



COURSE OUTLINE

The course description is online @ <http://camosun.ca/learn/calendar/current/web/chem.html>

Ω Please note: the College electronically stores this outline for five (5) years only.
It is **strongly recommended** you keep a copy of this outline with your academic records.
You will need this outline for any future application/s for transfer credit/s to other colleges/universities.

1. Instructor Information

(a)	Instructor:	Jill Murray, Ph.D		
(b)	Office Hours:	Monday 12:30pm to 2:20pm Tuesday 12:30pm to 1:30pm Wednesday 12:30pm to 1:30pm You are welcome to drop by my office F344D whenever I am in. Appointments can be made by email to meet at other times There will be extended office hours prior to the midterms and the final exam		
(c)	Location:	Room F344D, Fisher Building, Lansdowne Campus		
(d)	Phone:	250-370-3606	Alternative Phone:	
(e)	Email:	murrayj@camosun.bc.ca		
(f)	Website:	There will be a CHEM255 website on D2L Please update your email addresses on D2L or check every so often as I will post notices and documents and send emails to the class using D2L.		

2. Intended Learning Outcomes

Upon completion of this course the 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.

3. Required Materials

- (a) Texts
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 this course and includes links to web-based learning resources. A copy of the textbook is available in the Lansdowne Campus reserve library. There is a course

pack containing the laboratory manual and a chapter study guide. There is also a course pack containing a collection of relevant lecture slides. Available at the Lansdowne Campus bookstore.

(b) Other

CHEM255 Laboratory Manual & Course Study Guides, 2013 Edition. This course package is required material. It contains the laboratory experiment introductory materials as well as a study guide for each chapter covered in this course. Available at the Lansdowne Campus bookstore.

CHEM255 Lecture Slides Course Package, 2013 Edition. This course package of the relevant lecture slides is a required material and serves to promote lecture-based learning and in-class discussion. Available at the Lansdowne Campus bookstore.

Safety Glasses Safety Glasses are required when handling hazardous chemicals or biochemical. Each student is required to provide his or her pair of safety glasses. Students lacking safety glasses when they are required will not be permitted to be in the laboratory.

Lab Coats Lab coats are required for all experimental work in the laboratory. Each student is required to provide her or his own lab coat. Students lacking lab coats will not be permitted to be in the laboratory.

Latex Gloves Latex or other 'non-allergenic' gloves will be available in the laboratory and are used when appropriate to protect the skin from potentially hazardous chemicals or, more often, to protect labile biochemical from contamination or from becoming degraded by enzymes from the skin

Calculator A scientific calculator is required at times in the laboratory, in lectures and during exams. Each student is required to provide his or her own scientific calculator. Cell-phone based, tablet-based or computer-based calculators cannot be used during exams.

4. Course Content and Schedule

Credits: 4 credits

In class work load: 6 hours per week
Class hours: four 50-minute lectures per week. Exam review periods will be scheduled into an appropriate lecture or lab slot prior to each exam.
Lab hours: 1 hour and 50 min lab period will include pre-lab talks, experiments and post-lab analyses. The lab time period will also be used for the Midterm 1 and Midterm 2 exams as well as the Midterm 1 exam review.

Out of class workload: 6 hours per week

Number of weeks: 14 weeks

Pre-requisite: Chem 121 – College Chemistry 2

Pre- or co- requisite: Chem 230 – Organic Chemistry 1

Lectures: Monday 11:30 am – 12:30 pm
Fisher Building, Room F360

Tuesday 11:30 am – 12:30 pm
Fisher Building, Room F360

Wednesday 11:30 am – 12:30 pm
Fisher Building, Room F360

Thursday 11:30 am – 12:30 pm
Fisher Building, Room F360

Laboratory Experiments and Term Exam Times (see schedule below):

Monday 2:30 pm to 4:30 pm
Fisher Building, Room F360

Lecture Outline

This outline highlights key topics covered in class. Each chapter has a corresponding study guide in the *Chemistry 255 Laboratory Manual and Course Study Guides* course package. Reviewing the study guide is

highly recommended as it contains a recommended reading list including figures and tables, a list of web-based resources, a vocabulary list, study questions and recommended practice questions.

Introduction to Biochemistry (Chapter 1)

Introduction; History; Biochemically and Physiologically Relevant Elements; Classes of Organic Compounds; Functional Groups; Covalent Linkages; SI unit prefixes and metric conversions. (See also the additional review material listed in the study guide reading list).

Noncovalent bonding, pH & pKa, Buffers & Buffering (Chapter 2)

Noncovalent interactions in biomolecules; pH & pKa; Henderson-Hasselbach Equation; Buffers & Buffering; the Bicarbonate Blood-Buffer System; Acidosis & Alkalosis. (See also the additional review material listed in the study guide reading list).

