



Faculty of Medicine
School of Medical Sciences

PHSL2101 – 2121 - 2501

2nd Year Physiology

COURSE OUTLINE

Term 1, 2020

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COURSE INFORMATION

COURSE CONVENORS

Course Convenor:	Dr. Lesley Ulman l.ulman@unsw.edu.au	Room 204 West Wing Wallace Wurth (ph: 9385 3601)
Co-convenor:	Dr. Nicole Marden n.marden@unsw.edu.au	Room 204 West Wing Wallace Wurth (ph: 9385 3601)

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

LECTURERS IN THIS COURSE

A/Prof A. Moorhouse	A.Moorhouse@unsw.edu.au
Dr F. von Wegner	f.vonwegner@unsw.edu.au
Dr L. Ulman	L.Ulman@unsw.edu.au
Dr T. Murphy	Tim.Murphy@unsw.edu.au
A/Prof R. Vickery	Richard.Vickery@unsw.edu.au

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

The teaching staff involved in the running of this course are located on the second and third floors of the west wing of the Wallace Wurth building. Unfortunately, students are not able to access these areas and if you wish to contact one of us you will need to do so by email and we can organise to meet with you if necessary.

OBJECTIVES OF THE COURSE

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 cell physiology, 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

This is a 6 unit of credit course. There are 3 one hour lectures per week (Monday 9-10, Tuesday 1-2, and Wednesday 9-10). Lectures will provide you with the concepts and theory essential for understanding the fundamental processes of body function.

There are also online tutorials relating to all the major topic areas. These are designed to complement and enhance your understanding of the lecture material.

The practical classes are a major component of the course. You will be divided into small working teams of approximately 6 students within your practical group at the beginning of the term and you will remain in these teams throughout the term. There will be 5 timetabled face-to-face practical sessions. These comprise a fortnightly 3 hour laboratory session during which you will work in your teams 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. There are also 2 online self-directed practical classes which you will complete in your own

time. These can be accessed from any computer. In addition, there is one self-directed computer class which can only be accessed using the computers in the physiology laboratories on level 1 or the ground floor computer labs in the Wallace Wurth Building. These classes are clearly outlined in your practical timetable.

APPROACH TO LEARNING AND TEACHING

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 Moodle. Your practical classes will be directly related to the lectures and it is essential to prepare for practical classes before attending by completing the online pre-laboratory modules (accessed through Moodle) and reading the practical notes. The self-directed online tutorials (also accessed through Moodle) have been carefully designed to enhance and test your understanding of the lecture material. It is up to you to ensure you perform well in each part of the course: attending lectures, engaging with the tutorials, making full use of the pre and post laboratory modules, studying for exams and seeking assistance to clarify your understanding. Online feedback quizzes and past exam questions are provided to assist you in preparing for examinations.

UNSW LEARNING OUTCOMES

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. More specific learning outcomes for this course are documented towards the end of this chapter.

ASSESSMENT

Mid-term Theory Exam (40 min duration)	20%
The mid-term exam will be held on Wednesday 18th March 2020 and will consist of the following:	
<ul style="list-style-type: none">• 9 multiple choice questions on material covered in all Cell Physiology, Muscle and ANS lectures and tutorials.• Two 10 minute short answer questions: one on Cell Physiology and one on Muscle.	
End of Term Exam (2 hours duration) 2nd-15th May	60%
The end of term exam will consist of the following:	
<ul style="list-style-type: none">• 20 multiple choice questions on all Blood, Cardiovascular System and Neurophysiology lectures and tutorials.• Three 10 minute short answer questions: one on Blood, one on Cardiovascular System and one on Neurophysiology lectures and	

tutorials.	
<ul style="list-style-type: none"> • 30 multiple choice questions on material pertaining to the face-to-face and online practicals in Term 1. You will not be able to take your prac books into the exam. 	
Tutorials	10%
There will be 5 online tutorials over the term that relate to each of the major lecture topics. These tutorials will require you to interact and provide answers to questions. You can attempt these tutorials as many times as you wish but need to score 90% or more within 2 weeks of the completion of the lecture topic to attain the 2% course credit assigned to each of the online tutorials.	
Post-laboratory revision modules	10%
There will be 5 post-laboratory revision modules, one for each of the face-to-face practical classes. These must be completed after the respective practicals and have been designed to aid your understanding of the practical material. You can attempt these revision modules as many times as you wish but need to score 90% or more within 2 weeks of completing the relevant practical class to attain the 2% course credit assigned to each revision module.	

