

CAPS 306 Course Syllabus

CAPS 306. Molecular and cellular mechanisms of human health and disease (3 Credits)

Academic Calendar Description:

A study of the molecular and cellular mechanisms of human health, disease and therapeutics. [3-0-0]

Prerequisites:

CAPS 205 or 206 or BIOL 200.

Corequisites:

None

Student Expectations

Students are required to read all online modules, using session objectives to guide learning topics. Students are expected to complete all examinations and achieve an overall grade of 50% to pass the course.

Learning Activities

All classes are in person. Lectures and relevant materials will be provided prior to the start of the term. All students are expected to read the material for each class.

Learning Materials

All learning material is taken from a combination of textbooks (provided below) and additional current research literature (provided at the start of term in PDF format on CANVAS prior to the start of term).

Recommended Texts: Selected chapters from:

Molecular Biology of the Cell, Sixth Edition, Editors: Alberts, Johnson, Lewis.

Developmental Biology. Thirteenth Edition, Editor: Barresi, Gilbert.

Course Structure

There will be three 50-min sessions per week. Each session consists of an online module accessed via the course CANVAS site, and both asynchronous and in-person classes.

Course Director

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Land Acknowledgements

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

- The major signaling pathways in cellular communication
- The major cellular pathways dysregulated in cancer, including signaling pathway disruption, oncogenes and tumor suppressors, cellular polarity, proliferation and apoptosis, epithelial mesenchymal transition (EMT) and delamination in metastasis.
- The major processes in early human embryology up to the formation of major organ systems and the mechanism of lineage progression through body plan patterning, cellular specification and the differentiation of cellular identities.
- The origin and utility of embryonic stem cells, and how we can utilize knowledge regarding cellular specification and differentiation to program, reprogram and trans-differentiate cells for use in research and therapy.
- The development of induced pluri-potential stem cells and how they can be programmed to specific cellular fates and organoids.
- The roles of organelles in cellular health and their disruption in congenital and aging disorders. Including lysosomes, endoplasmic reticulum, peroxisomes, mitochondria.
- Describe challenges in rare and unresolved disorders, primarily with regard to the role of human genetics in identifying alleles of interest and how next generation sequencing technologies can assist in identifying novel de novo alleles of interest in rare disease cases.
- Describe strategies to manipulate the processes and pathways described above that are used to develop novel biologics that can be used therapeutically.

Schedule of Topics (36 50-min Sessions Total):

Module 1: Signaling

1-3. Signaling in health, disease and therapeutics - Classical Signaling Pathways (Roskelley)

- Cell surface, intracellular and nuclear receptor-initiated pathways
- Signal crosstalk
- small molecule inhibitors
- signal-mediated transcriptional regulation

4-6. Signaling in Cancer I: Initiation (Roskelley)

- Cell cycle, cell death, senescence
- Oncogene activation/tumor suppressor inactivation
- Broad-based and rational chemotherapeutics

7-8. Signaling in Cancer II: Progression (Roskelley)

- Cell adhesion, cell polarity
- Cell migration, invasion, EMT, metastasis

9. Module 1 test (50-min in class time)

Assigned readings for Module 1

Textbook: Molecular Biology of the Cell, Sixth Edition, Alberts, Johnson, Lewis - Chapter 15 Cell Signaling, Chapter 17 Cell Cycle, Chapter 19 Cell Junctions and ECM, Chapter 20 Cancer

Module 3: Embryology

10-12. Human Embryology 1: The germline (Allan)

- Meiosis and gametogenesis
- Germline vs de novo genetic variation

13-15. Human Embryology 2: Zygotic development (Allan)

- Gastrulation - proliferation
- body plan patterning - apoptosis
- cell lineage specification

16-17. Stem cells (Allan)

- Embryonic and induced pluripotent stem cells
- Stem cell programming in research and therapy

18. Module 2 test (50 min in class time)

Assigned readings for module 2:

Textbook: Developmental Biology 13th Edition, Barresi, Gilbert. Selected readings from Part II Gametogenesis and Fertilization. Part III chapter 14 Early Human Development. Parts IV and V. Building with Ectoderm, Mesoderm, Endoderm. Chapter 5 Stem cells.

Module 3: Cellular trafficking

19-21. Lipid dynamics (Loewen)

- Membrane organization/lipid domains
- Lipid signalling
- Lipid trafficking

22-24 Intracellular transport (Loewen)

- Protein transport
- RNA trafficking

25. Membrane contact sites

26. Review class

27. Module 3 test (50 min in class time)

Module 4: Cellular metabolism

28-30. Intracellular metabolism (Weidberg)

- Mitochondria and lysosomes structure and function
- Mitochondrial inheritance and metabolic disease
- Lysosomal storage diseases
- Sensing and responding to the cellular metabolic state..

31-33 Protein lifecycle (Weidberg)

- Protein translation and folding
- Stress responses to unfolded proteins
- Concepts of co-translational targeting vs post-translational targeting

34. Protein quality control, the proteasome-ubiquitin pathway, and autophagy.

35. Review class

36. End of term review session

Module 4 test (50 min end of term exam)

Assessments of Learning

Assessment is in the form of four invigilated tests, covering lectures within each module. Each student will be responsible for preparing a recorded 10-slide, 10-minute voice-over powerpoint presentation covering the content of one module (submitted on Canvas) by one week after the last day of term. In this presentation, the student will present a human disease, not covered in the lectures, and will outline the pathological mechanisms of the disease based on the content of material in the module. The student is expected to demonstrate a clear understanding of the mechanisms of disease and will be evaluated on overall clarity and quality. In this way, the students will demonstrate their understanding of the module's content and their ability to apply that understanding to a disease of interest not covered in class.

Grading scheme

Student's term paper powerpoint presentation	20%
Module 1 exam	20%
Module 2 exam	20%
Module 3 exam	20%
Module 4 exam	20%

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 their actions. Details of the policies and how to access support are available at the Policies and Resources 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

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