PHSL3211

Cardiovascular Physiology and Pathophysiology

Course Outline

Term 2, 2023

School of Biomedical Sciences

Faculty of Medicine & Health

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1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Dr. Tim Murphy	tim.murphy@unsw.edu.au	9-5 weekdays WW316	(02) 9065 9806
Lecturer	Dr. Matthew Perry Dr. Karen Gibson A/Prof. Lu Liu Dr. Blake Cochran Prof. Jamie Vandenberg Prof. Margaret Morris Dr. Nicole Jones	m.d.perry@unsw.edu.au k.gibson@unsw.edu.au l.lu@unsw.edu.au b.cochran@unsw.edu.au j.vandenberg@unsw.edu.au m.morris@unsw.edu.au n.jones@unsw.edu.au	By Appointment	E-mail for all
Tutors	Mr. Nathan Luque	n.luque@unsw.edu.au	By Appointment	E-mail

2. Course information

Units of credit: 6

Pre-requisite(s): PHSL2101 or PHSL2121 or PHSL 2501 AND PHSL2201 or PHSL2221 or PHSL2502

Teaching times and locations: http://timetable.unsw.edu.au/2023/PHSL3211.html

2.1 Course summary

The cardiovascular system is vital to normal functioning of the human body. Diseases afflicting the cardiovascular system result in high rates of illness and mortality throughout the world. This course aims to educate the student in important aspects of cardiovascular physiology and pathophysiology, and to present the latest research strategies used to investigate this complex system.

This course focuses on the physiology and pathophysiology of the cardiovascular system. Unit One covers molecular and cellular aspects of cardiovascular tissues; the vascular endothelium, cardiac and smooth muscle and cell communication. Unit Two addresses systemic cardiovascular physiology, from capillary exchange, the microcirculation, the ECG, control of regional blood flow and hemodynamics, up to regulation of cardiac output and blood pressure and the function of the cardiovascular system in exercise. Unit Three focuses on the pathophysiology of the cardiovascular system, with lectures delivered by leading researchers in the fields of atherosclerosis, heart failure, hypertension and cerebrovascular disease. Lecture-based material is complemented by practical classes, on-line tutorials and problem-based learning.

2.2 Course aims

The objective of this course is for students to gain an understanding of the physiology of the cardiovascular system, from characteristics of cardiac and vascular cells through to the functioning of circulatory systems, their contribution to homeostasis and how they interact with their environment. The course also aims to introduce students to modern experimental approaches and to apply basic physiological concepts to understanding cardiovascular pathology.

The course is divided into three units, over which the student will be taken from the physiology of cardiac and vascular cells, examine the function and regulation of these cells within vascular tissues and organs, and finally learn about the latest theories and techniques leading research into cardiovascular pathophysiology and disease. As the course progresses, material builds on information presented in earlier classes. Course material is delivered by staff actively engaged in cardiovascular research, able to illustrate theory with examples from their own laboratories.

Unit 1: Cellular Aspects

The aim of this unit is to become familiar with the cellular physiology of the heart and blood vessel wall. Further emphasis will be placed on interactions that occur between vascular cells and the extracellular environment.

- Endothelial cells
- Cardiac Muscle
- Smooth Muscle: Signal transduction, contractile activity, mechanics.
- Cellular Junctions: Gap junctions, adherens junctions, integrins

Unit 2: Integration and Control of the Cardiovascular System

This unit aims to expand the knowledge obtained in Unit 1 into circulatory systems and control situations.

- Haemodynamics
- Microcirculation
- Lymphatics: fluid exchange, oedema, cellular basis of lymphatic function
- Control of blood pressure
- Control of cardiac output
- Interaction with Neurohumoral Control: autonomic, hormonal, paracrine
- Control of the Regional Circulations
- Cardiovascular Regulation During Exercise

Unit 3: Molecular Approaches in the Study of the Cardiovascular System

Using modern state-of-the-art experimental approaches this unit aims to use pathophysiological situations to highlight function of the cardiovascular system.

- Circulatory Shock
- Cardiac Arrhythmia and Heart Failure
- Atherosclerosis – alterations in lipid handling leading to disturbed endothelial function and vasoreactivity.
- Reactive Oxygen Species / Ischemia Reperfusion / Adhesion
- Hypertension – use of animal models, including transgenic animals, for the study of disturbances in blood pressure control.

