

COURSE SYLLABUS



COURSE TITLE: CHEM-255: Biochemistry

CLASS SECTION: 001

TERM: 2022W

COURSE CREDITS: 4

DELIVERY METHOD(S): In Person

Camosun College campuses are located on the traditional territories of the Lək̓ʷəŋən and W̱SÁNEĆ peoples. We acknowledge their welcome and graciousness to the students who seek knowledge here.

Learn more about Camosun's [Territorial Acknowledgement](#).

For Covid-19 information please visit <https://legacy.camosun.ca/covid19/index.html>

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable explanation in advance, you will be removed from the course and the space offered to the next waitlisted student.

INSTRUCTOR DETAILS

NAME: Jamie Doran, Ph.D.

EMAIL: jdoran@camosun.ca

OFFICE: F350, Fisher Building, Lansdowne Campus

OFFICE HOURS: Mondays 7:00 – 8:00 pm on Zoom

Tuesdays 7:00 – 8:00 pm on Zoom

Wednesdays 7:00 – 8:00 pm on Zoom

Thursdays 7:00 – 8:00 pm on Zoom

Fridays 7:00 – 8:00 pm on Zoom

Feel free to contact me by email, including in the evenings and on weekends, to correspond by email or to set up a Zoom chat.

As your course instructor, I endeavour to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me. Camosun College is committed to identifying and removing institutional and social barriers that prevent access and impede success.

CALENDAR DESCRIPTION

This course concerns fundamental aspects of biomolecules and biochemical processes and their relevance to biotechnology and health. Topics include: noncovalent interactions, buffers, structure-function relationships in biomolecules, enzymology, lipids and membranes, bioenergetics; carbohydrate, lipid, amino acid and nucleotide metabolism, DNA synthesis, gene expression, protein synthesis and prevalent biochemistry laboratory techniques.

PREREQUISITE(S):

All of:

- CHEM 121

CO-REQUISITE(S):

All of:

- C in CHEM 230

COURSE LEARNING OUTCOMES / OBJECTIVES

Upon completion of this course a student will be able to:

1. Describe the fundamental characteristics of proteins, including enzymes, carbohydrates, lipids, and the nucleic acids, DNA and RNA.
2. Describe the chemical and biochemical principles governing the structure-function relationships of biomolecules and membranes.
3. Describe the underlying themes of key biochemical processes, including metabolism, bioenergetics, gene expression and protein synthesis.
4. Describe and evaluate the important aspects of the biochemical framework of cellular function at a molecular level, and the chemical bases thereof.
5. Use the basic vocabulary of biochemistry.
6. Explain the significance of biochemistry in clinical and veterinary medicine, laboratory analyses, nutrition, agriculture, and biotechnology.
7. Isolate specific proteins using gel-permeation, ion-exchange, and affinity-based column chromatography methods.
8. Analyze proteins by SDS-polyacrylamide electrophoresis.
9. Conduct polymerase chain reaction amplification of DNA molecules.
10. Utilize agarose gel electrophoresis for analysis of DNA samples.
11. Critically analyze the results obtained using each of the biochemical experimental techniques described above.
12. Work with an awareness of the basic safety considerations and general procedures associated with a biochemistry laboratory.

REQUIRED MATERIALS

Moran, L.A., Horton, H.R., Scrimgeour, K.G. & Perry, M.D. 2012. *Principles of Biochemistry*. 5th ed. Pearson Education Inc., Toronto.

This textbook is required for the course. It may be purchased from the Lansdowne Campus bookstore. Chapter study guides are included in the course pack which also contains the laboratory manual (please see below). Links to relevant web-based learning resources are presented in the textbook. A collection of relevant lecture slides, largely based on this textbook, are available as a separate course pack (please see below).

Chem 255 Laboratory Manual & Course Study Guides.

This course pack contains experimental procedures with introductory material that, along with the textbook, provide an understanding of the biochemical techniques employed in the laboratory component of the course.

This course pack also includes chapter study guides for optimal use of the textbook and lecture notes. This course pack is *required* material and is available through the Lansdowne Campus bookstore.

Chem 255 Lecture Slides Course Package.

This *required* material has proven to be vital in promoting optimal lecture-based learning, in-class discussion, and salient notetaking. It is available through the Lansdowne Campus bookstore.

Safety glasses

Safety glasses are required when handling hazardous chemicals, and are recommended when handling laboratory glassware. Each student is required to provide her or his own pair of safety glasses. Students lacking safety glasses when they are required will not be permitted in the laboratory. Prescription eyeglasses will suffice.

