

# UNSW



**SCHOOL OF MEDICAL SCIENCES  
DEPARTMENT OF PHYSIOLOGY**

**SECOND YEAR PHYSIOLOGY  
PHSL2101 PHSL2121 PHSL2501  
SESSION 1 2012**

**INTRODUCTION**

Course Information  
Lecture/Practical Timetables  
Lecture Outlines  
Physiology Practical Manual  
Practical Work in Physiology

**PRACTICALS**

1. Laboratory Health & Safety Induction
2. Safe Handling of Biological Fluids
3. Excitable Cell Physiology
4. Introduction to the Cardiovascular System
5. Electrical and Mechanical Events in the Cardiac Cycle
6. Microcirculation
7. Skeletal Muscle
8. Sensory Physiology

**SELF STUDY SESSIONS**

**PAST EXAM PAPERS**





# **COURSE INFORMATION**



## **EXAMINER AND COURSE CO-ORDINATOR**

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**Co-ordinator:**            **Dr. Lesley Ulman**      **Room 210B Wallace Wurth**  
   **L.Ulman@unsw.edu.au**                      **(ph: 9385 3601)**

If you need to consult with the course convenor, appointments can be set up through email.

## **LECTURERS IN THIS COURSE**

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<b>Dr A. Moorhouse</b>	<b>A.Moorhouse@unsw.edu.au</b>
<b>Dr S.Head</b>	<b>S.Head@unsw.edu.au</b>
<b>Dr L. Ulman</b>	<b>L.Ulman@unsw.edu.au</b>
<b>Dr T. Murphy</b>	<b>Tim.Murphy@unsw.edu.au</b>
<b>Dr R. Vickery</b>	<b>Richard.Vickery@unsw.edu.au</b>

If you require to consult with any of these staff, appointments can be made via email.

## **OBJECTIVES OF THE COURSE**

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This course is offered to second year students and is the first physiology course that you will encounter. The major aims of this course are to provide students with a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body. It should be noted that, although introductory, this course in Human Physiology is comprehensive in scope. Areas treated in detail include both relatively simple cellular mechanisms (for example, the sequence of ion permeability changes in membranes that can result in the initiation and propagation of a nerve impulse along a nerve fibre) as well as more complex interactions between whole organ systems. The major areas of study include excitable tissues, muscle, blood, the cardiovascular system and neurophysiology.

It should also be noted that, where appropriate, subject areas are treated quantitatively as well as qualitatively, an approach that requires students to have at least a basic knowledge of mathematics and chemistry.

## **COURSE STRUCTURE**

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This is a 6 unit of credit course. There are 2-3, one hour lectures per week (Mon 1-2, Wed 1-2 and Fri 2-3). Lectures will provide you with the concepts and theory essential for understanding the fundamental processes of body function. The Fri 2-3 slot on some occasions will be used for a tutorial which aids in better understanding of lecture material. The practical classes are a major component of the course and comprise a weekly 3 hour laboratory session during which students typically work in small groups of about 5 and carry out the laboratory exercises outlined in this practical manual. These sessions will give an insight into how knowledge is obtained, and how the results of experiments depend not only on what we measure but how we measure it. Some of these sessions will be computer based, rather than of a practical nature and some may be self directed learning sessions based on the interactive physiology website.

## **APPROACH TO LEARNING AND TEACHING**

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Although the primary source of information for this course is the lecture material, effective learning can be enhanced through self directed use of other resources

such as textbooks and UNSW Blackboard. Your practical classes will be directly related to the lectures and it is essential to prepare for practical classes before attendance. It is up to you to ensure you perform well in each part of the course: preparing for classes, studying for quizzes and exams and seeking assistance to clarify your understanding. Past exam questions are provided to assist you in preparing for examinations.

## **UNSW LEARNING OUTCOMES**

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UNSW aims to provide an environment that fosters students achieving the following generic graduate attributes:

1. the skills involved in scholarly enquiry
2. an in-depth engagement with the relevant disciplinary knowledge in its interdisciplinary context
3. the capacity for analytical and critical thinking and for creative problem-solving
4. the ability to engage in independent and reflective learning
5. information literacy - the skills to appropriately locate, evaluate and use relevant information
6. the capacity for enterprise, initiative and creativity
7. an appreciation of, and respect for, diversity
8. a capacity to contribute to, and work within, the international community
9. the skills required for collaborative and multidisciplinary work
10. an appreciation of, and a responsiveness to, change
11. a respect for ethical practice and social responsibility
12. the skills of effective communication.

Not every course addresses all these attributes evenly. In second year physiology, attributes 1-4 are most relevant. The following are more specific learning outcomes for this course designed to incorporate some of the generic graduate attributes listed above in a more context specific form.