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Demonstrate a basic understanding of the scope of cardiovascular physiology, and more detailed knowledge in vascular cell function, blood flow regulation, and cardiovascular function in exercise.
2. Apply basic physical and physiological principles to address questions related to cardiovascular function and pathophysiology.
3. Demonstrate critical evaluation and self-directed learning skills by effectively summarising and presenting research on a specific area of cardiovascular physiology and pathophysiology.
4. Demonstrate an understanding of the experimental approaches related to cardiovascular systems, and the interpretation of the experimental results.

2.4 Relationship between course learning outcomes and assessments

Course Learning Outcome (CLO)	**LO Statement**	**Related Tasks & Assessment**
CLO 1	Demonstrate a basic understanding of the scope of cardiovascular physiology, and more detailed knowledge in vascular cell function, blood flow regulation, and cardiovascular function in exercise.	Mid-session Exam Final Examination
CLO 2	Apply basic physical and physiological principles to address questions related to cardiovascular function and pathophysiology.	Mid-session Exam Final Examination Problem-Based Learning (PBL) Session
CLO 3	Demonstrate critical evaluation and self-directed learning skills by effectively summarising and presenting research on a specific area of cardiovascular physiology and pathophysiology.	Poster Presentation Problem-Based Learning (PBL) Session
CLO 4	Demonstrate an understanding of the experimental approaches related to cardiovascular systems, and the interpretation of the experimental results.	Mid-session Exam Final Examination Poster Presentation

3. Strategies and approaches to learning

3.1 Learning and teaching activities

Lectures

Face-to-face lectures will not be held in 2023. These will be made available as **pre-recordings accessible through Moodle and Teams**.

Practical / Laboratory Classes

We ask you to attend all practical classes. These are held in WW120, 10AM – 1PM Wednesdays, weeks 1-5 and week 8 (6 classes in total). These classes feature:

•Allowances for physical distancing.

•Additional health and safety measures have been introduced to keep students and staff safe.

•Work in teams of 4 students.

•Online practical group available - will be provided with online resources, and access to a synchronous Q&A session for each face-to-face practical class.

The practical classes are Cardiac Muscle; Recording and Interpretation of the ECG; Computer Lab; Microcirculation; Exercise Physiology and the Autonomic Nervous System. Completion of pre- and post-lab modules (where present) is compulsory. Students will be examined on the findings of these practicals and the concepts explored as part of the mid-session and final examinations.

Problem-Based Learning (PBL) Session

Students will undertake self-directed learning using case studies or scenarios relevant to cardiovascular physiology. In an introductory session students will be given an outline of the problem and "clues" towards what information is required. Students will then research the material and present their findings at a subsequent session. Facilitators will be available to provide direction. Students are split into groups of about 15. **Attend these classes** on campus.

Poster Presentation

Work will be undertaken in groups of 3-4, to which students will self-organize or be assigned. Each group will have a topic area assigned to them, and a published paper to report upon. The final product will be a Poster and should include: an Introduction; Methods; Data drawn from the article; Summary.

This poster must be completed for display between 10 AM and 1 PM on Wednesday 3rd August 2022.

Each group is expected to provide a brief (15-20 mins) oral presentation of poster.

Possible Topics:

1. Endothelium-mediated vasodilatation.
2. Conducted responses in the vasculature.
3. Ca^{2+}-dependency of smooth muscle contraction.
4. Ion channels in regulation of vascular tone.
5. Ion channels in regulation of cardiac function.
6. Mechanotransduction in vascular / cardiac cells.
7. Regulation of lymphatic (vaso) motion.
8. Exercise and cardiovascular remodelling.
9. Impact of altitude on cardiovascular physiology.
10. Transgenic models in the study of the cardiovascular system.
11. Cellular mechanisms underlying hypertension.

12. Cellular mechanisms underlying atherosclerosis.
13. Circulatory shock
14. Mechanisms underlying cardiac arrhythmia / heart failure.
15. Vascular remodelling.
16. Heart regeneration and cardiac reprogramming technology

Students may select a topic from the above list, plus a journal article upon which to base their final presentation. Students may use the literature to find extra journal articles to complement their poster presentation. Students may consult with Dr. Murphy or other staff members regarding their assigned topic prior to completing the poster project. Assessment will be based on both the poster presentation and its oral defence.

Seminars / Tutorials

On Tuesdays in weeks 2, 3, 5 and 9 there will be a live (face-to-face) 1-hour tutorial / seminar session at 9AM in Mathews Theatre B, which will also be recorded. These will alternately focus on certain aspects of cardiovascular physiology not covered thoroughly in lectures, or function as review sessions.