Formative Online Feedback Quizzes

There will be a series of 5 online feedback quizzes throughout the term covering each topic. These quizzes will be available online throughout the term but are best attempted after completion of the corresponding lectures. 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 there is no course credit assigned to them. You may attempt these quizzes as many times as you wish.

WHILE THERE IS NO COURSE CREDIT ASSIGNED TO THE ONLINE FEEDBACK QUIZZES, ALL MULTIPLE CHOICE QUESTIONS EXAMINING LECTURE AND TUTORIAL MATERIAL IN THE MID-TERM AND END OF TERM EXAMS WILL BE DRAWN FROM THE BANK OF QUESTIONS USED IN THE THESE QUIZZES.

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.

Please note that online feedback quizzes 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, it is recommended that you 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.

Grading of online tutorials

There are five major tutorial topics: Cell Physiology, Muscle, Blood, Cardiovascular System (CVS) and Neurophysiology. Within each of these major tutorial topics, some are broken down into smaller sub-topic modules (e.g. Cell Physiology part 1, part 2, and part 3; see below).

Each of the major tutorial topics is worth 2% towards the final course grade. The grades for the smaller sub-topic modules within a major topic are equally weighted and thus depend on the number of smaller modules within that topic (e.g. for muscle there are 4 sub-topic modules, which are each worth 0.5%, whereas for the Cardiovascular System, there are only 2 sub-topic modules, which are therefore each worth 1%).

Remember that you need to achieve a minimum score of 90% in a particular tutorial module in order to be awarded the grade for that module. If you do not achieve the required minimum score, the gradebook will either show no grade or a zero grade for that particular module and you will need to attempt it again before the due date.

The grades for all of the tutorial modules are outlined below:

Major Tutorial Topic	Sub-topic Module	Grade
Tutorial 1: Cell Physiology	Part 1: Cell membrane and membrane transport	0.67
	Part 2: Action potential	0.67
	Part 3: Synapse	0.66
	Maximum Total for Cell Physiology	2.00
Tutorial 2: Muscle	Part 1: Skeletal Muscle	0.50
	Part 2: Smooth Muscle	0.50
	Part 3: Cardiac Muscle	0.50
	Part 4: Comparing skeletal, cardiac and smooth muscle	0.50
	Maximum Total for Muscle	2.00
Tutorial 3: Blood	Only 1 part: Blood	2.00
	Maximum Total for Blood	2.00
Tutorial 4: CVS	Part 1: CVS lectures 1-4	1.00
	Part 2: CVS lectures 5-9	1.00
	Maximum Total for CVS	2.00
Tutorial 5: Neurophysiology	Part 1: Neural coding	0.66
	Part 2: Wiring a brain	0.67
	Part 3: Concept maps	0.67
	Maximum Total for Neurophysiology	2.00

TEXTBOOK

PRINCIPLES OF HUMAN PHYSIOLOGY by Cindy L. Stanfield, Global Edition (6th edition), 2017, published by Pearson Education. Books are available from the UNSW bookshop.

This textbook comes with an online platform called Mastering A&P and within this are some interactive modules. We have selected some of these which provide a good supplement to the lecture and tutorial material and will help with revision of this material. You will not be examined on this material specifically as it really serves to clarify and consolidate your lecture content. There is no set time allocated for these suggested self-study sessions. You are encouraged to work through these sessions in your own time. Please refer to the section on self-study sessions for further details, including how to access these.

STUDENT REPRESENTATIVES

We are seeking student representatives for term 1 2020. Ideally we would like to have two representatives from each of our different cohorts (Science, Medical Science, Engineering, Optometry and Exercise Physiology). In terms of commitment it is expected that we would meet with student representatives about twice during the term. During these meetings representatives will have the opportunity to report on any feedback relating to the course that has been gathered from peers either verbally or via email. Being a student representative gives you the opportunity to provide a voice for your student cohort and is a role that can be listed on your CV. Please email Dr Nicole Marden (N.Marden@unsw.edu.au) if you would like to be a student representative or if you would like any further information.