Lab coats

Lab coats are highly recommended for all experimental work in the laboratory. Each student is required to provide her or his own lab coat.

Disposable plastic gloves

Disposable, 'non-allergenic', plastic gloves will be available in the laboratory. These are to be used when appropriate to protect the skin from potentially hazardous chemicals, and to protect biochemicals from degradative enzymes found on the skin.

Calculator

A scientific calculator is required at times in the laboratory, in lecture, and during term tests & the final exam. Each student is required to provide her or his own calculator. Cell phone-based, tablet-based or computer based calculators, or graphing calculators, cannot be used during term tests or the final exam.

[COURSE SCHEDULE, TOPICS, AND ASSOCIATED PREPARATION / ACTIVITY / EVALUATION](#)

Course Times:

Monday	12:30 – 1:20 pm F358/F360
Monday Lab	3:00 – 4:50 pm F358/F360
Tuesday	12:30 – 1:20 pm F358/F360
Wednesday	12:30 – 1:20 pm F358/F360
Thursday	12:30 – 1:20 pm F358/F360

Course Length: 14 weeks

The following schedule and course components are subject to change with reasonable advance notice, as deemed appropriate by the instructor.

WEEK or DATE RANGE	ACTIVITY or TOPIC	OTHER NOTES
Week 1	<p>Course introduction and orientation; Defining biochemistry - the central life science; Perspective on the origins and early developments in biochemistry; 'Biochemically relevant' elements, major ions & trace elements; Organic compounds, functional groups & linkages; Metric conversions; Noncovalent interactions; Buffers & buffering; pH & pKa; Henderson-Hasselbalch equation; Buffer calculations; The blood buffer system; Some common laboratory buffers.</p> <p>Monday Lab, January 10th - Introduction to experimental biochemistry.</p>	Please refer to D2L for helpful information.
Week 2	<p>Introduction to proteins and amino acids; Structures, chemical characteristics, and properties of amino acids; Amino acid derivatives; Ionization (pH – pKa relationships); Hydrophobicity; Peptide bonds and peptide bond groups; Amino acid analysis; Protein sequence determination; Peptide mapping.</p> <p>Monday Lab, January 17th - Buffer preparation; <i>Making a Tris-HCl buffer.</i></p>	Please refer to D2L for helpful information.
Week 3	<p>MALDI-TOF; Putative protein sequences from gene sequences; Comparative protein sequence analysis; Introduction to proteins and proteomics; Predicting 3-D protein structure; Implications of peptide bond groups; The nature and properties of alpha-helices; The nature of beta-sheet secondary structures. Loops, turns, motifs, domains, and folds in tertiary and quaternary structures; Implications of quaternary structures; Protein machines; Quaternary protein structure-function relationships; SARS-CoV-2 spike protein quaternary structure and amino acid sequence variation.</p> <p>Monday Lab, January 24th - Introduction to column chromatography for protein purification. Experiment 1. <i>Separation of Proteins by Gel Permeation Column Chromatography.</i></p>	Please refer to D2L for helpful information.
Week 4	<p>Protein folding, stability, denaturation and renaturation; Quaternary structures of fibrous proteins; The nature of antibody quaternary structure; General properties and classes of enzymes; Introduction to enzyme kinetic constants. Pseudo-first order reactions; Determination and interpretation of the rate constants K_m, k_{cat} & k_{cat}/K_m; Michaelis-Menton equation; Interpretation of Lineweaver-Burk Plots.</p> <p>Monday Lab, January 31st - Experiment 2. <i>Purification of Proteins by Ion-Exchange Column Chromatography.</i> & Experiment 3. <i>Affinity Column Chromatography, Part 1.</i></p>	Please refer to D2L for helpful information.
Week 5	<p>Kinetics of allosteric enzyme inhibition; Concepts in reversible and irreversible enzyme inhibition; Allosteric and covalent regulation of enzyme activity; Chemical mechanisms of enzyme catalysis; Proximity effects in enzyme catalysis; Transition state stabilization in enzyme catalysis; Mechanism of chymotrypsin activity.</p> <p>Monday Lab, February 7th Experiment 3. <i>Isolation of Concanavalin A by Affinity Chromatography, Part 2. Discussion of Results & Comparative Review of Chromatography Principles & Techniques.</i></p>	Please refer to D2L for helpful information.