## **SPECIFIC LEARNING OUTCOMES**

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By the end of this course students are expected to have gained a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body. More specifically students should have a basic knowledge of:

### **Excitable tissues**

- introduction to excitable cells and electrical signals in cells
- basic properties and structure of the cell membrane
- movement of ions across cell membranes
- types of membrane transport proteins
- generation of electrical potentials in cells and electrochemical equilibrium
- action potentials and their propagation
- neuromuscular transmission, central synaptic transmission, neurotransmitters and receptors.

### **Muscle**

- structure and mechanical properties of skeletal muscle
- sliding filament hypothesis, excitation-contraction coupling, myofilaments, role of calcium, cross bridge cycle
- structure and function of cardiac and smooth muscle

## Blood

- functions and composition of blood
- nutritional requirements of erythropoiesis
- blood groups, Rh Factor
- blood clotting

## Autonomic Nervous System

- sympathetic and parasympathetic systems

## Cardiovascular system

- function of the cardiovascular system
- pulmonary and systemic circulations
- blood vessels
- cardiac output
- electrical events in the heart
- mechanical events in the heart
- myocardial contractility, regulation of cardiac output
- haemodynamics, physical laws governing the CVS, Poiseuilles equation, streamline and turbulent flow
- control of the cardiovascular system
- regional blood flows
- microcirculation and lymphatics
- integration of cardiovascular physiology

## Neurophysiology

- overview of the organization, components, and maintenance, of the nervous system
- sensory transduction and neural coding
- neurophysiology of touch, hearing and vision
- neural control of posture and movement

## ASSESSMENT

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	<b>%Total Marks</b>
<b>Mid-session Theory Exam (50 min duration)</b>	
The mid-session exam will be held on Friday 20 <sup>th</sup> April 2012 and will consist of the following:	<b>30%</b>
<ul style="list-style-type: none"><li>• 15 multiple choice questions on material covered in all Excitable Tissues, Muscle and Blood Lectures and tutorials.</li><li>• Two 10 minute short answer questions; one on Excitable Tissues and one on Muscle.</li></ul>	
<b>End of Session Exam (2 hours duration)</b>	
The end of session exam will consist of the following:	<b>50%</b>
<ul style="list-style-type: none"><li>• 15 multiple choice questions on all Autonomic Nervous System, Cardiovascular System and Neurophysiology lectures and tutorials.</li><li>• Three 10 minute short answer questions; one on Blood, one on Cardiovascular System and one on Neurophysiology lectures and tutorials.</li><li>• 30 multiple choice questions on material pertaining to the practical classes in Session 1. You will <b>not</b> be able to take your prac books into the exam.</li></ul>	

### **Online Feedback Quizzes**

**10%**

There will be a series of online feedback quizzes throughout the session covering each topic. These quizzes will be made available online a few days after the conclusion of each lecture series. These quizzes are to be used as a study aid and you will receive immediate detailed feedback after submitting your answers. The quizzes are to be attempted in your own time and each quiz will be accessible for a period of one week. You may attempt these quizzes as many times as you wish within this period. You will receive 2% towards your overall grade for each quiz provided you achieve a minimum score of 90% for the quiz.

**ALL MULTIPLE CHOICE QUESTIONS EXAMINING LECTURE AND TUTORIAL MATERIAL IN THE MIDSESSION AND END OF SESSION EXAM WILL BE DRAWN FROM THE BANK OF QUESTIONS USED IN THE ONLINE QUIZZES THROUGHOUT THE SESSION.**

**PLEASE NOTE THAT THIS DOES NOT APPLY TO MULTIPLE CHOICE QUESTIONS BASED ON PRACTICAL CLASS MATERIAL – THESE QUESTIONS WILL NOT HAVE BEEN SEEN BY YOU PRIOR TO THE END OF SESSION EXAM.**

A timetable of online quiz dates and periods of accessibility will be posted up on blackboard early in the session.

**Please note that online feedback assessments are intended to motivate your study, provide feedback on your progress and to stimulate your learning. There is published data which demonstrates that students who participate in online feedback assessments perform significantly better than their peers in end of course examinations.**

When attempting each online feedback assessment, please complete it under exam conditions (by exam conditions, we mean you should do it by yourself, don't look up the answers as you do it, and commit yourself to an answer), at least the first time you attempt it. This will provide the most realistic appraisal of your performance.

Give yourself plenty of time, and attempt the feedback assessment in a place where you won't be interrupted. If you are attempting to simulate exam conditions, you should allow up to 2 minutes per question.