Amino Acids and the Primary Structure of a Protein (Chapter 3)

Structures of Common Amino Acids; pKa, Ionization, and Potential Roles of Amino Acid Functional Groups in Covalent and Noncovalent bonding; Peptide Bonds; Peptide Bond Group Structure-Function Relationships; Protein Purification Techniques; Primary Protein Sequence; Protein Sequencing; MALDI-TOF MS; Comparative Analyses of Protein Sequences.

Protein Structure and Function (Chapter 4)

Proteomics; Nature of the Peptide Bond; Primary, Secondary, Super-Secondary, Tertiary and Quaternary Protein Structures; Protein Folding; Protein Stability, Denaturation and Renaturation; Protein-Structure-Function Relationships; Introduction to Protein X-Ray crystallography and Protein NMR.

Enzymes (Chapter 5)

Classes of Enzymes; Enzyme Kinetics; Michaelis-Menton Equation; Enzyme inhibition; Interpretation of Lineweaver-Burk Plots; Allosteric and Covalent Regulation of Enzyme Activity; Regulation of Quaternary-Structured Enzymes.

Mechanisms of Enzyme Catalysis (Chapter 6)

Overview of Enzyme Function; Chemical Mechanisms of Enzyme Catalysis; Proximity Effects and Transition State Stabilization; Mechanism of Chymotrypsin Activity.

Coenzymes and Vitamins (Chapter 7)

Roles and Structures of Essential Ions, Coenzymes and Vitamins; Vitamins & Health

Carbohydrates (Chapter 8)

Roles and Structure of Monosaccharides, Disaccharides, Polysaccharides and Proteoglycan Complexes. Structure-Function Relationships in Carbohydrates and in Glycoconjugates.

Lipids and Membranes (Chapter 9)

Classes of Lipids, Structures and Roles of Lipids; Membrane Structure and Functions; Membrane Transport; Transmembrane Signal Transduction Mechanisms.

Introduction to Metabolism (Chapter 10)

Introduction to Metabolism and Bioenergetics

Glycolysis (Chapter 11)

The Nature and Role of the Glycolytic Metabolic Pathway, and its Regulation

Other Major Pathways in Carbohydrate Metabolism (Chapter 12)

Glycogen Metabolism, Gluconeogenesis; Cori Cycle; Glucose-Alanine Cycle; Pentose Phosphate Pathway; Maintenance and Regulation of Blood Glucose Levels.

Citric Acid Cycle (Chapter 13)

Mitochondrial Transport of Pyruvate; Pyruvate Dehydrogenase Complex Activity and Regulation; The Nature and Roles and Regulation of the Citric Acid Cycle.

Electron Transport and Oxidative Phosphorylation (Chapter 14)

Introduction to Bioenergetics; The Chemiosmotic Hypothesis; Electron Transport; Oxidative Phosphorylation in Mitochondria; Glycerol Phosphate and Malate-Aspartate Shuttle Systems; Shuttling of Citric Acid Cycle Intermediates.

Lipid Metabolism (Chapter 16)

Lipoprotein Structure and Function; Storage and Mobilization of Fatty Acids and Cholesterol; Fatty Acid, Phospholipid and Cholesterol Metabolism; Fatty Acid β -Oxidation; Ketone Bodies; Dietary Lipids & Health.

Amino Acid Metabolism (Chapter 17)

Assimilation of Ammonia; Amino Acid Catabolism and Anabolism; Urea Cycle; Renal Glutamine Metabolism.

Nucleotide Metabolism (Chapter 18)

Purine and Pyrimidine Biosynthetic Pathways and their Regulation

DNA and RNA (Chapter 19)

Nucleosides and Nucleotides; DNA structure; Restriction Endonucleases and The Physical Mapping of DNA; DNA Finger-Printing

DNA Replication and Repair (Chapter 20)

DNA polymerase; DNA replication; DNA repair; DNA sequencing

Transcription (Chapter 21)

Classes of RNA, RNA Polymerase Function and Promoter Sequences; Transcriptional Regulation of the lac Operon.

Translation (Chapter 22)

The Genetic Code; tRNA Structure and Function; Aminoacyl tRNA Synthetases; Ribosome Structure and Function; The Shine-Dalgarno Sequence and the Initiation of Translation; Translational Regulation by Repression and Attenuation; Signal Sequences and Protein Secretion.

Laboratory Experiments, Exam and Assignment Schedule

Students are expected to thoroughly read the introductory material and experimental protocols in preparation for each experiment

Monday January 5

Experiment 1

Separation of Proteins by Gel Permeation Column Chromatography

Monday January 12

Experiment 2 and 3

Purification of Proteins Ion-Exchange Column Chromatography

Monday January 19

Experiment 3

**Purification of Concanavalin A by Affinity Chromatography (completion of Experiment 3)
Analyses of Column Chromatography Results and Comparative Review of Chromatography Principles** (Refer to Chapter 3 in the text and the laboratory manual)

Monday January 26

Review Session

Review session for Midterm1

Monday February 2

Midterm 1

Midterm 1 Exam 2:30 pm to 4:30 pm Fisher 360

Monday February 9

Family Day, Camosun College is closed.

