CHEM 3251/BIOL 3252 Biochemistry 1

2024F

Class Organization

Instructor	Dr. Wely B. Floriano Email: wely.floriano@lakeheadu.ca
Office Hours	Zoom office hours and links are posted on D2L. Individual meetings can also be arranged. Email instructor with a request.
Experimental Coordinator	Christina Richard (CB 2028A, 343-8765, crichar3@lakeheadu.ca) Please email to schedule meetings as needed.
Prerequisites	Organic II
Course Description	Chemistry and metabolism of monosaccharides, disaccharides and polysaccharides. Chemistry of amino acids and proteins. Structure and reaction of fatty acids, triacylglycerols and phospholipids. Structure and properties of nucleotides and polynucleotides of DNA and RNA.
Course Delivery	• Lectures - Asynchronous online course delivery. • Labs – In-person, on-campus (Thunder Bay). Lab sections are: F1 = Fri 8:30-11:30; F2 = Thu 11:30-14:30; F3 = Thu 14:30-17:30
Course Resources	All course materials are posted on Lakehead's Desire2Learn (D2L). Links to textbook assignments are also posted on D2L.
Required EBook	• Biochemistry (9th edition) by Stryer/Berg/Tymoczko/Gatto, (2019). Achieve access code with/without Ebook **ISBN:9781319402846**. • You are **not** required to purchase a new hard copy of the book or even the electronic copy if you already have access to the book; you only need to purchase access to Achieve. • According to Macmillan, if you purchase Achieve with EBook, you can download the complete EBook at any time before your access key expires and use it offline for up to 4 years. • Follow these instructions to enroll in the Achieve platform for this course (the course code is **89cv5y**). Once enrolled, clicking in the links provided on D2L will automatically take you to the Achieve platform and your assignment grades will automatically be transferred to D2L.
Learn	• Lectures for this course are web asynchronous. • Materials includes videos, animations, video notes, PDF lecture notes, reading assignments, quizzes, case studies, and problems. • The course is organized per week, and students are expected to follow the course's organization by completing each week on or ahead of schedule.
Experiment	• The experimental component of the course is held in-person on "wet" labs. • Instructions, guides and videos are posted on the weekly sections under the section "**Experiments**".

Grading	• **Achieve Assignments** (Homework, Case Study, Reading Quiz) (18X2 points = 36 points or **36%**) – read/watch assigned weekly materials and complete an online reading quiz, homework, or case study. • **Prelab assignments** (6X1 point = 6 points or **6%**) – Read materials and answer questions before the start of a lab experiment. • **Lab Reports** (1X3.5 points + 5X 2.5 points = points or **16%**) – Perform experiments, analyze results, answer questions and submit a report. • **Midterm exams** (2X21 points = 42 points or **42%**) – Students have access to D2L and Achieve materials during exams. **Midterm exams have a set time and date for opening and for closing**, as well as a 90 minutes duration from the start for most students (exceptions for accommodation through SAS). Please plan accordingly.
Final Examination	• Students who complete <u>all</u> coursework (achieve assignments, midterms, lab reports), and earn an average of 50% or more in the lab component (prelab assignments plus lab reports), as well as in the lecture component (assignments plus midterm exams), do NOT need to complete a final exam. For these students, the final grade of the course is the sum of all individual grades, to a maximum of 100 points or 100%. • For everyone else, the mark of the final exam counts as 28% of the final grade for the course, with the remaining 72% coming from coursework (achieve and prelab assignments, lab reports and midterms). • **Final exam is synchronous.** Please plan accordingly.
Due Dates	• Graded activities carry due dates posted on the Course Schedule (see below) and on D2L. ***It is the responsibility of each student to meet these deadlines without reminders from the instructor***. • Learning assignments are open for completion until **11:30pm** on their deadline date, unless noted otherwise. Assignments not submitted by the deadline will automatically receive a mark of 0.
Late Assignments	• You may submit an assignment after the deadline if you have accommodation through SAS, or if you were absent either for (documented) medical or compassionate reasons on the WEEK the assignment was due. • Late lab reports will be deducted 10% of the total marks for each day they are late.
Missed Exam	• Any exam missed for compassionate or medical reasons **must be justified** with proper documentation. • Missed exams may be replaced with an **oral examination** scheduled at the instructor's convenience, in consultation with the student.
Copyright	Students should be aware that all instructional, reference, and administrative materials prepared for this course are protected in their entirety by copyright. Students are expected to comply with this copyright by only accessing and using the course materials for personal educational use related to the course, and that the materials cannot be shared in any way, without the written authorization of the course instructor. If this copyright is infringed in anyway, students may be prosecuted under the Lakehead University Student Code of Conduct – Academic Integrity, which requires students to act ethically and with integrity in academic matters and to demonstrate behaviours that support the University's academic values.