Write down items that you are not sure about as you go. Even if you get the question right you should still read further about anything that is unclear to you.

If you don't agree with, or can't understand the reason for an answer, ask the appropriate member of academic staff. If you are not sure who that is, ask your colleagues or the course convenor.

Technical problems regarding access to the assessment should be directed to the course convenor.

### **Practical Quizzes**

**10%**

Conducted immediately before some of the practical classes. These quizzes will contain a mixture of questions on that day's work and on the previous supervised practical class that you did. Please note that the computer practical: Electrical and Mechanical Events in the Cardiac Cycle is not a supervised practical and questions on this practical will not be included in the practical quizzes, however this practical **will** be examined in the end of session exam. A minimum of three

quizzes will be given throughout the session and your mark for this component will be an average of all the quizzes you are given.

## **TEXTBOOK**

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PRINCIPLES OF HUMAN PHYSIOLOGY by Cindy L. Stanfield, Benjamin Cummings, 4<sup>th</sup> edition, 2011. This book comes with an Interactive Physiology CD which is used in some self study sessions. Books are available from the UNSW bookshop.

## **GENERAL INFORMATION**

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The Department of Physiology is part of the School of Medical Sciences and is within the Faculty of Medicine. It is located on the 2<sup>nd</sup> and 3<sup>rd</sup> floors of the Wallace Wurth building. General inquiries can be made to the school teaching administrator Carmen Robinson (9385 2464, carmen.robinson@unsw.edu.au) who is located on the Ground Floor of the Biosciences Building room G27.

**Professor Gary Housley** is Head of Department and appointments to see him may be made through email (G.Housley@unsw.edu.au).

***There is an honours program conducted by the School.*** The Honours program is co-ordinated by Dr Patsie Polly (patsie.polly@unsw.edu.au). Any students considering an Honours year should discuss the requirements with the co-ordinator. Outstanding students may be considered for scholarships offered by the University and School and these are offered annually.

### ***Postgraduate research degrees***

The Department of Physiology offers students the opportunity to undertake a **Doctorate (Ph.D)**. For further information contact the co-ordinator, Dr Pascal Carrive (P.Carrive@unsw.edu.au).

***Departmental Vacation Scholarships:*** The Department of Physiology supports several summer vacation scholarships each year to enable good students to undertake short research projects within the department. For further details contact the Administrative Officer.

## **ATTENDANCE REQUIREMENTS**

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***Attendance at ALL practical classes/demonstrations is compulsory FOR ALL STUDENTS, 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 and IS A REQUIREMENT FOR PASSING PHYSIOLOGY. Non-attendance for other than documented medical or other serious reasons may make you ineligible to successfully complete this course. At the very least you may be required to pass an additional oral examination on the practical classes, as well as undertaking the normal practical exam and quizzes. Students who miss practical classes due to illness or for other reasons must submit a medical certificate to Dr. Lesley Ulman (Rm 210B) **WITHIN 7 DAYS (practical classes only)** of missing a class. If received after this time, no consideration will be given and the student will be marked absent from that class. **The following details must be attached: Name,*****

**Student number, Course number, Group number, Date of the class, Name of class missed.**

**The practical component of the final exam is compulsory FOR ALL STUDENTS.**

**PLEASE NOTE** that missing any examination requires lodging a medical certificate with Student Central within **3 DAYS** (refer to UNSW Student Gateway @ [www.student.unsw.edu.au](http://www.student.unsw.edu.au) for further details).

### **OFFICIAL COMMUNICATION BY EMAIL**

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All students in courses PHSL2101, 2121 and 2501 are advised that e-mail is the official means by which the School of Medical Sciences at UNSW will communicate with you. All e-mail messages will be sent to your official UNSW e-mail address (e.g., z1234567@student.unsw.edu.au) and, if you do not wish to use the University e-mail system, you **MUST** arrange for your official mail to be forwarded to your chosen address. The University recommends that you check your mail at least every other day. Facilities for checking e-mail are available in the School of Medical Sciences and in the University library. Further information and assistance is available from DIS-Connect, ph. 9385 1777. Free e-mail courses are run by the UNSW Library.

### **NOTICEBOARDS**

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Noticeboards for this course can be found on the 2<sup>nd</sup> floor of the Wallace Wurth building. Current timetables and information relevant to you will be displayed here. It is your responsibility to check these regularly.

All lectures are taped by the ilecture system and can be accessed via UNSW Blackboard. Textbooks and some reference materials are available through open reserve.