GENERAL INFORMATION

The Department of Physiology is part of the School of Medical Sciences and is within the Faculty of Medicine. It is located on the 2nd and 3rd floors of the West Wing of the Wallace Wurth Building. General inquiries can be submitted via the UNSW Student Portal Web Forms <https://unswinsight.microsoftcrmportals.com/web-forms/>

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. Cristan Herbert (c.herbert@unsw.edu.au). Any students considering an Honours year should discuss the requirements with him. 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, A.Prof Pascal Carrive (P.Carrive@unsw.edu.au).

ATTENDANCE REQUIREMENTS

Attendance at ALL face-to-face practical classes 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. Students who miss practical classes due to illness or for other reasons must submit a medical certificate to academic staff during lab time or leave it with a member of the technical staff located in room 118 East Wing Wallace Wurth Building **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 you are not required to apply for special consideration via Online Services in myUNSW for a missed practical class.

Missing any examination however, requires lodging a medical certificate via Online Services in myUNSW (further details on how to do this can be found here: <https://student.unsw.edu.au/special-consideration>).

OFFICIAL COMMUNICATION BY EMAIL

All students in courses PHSL2101, 2121 and 2501 are advised that email is 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@unsw.edu.au) and, if you do not wish to use the University email system, you **MUST** arrange for your official mail to be forwarded to your chosen address. Email correspondence with the University should be from your UNSW email address in order to reduce identity confusion.

The University recommends that you check your mail 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 Centre (02) 9385 1333.

NOTICES

All current timetables, notices and information relevant to you will be available on Moodle. It is your responsibility to check Moodle regularly.

All lectures are recorded by the Lecture Recording+ system and can be accessed via Moodle. Textbooks and some reference materials are available through open reserve.

TEACHING RESOURCES IN PHYSIOLOGY

Moodle: moodle.telt.unsw.edu.au

Information about the course and a number of electronic study resources can be accessed via the UNSW Moodle learning management system. Lecture notes, online modules, access to your grades, course documents and reference material can be found on the course Moodle site.

For System Requirements for Moodle refer to:
<https://student.unsw.edu.au/moodle-system-requirements>

Lecture Recording+

Lecture Recording+ provides digital audio-visual recordings of lectures that can be accessed via streaming media over the web or as a podcast. Links are provided via Moodle. Please note that this is not guaranteed as from time to time we expect that there will be some IT issues with these.

HANDWRITING

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

APPLICATIONS FOR SPECIAL CONSIDERATION FOR MISSED ASSESSMENTS / EXAMS

Please note the following Statement regarding Special Consideration.

If you believe that your performance in a course, either during term or in an examination, has been adversely affected by sickness or for any other reason, you should 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.**

An application for special consideration must be made via Online Services in myUNSW. **You must obtain and attach Third Party documentation (e.g. medical certificates) before submitting the application. Failure to do so may result in the application being rejected.** Log into myUNSW and go to My Student Profile tab > My Student Services channel > Online Services > Special Consideration. In addition to this, you should also inform the course convenor that you have applied for special consideration.

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. **These will be held between 25-29 May 2020 so you MUST ensure that you are available throughout this period.**

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 student.unsw.edu.au/special-consideration for further details regarding special consideration.

REPEATING STUDENTS

Practical class exemptions may be granted to repeat students but students **must** check with the course convenor 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

Periodically student evaluative feedback on the course is gathered, using among other means, UNSW's MyExperience 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

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 convenor prior to, or at the commencement of their course, or with the Disability Advisor in the Equitable Learning Services unit (formerly Disability Support Services) (9385 4734 or <https://student.unsw.edu.au/els>). 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.

ACADEMIC SKILLS

The UNSW Learning and Career Hub offers workshop programmes throughout the academic year on a wide variety of Academic and Career Development skills. These include referencing, writing skills, critical thinking, exam preparation and time management. Individual assistance is available on request. Further information can be obtained using the link <https://student.unsw.edu.au/support>

ACADEMIC HONESTY AND PLAGIARISM

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.

