by the end of week 12.

The group assignment will require students to work in groups of four or five students, researching the properties of a gene product, which will be allocated to the group. Each gene product is either an ion channel or transporter and there are one or more diseases that are associated with mutations in the gene. Groups will use online databases to identify characteristics of the gene and the ion channel / transporter for which it codes. A literature search will be required to identify the function of the channel / transporter and how this is altered in the disease state. The group will produce a progress report, a final written report and each member will provide a reflection on how they have worked together as a team. Each group will make an oral presentation summarising the work to the class. The assessment will be based on the ability of the group to identify relevant information from appropriate sources and provide proper references for all sources; the group needs to be able to analyse the variety of information collected and communicate this in a manner that demonstrates an integration of the material, not just summarising the individual components.

There will be four progress exams throughout the course. These exams will be comprised of short answer questions, multiple choice and/or short calculations. The questions will be based on the material covered in the lectures, practical classes and tutorials. The purpose of these progress exams is to provide feedback to students on their understanding and application of the concepts developed in the course. The exams will be held during the scheduled tutorial sessions.

The end of session exam will be comprised of short answer questions and will include some simple calculations. The questions will be based on the material covered in the lectures, practical classes and tutorials. Material covered in the progress exams may be again examined in the final exam. The short answer questions will be marked by the lecturer who provided the question. Students are advised to use the list of previous exam questions provided to self-evaluate their progress during the course, although questions from year to year may vary as the content of the course is developed.

## **ACADEMIC HONESTY AND PLAGIARISM**

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The School of Medical Sciences will not tolerate plagiarism in submitted written work. The University regards this as academic misconduct. See the UNSW policy on academic and student misconduct at:

<https://my.unsw.edu.au/student/academiclife/assessment/AcademicMisconductStudentMisconduct.html>

Evidence of plagiarism in submitted assignments, etc. will be thoroughly investigated and may be penalised by the award of a score of zero for the assessable work. Evidence of plagiarism may result in a record being made in the Central Plagiarism Register and the Faculty Student Ethics Officer being notified.

### ***What is plagiarism?***

Plagiarism is the presentation of the thoughts or work of another as one's own.<sup>1</sup> Examples include:

- Direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;

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<sup>1</sup> Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle

- Paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- Piecing together sections of the work of others into a new whole;
- Presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,
- Claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.<sup>2</sup>

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does **not** amount to plagiarism.

The Learning Centre website is the main repository for resources for staff and students on plagiarism and academic honesty. It can be located at: [www.lc.unsw.edu.au/plagiarism](http://www.lc.unsw.edu.au/plagiarism)

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

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## SCHEDULE

Lectures are scheduled for Tuesdays 4-5 pm in Biomed E and Fridays 2-3 pm in Central Lecture Block 4. Practical classes are Fridays 9 am to 12 pm in lab M210, Wallace Wurth Building. Tutorials are Tuesdays 5-6 pm in Matthews 104. Students are expected to attend all rostered activities for their full duration. Students are reminded that UNSW recommends that a six units-of-credit course should involve about 150-180 hrs of study and learning activities. The formal learning activities for this course are approximately 75 hours throughout the semester and students are expected (and strongly recommended) to do at least the same number of hours of additional study.

The course timetable is appended at the end of this course outline and can also be found on WebCT Vista.

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## RESOURCES

### ***Prescribed Textbook***

Matthews G.G. (2004). Cellular Physiology of Nerve and Muscle. 4th edition. Wiley-Blackwell. [One copy is held in the UNSW library in the MyCourse reserve collection (call number MB 573.836/1 A) and is available from the UNSW Bookshop. There are also copies of the third edition in the stacks of the UNSW library.]

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<sup>2</sup> Adapted with kind permission from the University of Melbourne.

### **Recommended textbooks**

Byrne JH and Roberts JL (2004). *From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience*. Elsevier Academic Press, San Diego, USA. ISBN 978-0121486605. [One copy is held in the UNSW library in the MyCourse reserve collection, call number MBQ 612.8/229. Copies are also available from the UNSW Bookshop.]

Aidley DJ (1998). *The Physiology of Excitable Cells*. 4th edition. Cambridge University Press, Cambridge, UK. ISBN 978-0521574218.

[Copies held in the UNSW library and in the MyCourse reserve collection, call number MB 573.8/2 ]

Aidley DJ and Stanfield PR (1996). *Ion Channels: Molecules in Action*, Cambridge University Press, Cambridge, UK. ISBN 978-0521498821.

[Copies held in the UNSW library and in the MyCourse reserve collection, call number MB 571.64/4]

Kandel ER, Schwartz JH and Jessell TM (2000). *Principles of Neural Science*, 4th edition. New York : McGraw-Hill. ISBN 0838577016.

[An advanced textbook for extended reading. Copies held in the UNSW library, call number MBQ 612.8/204]

### **Other Resources**

A number of other resources for this course will be provided on Blackboard. This will include: specific reading lists for different lectures, lecture notes (when provided by the lecturer), a list of online resources, learning activities for the tutorials, the course timetable and outline, as well as various supplementary articles. Announcements will be made via Blackboard and it is the students' responsibility to regularly check this site.