3.2 Expectations of students

Students are reminded that UNSW recommends that a 6 units-of-credit course should involve about 150 hours of study and learning activities. The formal learning activities total approximately 50 hours throughout the term and students are expected (and strongly recommended) to do at least the same number of hours of additional study.

Course-specific expectations of students:

- 3-4 hours lecture material per week to be viewed at your convenience.
- On-campus attendance for labs and PBL classes (10-1 Wednesdays).
- Completion of PBL assignment and group project at your own convenience. Assessment on-campus.
- protocols governing email, social networks and discussion forums.

4. Course schedule and structure

This course consists of 27 hours of class contact hours. You are expected to take an additional 40 hours of non-class contact hours to complete assessments, readings and exam preparation.

Week [Date/Session]	Topic [Module]	Activity [Learning opportunity]	Related CLO
Week 1 **May 29 -Jun 2**	Cellular Aspects of the Cardiovascular System	Cardiac Muscle (L) Vascular Smooth Muscle (L) Cardiac Muscle (P)	1 1 2
Week 2 **Jun 5 - 9**	Cellular Aspects of the Cardiovascular System	Vascular Endothelium (L) Introduction to the ECG (L) Recording and Interpretation of the ECG (P)	1 1 2
Week 3 **Jun 12 - 16**	Integration and Control of the Cardiovascular System	Control of Cardiac Output (L) Haemodynamics (L) Unit One Revision (S) Computer Lab: Isolated Heart Muscle and Cardiovascular Exercises (P)	1 1 2 2
Week 4 **Jun 19 - 23**	Integration and Control of the Cardiovascular System	Microcirculation and Lymphatics (L) Microcirculation (P)	1 2
Week 5 **Jun 26 - 30**	Integration and Control of the Cardiovascular System	Autonomic Control of the Cardiovascular System (L) Cardiovascular Regulation During Exercise (L) Inflammation and the Microcirculation (S) Exercise Physiology (P) Mid-session exam	1 1 1 2 1, 2, 4
Week 7 **Jul 10 - 14**	Integration and Control of the Cardiovascular System	Control of Blood Pressure (L) Control of the Regional Circulations (L) Revision exercise (S) PBL-1 *'Joan Murray'*	1 1 3, 4 2, 3

Week 8 **Jul 17 - 21**	Molecular Approaches in the Study of the Cardiovascular System	Circulatory Shock (L) Atherosclerosis (L) Autonomic Control of the CVS (P)	1 1 2
Week 9 **Jul 24 - 28**	Molecular Approaches in the Study of the Cardiovascular System	Heart Failure (L) Cardiac Arrhythmia (L) Revision exercise (S) PBL-2'*Joan Murray*'	1 1 3, 4 2, 3
Week 10 **Jul 31 – Aug 4**	Molecular Approaches in the Study of the Cardiovascular System	Hypertension (L) Oxygen Radicals and Reperfusion Injury (L) Poster Presentations	1 1 3, 4

Exam Period: 11 Aug – 24 Aug 2023

Supplementary Exam Period: 4 Sep – 8 Sep 2023

5. Assessment

5.1 Assessment tasks

Assessment task	Length	Weight	Mark	Due date and time
Assessment 1: Mid-session Exam The mid-session examination is composed of multiple-choice and short answer questions covering both lecture and practical class content from approximately the first half of the course. For the practical component, students will be examined on the experimental approaches and interpretation of results. Feedback is provided through grades and model answers released to students following assessment.	60 min	30%	/25 15 MCQ (1 each) 2 SAQ (5 each) (scaled to 30)	Weds June 28th, 4-5 PM
Assessment 2: Problem-Based Learning (PBL) Session Students will undertake self-directed learning using a case study or scenario relevant to cardiovascular physiology and pathophysiology. Students will be given an outline of the problem and "clues" towards what information is required, and tutors will be available to support this activity. Students will then research the material and present their findings using both oral and written communication. The oral presentation is to last no longer than 5 minutes and may be accompanied by slides, overheads or other visual aids. The written summary is to be no longer than a single-side A4-sized sheet. Feedback is provided at the end of the assessment process with specific comments and marks.	5 min oral plus 1 written page	10%	/15 5 marks participation 10 marks presentation (scaled to 10)	Weds July 12th and 26th, 10 AM - 12 PM
Assessment 3: Poster Presentation Students will work in groups to evaluate and summarise a research article on a specific topic of cardiovascular physiology and pathophysiology and to communicate this work in a poster presentation. Groups and topics will be assigned. The poster should include: an Introduction; Methods; Data drawn from the article; and a Summary. Each group is expected to also provide a brief (5	~30 min oral (plus poster)	20%	/20 (see Moodle-Teams for assessment rubric)	Weds August 2nd, 10AM – 1 PM