WEEK or DATE RANGE	ACTIVITY or TOPIC	OTHER NOTES
Week 6	<p>Cofactors: coenzymes and essential ions; Biochemical structures and roles of vitamin-derived and metabolite-derived coenzymes. Vitamins and health; Protein coenzymes; Vitamin-like compounds; Carbohydrate biochemistry: Roles and structures of monosaccharides.</p> <p>Monday Lab Period, February 14th - Experiment 4. <i>SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE): Separation & Identification of Proteins, and Determination of Protein Molecular Weight, Part 1. Theory & Preparation of a Polyacrylamide Gel for the Separation of Proteins.</i></p>	Please refer to D2L for helpful information.
Week 7	<p>Monday – BC Family Day (statutory holiday)</p> <p>Tuesday to Friday – Reading Week (no classes)</p>	Please refer to D2L for helpful information.
Week 8	<p>Term test 1 review. Carbohydrate biochemistry: Roles and structures of disaccharides, polysaccharides, and proteoglycan complexes; Glycoproteins and glycolipids; The nature of lipids; Classes of lipids; Lipid biochemistry: Fatty acids; Phospholipids; Plasmalogens; Sphingolipids. Sources of, and intake recommendations, for SFA, MUFA and PUFA; Sterols and steroids; Nature of membranes; Membrane proteins; Membrane transport.</p> <p>Monday Lab, February 28th - Term Test 1. 3:00 PM to 4:50 PM in F358/F360</p>	Please refer to D2L for helpful information.
Week 9	<p>Transmembrane signal transduction; Anabolic and catabolic metabolic reactions; Central metabolism; Metabolic flux; High energy compounds and bioenergetics; Glycolysis; Metabolic fates of pyruvate and glucose-6-phosphate; Regulation of glycolysis; Fructose, galactose, and mannose metabolism; Gluconeogenesis; Cori Cycle; Glucose-Alanine Cycle; Pentose Phosphate Pathway; Glycogen Metabolism; Carbohydrate metabolism during fasting.</p> <p>Monday Lab, March 7th - Experiment 4 - <i>SDS-PAGE Part 2, Protein Electrophoresis and Staining for Detection of Separated Proteins.</i></p>	Please refer to D2L for helpful information.
Week 10	<p>Regulation of glycogen metabolism; Pyruvate dehydrogenase complex; Citric acid cycle (aka Krebs Cycle; TCA Cycle); Connections to the Krebs cycle in metabolism; PDH regulation; Electron transport & oxidative phosphorylation; Glycerol phosphate shuttle system.</p> <p>Monday Lab, March 14th - Experiment 4. <i>SDS-PAGE Part 3, Analyses of SDS-PAGE Results & Further Principles and Theory.</i></p>	Please refer to D2L for helpful information.

WEEK or DATE RANGE	ACTIVITY or TOPIC	OTHER NOTES
Week 11	<p>Malate-aspartate shuttle system; Lipid metabolism; Lipoprotein metabolism; Beta-oxidation; Ketogenesis; Macronutrient utilization at rest and during exercise. Fatty acid synthesis; Regulation of fatty acid synthesis and oxidation; Cholesterol synthesis; Amino acid metabolism; Assimilation of ammonia; Amino acid catabolism and anabolism; Renal glutamine metabolism; Nucleotide metabolism; Purine and pyrimidine biosynthetic pathways.</p> <p>Monday Lab Period, March 21st - Experiment 5. <i>Polymerase Chain Reaction (PCR) Amplification of Cloned SAGE Tag Fragment, Part 1, Theory & PCR Amplification of DNA Fragments.</i></p>	Please refer to D2L for helpful information.
Week 12	<p>Term test 2 review. Nucleosides & nucleotides; DNA structure; Restriction endonucleases; DNA cloning; Physical mapping of DNA; DNA fingerprinting; Polymerase Chain Reaction (PCR); Sanger enzymatic DNA sequencing. Metabolic Pathways Chart project.</p> <p>Monday Lab, March 28th - Term Test 2 3:00 to 4:50 PM in F358/F360</p>	Please refer to D2L for helpful information.
Week 13	<p>Site-Specific Mutagenesis; Gene expression; RNA polymerase; Promoters and the initiation of transcription; The Shine-Dalgarno sequence and the initiation of translation; Transcriptional regulation of the <i>lac</i> operon; Signal sequences and protein secretion.</p> <p>Monday Lab, April 4th - Experiment 5. <i>PCR Amplification of Cloned SAGE Tag Fragments. Part 2, Agarose Gel Electrophoresis & Detection of PCR Amplified DNA Fragments.</i></p>	Please refer to D2L for helpful information.
Week 14	<p>Final exam orientation. Final exam review.</p> <p>Monday Lab, April 11th - Experiment 5. <i>PCR Amplification of Cloned SAGE Tag Fragments. Part 3, Analysis of PCR Results.</i></p>	Please refer to D2L for helpful information.
Final Exam Week	<p>Final Exam</p> <p>The date & time of the final exam will be posted by the College during the 2022W semester.</p>	Please refer to D2L for helpful information.

