



School of Arts & Science
CHEMISTRY AND GEOSCIENCE DEPARTMENT

CHEM 255-01
Principles of Biochemistry
2006F

COURSE OUTLINE

The Approved Course Description is available on the web @
<http://www.camosun.bc.ca/calendar/chem.php#255>

Ω Please note: this outline will be electronically stored for five (5) years only.
It is strongly recommended students keep this outline for your records.

1. Instructor Information

(a)	Instructor:	Jamie Doran, Ph.D.		
(b)	Office Hours:	Monday, 12:30 to 2:20 pm Thursday, 12:30 to 2:20 pm Friday, 11:30 am to 1:15 pm Students are welcome whenever my office door is open. Appointments may be made to meet at other times. Office hours will be extended prior to quiz or exam times.		
(c)	Location:	Room 350A, Fisher Building, Lansdowne Campus		
(d)	Phone:	370-3438	Alternative Phone:	
(e)	Email:	jdoran@camosun.bc.ca		
(f)	Website:	http://www.camosun.bc.ca/schools/artsci/chemgeo/doran.php		

2. Intended Learning Outcomes

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

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	<p><i>Principles of Biochemistry</i>. Third Edition. 2002. H.R. Horton, L.A. Moran, R.S. Ochs, J.D. Rawn & K.G. Scrimgeour. Prentice-Hall Canada Inc., Toronto.</p> <p>This textbook is required for this course.</p> <p>Various relevant web-based learning resources are present in the text.</p> <p>Copies of the textbook and lecture slides are available in the reserve library. <i>[Copies of the lecture slides are available through the bookstore if desired.]</i></p> <p><i>(Experimental Procedures & Course Study Guide</i>. 2005 Edition</p> <p>This is a booklet of experimental procedures as well as course study guides for those subjects of each chapter of the textbook that are included in the course. <u>It is required material</u> and is available through the Camosun College Bookstore.</p>
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(b)	Other	<p><i>Course lecture slide package.</i> The experience of past students for many years has indicated that this package is extremely beneficial and, therefore, is considered <u>very highly recommended</u>. It is available through the Camosun College Bookstore.</p> <p><i>General Materials and Supplies</i></p> <p><u>Safety glasses:</u> Safety glasses are required when handling hazardous chemicals or biochemicals. The students are required to provide their own pairs of glasses. <u>Students lacking safety glasses when they are required will not be permitted to work in the laboratory.</u></p> <p><u>Lab coats:</u> Lab coats are required for any experiments involving hazardous chemicals or biochemicals. Students are required to provide their own lab coats. Students lacking lab coats when required will not be permitted to work in the laboratory.</p> <p><u>Latex gloves:</u> Latex or 'non-allergenic' gloves <u>will be available in the lab</u> and are to be used when appropriate to protect the skin from potentially hazardous chemicals or, more frequently, to protect valuable biochemicals from becoming degraded by enzymes from skin.</p> <p><u>Scientific calculator:</u> Calculators may be required in the lab, in class and during exams. Students are required to provide their own calculators.</p>
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4. Course Content and Schedule

(Can include: class hours, lab hours, out of class requirements and/or dates for quizzes, exams, lectures, labs, seminars, practicums, etc.)

Course Content and Schedule

Credits 4 credits

In-class workload 6 hours per week

- Typically, there are four 50-minute lectures per week.
- Experiments, pre-lab talks & post-lab analyses are conducted during most of the 2 h Friday time slots. This time slot is also used for the

two midterm exams, and for a final exam review period.

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

Course times and locations

<u>Lecture times</u>	Monday, AM Fisher Building, Room
	Tuesday, AM Fisher Building, Room
	Wednesday, AM Fisher Building, Room
	Thursday, AM Fisher Building, Room

<u>Laboratory/ Periods*</u>	Friday 10:30 AM to 12:20 PM Fisher Building, Rooms F360 and F358
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*This 2 h time period is used for laboratory experiments, lab lectures, midterm exams, and a final exam review.

Please see the laboratory and midterm exam schedules below.