### **TEACHING RESOURCES IN PHYSIOLOGY**

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The Department of Physiology has chosen to use the UNSW Blackboard Learning platform to provide teaching material for all of its courses. You can make use of ilecture recordings (audio only) taken of the lectures which are available on Blackboard Learning. Lecture notes and various learning materials will also be made available on BBL either before or shortly after the lecture.

For BBL direct access point your browser to:

<http://lms-blackboard.telt.unsw.edu.au/webapps/portal/frameset.jsp>

or go to the School's home page at:

<http://medicallsciences.med.unsw.edu.au/>, then select "Current Students" from the menu bar and click on UNSW Blackboard Learning, under "Quicklinks" in the left column. You will need to enter your Zpass credentials (zStudentNo and Zpass). You should have access to the available individual course links if you are properly enrolled. Please note that not every course you have enrolled in has chosen to use UNSW Blackboard Learning as a learning supplement.

*System Requirement for BBL:*

UNSW Blackboard supports the following web browsers for Windows XP or VISTA.

- Internet Explorer (IE) version 7 or 9
- Firefox 3.0x (must run version 3.0.3 and above)

UNSW Blackboard supports the following web browsers for Mac 10.4 or 10.5 (Mac OS 10.3 is not supported)

- Firefox 3.0.x(must run version 3.0.3 and above)
- Safari 2 or 3

*Firefox is the preferred browser in both PC & Mac environment.*

## **HANDWRITING**

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Students whose writing is difficult to understand will disadvantage themselves in their written assessment. Make every effort to write clearly and legibly. Do not use your own abbreviations.

## **APPLICATIONS FOR SPECIAL CONSIDERATION FOR MISSED ASSESSMENTS / EXAMS**

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**Please note the following Statement regarding Special Consideration.**

*If you believe that your performance in a course, either during session or in an examination, has been adversely affected by sickness or for any other reason, 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 consideration sought more than three days after an examination in a course 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 e.g. by extrapolating from your percentile rank on those tasks. Where appropriate, supplementary examination may be offered, but only when warranted by the circumstances.

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 <https://my.unsw.edu.au/student/atoz/SpecialConsideration.html> for further details regarding special consideration.

## **REPEATING STUDENTS**

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Practical class exemptions may be granted to repeat students but students **must** check with the course co-ordinator whether they have exemption **prior** to their first practical class. All students must be familiar with the material covered in the practical classes. All students must do the practical component of the final exam.

## **CONTINUAL COURSE IMPROVEMENT**

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Periodically student evaluative feedback on the course is gathered, using among other means, UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process. Student feedback is taken seriously, and continual improvements are made to the course based in part on such feedback. Significant changes to the course will be communicated to subsequent cohorts of students taking the course.

## **STUDENT SUPPORT SERVICES**

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Those 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 co-ordinator prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the 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. Information on designing courses and course outlines that take into account the needs of students with disabilities can be found at:

[www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf](http://www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf)

## **STUDENT RIGHTS AND RESPONSIBILITIES**

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Refer to UNSW Student Gateway @ [www.student.unsw.edu.au](http://www.student.unsw.edu.au)

## **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 and imposes severe penalties. 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. Flagrant plagiarism will be directly referred to the Division of the Registrar for disciplinary action under UNSW rules.

Plagiarism is the presentation of the thoughts or work of another as one's own.\*  
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;
- 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;
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism.

Other examples of plagiarism include:

- quotation without the use of quotation marks. It is a serious breach of these rules to quote another's work without using quotation marks, even if one then refers to the quoted source. The fact that it is quoted must be acknowledged in your work.
- unacknowledged use of information or ideas, unless such information or ideas are commonplace.
- citing sources (e.g. texts) which you have not read, without acknowledging the 'secondary' source from which knowledge of them has been obtained.

Appropriate citation of sources therefore includes surrounding any directly quoted text with quotation marks, with block indentation for larger segments of directly-quoted text. The preferred format for citation of references is an author-date format with an alphabetically arranged bibliography at the end of the assignment. Note that merely citing textbooks or website URLs is unlikely to yield a bibliography of satisfactory standard. The internet should be avoided as a primary source of information. Inclusion of appropriate journal articles, both primary research publications and reviews, is usually expected.

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

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University online resource for staff and student information 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.

\* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

† Adapted with kind permission from the University of Melbourne.

## **GUIDELINES ON EXTRA-CURRICULAR ACTIVITIES AFFECTING ATTENDANCE**

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Students should refer to the following website for information relating to extracurricular activities.