Academic Integrity	A breach of Academic Integrity is a serious offence. The principle of Academic Integrity, particularly of doing one's own work, documenting properly (including use of quotation marks, appropriate paraphrasing and referencing/citation), collaborating appropriately, and avoiding misrepresentation, is a core principle in university study. Students should view the Student Code of Conduct - Academic Integrity for a full description of academic offences, procedures when Academic Integrity breaches are suspected and sanctions for breaches of Academic Integrity.
Accommodations	Lakehead University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you think you may need accommodations, you are strongly encouraged to contact Student Accessibility Services (SAS) and register as early as possible. For more information, please visit: http://studentaccessibility.lakeheadu.ca
Student Support	There are many resources available to support students. These include but are not limited to: • Library • Health and Wellness • Student Success Centre • Student Accessibility Centre • Lakehead International • Indigenous Initiatives
Regulations	• It is the responsibility of each student registered at Lakehead University to be familiar with, and comply with all the terms, requirements, regulations, policies and conditions in the Lakehead University Academic Calendar. This includes, but is not limited to, Academic Program Requirements, Academic Schedule of Dates, University and Faculty/School Policies and Regulations and the Fees and Refund Policies and Schedules (Lakehead University Regulations webpage, 2020-21).

Tentative Course Schedule

Week	Learn (2X90 minutes per week)	Experiment (180 minutes per week)

1
Sep 2
to
Sep 6
 	
No classes Sep 2
	Watch
	D2L Videos
	• Start Here! section
	  ○ Your instructor (Dr. Floriano) 1 min
	  ○ Quick tour of the course's D2L site (Dr. Floriano) 7 min
	• Review of biochemical concepts (Dr. Floriano)
	
	Summary notes (pdf)
	• Review of biochemical concepts
	
	Read
	• Start Here! section
	  ○ Syllabus
	  ○ Summary of Course Organization
	  ○ Achieve platform – Getting started
	  ○ University's policies and regulations
	• Achieve EBook - Review of biochemical concepts - Chp 1 Sections 1.1, 1.2, 1.3
	
	Assignments to complete
	• Achieve – Chp 1 Reading Quiz (15 questions) **2%**
	• Start Here! section - Course's pledges
	  ○ Pledge - Copyright Compliance
	  ○ Pledge - Academic Integrity
	Complete all of them before 11:59 pm on Sep 6
		Read
		• CHEM3251/BIOL3252 Biochemistry I Lab manual 2024F
		• How to write a proper figure legend in your lab reports
		
		Assignments to complete
		• D2L "myChemistry"
		All 3 components must be completed:
		1. WHMIS and GHS
		2. Chemistry Department Safety Regulations
		3. Academic Integrity
		
		A student is required to complete the safety course only once for all chemistry courses in an academic year.
		Complete before 11:59 pm on Sep 19 (Thu lab section) or Sep 20 (Fri lab section)
		
		NOTE: If you have not done so, explore the section "START HERE" before exploring the Week 1 section.

2
Sep 9
to
Sep 13
	Watch
	D2L videos
	• Nucleic acids (Dr. Floriano) 40 min
	• tRNA Synthetases (Dr. Floriano) 9:35 min
	
	HHMI BioInteractive
	  ○ Building Blocks of DNA
	  ○ Chargaff's Ratio
	  ○ The Chemical Structure of DNA
	  ○ DNA Replication (Advanced Detail)
	  ○ DNA Transcription (Advanced Detail)
	  ○ Regulation of Eukaryotic DNA Transcription
	  ○ Translation (Advanced Detail)
	
	Summary notes (pdf)
	• Nucleic acids (chp 4)
	• DNA replication, transcription and translation (chp 4)
	
	Read
	Achieve EBook
	• Nucleic acids (chp 4) - sections 4.1 to 4.3 with exclusions
	• DNA replication, transcription and translation (chp 4) sections 4.4 to 4.6 with exclusions
	
	Assignments to complete
	• Achieve – Chp 4 Reading Quiz (15 questions) **2%**
	Complete before 11:59pm on Sep 13
		Lab 1 Introduction to automatic pipettors and proper pipetting technique
		
		Watch
		• Using a Micropipette (Youtube, University of Leicester) 8:48 min
		• Micropipette technique demo (Youtube, Sci Vis lab) 10:22 min
		• Basic usage of a Synergy HT spectrophotometer part 1 (Youtube, Greg Petersen) - Synergy HT + Gen5 (2010) 9:47 min
		
		Read
		• Lab 1 Instructions
		• Lab report template for Lab #1
		
		Assignments to complete
		• Lab Report 1 **2.9%**
		Due on Sept 19 (Thu sections) or Sep 20 (Fri section)

3
Sep 16
to
Sep 20
 	
Last day to add classes Sep 16
	Watch
	D2L Videos
	• Introduction to Bioinformatics (Dr. Floriano)
	  ○ What is Bioinformatics? (Dr. Floriano) 12 min
	  ○ Comparing sequences (Dr. Floriano) 42 min
	  ○ Elements of a phylogenetic tree (Dr. Floriano) 12 min
	HHMI BioInteractive
	• Triplet Code
	• Human Chromosomes
	• Human Genome Sequencing
	• DNA Damage and Mutations
	• Coding Sequences in DNA
	• Sanger Sequencing
	• Shotgun Sequencing
	