No classes or labs.

Monday February 16

Experiment 4

SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE): Separation & Identification of Proteins, and Determination of Protein Molecular Weight

Part 1 – Theory and Preparation of Polyacrylamide Gel for Separation of Proteins

Monday February 23

Experiment 4

SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE): Separation & Identification of Proteins, and Determination of Protein Molecular Weight

Part 2 – Protein Electrophoresis and Staining for Detection of Proteins

Monday March 2

Experiment 4

SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE): Separation & Identification of Proteins, and Determination of Protein Molecular Weight

Part 3 – Analysis of SDS-PAGE Results and Review of Principles and Theory
(Refer to Chapter 3 in the text and the laboratory manual)

Monday March 9

Experiment 5

Polymerase Chain Reaction (PCR) Amplification of Cloned SAGE Tag Fragments

Part 1- Theory and PCR amplification of DNA Fragments

Monday March 16 **Experiment 5**
Polymerase Chain Reaction (PCR) Amplification of Cloned SAGE Tag Fragments
Part 2- Agarose Gel Electrophoresis and Detection of PCR Amplified DNA Fragments

Monday March 23 **Midterm 2**
Midterm 2 Exam 2:30 to 4:30 pm Fisher 360

Monday March 30 **Experiment 5**
Polymerase Chain Reaction (PCR) Amplification of Cloned SAGE Tag Fragments
Part 3- Analysis of PCR Results

Monday April 6 **Easter Monday, Camosun College is closed.**
No classes or labs.

Thursday April 9 **Review Session**
Final Exam Review Session
Metabolic Pathways Chart Assignment Due
During regular class hours, Thursday April 9, 11:30 am to 12:30 pm, F360.

Final Exam: The Time and Location of the CHEM255 Final Exam will be published by Camosun College during the Winter Semester.

5. Basis of Student Assessment (Weighting)

(a) Assignments

Metabolic Pathways Chart Assignment (5% of final grade)

This assignment will be given when we begin our study of metabolism and will be due on the last day of class (April 9 2015). Students are encourage to discuss and work on the assignment in groups but must hand in their own hand-drawn chart.

(b) Midterm Exams

Midterm 1 (25% of final grade)

Midterm 1 covers material from the first section of the course. A detailed description of the expectations for the exam will be provided in class. It is a 90 min exam that will be written during the lab period on Monday Feb 9 2:30 to 4:30 pm.

Midterm 2 (25% of final grade)

Midterm 2 covers the middle section of the course. A detailed description of the expectations for the exam will be provided in class. It is a 90 minute exam that will be written during the lab period of Monday March 16 2:30 to 4:30 pm.

If either of the term exams is missed due to illness or other justifiable reason with accompanying documentation, the percentage value of that term exam (25%) will be added to the percentage value of the final exam.

(c) **Final Exam** (40% of final grade)

The final exam is a comprehensive exam that includes topics from the laboratory section of the class. The time and location of the final exam will be published by Camosun College during the Winter Semester. (Please note that the final exam time and date cannot be changed to accommodate vacation or other plans)

(d) **Laboratory Experiments** (5% of final grade)

Attendance in the laboratory periods is mandatory. No laboratory experiment can be missed without an acceptable reason submitted in writing, such as a proper letter from a Medical Doctor. Laboratory preparation, participation and performance contributes 5% to the final grade.

Please come to each lab period prepared for the experiment

There are no laboratory reports due for the experiments but students are responsible for understanding the principles, technical bases, and results of each experiment. These aspects of the laboratory work will be subject to examination on the midterm and final exams.

6. Grading System

(No changes are to be made to this section unless the Approved Course Description has been forwarded through the Education Council of Camosun College for approval.)

Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D	Minimum level of achievement for which credit is granted; a course with a "D" grade cannot be used as a prerequisite.	1
0-49	F	Minimum level has not been achieved.	0

Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy E-1.5 at camosun.ca for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	<i>Incomplete:</i> A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	<i>In progress:</i> A temporary grade assigned for courses that, due to design may require a further enrollment in the same course. No more than two IP grades will be assigned for the same course. (For these courses a final grade will be assigned to either the 3 rd course attempt or at the point of course completion.)
CW	<i>Compulsory Withdrawal:</i> A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.

7. Recommended Materials or Services to Assist Students to Succeed Throughout the Course

LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College calendar, at Student Services, or the College web site at camosun.ca.

STUDENT CONDUCT POLICY

There is a Student Conduct Policy **which includes plagiarism**. It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, at Student Services, and the College web site in the Policy Section.

Please note:

Students may not use recording devices in the classroom without the prior permission of the instructor or Disability Resource Centre (DRC). The instructor's permission is not required when the use of a recording device is sanctioned by the College's Disability Resource Centre for Students 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. Recording 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 many based on the recordings.