[http://medicallsciences.med.unsw.edu.au/SOMSWeb.nsf/resources/Course+Outline+NEUR+2/\\$file/Extra-curricularActivitiesSOMS.pdf](http://medicallsciences.med.unsw.edu.au/SOMSWeb.nsf/resources/Course+Outline+NEUR+2/$file/Extra-curricularActivitiesSOMS.pdf)

## **APPEAL PROCEDURES**

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Refer to UNSW Student Gateway @ [www.student.unsw.edu.au](http://www.student.unsw.edu.au).

## **GRIEVANCE RESOLUTION OFFICER**

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In case you have any problems or grievance about the course, you should try to resolve it with the Course Co-ordinator (Dr Lesley Ulman 9385 3601). If the grievance cannot be resolved in this way, you should contact the School of Medical Sciences Grievance Officer, Dr P.Pandey (9385 2483, [P.Pandey@unsw.edu.au](mailto:P.Pandey@unsw.edu.au)).

# TIMETABLES

**PHYSIOLOGY 1A PHS2101, PHS2121, PHS2501  
SESSION 1 2012**

**LECTURES AND TUTORIALS**

Week No. Commencing	LECTURE Monday 1-2 Clancy	LECTURE Wednesday 1-2 CLB 7	LECTURE Friday 2-3 Lecture – CLB 7 Tutorials – Biomed E, Mathews C, D, Mathews 102 & 312, CLB 5.
1 27-Feb	<b>Introduction</b> ULMAN	<b>Excitable Tissues 1</b> MOORHOUSE	<b>Excitable Tissues 2</b> MOORHOUSE
2 5-Mar	<b>Excitable Tissues 3</b> MOORHOUSE	<b>Excitable Tissues 4</b> MOORHOUSE	<b>Excitable Tissues 5</b> MOORHOUSE
3 12-Mar	<b>Muscle 1</b> HEAD	<b>Muscle 2</b> HEAD	<i>Tutorial – excitable tissues</i>
4 19-Mar	<b>Excitable Tissues 6</b> MOORHOUSE	<b>Muscle 3</b> HEAD	<i>Tutorial – excitable tissues</i>
5 26-Mar	<b>Blood 1</b> ULMAN	<b>Blood 2</b> ULMAN	<b>Blood 3</b> ULMAN
6 2-Apr	<b>NO LECTURE</b>	<b>NO LECTURE</b>	<b>GOOD FRIDAY</b>
<b>EASTER RECESS 6th April – 15th April</b>			
7 16-Apr	<b>Autonomic Nervous System</b> VICKERY	<b>Cardiovascular System 1</b> ULMAN	<b>MID SESSION EXAM</b>
8 23-Apr	<b>Cardiovascular System 2</b> ULMAN	<b>ANZAC DAY</b>	<b>Cardiovascular System 3</b> ULMAN
9 30-Apr	<b>Cardiovascular System 4</b> ULMAN	<b>Cardiovascular System 5</b> MURPHY	<b>Cardiovascular System 6</b> MURPHY
10 7-May	<b>Cardiovascular System 7</b> MURPHY	<b>Cardiovascular System 8</b> MURPHY	<i>Tutorial – CVS</i>
11 14-May	<b>Cardiovascular System 9</b> MURPHY	<b>Neurophysiology 1</b> VICKERY	<b>Neurophysiology 2</b> VICKERY
12 21-May	<b>Neurophysiology 3</b> VICKERY	<b>Neurophysiology 4</b> VICKERY	<i>Tutorial – neurophysiology</i>
13 28-May	<b>Neurophysiology 5</b> VICKERY	<b>Neurophysiology 6</b> VICKERY	<i>Tutorial – neurophysiology</i>