What is plagiarism? **STUDENT.UNSW.EDU.AU/PLAGIARISM**

Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own. Examples include:

Copying	Using the same or very similar words to the original text or idea without acknowledging the source or using quotation marks. This includes copying materials, ideas or concepts from a book, article, report or other written document, presentation, composition, artwork, design, drawing, circuitry, computer program or software, website, internet, other electronic resource, or another person's assignment, without appropriate acknowledgement.
Inappropriate paraphrasing	Changing a few words and phrases while mostly retaining the original structure and/or progression of ideas of the original, and information without acknowledgement. This also applies in presentations where someone paraphrases another's ideas or words without credit and to piecing together quotes and paraphrases into a new whole, without appropriate referencing.
Collusion	Presenting work as independent work when it has been produced in whole or part in collusion with other people. Collusion includes <ul style="list-style-type: none"> ▪ students providing their work to another student before the due date, or for the purpose of them plagiarising at any time ▪ paying another person to perform an academic task and passing it off as your own ▪ stealing or acquiring another person's academic work and copying it ▪ offering to complete another person's work or seeking payment for completing academic work. This should not be confused with academic collaboration.
Inappropriate citation	Citing sources which have not been read, without acknowledging the 'secondary' source from which knowledge of them has been obtained.
Self-plagiarism	'Self-plagiarism' occurs where an author republishes their own previously written work and presents it as new findings without referencing the earlier work, either in its entirety or partially. Self-plagiarism is also referred to as 'recycling', 'duplication', or 'multiple submissions of research findings' without disclosure. In the student context, self-plagiarism includes re-using parts of, or all of, a body of work that has already been submitted for assessment without proper citation.

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. student.unsw.edu.au/plagiarism is the central University online resource for information on plagiarism and academic honesty.

Guidelines on extra-curricular activities affecting attendance

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

<https://medicalsciences.med.unsw.edu.au/sites/default/files/Extra-curricularActivitiesSOMS.pdf>

GRIEVANCE RESOLUTION OFFICER

In case you have any problems or grievance about the course, you should try to resolve it with the Course Convenor (Dr Lesley Ulman 9385 3601). If the grievance cannot be resolved in this way, you should contact the School of Medical Sciences Grievance Officer, Prof Nick di Girolamo (n.digirolamo@unsw.edu.au).

TIMETABLES

PHYSIOLOGY
PHSL2101, PHSL2121, PHSL2501

TERM 1 2020 LECTURES

Week No. Commencing	LECTURE 1 Monday 9-10 Clancy	LECTURE 2 Tuesday 1-2 Clancy	LECTURE 3 Wednesday 9-10 Clancy
1 17-Feb	Introduction/Animal Ethics ULMAN / VICKERY	Cell Physiology 1 MOORHOUSE	Cell Physiology 2 MOORHOUSE
2 24-Feb	Cell Physiology 3 MOORHOUSE	Cell Physiology 4 MOORHOUSE	Cell Physiology 5 MOORHOUSE
3 2-Mar	Cell Physiology 6 MOORHOUSE	Muscle 1 VON WEGNER	Muscle 2 VON WEGNER
4 9-Mar	Muscle 3 VON WEGNER	Autonomic Nervous System VICKERY	Cardiovascular System 1 ULMAN
5 16-Mar	Cardiovascular System 2 ULMAN	Cardiovascular System 3 ULMAN	MIDSESSION EXAM
6 23-Mar	Cardiovascular System 4 ULMAN	Cardiovascular System 5 MURPHY	Cardiovascular System 6 MURPHY
7 30-Mar	Cardiovascular System 7 MURPHY	Cardiovascular System 8 MURPHY	Cardiovascular System 9 MURPHY
8 6-Apr	Blood 1 ULMAN	Blood 2 ULMAN	Blood 3 ULMAN
9 13-Apr	EASTER MONDAY	Neurophysiology 1 VICKERY	Neurophysiology 2 VICKERY
10 20-Apr	Neurophysiology 3 VICKERY	Neurophysiology 4 VICKERY	Neurophysiology 5 VICKERY
11 27-Apr	Neurophysiology 6 VICKERY		

Practical class information

The practical component of the course will consist of 5 face to face practicals and 3 self-directed computer labs. All are examinable in the final examination.

The first self-directed lab is the Health and Safety practical and this **must** be completed prior to coming to your first face-to-face practical. Completion of this practical will be monitored and students will not be allowed to enter the laboratory unless this has been done.

The second online lab class is the Cell Physiology – Membrane Potential Virtual Lab. This will be accessible after completion of the Excitable Tissues lecture series and will remain open for the remainder of the term.