mins) oral presentation of poster. The task is worth 20%: 15% ascribed by the examiners based on both the poster presentation and its oral defence, where each group member gets the same grade; and 5% peer-marked based on a mark given to each individual group member by fellow group members. Feedback is provided at the end of the assessment process with specific comments and marks.				
Assessment 4: Final Examination The final examination will be a 2-hour exam composed of multiple-choice and short answer questions covering both lecture and practical class content from approximately the second half of the course. For the practical component, students will be examined on the experimental approaches and interpretation of results. Feedback is provided through grades incorporated into a final course grade released via official UNSW communication.	120 min	40%	/55 25 MCQ (1 each) 3 SAQ (10 each) (scaled to 40)	TBD (11-24 August)

Further information

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

5.2 Assessment criteria and standards

Mid-Session Exam

The mid-session test on June 28th will be a 1-hour online exam on the material covered to the end of Week 4 including practical material where it overlaps with lecture material (e.g. ECGs, refractory periods etc.). The format is 15 MCQs worth 1 mark each and a choice of 2 from 4 short-answer questions worth 5 marks each. Total = 25 marks.

Marking scheme:

Class Interaction – Assessed by facilitator during session 1 of PBLs 1-4

Standard	Mark (out of 5)	Required Performance
Very Poor	0-1	- no participation in class discussion; not obviously listening to other group members
Poor	2	- minimal participation; only participated in response to direct questioning
Adequate	3	- participated in discussion voluntarily;
Good	4	- voluntarily contributed to the group discussion; provided insightful comments or questions
Very Good	5	- major role in group discussion without dominating the group and still allowing other members of the group to contribute

Reporting – Presentation assessed by facilitator during session 2 of PBLs 1-4

Standard	Mark (out of 10)	Required Performance
Very Poor	0-2	- no research or preparation on allocated topic
Poor	3-4	- inadequate research on the allocated topic - explanation unclear or contains major errors
Adequate	5-7	- adequate research on the topic - mainly accurate information provided, although some errors noted - failure to comply with time limit, slide or handout requirements eg provided too much information
Good	8-9	- topic researched thoroughly - information explained clearly, accurately and concisely - complied with time limit, slide and handout requirements - good understanding of topic and able to answer questions - able to relate their topic to the whole PBL
Very Good	10	- topic researched thoroughly - information explained clearly, accurately and concisely - information presented in an interesting or novel way - complied with time limit, slide and handout requirements - thorough understanding of topic and able to answer questions - able to relate their topic to the whole PBL

Problem-Based Learning (PBL) Session

Marking rubric below:

Standard / Mark	Poster appearance	Presentation	Questions
Poor 1	Poster very difficult to read or understand; inadequate content, font and diagrams too small. Key information from article not shown.	Students lack understanding of article; simply read text directly from article.	Unable to answer questions
Fair 2	Poster difficult to read and understand; too much text. Some key information from article not shown.	Students have tried to summarize article but show lack of understanding (read article text).	Questions answered poorly and / or one group member dominates answers; consult article often.
Good 3	Poster laid out neatly with readable text and Figures; key information included.	Article mostly summarized with clarity with students showing some understanding of the article.	Answers to questions are reasonably shared amongst group and mostly adequate; some aspects not clear unless manuscript consulted.
Very good 4	Poster design and layout enables easy reading and highlights important data / key points.	Students have summarized article succinctly and can explain rationale, methods, findings and conclusions.	Answers to questions are shared evenly amongst group and comprehensive, some appreciation of broader implications.
Excellent 5	Poster design and layout shows imagination and effort to assist interpretation and highlight key points.	Students demonstrate thorough understanding of article through summary of all aspects.	Answers shared and comprehensive, mostly support excellent understanding of article and broader implications.
TOTAL / 15	Subtotal / 5	Subtotal / 5	Subtotal / 5

Your individual contribution (as assessed by other members of your group; see below; 5 marks)
Total = 20 marks

Poster Presentation

Group members – Evaluation form

Student name: _____

Instructions: Use this form to evaluate the members of your group. Write the name of each member, including yourself, at the top of one of the columns, then assign a score of 0 to 5 (0 being the lowest grade, 5 the highest) to each group member for each criterion. Because each group member has different strengths and weaknesses, the scores you assign will differ. Write any additional comments you wish to make at the bottom of the sheet.