Lecture Outline

A general outline of the topics to be covered in the course, and the respective chapters of *Principles of Biochemistry* by Horton et al., 2006, is provided below in the order in which the topics will be presented. ***Study guides for each chapter of the textbook are provided in the 'course package' available through the College Bookstore. Each study guide includes an assigned reading list for the chapter, a listing of the relevant vocabulary, and a collection of assigned practice questions.***

Introduction to Biochemistry:

Chapter 1

Introduction; History; Physiologically Relevant Elements, Classes of Organic Compounds, Functional Groups; Covalent Linkages; Classes of Biomolecules. *(Other review material in this chapter forms part of the assigned reading listed in the study guide)*

Noncovalent bonding, pH, pKa, and Buffers & Buffering:

Chapter 2

Noncovalent Bonding in Biomolecules; pKa; The Henderson-Hasselbach Equation; Buffering; the Bicarbonate Blood-Buffer System; Acidosis & Alkalosis *(additional material not presented in Chapter 2)*. *(Other review material in this chapter forms part of the assigned reading)*

Amino Acids and the Primary Sequence of a Protein:

Chapter 3

Structures of Common Amino Acids; Ionization & pKa of Amino Acids and Their Functional Groups; Peptide Bonds; Protein Purification Techniques (Most of which are also covered in the laboratory portion of the course); Primary Protein Sequence; Protein Sequencing; Comparative Analyses of Protein Sequences; MALDI-TOF.

Protein Structure & Function

Chapter 4

Informatics - Proteomics, Genomics, Systemics, & Metabonomics *(additional material not presented in Chapter 4)*; The Nature of the Peptide Bond; Secondary, Tertiary and Quaternary Protein Structures; Protein Folding and Stability; Protein Structure-Function Relationships.

Enzymes

Chapter 5

Classes of Enzymes; Enzyme Kinetics; Michaelis-Menton Equation; Enzyme Inhibition; Interpretation of Lineweaver-Burk Plots; Regulation of Enzyme Activity.

Enzyme Mechanisms

Chapter 6

Overview of Enzyme Function; Mechanisms of Enzyme Catalysis; Mechanism of Chymotrypsin Activity.

Coenzymes and Vitamins

Chapter 7

Vitamins and Health (overview); Nature, Roles and Structures of Coenzymes and Vitamins.

Carbohydrates

Chapter 8

Roles and Structures of Monosaccharides, Disaccharides, Polysaccharides & Glycoconjugates.

Lipids & Membranes

Chapter 9

Classes and Structures of Lipids, Membrane Structures, Membrane Transport, Transmembrane Signal Transduction.

Overview of Metabolism

Chapter 10

Introduction to Intermediary Metabolism and Bioenergetics.

Glycolysis

Chapter 11

The Metabolic Pathway of Glycolysis and its Regulation.

TCA Cycle

Chapter 12

Mitochondrial Transport of Pyruvate; Pyruvate Dehydrogenase Activity and Regulation; The Citric Acid Cycle (Krebs) Cycle; Regulation of Krebs' Cycle.

Electron Transport and Oxidative Phosphorylation

Chapter 14

Introduction to Bioenergetics; The Chemiosmotic Hypothesis; Electron Transport; Oxidative Phosphorylation in Mitochondria; Malate-Aspartate Shuttle System.

Other Pathways in Carbohydrate Metabolism

Chapter 13

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

Lipid Metabolism

Chapter 16

Dietary Fats and Health (Overview); Lipoprotein Structure and Function; Storage and Mobilization of Fatty Acids and Cholesterol; Fatty Acid β -Oxidation; Ketone Bodies; Fatty Acid, Phospholipid and Cholesterol Metabolism.

Amino Acid Metabolism

Chapter 17

Nitrogen Assimilation; Introduction to Amino Acid Metabolism; Urea Cycle.

Nucleotide Metabolism

Chapter 18

Introduction to Nucleotide Metabolic Pathways.

DNA Composition, Structure and Mapping

Chapter 19

Introduction to Nucleic Acids; Nucleotides, Nucleosides; DNA Structure; Nucleases; Restriction Endonucleases and Physical Mapping of DNA; DNA Finger-Printing.

DNA Replication and Repair

Chapter 20

DNA polymerase; DNA Replication; DNA Sequencing; DNA Repair.

RNA Synthesis (Transcription)

Chapter 21

Classes of RNA; RNA polymerases; Promoter Sequences; Prokaryotic Transcription; Regulation of the *lac* Operon; Eukaryotic Transcription and RNA Processing.

Protein Synthesis (Translation)

Chapter 22

The Genetic Code; tRNA Structure and Function; Aminoacyl tRNA Synthetases; Ribosome Structure and Function; Shine-Dalgarno Sequence; Signal Sequences and Protein Secretion.

Recombinant DNA Technologies & Biotechnology

Chapter 23

Basic Molecular Cloning Strategies; PCR (Laboratory); Site-Directed Mutagenesis; Genomics & Proteomics.

Laboratory, Exam & Assignment Schedule

Friday, January 13th. Regular lectures; no laboratory experiment in this period.