The third on-line module is the Electrical and Mechanical Events in the cardiac cycle. This is best attempted after CVS lecture 4 and can only be accessed in the Wallace Wurth laboratories.

PHYSIOLOGY TERM 1 PRACTICAL TIMETABLE 2020

Wk	Day & Time	Date	Prac Group	Supervised practical Wallace Wurth East Wing LAB 115	Prac Group	Online practicals (any computer) / Self-directed computer class (Wallace Wurth Physiology laboratories)
Orientation week			All		All	* HEALTH & SAFETY ONLINE PRACTICAL (any computer)
1	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	18/2 18/2 19/2 19/2	1 2 3 4	FUN WITH BLOOD		
2	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	25/2 25/2 26/2 26/2	5 6 7 8	FUN WITH BLOOD		ONLINE CELL PHYSIOLOGY – MEMBRANE POTENTIAL VIRTUAL LAB (any computer)
3	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	3/3 3/3 4/3 4/3	1 2 3 4	SKELETAL MUSCLE		
4	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	10/3 10/3 11/3 11/3	5 6 7 8	SKELETAL MUSCLE		
5	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	17/3 17/3 18/3 18/3	1 2 3 4	INTRODUCTION TO CVS		
6	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	24/3 24/3 25/3 25/3	5 6 7 8	INTRODUCTION TO CVS		
7	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	31/3 31/3 1/4 1/4	1 2 3 4	MICROCIRCULATION	5 6 7 8	**ELECTRICAL & MECHANICAL EVENTS IN THE CARDIAC CYCLE (Wallace Wurth physiology lab computers)
8	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	7/4 7/4 8/4 8/4	5 6 7 8	MICROCIRCULATION	1 2 3 4	**ELECTRICAL & MECHANICAL EVENTS IN THE CARDIAC CYCLE (Wallace Wurth physiology lab computers)
9	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	14/4 14/4 15/4 15/4	1 2 3 4	SENSORY PHYSIOLOGY		
10	Tues 10-1 Tues 2-5 Wed 10-1 Wed 2-5	21/4 21/4 22/4 22/4	5 6 7 8	SENSORY PHYSIOLOGY		

COMPULSORY LAB COATS REQUIRED FOR “SHADED” CLASSES

*** You MUST complete the Health & Safety online practical class prior to attending your first supervised practical class (Fun with Blood). If you have not completed this online practical, you will NOT be permitted to attend the Fun with Blood practical class.**

**** The Electrical & Mechanical Events in the Cardiac cycle computer class is a self-directed computer practical that must be accessed using the computers in the physiology laboratories on level 1 Wallace Wurth Building (labs 115, 116 & 120). For each practical group we have provided a timetabled session in lab 116 (weeks 7 or 8). However, you may do this class any time the labs are free. Please see the technical officers in lab 118 for computer access if the labs are locked.**

SPECIFIC LEARNING OBJECTIVES

CELL PHYSIOLOGY

Lecture 1

- 1.1 To define the study of Physiology and give two examples of a single cell function
- 1.2 To be able to define what is meant by excitable cells and define the broad function of muscle cells, neurons and epithelial cells
- 1.3 To appreciate single cells use chemical and electrical signalling
- 1.4 To schematically draw a cell membrane and to identify the functional components of a typical membrane phospholipid and give an example
- 1.5 To understand the terms polar and non-polar and to know the typical components of intracellular and extracellular solutions
- 1.6 To describe the general classes of mechanisms by which cells communicate to other cells

Lecture 2 (with online tute)

- 2.1 To review the terms polar and non-polar and know how this relates to membranes and ions. To appreciate ions are hydrated in solution
- 2.2 To relate the basic components of an electrical circuit to a potential difference across the cell membrane.
- 2.3 To be able to define the three broad classes of transport by which substances cross the cell membrane
- 2.4 To state factors which influence the passive diffusion of molecules across a cell membrane, as expressed by Ficks' Law
- 2.5 To distinguish simple and facilitated diffusion, and facilitated diffusion via channels and carriers
- 2.6 To briefly describe an example of a facilitated diffusion transport process including physiological relevance and protein involved

Lecture 3 (with online tute and homeostasis prac)