Criterion	Group members			
Regularly attends meetings				
Is prepared at meetings				
Meets deadlines				
Contributes good ideas				
Effort given to researching subject				
Submits high-quality work				
Listens to other group members				
Gives constructive feedback				
Responds to feedback				
Overall assessment of this person's contribution				
Average (/5)				

Comments:

Final Examination

The final exam will be a 2-hour online exam on the material covered over the entire course (i.e. including weeks 1-4), focussing primarily on lecture material. The format is 25 MCQs worth 1 mark each and a choice of 3 from 7 short-answer questions worth 10 marks each. Total = 55 marks.

5.3 Submission of assessment tasks

Late Submission

UNSW has standard late submission penalties as outlined in the UNSW Assessment Implementation Procedure, with no permitted variation. All late assignments (unless extension or exemption previously agreed) will be penalised by 5% of the maximum mark per day (including Saturday, Sunday and public holidays). For example, if an assessment task is worth 30 marks, then 1.5 marks will be lost per day (5% of 30) for each day it is late. So, if the grade earnt is 24/30 and the task is two days late the student receives a grade of 24 – 3 marks = 21 marks.

Late submission is capped at 5 days (120 hours). This means that a student cannot submit an assessment more than 5 days (120 hours) after the due date for that assessment.

Special Consideration

If you experience a short-term event beyond your control (exceptional circumstances) that impacts your performance in a particular assessment task, you can apply for Special Considerations.

You must apply for Special Consideration **before** the start of your exam or due date for your assessment, except where your circumstances of illness or misadventure stop you from doing so.

If your circumstances stop you from applying before your exam or assessment due date, you must **apply within 3 working days** of the assessment, or the period covered by your supporting documentation.

More information can be found on the Special Consideration website.

5.4. Feedback on assessment

Mid-session Exam – mark breakdown and comments will be provided through Inspera or Moodle within 1 week of exam completion.

PBL Session - mark breakdown and comments relevant to the marking rubric will be provided through Moodle within 1 week of class completion.

Poster Presentation - mark breakdown and comments relevant to the marking rubric will be provided through Moodle within 1 week of class completion.

Final Examination – feedback on mark breakdown and comments provided upon request.

6. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Please use Vancouver or APA referencing style for this course.

Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity *is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect,*

responsibility and courage.[1] *At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.*

Further information about academic integrity and ***plagiarism*** *can be located at:*

- *The Current Students site* https://student.unsw.edu.au/plagiarism*, and*
- *The ELISE training site* https://subjectguides.library.unsw.edu.au/elise

The Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct.

7. Readings and resources

Herring N. and Paterson DJ. Levick's Introduction to Cardiovascular Physiology 6th Ed., CRC Press, 2018. https://unswbookshop.vitalsource.com/products/levick-39-s-introduction-to-cardiovascular-physiology-neil-herring-v9781498739917

Boron WF and Boulpaep EL. Medical Physiology 3rd Ed., Elsevier, 2017. https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9781455743773

Hall JE. Guyton and Hall Textbook of Medical Physiology, 13th Ed., Elsevier, 2015 (online through library).

8. Administrative matters

Student enquiries should be submitted via student portal https://portal.insight.unsw.edu.au/web-forms/

9. Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- *Student Wellbeing and Health* https://www.student.unsw.edu.au/wellbeing
- UNSW IT Service Centre: https://www.myit.unsw.edu.au/services/students
- *UNSW Student Life Hub:* https://student.unsw.edu.au/hub#main-content
- *Student Support and Development:* https://student.unsw.edu.au/support
- *IT, eLearning and Apps:* https://student.unsw.edu.au/elearning
- *Student Support and Success Advisors:* https://student.unsw.edu.au/advisors
- *Equitable Learning Services (Formerly Disability Support Unit):* https://student.unsw.edu.au/els
- *Transitioning to Online Learning* https://www.covid19studyonline.unsw.edu.au/
- *Guide to Online Study* https://student.unsw.edu.au/online-study

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.