WK	DAY	DATE	GP	PRAC TIMES Tues 10-1 (gps 1,2&3), Tues 2-5 (gps 4,5&6) Wed 10-1 (gps 7,8&9)	GP	PRAC TIMES Tues 10-1 (gps 1,2&3), Tues 2-5 (gps 4,5&6) Wed 10-1 (gps 7,8&9)	GP	PRAC TIMES Tues 10-1 (gps 1,2&3), Tues 2-5 (gps 4,5&6) Wed 10-1 (gps 7,8&9)		
1	Tues Wed	28/2 29/2	All grps	<b>NO PRACTICALS</b>						
2	Tues am Tues pm Wed am	6/3 6/3 7/3	1 4 7	<b>LAB H&amp;S INDUCTION</b> Wallace Wurth (WW) Lab 202/204	2 5 8	<b>LAB H&amp;S INDUCTION</b> WW Lab 202/204				
3	Tues am Tues pm Wed am	13/3 13/3 14/3	3 6 9	<b>LAB H&amp;S INDUCTION</b> WW Lab 202/204						
4	Tues am Tues pm Wed am	20/3 20/3 21/3	1 4 7	<b>SAFE HANDLING OF BIOLOGICAL FLUIDS</b>  Bioscience (Bio) Lab 329		<b>EXCITABLE CELL PHYSIOLOGY</b>  Wallace Wurth (WW) Lab 202		<b>INTRODUCTION TO CVS</b>  Wallace Wurth (WW) Lab 204		
5	Tues am Tues pm Wed am	27/3 27/3 28/3	2 5 8						1 4 7	3 6 9
6	Tues am Tues pm Wed am	3/4 3/4 4/4	3 6 9						2 5 8	1 4 7
<b>EASTER BREAK 6<sup>TH</sup> APRIL – 15<sup>TH</sup> APRIL</b>										
7	Tues am Tues pm Wed am	17/4 17/4 18/4		<b>SAFE HANDLING OF BIOLOGICAL FLUIDS</b>	3 6 9	<b>EXCITABLE CELL PHYSIOLOGY</b>	2 5 8	<b>INTRODUCTION TO CVS</b>		
8	Tues Wed	24/4 25/4	All grps	<b>NO PRACTICALS</b>						
9	Tues am Tues pm Wed am	1/5 1/5 2/5	All grps	<b>COMPUTER PRACTICAL: ELECTRICAL &amp; MECHANICAL EVENTS IN THE CARDIAC CYCLE</b> WW Labs 202 & 204						
10	Tues am Tues pm Wed am	8/5 8/5 9/5	1 4 7	<b>MICROCIRCULATION</b>  Bio Lab 329		<b>SKELETAL MUSCLE</b>  WW Lab 204		<b>SENSORY PHYSIOLOGY</b>  WW Lab 202		
11	Tues am Tues pm Wed am	15/5 15/5 16/5	2 5 8						1 4 7	3 6 9
12	Tues am Tues pm Wed am	22/5 22/5 23/5	3 6 9						2 5 8	1 4 7
13	Tues am Tues pm Wed am	29/5 29/5 30/5							3 6 9	2 5 8





# **LECTURE OUTLINES**

## **EXCITABLE TISSUES**

1. Introduction to excitable cells and electrical signals in cells. Brief review of electricity and chemical properties of ions. Electrical and chemical properties of the cell membrane.
2. How substances cross the cell membrane: diffusion; exocytosis and endocytosis; via membrane transporters. Facilitated diffusion and ion channels. Primary and secondary membrane transporters. The Na<sup>+</sup>/K<sup>+</sup>/ATPase.
3. How electrical potentials are generated. Membrane potential. Nernst equation. Action potentials. Ionic currents and channels mediating a nerve action potential.
4. Action potential propagation and myelination. Cell to cell communication. Receptors. Chemical synaptic transmission.
5. Neuromuscular transmission. Central synaptic transmission. Neurotransmitters and receptors. Inhibitory and excitatory synaptic responses. Termination of neurotransmitter action. Neurotransmitter transporters.
6. Completion of lecture content, review of practical classes, and wrap up of major course objectives.

## **MUSCLE**

1. Structure of skeletal muscle. Mechanical properties of whole skeletal muscle, summation and tetanus.
2. Sliding filament hypothesis; excitation-contraction coupling; the myofilaments; the role of calcium; cross bridge cycle.
3. The structure and functions of cardiac and smooth muscle.

## **BLOOD**

1. Functions and composition of blood. Leucocytes, erythrocytes, plasma proteins, erythropoiesis.
2. Nutritional requirements of erythropoiesis, B<sub>12</sub> Fe. Anaemia. Blood groups: ABO and Rh and incompatibilities.
3. Blood clotting – vascular spasm, platelet plug formation, coagulation, clot retraction and clot replacement, clotting abnormalities, anticlotting agents.

## **AUTONOMIC NERVOUS SYSTEM**

1. Organization of the sympathetic and parasympathetic systems; differences between autonomic and somatic synapses; receptor classes and second-messenger systems; levels of reflex control; diverse effects of the autonomic nervous system.