- 3.1 To be able to define ion channels and their basic properties of gating and selectivity
- 3.2 To recognise osmosis as water diffusion and relate tonicity and water flux across cell membranes. To know what aquaporins are.
- 3.3 To be able to define primary and secondary active transport, and co-transport and counter-transport, and give examples of each
- 3.4 To know the basic cellular function of the Na⁺ pump and the ions that it transports, including the directions and quantities (stoichiometry)
- 3.5 To be able to briefly describe exocytosis and endocytosis using physiological examples

Lecture 4 (with the online membrane potentials prac and tute)

- 4.1 To understand the electrical and chemical forces that dictate how an ion moves across the cell membrane, including the concept of electrochemical equilibrium
- 4.2 To predict how an ion moves across the membrane and how this will effect membrane potential.
- 4.3 To know the Nernst equation and be able to use it (if given the values of the constants) to calculate equilibrium potentials
- 4.4 To be able to describe how the resting membrane potential is generated and how changes in membrane potential occur (in terms of ion flows)
- 4.5 To define depolarization, hyperpolarization, electrochemical equilibrium

Lecture 5 (with the online membrane potentials prac, the online myelination activity, and the tute)

- 5.1 To understand the physiological mechanisms of the Action Potential, including:
 - ∅ Being able to draw the nerve AP with correctly identified x and y axis, and with the major phases of the AP identified
 - ∅ To appreciate the voltage threshold concept and to describe briefly what happens here to elicit the action potential (i.e. voltage-dependent gating).
 - ∅ To describe the ionic currents that mediate the depolarisation and repolarisation phases of the AP
 - ∅ To be able to describe the ion channels that mediate the above ionic currents, and to link the different conformation states of these channels (i.e. their gates) to the different phases of the AP. To define what is meant by voltage-dependent gating, activation and inactivation (in terms of these ion channels)
- 5.2 To describe what is meant by passive and active propagation and describe how these two processes contribute to AP propagation along an axon (with the prac)
- 5.3 To appreciate what myelin is and how it affects AP propagation velocity

Lecture 6 (with online tute)

- 6.1 To describe the general features of chemical and electrical communication between cells
- 6.2 To list the steps involved in synaptic transmission at the neuromuscular junction (as a model synapse)
- 6.3 To know the transmitters and ionotropic receptors at neuromuscular and central synapses
- 6.4 To be able to distinguish ionotropic and metabotropic receptor signalling
- 6.5 To understand the receptors and ionic fluxes involved with excitation and inhibition at central synapses, including defining EPSP and IPSPs
- 6.6 To describe how EPSPs and IPSPs get integrated by a neuron to elicit an action potential response, and define temporal and spatial summation
- 6.6 To be able to briefly describe different ways neurotransmitter signalling may be switched off

MUSCLE

Lecture 1: Skeletal Muscle 1

- 1.1 Describe the organisation of skeletal muscle, identifying structures and tissues from macroscopic to microscopic.
- 1.2 Explain how skeletal muscle contraction is initiated at the neuromuscular junction.
- 1.3 Describe the sliding filament hypothesis.
- 1.4 Understand the different roles of contractile proteins, structural proteins and connective tissues during muscle contractions.

Lecture 2: Skeletal Muscle 2

- 2.1 Describe the process of excitation-contraction coupling in skeletal muscle.
- 2.2 Describe the steps involved in the cross-bridge cycle and the key role of calcium.
- 2.3 Explain the mechanisms which control force output from skeletal muscle.
- 2.4 Outline the differences between slow-twitch and fast-twitch muscle fibres and how they affect skeletal muscle contractions.

Lecture 3: Cardiac and Smooth Muscle

- 3.1 Describe the structure and organisation of myocytes in smooth & cardiac muscle.
- 3.2 Explain how muscle contraction is initiated for smooth & cardiac muscle.
- 3.3 Describe the process of excitation-contraction coupling in smooth & cardiac muscle.
- 3.4 Compare and contrast properties of the three muscle types in terms of structure and function.

AUTONOMIC NERVOUS SYSTEM

Lecture 1

- 1.1 Outline the operation of reflex control in the autonomic nervous system.
- 1.2 Describe the anatomical organization of the sympathetic and parasympathetic systems.
- 1.3 List the neurotransmitters and receptor classes used by the sympathetic & parasympathetic systems at pre-ganglionic & post-ganglionic synapses.
- 1.4 List the effects of the autonomic nervous system on three organs.

