CAPS 421 Cell Biology and Human Disease

CAPS 421.Course Syllabus

CAPS 421. **Cell Biology and Human Disease (3 Credits)**

Academic Calendar Description:
Outlines major discoveries and current advancments that are revolutionalizing our understanding of subcellular structure and function in health and diseases such as cancer [3-0-0]

Prerequisites
CAPS 306

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 requested materials for presentations in class. Actively contribute to all class discussions.

Course Structure
2 SESSIONS PER WEEK (2 HOURS EACH) total of 36 hours.. Each session comprises in-person classes. Lecture-based and active learning-based instruction with all materials provided at the start of term on CANVAS. In each lecture session, the instructor will focus on a specific concept and provide background. Active learning sessions provided for each module will provide opportunities for students to lead guided discussions through the presentation of the assigned literature. These active learning sessions will provide opportunities for students to discuss the relative impact of advances in the field. An exam at mid term and at end of term will be in person and will examine the respective half of the course.

Learning Activities
Each week, all students are expected to read and understand the assigned literature prior to each class.

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

CAPS 421 Cell Biology and Human Disease

Topical original articles (at least 2 per class) will be assigned at the start of term for all these classes. As these articles will include current papers, these will be added at a later date. Prior to each session, students must have read the following research articles. The expected level of comprehension will be a broad understanding of the article's main goals, methodologies, observations and conclusions. This should take no longer than 2 hours. Once per term, each student will be expected to read the assigned literature more deeply to put together a 4-5 slide summary that they will use in class to lead discussion on the paper.

Instructor Contacts

Course director - Hilla Weidberg. <hilla.weidberg@ubc.ca>
Assistant Professor, Dept. of Cellular and Physiological Sciences.

Ivan Robert Nabi. <irnabi@mail.ubc.ca>
Professor, Dept. of Cellular and Physiological Sciences.

Christopher Loewen. <cloewen@mail.ubc.ca>
Professor, Dept. of Cellular and Physiological Sciences

Calvin Roskelley. <calvin.roskelley@ubc.ca>
Professor, Dept of Cellular and Physiological Sciences, Obstetrics and Gynecology, and Biomedical Engineering.

Other Instructional Staff

TA's to be updated annually

Acknowledgement

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (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

Module 1: The endoplasmic reticulum (ER) and cellular stress

- The endoplasmic reticulum (ER) and cellular stress
  Describe how ER shaping proteins define the structure of the ER at the macro and nanoscales.
- Explain the mechanisms underlying protein folding in the ER and how defects in this process contribute to cystic fibrosis
- Describe how organelle functions are maintained under stress: From retrograde signaling to organelle repair

Module 2: Membrane domains and organelles including ER, mitochondria, and peroxisomes.

- Describe how proteins are targeted and inserted into organelles and how defects in this process cause disease
- Differentiate between the different types of MERCs and their function
- Describe the different types of ER-PM contacts and their functions in different organism
- Explain how lipids act as signalling molecules through their biophysical properties and their interaction with proteins
- Explain the domain organization of the plasma membrane and its regulation of receptor signaling
- Explain the domain organization of the plasma membrane and its regulation of receptor signaling

Module 3: Glycosylation and disease, from the golgi to endolysosome

- Describe Golgi structure and its role in glycosylation, cancer progression and metastasis.
- Describe endosome maturation and diverse endocytic processes.
- Describe lysosomal function and regulation, and also how defective mitophagy contributes to Parkinson's disease.

Module 4: Cellular interaction and cancer progression

- Describe how cancers form, and the role of substrate adhesion and the actin cytoskeleton in tumor cell migration
- Explain intrinsic and extrinsic forces in in the microenvironment modulate cell structure and function via cell-ECM adhesion complexes
- Describe how cell-cell adhesion complexes lead to the formation of a mechanically coupled unit that responds to microenvironmental forces in an integrated manner.
- Outline how mechanical adhesion complex coupling to the cytoskeleton influences biochemical signal transduction to regulate changes in chromatin structure and gene expression

Schedule of Topics

.

WEEK 1

MODULE 1. THE ENDOPLASMIC RETICULUM (ER) AND CELLULAR STRESS

Session 1. Course introduction and review of cell biology fundamentals (Nabi)

- Students will be able to describe fundamental aspects of cell biology from their previously acquired knowledge.

Session 2. Endoplasmic reticulum organization and function (Nabi)

- Students will be able to describe how ER shaping proteins define the structure of the ER at the macro and nanoscales.

WEEK 2.

Session 3. Endoplasmic reticulum quality control and CFTR in cystic fibrosis (Nabi)

- Students will be able to describe the mechanisms underlying protein folding in the ER and how defects in this process contribute to cystic fibrosis.

Session 4. Organelle stress and signaling (UPR ER Stress) (Weidberg)

- Students will be able to how organelle functions are maintained under stress, from retrograde signaling to organelle repair.

