CAPS 432 Course Syllabus

CAPS 432 Systems Physiology in Human Health and Disease I (3 Credits)

Academic Calendar Description*:*
Major discoveries and current advancements that are revolutionizing our understanding of the physiological, compensatory responses of the human body to extreme conditions . [3-0-0

Prerequisites
CAPS 305 and CAPS 306 and CAPS 310, (or CAPS 301)

Corequisites: *None*

Other Requirements
This course is open to CAPS Majors and Honours students. Other 4th year students with 3 and 4 year cell biology credits may be considered at the discretion of the Course Director

Instructional Schedule**:** *2 weekly 90 min sessions*

Student Expectations
Attend all classes and all exams in person. Read all assigned literature. Prepare any requested materials for presentations in class. Actively contribute to all class discussions.

Course Structure
2 SESSIONS PER WEEK (1.5 HOURS EACH). Each session comprises in-person classes. Sessions are comprised of both lecture-based and seminar-based instruction with all materials provided at the start of term on CANVAS. The course instructor will provide an introduction to the concept and a groupof students will then be responsible for presenting and leading discussion on the selected papers.An exam at midterm and at end of term will be in person and will examine the respective half ofthe course.

Learning Materials
All learning and reading material will be provided in PDF format on Canvas prior to the start ofterm. This will include all assigned reading and Instructor lecture and instructional material.

Assigned literature comprises original research articles that are intended to be 'current', therefore these will be added before the start of each term. Prior to each session, students must have read these research articles.

Student Journal Clubs: Students will be assigned to groups, each will present one of the figures for discussion. These are not graded. The purpose is to become familiar with modern literature and to develop skills in hypothesis generation and testing.

Examples of assigned research articles include:

Limiting factors for maximum oxygen uptake and determinants of endurance performance Bassett , David R. Jr. Edward T. Howley, Medicine & Science in Sports & Exercise 32(1):p 70, January 2000. PMID: 10647532

An acute immune response underlies the benefit of cardiac stem cell therapy.
Vagnozzi RJ, Maillet M, Sargent MA, Khalil H, Johansen AKZ, Schwanekamp JA, York AJ, Huang V, Nahrendorf M, Sadayappan S, Molkentin JD., Nature. 2020 Jan;577(7790):405-409. PMID: 31775156

Instructor Contacts

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Other Instructional Staff

TA's to be updated annually

Acknowledgements

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓ əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next on this site.

Learning Outcomes

At the successful completion of this course, students will be able to:

1) Discuss and analyze cardiopulmonary responses to stressors.
2) Discuss and explain cardiopulmonary adaptations to disease and their limitations.

2) Design experimental protocols to test hypotheses.
3) Demonstrate the ability to present, understand and evaluate literature.
4) Compare and contrast physiological adaptations to stressors and disease states.

Schedule of Topics

For each week: Assigned literature comprises original research or review articles (maximum 2per class) that are intended to be 'current', therefore these will be added before the start of eachterm. Prior to each session, students must have read these research articles.

MODULE 1 – INTEGRATED CARDIOPULMONARY PHYSIOLOGY IN REAL LIFEAPPLICATIONS

WEEKS 1&2. Advanced Exercise Physiology 1 (4 sessions)

Session 1

Students will apply their understanding of integrated cardiopulmonary and autonomic physiology to the physiological stress associated with an acute bout of exercise. Focus will be placed upon how the body responds to the anticipation and initiation of exercise across all physiological systems.

Session 2

Students will develop an advanced understanding of how feed-forward vs. feedback neural control mechanisms 'tune' the cardiopulmonary system to ensure an appropriate physiological response to exercise.

Session 3

Students will compare and contrast strength vs. endurance training on the cardiovascular system.

Session 4

Students will discuss limiting factors underlying maximal aerobic capacity (i.e., VO2max) and elite endurance running performance. Paper – Student journal club

Week 3: Up, Up, And Away: Exercise Physiology In The Setting Of High-Altitude And Space

Session 5

QUIZ
Students will be able to apply their understanding of integrated cardiopulmonary

physiology to compare and contrast exercise responses at high altitude between low-landers and highlanders. The concept of altitude training as a way to improve elite endurance performance will also be introduced.