CARDIOVASCULAR SYSTEM

Lecture 1: Introduction to CVS

- 1.1 Understand the functions of the CVS
- 1.2 Describe the path of blood flow through the heart and vasculature
- 1.3 Name the different valves in the heart and understand how they operate
- 1.4 Understand the physiology of cardiac muscle
- 1.5 Describe the nervous supply to the heart
- 1.6 Define cardiac output
- 1.7 Describe the distribution of systemic blood flow at rest and during exercise

Lecture 2: Blood vessels and blood volumes

- 2.1 Describe the various components of the vasculature
- 2.2 Describe the unique characteristics of the different types of vessels in terms of both structure and function
- 2.3 Describe the changes in pressure, velocity of flow and cross-sectional area that are seen across the vasculature
- 2.4 Understand the use of the Fick principle and the indicator dilution technique in measuring cardiac output.
- 2.5 Understand how different indicators can be used to measure different volumes

Lecture 3: Electrical events in the heart

- 3.1 Describe the path of action potentials through the conduction system of the heart
- 3.2 Understand the ionic basis of the different phases of the pacemaker potential
- 3.3 Describe the effects of the autonomic nervous system on pacemaker potentials
- 3.4 Understand the ionic basis of the different phases of the ventricular action potential
- 3.5 Describe the different waves of the electrocardiogram and how they relate to the events of the cardiac cycle

Lecture 4: Mechanical events in the heart

Understand the different phases of the cardiac cycle and how the following parameters vary in each of the phases

- Left ventricular pressure
- Aortic pressure
- Left atrial pressure
- Ventricular volume
- Opening and closing of valves
- Heart sounds
- The ECG

Lecture 5: Regulation of Cardiac Output

- 5.1 Define Cardiac Output and know the factors controlling cardiac output.
- 5.2 Appreciate that heart rate is controlled by the autonomic nervous system and adrenaline
- 5.3 Understand Starling's law of the Heart and the effects of pre-load and afterload on cardiac output.
- 5.4 Understand the concept of myocardial contractility, how it may be altered and effects of cardiac output.

Lecture 6: Haemodynamics

- 6.1 Know Poiseuille's Law and what it describes
- 6.2 Understand the relationship between vascular cross-sectional area and blood flow velocity in different parts of the vascular system.
- 6.3 Understand the concept of resistance to blood flow and the structural and architectural arrangement of blood vessels to counter resistance.
- 6.4 Appreciate the concepts of laminar and turbulent blood flow.

Lecture 7: Control of the Cardiovascular System

- 7.1 Understand the role of the autonomic nervous system in controlling the cardiovascular system.
- 7.2 Know the baroreceptor reflex and its' role in controlling blood pressure.
- 7.3 Appreciate the role of cardiac volume receptors in controlling blood pressure.
- 7.4 Understand that long-term maintenance of blood pressure involves regulation of blood volume and that renal function is vital in this role.

Lecture 8: Local and Regional Blood Flow

- 8.1 Understand the concept of autoregulation of blood flow and the myogenic and metabolic theories of autoregulation.
- 8.2 Appreciate the role of neurotransmitters, hormones and paracrine substances in controlling blood flow.
- 8.3 Understand the main mechanisms controlling blood flow in the skin, heart, skeletal muscle, lungs and brain.

Lecture 9: Microcirculation, Lymphatics and Integrated Cardiovascular Physiology

- 9.1 Understand the roles of arterioles, capillaries and venules in the microcirculation
- 9.2 Appreciate the mechanisms of substance exchange at the capillary level: diffusion, filtration and pinocytosis.
- 9.3 Understand the Starling forces and equation controlling and balancing the net movement of fluid in and out of capillaries.
- 9.4 Appreciate the role of the lymphatic system in retrieving tissue fluid.
- 9.5 Understand the integrated cardiovascular response to exercise.