Students registered with the Centre for Accessible Learning (CAL) who complete quizzes, tests, and exams with academic accommodations have booking procedures and deadlines with CAL where advanced notice is required. Deadlines can be reviewed on the [CAL exams page](http://camosun.ca/services/accessible-learning/exams.html). <http://camosun.ca/services/accessible-learning/exams.html>

DESCRIPTION	WEIGHTING
<p>Metabolic Pathways Chart Project This assignment is described in detail in a handout to be provided once topics of intermediary metabolism arise formally in the course. Each individual is required to hand in the results of her or his own work. This metabolic pathways chart is due on the final day of class.</p>	5%
<p>Term Test 1 This term test covers relevant material from approximately the first third of the course. The delineation of material that students are responsible for, including that from the laboratory section of the course, will be provided in class about one week prior to the date of the test. This is a 110-minute test that will be written during the lab period on Monday, February 28th from 3:00 to 4:50 PM in F358/F360. If this term test is missed due to illness, or a similarly justifiable reason, with accompanying documentation the percentage value of this term test will be added to the value of the final exam.</p>	20%
<p>Term Test 2 This term test covers relevant material from approximately the second third of the course. The delineation of material that students are responsible for, including that from the laboratory section of the course, will be provided in class about one week before the date of the test. This is a 110-minute test that will be written during the lab period on Monday, March 28th from 3:00 to 4:50 PM in F360/F358. If this term test is missed due to illness, or a similarly justifiable reason, with accompanying documentation the percentage value of this term test will be added to the value of the final exam.</p>	25%
<p>Laboratory Experiments Laboratory participation and performance contributes 10% to the final grade. Attendance in the lab periods is mandatory. No laboratory experiment can be missed without an acceptable reason submitted in writing, such as a letter from a MD. Pre-lab assignments and flowcharts also contribute to a total of 5% of the final grade. As part of achieving the learning outcomes, students must pass the lab portion of the course in order to pass this course. <i>Please come to each lab period prepared for the experiment.</i> Understanding of the principles, scientific and technical bases, and results of each experiment is subject to examination on term tests and the final exam.</p>	15%

DESCRIPTION	WEIGHTING
<p>Final Exam The final exam is a comprehensive exam that includes components from the laboratory section of the course. The value this exam contributes to the final grade is 35%. The time and location of the final exam will be published by the College during the semester. Attendance at the final exam is mandatory. Appropriate documentation must accompany an explanation for absence if an incomplete grade (I grade) is warranted.</p>	35%
TOTAL	100%

If you have a concern about a grade you have received for an evaluation, please come and see me as soon as possible. Refer to the [Grade Review and Appeals](http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf) policy for more information.
<http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf>

COURSE GUIDELINES & EXPECTATIONS

Students may **not** use recording devices in the classroom without the prior permission of the instructor or the Centre for Accessible Learning. The instructor's permission is not required when the use of a recording device is sanctioned by the College's Centre for Accessible Learning in order to accommodate a student's disability, *and* when the instructor has been provided with an instructor notification letter which specifies the use of a recording device. Such recordings made in the classroom are for the student's personal use only, and distribution of recorded material is prohibited. Recordings made during the course would include statements, questions and comments made by students in the class, and these are not to be disseminated or repeated in any manner based on the recordings. Otherwise, **please have cell phones turned off and put away while in lectures.** *Thank you.*

SCHOOL OR DEPARTMENTAL INFORMATION

Here is a link to the Science Help Centre.
<https://camosun.ca/services/academic-supports/help-centres/science-help-centres>

The schedule for the Chem Tutors will be posted during the semester.

Camosun College is a scent-free institution. **Please refrain from wearing scents.** Thank you.

STUDENT RESPONSIBILITY

Enrolment at Camosun assumes that the student will become a responsible member of the College community. As such, each student will display a positive work ethic, assist in the preservation of College property, and assume responsibility for their education by researching academic requirements and policies; demonstrating courtesy and respect toward others; and respecting expectations concerning attendance, assignments, deadlines, and appointments.