## **CARDIOVASCULAR SYSTEM**

1. Introduction to the cardiovascular system. Role of the circulation. Circulation of blood through heart, pulmonary and systemic circuits.
2. Blood vessels. Types of vessels; arteries, veins, capillaries and their functions. Cardiac output; normal values and method of measurement. Distribution of body fluid.
3. Electrical events in the heart. Conduction through the heart. Cardiac action potentials: pacemaker and non-pacemaker. The ECG.
4. Mechanical events in the heart. Relation of mechanical events to electrical events. Relation of pressures and volumes of cardiac chambers to ECG. Points of opening and closing of valves.
5. Myocardial contractility and regulation of cardiac output.
6. Haemodynamics. The distribution of pressure, resistance and vessel surface area throughout the CVS. Physical laws governing the CVS. Poiseuille's equation, streamline and turbulent flow.
7. Control of the cardiovascular system. The autonomic nervous system and effects on CVS. Central control of CVS. Cardiovascular reflexes; arterial baroreceptors, arterial chemoreceptors, atrial and great vein baroreceptors.
8. Regional blood flows. Local control of blood flow; intrinsic mechanisms (metabolic and myogenic) and autoregulation. Extrinsic control - neural and humoral. Major factors regulating coronary, cerebral, pulmonary and muscle circulation.
9. Microcirculation and lymphatics. Capillary morphology. Exchange across the capillary wall. Starling forces and fluid balance. Role of lymphatics. Integration of cardiovascular physiology.

## **NEUROPHYSIOLOGY**

1. Overview of the organization of the peripheral and central nervous system. The roles and structural features of neurons and glia. The blood-brain barrier and functions of cerebro-spinal fluid.
2. Principles of stimulus transduction and neural coding of the environment. Receptors for touch, temperature and pain. Pathways for somatosensory information to cortex, and somatotopic organization.
3. Hearing & Balance: structure and function of the outer, middle and inner ear, and their roles in the transduction of sound. Structure and function of vestibular system: semicircular canals, utricle and sacule.
4. Forming an image in the eye and optical defects. Classification and distribution of photoreceptors. Colour vision and colour blindness.
5. Topographic organization of sensory and motor cortex. The motor unit, motor neuron and Ia spindle afferent and control of muscle force.
6. Definition of a reflex; the myotatic reflex; Golgi tendon organ; spinal inhibitory interneurons; role of reflexes in posture and movement. Roles of cerebellum, basal ganglia and motor cortex in planning and conducting movements.

## LABORATORY REGULATIONS AND BEHAVIOUR

Health and Safety is a primary concern for both students and staff working in any laboratory.

**The following regulations MUST be adhered to when participating in Physiology practical classes:**

- Each practical class has a student risk assessment (SRA) and a student safe working procedure (SSWP) associated with it.
- The SRA identifies the hazards and risks associated with the particular practical and outlines appropriate controls that must be followed to minimize these risks. The SRA also lists the personal protective equipment (PPE) that students are required to wear for that class, emergency procedures and clean up and waste disposal instructions.
- The SSWP provides background information relating to the class and outlines the procedures to be carried out in that class.
- Students must read the practical notes and sign the SRA prior to commencing the class.
- In each laboratory there are also more comprehensive school approved risk assessments, associated safe work procedures and safety data sheets (SDS) for each particular class. You may refer to these if you require further information. First aid kits and specific spill kits are also located in the laboratories.
- If any accidents or incidents occur they should be reported immediately to the demonstrator in charge of the class who will record the incident and recommend what further action is required.
- Random tests will be given throughout the session prior to the class, to encourage adequate preparation by the students. The results of these tests will contribute 10% of your assessment for the session.
- Students are required to wear the appropriate PPE for each class. Enclosed shoes are mandatory for entering any laboratory (other than computer classes) and you will not be permitted to participate in the practical if you are not wearing appropriate footwear. Most practical classes will also require a lab coat which you must provide. You must regularly wash your lab coat. If you do not bring your lab coat to these classes you will not be able to participate.
- Many classes will require you to wear gloves (which will be provided). Gloves must be removed before writing in lab books and using computers or other electrical equipment.
- You must not wear lab coats or gloves outside the laboratory.
- You must not eat or drink in any laboratory.
- Students are expected to arrive on time. Any student arriving more than 10 minutes late may be refused entry.
- Mobile phones should be turned off before entering the class.
- Laboratory computers may only be used for work relating to the practical class.
- It is expected that students behave appropriately in laboratory classes. In the event of inappropriate behavior students may be asked to leave.

The procedures used in the laboratory classes involving the use of animals have been approved by the Committee on the Use of Animals in Research and Teaching (CUART registration number ACEC 10/73B expiring 4/6/13).

Experiments in this manual, which involve the use of human subjects, have been considered and approved by the University's Committee on Experimental Procedures Involving Human Subjects. Practical classes involving your participation as a subject require you to sign a witnessed, informed consent form.

## PRACTICAL WORK IN PHYSIOLOGY

An important component of our Physiology courses is the practical work. All the classes have been carefully considered and they are included for various reasons. It is hoped that students will not only gain maximum benefit from the content of the classes but will understand why they are included.