## **COURSE EVALUATION AND DEVELOPMENT**

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NEUR3121 Molecular and Cellular Neuroscience has been developed as part of a broader process to provide a study plan for students wishing to follow a neuroscience path.

In the continuing development of this course, consideration is given to the feedback obtained from the Course and Teaching Evaluation and Improvement (CATEI) survey and the direct feedback from student representatives. Student feedback is always welcome and is taken seriously. In response to the feedback from 2009, the prescribed text book has been changed to provide greater support of the material at a more appropriate level, particularly for the electrical and cellular topics. For the molecular aspects, recommended texts have been placed in MyCourse reserve in the library. As in 2009, additional reading material will be provided in the lectures, where required. Where possible, the timetabling clashes have been reduced. Several lectures have been revised to include supporting information on protein biochemistry. The integration of the lectures following on from each other has also been considered and improved.

Students enrolled in the course will be invited to elect three student representatives who will meet with the course convener and teaching staff on two occasions during the session, in a student feedback forum. The representatives need to seek feedback from their colleagues on the content, delivery and relevance of the course and any other issues that arise. A Course and Teaching Evaluation and Improvement (CATEI) survey will be provided at the completion of the course to formally evaluate the student response to the course. The information gathered from these processes will be used to inform any future improvements to the course.

## **ADMINISTRATIVE MATTERS**

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The Department of Physiology is located in the School of Medical Sciences (SoMS), Wallace Wurth building (C27), Faculty of Medicine. General inquiries can be made at the SoMS reception, located in room MG14 on the ground floor of the Wallace Wurth building (office hours are 8:30am - 5:00pm).

**Prof. Gary Housley** is the Head of Department and appointments may be made through the administrative assistant located at the SoMS reception, room MG14.

The School Student Advisor is **Ms. Carmen Robinson** and she is able to provide additional information on any courses offered by the School. Ms. Robinson may be contacted either by telephone on 9385 2464 or by email: [Carmen.robinson@unsw.edu.au](mailto:Carmen.robinson@unsw.edu.au)

### **Honours**

The School of Medical Sciences offers an honours program, along with a cross-Faculty honours program in Neuroscience. Any students considering an honours year should become familiar with the requirements, which are available on the [honours](#) page of the SoMS web site. Students should consider which research area(s) is/are of interest and then directly approach the relevant academic(s) / researcher(s). Outstanding students may be considered for honours scholarships offered annually by the School. Further information can be obtained from the SoMS website, the honours program co-ordinator (Dr Patsie Polly, [patsie.polly@unsw.edu.au](mailto:patsie.polly@unsw.edu.au)), or the Neuroscience honours co-ordinator (Dr Richard Vickery, [r.vickery@unsw.edu.au](mailto:r.vickery@unsw.edu.au)).

### **Postgraduate Research Degrees**

The Department of Physiology offers students the opportunity to enter into a Doctorate (PhD) in Physiology. Further information about this and other postgraduate degrees is available on the ['Future Students'](#) section of the SoMS website.

### **Attendance Requirements**

Attendance at practical classes/demonstrations is compulsory and must be recorded in the class roll on the day of the class. It is your responsibility to ensure that the demonstrator records your attendance and no discussions will be entered into after the completion of the class. Satisfactory completion of the work set for each class is essential. It should be noted that non-attendance for other than documented medical or other serious reasons, or unsatisfactory performance, for more than one class per course may result in an additional practical assessment exam or in ineligibility to pass the course. Attendance at all examinations is required, including the four progress exams held during the scheduled tutorial sessions.

### **Computing Facilities**

Computer facilities are available to students in the School of Medical Sciences for access to various course-specific teaching programs in Room 106/108 and G2/G4. Swipe card access will be given to all students. Hours of access are 8:30am - 6:00pm. However, priority is given to scheduled classes and meetings.

The use of computing facilities and IT services is governed by the UNSW policies and guidelines that can be found at: [http://www.it.unsw.edu.au/policies/policies\\_home.html](http://www.it.unsw.edu.au/policies/policies_home.html)  
All students need to arrange a zPass to be able to login to the computers. This can be arranged at the UNSW Identity Manager: <http://idm.unsw.edu.au>

### **Special Consideration**

If you believe that your performance in a course, either during session or in an examination, has been adversely affected due to illness or misadventure, you should notify the Registrar and ask for special consideration in the determination of your results. Such requests should be made as soon as practicable after the problem occurs. **Special considerations sought outside the three day time period WILL NOT be accepted except in TRULY exceptional circumstances.**

When submitting a request for special consideration you should provide all possible supporting evidence (eg medical certificates) together with your student number and enrolment details. Consideration request forms are available from Student Central in the Chancellery.