Session 6

Students will learn about the impact spaceflight has on systems physiology through an integrated lens. The usefulness of exercise training as part of long-term space missions, to stave of future disease, will also be examined.

MODULE 2: EXTREME CONDITIONS - CARDIOPULMONARY RESPONSES TO SPINAL CORD INJURY.

Session 7: Effect of SCI on the heart and cardiac function

Students will be able to apply their understanding of integrated cardiopulmonary physiology to describe how spinal cord injury affects the heart and cardiac function, the level-dependence of these effects, the underlying importance of the bulbospinal pathway and its input to presympathetic preganglionic neurons, and how exercise helps ameliorate effects of SCI on cardiac function.

Session 8: Effect of SCI on blood pressure & autonomic dysreflexia

Students will be able to describe the role of supraspinal input, baroreflexes, and sympathetic circuitry in blood pressure regulation and to describe the anatomical and physiological basis for autonomic dysreflexia following spinal cord injury with a particular emphasis of remodeling of spinal autonomic circuitry. Students will also be able to define the cardiovascular manifestations of autonomic dysreflexia in the short-term (i.e. during an episode) and in the long-term.

Session 9: Interventions to improve cardiovascular and autonomic function following SCI

QUIZ
Students will be able to describe cutting edge technological, cellular, and systems approaches to improve cardiovascular and autonomic function in acute and chronic SCI.

Session 10: Focus on recent literature in experimental strategies to treat autonomic dysreflexia following spinal cord injury (Acute post-injury blockade of α2δ-1 calcium channel subunits prevents pathological autonomic plasticity after spinal cord injury, Cell Reports 2021 Brennan et al.). Students will be able to critique key literature with respect to the efficacy of Gabapentin as a treatment for autonomic dysreflexia and the underlying cellular and molecular mechanisms. Paper – Student journal club

Session 11: Students will learn the organization of respiratory motor circuitry and how their disruption after SCI leads to impaired respiratory function. They will understand the short

and long-term consequences of SCI on respiratory function, and where in the brain and spinal cord plasticity can occur to mediate recovery of respiratory function.

Session 12. MIDTERM

MODULE 3 – INHERITED AND ACQUIRED DISEASE

WEEK 7. Heart Failure

Sessions 13 and 14

An integrated, systems level analysis of heart failure, from compensated to decompensated. Examples will be drawn from cases with both preserved and reduced ejection fraction. At the end of the sessions, students will be able to analyse and critique the body's physiological response to heart failure and discuss male and female differences in the responses and the use of exercise as a treatment strategy.

WEEK 8. Development And Inherited Disease

Session 15

Students will be able to describe and discuss cardiopulmonary system transformations in development; fetal to neonatal to adult.

Session 16

Students will be able to differentiate between numerous common cardiac malformations and their physiological consequences, including Atrial Septal Defect, Ventricular Septal Defect and Patent Ductus Arteriosus and to discuss their lifelong impact.

WEEK 9. The Physiology Of Ageing

Session 17

Students will be able to describe systems and molecular level events that accompany ageing with an emphasis on the cardiopulmonary system and to compare and contrast those with development.

Session 18

QUIZ
Stem cells as viable treatments for inherited and acquired diseases. Paper – Student journal club.

MODULE 4. SLEEP APNEA

Session 19

Students will be able to discuss the body's known molecular and systems level changes that accompany the diurnal cycle.

Session 20

Diagnosis, treatment and physiologic consequences of central and obstructive sleep apnea.
Students will be able to differentiate between chronic intermittent hypoxia, increased sympathetic activation, oxidative stress and systemic inflammation as potential mechanisms of clinical outcomes.

Session 21.

Students will be able to compare and contrast findings from recent studies that have probed how sympatho-excitation may be a central component underlying sleep apnea, inboth animal models and human patients.

Session 22

Students will be able to identify and discuss the molecular pathophysiology underlying sleep apnea

Session 23

QUIZ
Sleep apnea and its connection to cardiac arrhythmias

Session 24

Paper – Student journal club

Assessments of Learning

Assessment is in the form of four in-class quizzes close to the end of each module that

examine factual information presented in that module, and two invigilated exams. The exams only include material not covered by a prior exam.

Quiz #1	10%
Quiz #2	10%
Midterm Exam	30%
Quiz #3	10%
Quiz #4	10%
Final Exam	30%