Friday, January 20th. **Experiment 1**

Separation of Proteins by Gel Permeation Column Chromatography

Friday, January 23rd & Friday, February 3rd. **Experiments 2 & 3**
Ion-Exchange Column Chromatography & Affinity Chromatography

Friday, February 10th. *Reading Break* February 9th & 10th

Friday, February 17th. ***10:30 AM to 12:20 PM. F360/358 - Midterm Exam #1**

Friday, February 24th. **Experiment 4**
SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE) Separation & Identification of Proteins, and Determination of Protein Molecular Weight
Part 1 - Preparation of a Polyacrylamide Gel for the Separation of Proteins

Friday, March 3rd. **Experiment 4** (continued)
SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE) Separation & Identification of Proteins, and Determination of Protein Molecular Weight
Part 2 - Polyacrylamide Gel Electrophoresis, & Staining for Detection of Proteins

Friday, March 10th. **Experiment 4** (continued)
SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE) Separation & Identification of Proteins, and Determination of Protein Molecular Weight
Part 3 - Analysis of SDS-PAGE Results

Friday, March 17th. **Experiment 5**
Polymerase Chain Reaction (PCR) Amplification of Cloned SAGE Tag Fragments
Part 1 - PCR Amplification of DNA Fragments.

Friday, March 24th. ***10:30 AM to 12:20 PM. F360/358 - Midterm Exam #2**

Friday, March 31st. **Experiment 5** (continued)
Polymerase Chain Reaction (PCR) Amplification of Cloned SAGE Tag Fragments
Part 2 - Agarose Gel Electrophoresis & Detection of PCR Amplified DNA Fragments.

Friday, April, 7th. **Experiment 5** (continued)
Polymerase Chain Reaction (PCR) Amplification of Cloned SAGE Tag Fragments
Part 3 - Analysis of PCR Results.

*Thursday, April 13th. **The metabolic pathways assignment due.**

Friday, April 14th. **Good Friday Holiday**

Final Exam: The time and location of the Winter 2006 Semester Chem 255 Final Exam will be published by the College during the Winter Semester.

5. Basis of Student Assessment (Weighting)

(Should be linked directly to learning outcomes.)

(a) Assignment

Metabolic Pathways Chart Project.

This assignment will be described in detail in a handout to be provided prior to the time when the course begins to deal with the relevant topics of intermediary metabolism.

This is an out-of-class project. Each individual is required to hand in the results of her or his own work.

The metabolic pathways chart is due on the final day of classes of the Fall 2005 semester, but may be kept by students until the date of the final exam to be used for study purposes.

The value this project contributes to the final grade is 5%.

(b) Laboratory Experiments

Attendance in the lab periods is mandatory. No laboratory experiment can be missed without an acceptable reason submitted in writing such as a suitable note from Medical Doctor.

NB. There are no laboratory reports to be handed in after each experiment 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 exams and the final exam.

(c) Midterm Exams

Midterm Exam #1

This exam covers relevant material from approximately the first third of the course. The delineation of material that you may be responsible for on this exam will be provided in class at least one week before the date of the exam.

This is a 110 minute exam that will be written on Friday, February 17th in the adjoining rooms F360 & F358 from 10:30 AM to 12:20 PM.

The value this exam contributes to the final grade is 25%.

Midterm Exam #2

This exam covers relevant material from approximately the second third of the course. The delineation of material that you may be responsible for on this exam will be provided in class at least one week before the date of the exam.

This is a 110 min. exam that will be written on Friday, March 24th in the adjoining rooms F360 & F358 from 10:30 AM to 12:20 PM.

The value this exam contributes to the final grade is 30%.

If either of the midterm exams is missed due to illness or for any other justifiable reason (accompanied by appropriate documentation), a student may either take a substitute test to be written at a mutually agreeable time, or choose to add the

percentage value of that midterm exam (25% or 30%) to the percentage value of the final exam.

(d) Final Exam

Attendance at the final exam is mandatory. Appropriate documentation must accompany any explanation for absence.

The final exam is a comprehensive exam. The value this exam contributes to the final grade is **40%**. The time and location of the final exam will be published by the College during the Fall Semester.

6. Grading System

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
95-100	A+		9
90-94	A		8
85-89	A-		7
80-84	B+		6
75-79	B		5
70-74	B-		4
65-69	C+		3
60-64	C		2
50-59	D		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 at camosun.ca or 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 are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
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.

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.

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

The study guides that are provided in the manual that includes the experimental protocols should prove quite valuable. In addition to the practice problems provided are short lists of representation problems from the text. The textbook includes additional problems and provides links to websites that will enhance the learning and appreciation of the material in this course in biochemistry. Copies of all lecture slides are available on Reserve in the library. Also, copies of the lecture slides are available in a four per page (two per side) format through the campus book store.

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 on the College web site in the Policy Section.

ADDITIONAL COMMENTS AS APPROPRIATE OR AS REQUIRED