Students who miss an assessment must submit an application for consideration to Student Central and must also contact the course convenor immediately. If you miss an assessment and have applied for Special Consideration, this will be taken into account when your final grade is

determined. You should note that marks derived from completed assessment tasks may be used as the primary basis for determining an overall mark; for example, by extrapolating from your percentile rank on those tasks. Where appropriate, supplementary examination may be offered, but only when warranted by the circumstances. If required, supplementary exams for School of Medical Sciences courses in Semester 1, 2010 will be held in the week commencing Monday 19th July, 2010.

Normally, if you miss an exam (without medical reasons) you will be given an absent fail. If you arrive late for an exam no time extension will be granted. It is your responsibility to check timetables and ensure that you arrive with sufficient time.

Please refer to the A-Z Student Guide at myUNSW:  
<https://my.unsw.edu.au/student/atoz/SpecialConsideration.html>  
for further details regarding special consideration.

### ***Medical Certificates***

Students who miss classes due to illness or for other reasons must submit a copy of medical certificates or other acceptable documentation to the course convener. Certificates should be lodged no more than seven days after an absence. Certificates lodged after seven days will not be accepted. The following details must be attached:

Name, Course number, Date of the class, Name of class/es missed.

### ***Equity and Diversity***

Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of the course, or with the Equity Officer (Disability) in the Student Equity and Diversity Unit (9385 4734 or [www.equity.unsw.edu.au/disabil.html](http://www.equity.unsw.edu.au/disabil.html)). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

### ***Official Communication by Email***

Students are advised that email is now the official means by which the School of Medical Sciences at UNSW will communicate with you. All email messages will be sent to your official UNSW email address (e.g., z1234567@student.unsw.edu.au). If you do not wish to use the University email system, you MUST arrange for your official email to be forwarded to your chosen address. The University recommends that you check your email at least every other day. Facilities for checking email are available in the School of Medical Sciences and in the University Library. Further information and assistance is available from the IT Service Desk Counter, in person at the Library level 2, by telephone (9385 1333) or via email ([servicedesk@unsw.edu.au](mailto:servicedesk@unsw.edu.au)).

### ***Grievance Officer***

If you have any problems or grievance about the course, you should try to resolve it with the course convener. If the grievance cannot be resolved in this way, you should contact the School of Medical Sciences Grievance Officer, Dr Priti Pandey ([p.pandey@unsw.edu.au](mailto:p.pandey@unsw.edu.au), 9385 2483).

## CLASS TIMETABLE S1, 2010

Week	Week Starting	Lecture 1 Tuesday 4-5 pm Biomed E	Tutorial Tuesday 5-6 pm Matthews 104	Lecture 2 Friday 2-3 pm CLB 4	Practical classes Friday 9 am - 12 pm Wallace Wurth M210
1	1 Mar			1. Welcome. Course overview and information.	
2	8 Mar	2. Equilibrium and Gibbs-Donnan potentials [P. Barry]	Tutorial – introduction to group projects	3. Membrane potentials and GHK [P. Barry]	Introduction to Neurons in Action. NIA: The Na action potential
3	15 Mar	4. Electrophysiological techniques [A. Moorhouse]	Tutorial – membrane potentials	5. Overview of ion channel, receptor and transporter families [T. Lewis]	Membrane Potentials (MemPot, ArtMem).
4	22 Mar	6. Electrotonic properties of axons and dendrites [P. Barry]	Progress test	7. Voltage-gated ion channel families [J. Vandenberg]	Voltage responses to membrane currents (MemCable).
5	29 Mar	8. Action potential generation in axons [A. Moorhouse]	Tutorial – electrotonic potentials	Good Friday	Good Friday
			<b>Mid-semester break</b>		
6	12 Apr	9. Mechanisms of voltage-dependent gating [J. Vandenberg]	Tutorial – analysis of voltage-gated currents	10. Ligand-gated ion channel families [T. Lewis]	Group project progress reports. NIA: Voltage clamping a patch
7	19 Apr	11. Ligand recognition and signal transduction [T. Lewis]	Progress test	12. Mechanisms of ion permeation [A. Moorhouse]	Compound action potential from the toad sciatic nerve.
8	26 Apr	13. Cell-cell communication [T. Lewis]	Tutorial – analysis of ligand-gated currents	14. GPCR structure – function [A. Finch]	NIA: Chattering ion channels
9	3 May	15. Metabotropic receptor signalling [A. Finch]	Tutorial – molecular biology for neuroscience	16. Transient receptor potential channels [G. Housley]	Research laboratory visit and data analysis exercise
10	10 May	17. Synaptic transmission – Pre-synaptic modulation [A. Moorhouse]	Progress test	18. Synaptic transmission – neuronal integration [A. Moorhouse]	NIA: Postsynaptic inhibition
11	17 May	19. Recombinant DNA technology and neuroscience [G. Housley]	Tutorial – neuronal integration	20. Receptor response shapes post-synaptic signalling [T. Lewis]	NIA: Interactions of synaptic potentials
12	24 May	21. Transgenic and conditional knockout mouse models [G. Housley]	Progress test	22. Synaptic plasticity [T. Lewis]	Group presentations.
13	31 May	23. Targeting receptor function with transgenic mice [G. Housley]	Tutorial- revision session		Group presentations.