WEEK 3

MODULE 2. MEMBRANE DOMAINS AND ORGANELLES INCLUDING ER, MITOCHONDRIA, AND PEROXISOMES.

Session 5. Protein targeting to mitochondria and peroxisomes (Weidberg)

- Students will be able to describe how proteins are targeted and inserted into organelles and how defects in this process cause disease.

WEEK 4

Session 6. Mitochondria-ER contacts (MERCs): structure and function (Nabi)

- Students will be able to explain the different types of MERCs and their function.

Session 7. Plasma membrane-ER contact sites: structure and function (Loewen)

- Students will be able to describe the different types of ER-PM contacts and their functions in different organisms

WEEK 5

Session 8. Lipid signalling (Loewen)

- Students will be able to describe how lipids act as signalling molecules through their biophysical properties and their interaction with proteins.

Session 9. Plasma membrane organization and receptor signaling (Nabi)

- Students will be able to describe the domain organization of the plasma membrane and its regulation of receptor signaling.

WEEK 6

Session 10. Mid-term exam (covering material in weeks 1-6)

WEEK 7

MODULE 3. GLYCOSYLATION AND DISEASE, FROM THE GOLGI TO ENDOLYSOSOME

Session 11. The Golgi and protein glycosylation in cancer (Nabi)

- Students will be able to describe Golgi structure and its role in glycosylation, cancer progression and metastasis.

WEEK 8

Session 12. Endocytosis and the CLIC pathway (Nabi)

- Students will be able to describe endosome maturation and diverse endocytic processes.

Session 13. Lysosomes and autophagy: ESCRT and Parkinson's disease (Nabi)

- Students will be able to describe lysosomal function and regulation, and also how defective mitophagy contributes to Parkinson's disease.

WEEK 9

MODULE 4. CELLULAR INTERACTION AND CANCER PROGRESSION

Session 14. Cell-substrate adhesions and tumor cell migration (Nabi)

- Students will be able to describe how cancers form and the role of substrate adhesion and the actin cytoskeleton in tumor cell migration.

WEEK 10

Session 15. Cellular responses to microenvironmental forces (Roskelley)

- Students will be able to explain how intrinsic and extrinsic forces in the microenvironment modulate cell structure and function via cell-ECM adhesion complexes.

Session 16. Building mechanically-coupled multicellular structures (Roskelley)

- Students will be able to explain how cell-cell adhesion complexes leads to the formation of a mechanically coupled unit that responds to microenvironmental forces in an integrated manner.

WEEK 11

Session 17. Integration of mechanical and biochemical signaling to regulate gene expression (Roskelley)

- Students will be able to describe the mechanical adhesion complex coupling to the cytoskeleton influences biochemical signal transduction to regulate changes in chromatin structure and gene expression.

WEEK 12

Session 18. End of-term exam (covering material in weeks 7-12)

Assessments of Learning

Assessment is in the following form:

1) A short quiz at the start of each active learning class will test the content of the assigned literature. These quizzes will be administered through CANVAS. The end of term mark for quizzes will be the mean of all quizzes, and represent 10% of the final mark.

2) For each active learning class, a group of students will be responsible for preparing discussion questions and leading the discussion for the assigned literature (no more than 4-5 slides). Each student will receive 20% of their final course mark based on instructor assessment of their performance. Each student will participate in one of these during the course.

3) Two invigilated, in person exams. The midterm exam assesses comprehension of material covered in the first half of term only. The end of term exam assesses comprehension of material covered in the second half of term only.

Tentative grading scheme:

Short quizzes on assigned literature(s) at beginning of active learning sessions	10%
Leading discussion of assigned literature	20%
Midterm exam (introductory content plus 3 papers from each of the 2 sections)	35%
End of term exam (introductory content plus 3 papers from each of the 2 sections)	35%

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available at the Policies and Rsources section of the UBC Senate website.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Discipline for Academic Misconduct section of the UBC Academic Calendar.

- No assignment may be submitted to any other instructor of any course for a grade.
- The minimum penalty for plagiarism in any assignment is a zero for the paper; the maximum penalty is a zero for the course.

UBC Grading Standards

Undergraduate Grading Scale

Percentage (%)	Letter Grade
90-100	A+
85-89	A
80-84	A-
76-79	B+
72-75	B
68-71	B-
64-67	C+
60-63	C
55-59	C-
50-54	D
0-49	F

Learning Analytics

Learning analytics includes the collection and analysis of data about students to improve teaching and learning. This course will be using the following learning technologies: [Canvas, WordPress, edX, iPeer, Piazza….]. Many of these tools capture data about your activity and provide information that can be used to improve the quality of teaching and learning. In this course, I plan to use analytics data to: [Example data uses:]

View overall class progress
Track your progress in order to provide you with personalized feedback
Review statistics on course content being accessed to support improvements in the course
Track participation in discussion forums
Assess your participation in the course]

Learning Resources
All learning resources will be accessible on CANVAS at the start of each term

Copyright