The scope of the practical work in the different courses offered is determined by a number of factors such as the level of the course, the perceived needs of the students for whom the course is intended, and the safety of different experimental procedures. Some valuable classes have always been beyond the financial or human resources of the Department, and regrettably financial and other pressures continue to militate against the practical component of the curriculum.

The following should help students understand why the course is given and why the classes have been chosen.

**Why practical work?** The value of having practical work at all may be questioned. It is sometimes said that one could use the time simply in working from a book or notes, and learn more. This may be true in the short term in some instances. But even if it were true one must understand that the purpose of the course is not merely to acquire as much book learning as possible in the minimum time. In discussing Medicine, Sir William Osler once said "*To study Medicine without books is to sail an uncharted sea; to study Medicine without seeing patients is not to go to sea at all*". Much the same could be said about studying science without experiments. The practical course in an undergraduate curriculum cannot produce a fully fledged scientist any more than a few yacht races can produce a master mariner; but at least doing some experiments will give an insight into how knowledge is obtained, and how the results of experiments depend not only on what we measure but how we measure it.

These classes show important principles or methods and it must also be realized that many graduates from the Science course will work in health-related areas.

As far as possible the classes in the practical course cover a wide range of physiological systems. We have also incorporated several different types of practical classes which provide information on how physiological systems function as well as allowing students to develop various practical and safety skills in the laboratory.

Some of the different sorts of practical classes are listed below.

1. **Training in general laboratory practice.** An example is the class on safe handling of biological fluids, which teaches little new material but is designed to warn students of the dangers of some laboratory procedures and teach how to minimize these dangers.
2. **Classes on human subjects.** Much of physiology has been, and will continue to be, driven by an interest in human function. Therefore it is desirable that students perform a number of experiments on one another and learn what it is like to be a subject. They also learn the sensitivities of one another and the carrying out of these experiments is some introduction to what they may be doing later in their careers.

These classes illustrate physiological principles but have other values. For example the class on human blood pressure introduces students to a very common clinical measurement; and the classes on respiratory gas exchange and control of respiration (session 2) give an introduction to some of the physiological testing or monitoring procedures used in operating theatres, in intensive care units, or in a sports medicine laboratory.

3. **Classes using animals** There are several reasons for classes involving use of animals. Many of the advances in Physiology and related sciences have come from animal-based research, and in the foreseeable future many more advances will come from such work. It is vital that students are acquainted with the use of animals so that they can understand how present knowledge has been obtained and how it may change in the future. If there is no exposure to animal based experiments, it is all too easy to fall into one of two errors. It can be thought (wrongly) that animal experiments cannot be applicable to human beings; or it can be thought (also wrongly) that animal results can be transferred directly to human beings. Some examples illustrate this. Many of the cardiovascular reflexes that apply to humans can be shown well in the rabbit, or other experimental animals, and these cannot be shown in class in the intact animal or in a human being. However study of the rabbit shows that its resting heart rate is much higher than that of humans - the two species have a different resting balance in the influence of the sympathetic and parasympathetic nervous systems. Without study of rabbits or other animals, one cannot see how these vital reflexes operate; nor can one see the limitation of animals as experimental models.

For experiments on microcirculation, nerve conduction and muscle contraction, amphibian preparations are used. They have advantages in several important respects. The red cells of the amphibian are nucleated and larger than those of mammals and so are easier to see under the microscope. Also the preparations from these cold-blooded animals last better at room temperature than preparations from a warm-blooded mammal. Much of the knowledge of the properties of nerve fibres and muscle has been gained from studies on cold-blooded animals.

It is of course vital that animals in classes are treated humanely and with respect and it is important that students are given instruction in these aspects, both by word and example.

4. **Classes on cells.** The basis of animal function is the cell and some classes study the properties of cells on their own rather than the properties of organ systems. An example is the section on blood typing included in the class on safe handling of biological fluids.
5. **Classes based on computers, models, or films.** A number of classes involve computer simulated experiments. This is partly in response to pressures on resources and partly because some aspects of the course are better taught in this way. For instance, the accurate, direct recording of membrane and action potentials in nerves requires extensive experience and specialised equipment making it impractical for a large introductory Physiology course. In this case students can be given ideal results and from there calculate the properties of the nerve.

There are other benefits of the practical course. The experiments are not designed for fast learning but they give greater depth of study in some areas. The classes also provide an opportunity for students and staff to meet and discuss the work together, in a different setting from the tutorial class. Many problems of understanding are resolved in this way.

We believe that the present practical course is a good balance between what is ideal and what is readily achievable. It includes classes with a number of different approaches and on different systems of the body. We hope that all students will find it stimulating and profitable and the Department is always open to suggestions as to how improvements can be made.

Staff of the Department of Physiology