SUPPORTS AND SERVICES FOR STUDENTS

Camosun College offers a number of services to help you succeed in and out of the classroom. For a detailed overview of the supports and services visit <http://camosun.ca/students/>.

Academic Advising	http://camosun.ca/advising
Accessible Learning	http://camosun.ca/accessible-learning
Counselling	http://camosun.ca/counselling
Career Services	http://camosun.ca/coop
Financial Aid and Awards	http://camosun.ca/financialaid
Help Centres (Math/English/Science)	http://camosun.ca/help-centres
Indigenous Student Support	http://camosun.ca/indigenous
International Student Support	http://camosun.ca/international/
Learning Skills	http://camosun.ca/learningskills
Library	http://camosun.ca/services/library/
Office of Student Support	http://camosun.ca/oss
Ombudsperson	http://camosun.ca/ombuds
Registration	http://camosun.ca/registration
Technology Support	http://camosun.ca/its
Writing Centre	http://camosun.ca/writing-centre

If you have a mental health concern, please contact Counselling to arrange an appointment as soon as possible. Counselling sessions are available at both campuses during business hours. If you need urgent support after-hours, please contact the Vancouver Island Crisis Line at 1-888-494-3888 or call 911.

COLLEGE-WIDE POLICIES, PROCEDURES, REQUIREMENTS, AND STANDARDS

Academic Accommodations for Students with Disabilities

The College is committed to providing appropriate and reasonable academic accommodations to students with disabilities (i.e. physical, depression, learning, etc.). If you have a disability, the [Centre for Accessible Learning](http://camosun.ca/services/accessible-learning/) (CAL) can help you document your needs, and where disability-related barriers to access in your courses exist, create an accommodation plan. By making a plan through CAL, you can ensure you have the appropriate academic accommodations you need without disclosing your diagnosis or condition to course instructors. Please visit the CAL website for contacts and to learn how to get started:

<http://camosun.ca/services/accessible-learning/>

Academic Integrity

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.13.pdf> for policy regarding academic expectations and details for addressing and resolving matters of academic misconduct.

Academic Progress

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.1.pdf> for further details on how Camosun College monitors students' academic progress and what steps can be taken if a student is at risk of not meeting the College's academic progress standards.

Course Withdrawals Policy

Please visit <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.2.pdf> for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit <http://camosun.ca/learn/fees/#deadlines>.

Grading Policy

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf> for further details about grading.

Grade Review and Appeals

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf> for policy relating to requests for review and appeal of grades.

Mandatory Attendance for First Class Meeting of Each Course

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable reason in advance, you will be removed from the course and the space offered to the next waitlisted student. For more information, please see the "Attendance" section under "Registration Policies and Procedures" (<http://camosun.ca/learn/calendar/current/procedures.html>) and the Grading Policy at <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf>.

Medical / Compassionate Withdrawals

Students who are incapacitated and unable to complete or succeed in their studies by virtue of serious and demonstrated exceptional circumstances may be eligible for a medical/compassionate withdrawal. Please visit <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.8.pdf> to learn more about the process involved in a medical/compassionate withdrawal.

Sexual Violence and Misconduct

Camosun is committed to creating a campus culture of safety, respect, and consent. Camosun's Office of Student Support is responsible for offering support to students impacted by sexual violence. Regardless of when or where the sexual violence or misconduct occurred, students can access support at Camosun. The Office of Student Support will make sure students have a safe and private place to talk and will help them understand what supports are available and their options for next steps. The Office of Student Support respects a student's right to choose what is right for them. For more information see Camosun's Sexualized Violence and Misconduct Policy: <http://camosun.ca/about/policies/education-academic/e-2-student-services->

and-support/e-2.9.pdf and camosun.ca/sexual-violence. To contact the Office of Student Support: oss@camosun.ca or by phone: 250-370-3046 or 250-3703841

Student Misconduct (Non-Academic)

Camosun College is committed to building the academic competency of all students, seeks to empower students to become agents of their own learning, and promotes academic belonging for everyone. Camosun also expects that all students to conduct themselves in a manner that contributes to a positive, supportive, and safe learning environment. Please review Camosun College's Student Misconduct Policy at <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.5.pdf> to understand the College's expectations of academic integrity and student behavioural conduct.

Changes to this syllabus: Every effort has been made to ensure that information in this syllabus is accurate at the time of publication. The College reserves the right to change courses if it becomes necessary so that course content remains relevant. In such cases, the instructor will give the students clear and timely notice of the changes.