BLOOD

Lecture 1: Functions and composition of blood

- 1.1 Describe the main functions of blood
- 1.2 Identify the major components of blood
- 1.3 Identify the types of leukocytes (white blood cells) and describe their roles in defence
- 1.4 Describe the characteristics of erythrocytes (red blood cells)
- 1.5 Understand the structure and functions of haemoglobin
- 1.6 Describe the changes in haemoglobin concentration with age
- 1.7 Identify the sites of red blood cell formation at different ages

Lecture 2: Erythropoiesis and its nutritional requirements, ABO and Rhesus blood groups

- 2.1 Describe the developmental stages of the red blood cell
- 2.2 Describe the control of erythropoiesis and the role of erythropoietin
- 2.3 Understand the nutritional requirements for red cell production
- 2.4 Describe some of the different types of anaemias
- 2.5 Understand the basis of ABO blood groups and the reasons for incompatibilities
- 2.6 Understand the basis of Rhesus blood groups and the repercussions of incompatibilities

Lecture 3: Haemostasis and its disorders

- 3.1 Understand the term haemostasis
- 3.2 Describe the role of vascular spasm in haemostasis
- 3.3 Describe how a platelet plug is formed
- 3.4 Describe the 3 major stages of blood coagulation including the intrinsic and extrinsic pathways
- 3.5 Understand clot retraction
- 3.6 Understand how a clot is replaced with fibrous tissue
- 3.7 Describe some clotting abnormalities
- 3.8 Understand the mechanism of action of some anticlotting drugs and other agents

NEUROPHYSIOLOGY

Lecture 1: Overview

- 1.1 Describe the blood-brain barrier and the role of cerebro-spinal fluid (CSF).
- 1.2 Describe the two classes of stroke and why reduced blood circulation is a more severe problem for the brain than other organs.
- 1.3 Describe the organization of grey and white matter in the spinal cord and the brain.
- 1.4 Outline how neural activity represents a memory.

Lecture 2: Receptors & Somatosensory system

- 2.1 Explain sensory transduction and its significance in brain function.
- 2.2 Describe how afferent type, location and activity encodes the properties of a skin stimulus.
- 2.3 Describe an example receptor and afferent used to signal each of touch, pain and temperature.
- 2.4 Outline the dorsal column/medial-lemniscal and spinothalamic pathways to somatosensory cortex.

Lecture 3: Auditory & Vestibular system

- 3.1 Describe the structure and function of the outer, middle and inner ear.
- 3.2 Explain how mechanical energy is transduced into a neural signal by the cochlear hair cells.
- 3.3 Explain the cochlear place code for pitch.
- 3.4 Explain how the semi-circular canals and the otolith organs both use hair cells.

Lecture 4: Convergence & Optics

- 4.1 Describe convergence, divergence and spatial summation in central neural pathways. Give an example of an emergent neural property.
- 4.2 Explain topographic organization and somatotopy, tonotopy and visuotopy.
- 4.3 Describe the contribution of the various parts of the eye to image formation on the retina.
- 4.4 Describe myopia, hyperopia, and presbyopia, and the lenses used to correct them.

Lecture 5: Vision & Motor units

- 5.1 Describe the transduction of light at the rods and cones.
- 5.2 Explain the basis of colour vision, and of anomalous trichromacy (red/green colour blindness).
- 5.3 Describe the organization of a motor unit, and the control of contractile force in skeletal muscle.
- 5.4 Describe a muscle spindle and its response to muscle stretch and contraction.

Lecture 6: Reflexes & Motor system

- 6.1 Draw and explain the neural circuits for the myotatic, Golgi tendon organ, and withdrawal reflexes.
- 6.2 Distinguish the function and general course of the pyramidal and extrapyramidal motor pathways.
- 6.3 Describe the roles of the higher motor areas, and the topographic organization of motor cortex.
- 6.4 List the sequence of events in a movement, from initial planning through to execution.

LABAROTARY 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.
- Students are required to wear the appropriate PPE for each class. Enclosed shoes are mandatory for entering any laboratory 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.
- It is of course vital that animals used in practical classes MUST be treated humanely and with respect. Taking photos is **ABSOLUTELY UNACCEPTABLE**, and will result in removal from the class and a referral to the Head of Department.

The procedures used in the laboratory classes involving the use of animals have been approved by the UNSW Animal Ethics Committee on the Use of Animals in Research and Teaching (Approval Number: ACEC 19/67B expiring May 2022).

Experiments in this manual, which involve the use of human subjects, have been considered and approved by the School of Medical Sciences Teaching Ethics Committee on Experimental Procedures Involving Human Subjects for teaching. Practical classes involving

your participation as a subject requires you to read the Participant information sheet and 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 health and safety and safe handling of biological fluids, which is designed to warn students of the dangers of some laboratory procedures and to 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 (term 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.** 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.