	Achieve Chapter 5 animations:
	• Animated Technique - Gel Electrophoresis with Restriction Digest 2.30 minutes
	• Animated Technique - Dideoxy Sequencing of DNA 3:08 minutes
	• Animated Technique - Polymerase Chain Reaction (PCR) 4:34 minutes
	
	Summary notes (pdf)
	• Genomes and Genome sequencing (chp 5)
	• Introduction to Bioinformatics (chp 6)
	
	Read
	EBook
	• Exploring Genes and Genomes (chp 5) sections 5.1, 5.2, 5.3 with exclusions
	• Exploring Evolution and Bioinformatics (chp 6) sections 6.1 to 6.4
	
	Assignments to complete
	• Achieve - Chp 5 Reading Quiz (8 questions) **2%**
	• Achieve - Chp 6 Homework (7 questions) **2%**
	Complete both before 11:59pm on Sep 20
		Lab 2 Introduction to recombinant DNA methodology
		
		Watch
		• Making an agarose gel (5 min) - University of Leicester
		• Running an agarose gel (7 min) - University of Leicester
		
		Read
		• Lab 2 Instructions
		• Lab Report Template for Lab #2
		
		Assignments to complete
		• Prelab assignment 2 **0.8%**
		Due on Sept 19 (Thu sections) or Sep 20 (Fri section)
		
		• Lab report #2 **2.7%**
		Due on Oct 10 (Thu sections) or Oct 11 (Fri section)

4
Sep 23
to
Sep 27
	Watch
	D2L Videos
	• Levels of Protein Structure (Dr. Floriano) 29 min
	• Protein Assay and Purification
	  ○ Protein Assay (Dr. Floriano) 12:43 min
	  ○ Protein Purification (Dr. Floriano) 13:06 min
	
	Achieve Chapter 3 Animations:
	• Animated Technique - Gel-Filtration Chromatography 2:28 minutes
	• Animated Technique - Affinity Chromatography 1:59 minutes
	
	Summary notes (pdf)
	• Protein composition and structure (chp 2)
	• Protein assay and purification (chp 3)
	
	Read
	Achieve EBook
	• Protein composition and structure (chp 2) sections 2.1 to 2.6 with one exclusion
	• Exploring proteins and proteomes (chp 3) - Read sections 3.1 (subsections 3.1.1 to 3.1.3)
		Lab 3.1 Purification of bovine liver lactate dehydrogenase: Affinity chromatography and LDH quantification
		
		Watch
		• Affinity chromatography (5 min)
		• Packing a chromatography column (2 min)
		
		Read
		• Lab 3 week 1 - Instructions
		• Lab Report Template for Lab #3 – Preliminary Data Report
		
		Assignments to complete
		• Prelab assignment 3.1 **0.8%**
		Due on Sept 26 (Thu sections) or Sep 27 (Fri section)

	Assignments to complete • Achieve - Chapter 2 Case Study: pH Peril (10 questions) **2%** • Achieve - Chapter 3 Homework (5 Questions) **2%** **Complete both before 11:59pm on Sep 27**	
5 Sep 30 to Oct 4 No classes Sep 30	**Watch** D2L videos • Proteins: physical characterization (Dr. Floriano) • Calculate the charge of a peptide at a given pH (Dr. Floriano) 8 min • ELISA Tutorial 2: Coating and Blocking the ELISA Plate (Youtube) 7 min • ELISA Tutorial 3: Preparing and Adding Samples to the ELISA Plate (Youtube) 4 min Achieve Chapter 3 Animations: • Animated Technique - Gel Electrophoresis (SDS-PAGE) 3:11 minutes • Animated Technique - Isoelectric Focusing 2:57 minutes • Animated Technique - Two-dimensional Electrophoresis 2:11 minutes • Animated Technique - Western Blotting (Immunoblotting) 2:29 minutes BioRad animations • BioRad's antibody detection ELISA animation • BioRad's antigen detection ELISA animation **Summary notes (pdf)** • Proteins: physical characterization (chp 3) • Uses of pure protein and protein detection methods (chp 3) **Read** Achieve EBook • Exploring proteins and proteomes (chp 3) - Read section 3.1 (subsections 3.1.4 to 3.1.5); section 3.2 (subsections 3.2.1 to 3.2.4, 3.2.6); section 3.3 (subsections 3.3.1, 3.3.4); and section 3.5 D2L • Exams - What to expect **Assignments to complete** • Achieve - Chp 3 Homework (18 Questions) **2%** **Complete before 11:59pm on Oct 4**	**MIDTERM EXAM 1** **Opens Thu Oct 3 at 11:30hr EDT** **Closes Fri Oct 4 at 17:30hr EDT**

6 Oct 7 to Oct 11	**Watch** D2L video • Introduction to metabolism (Dr. Floriano) 25 min Achieve • Problem Solving Video - Free Energy, ATP, and Creatine in Resting Muscle 4:31 min **Summary notes (pdf)** • Introduction to metabolism (chp 15) **Read** Achieve EBook • Metabolism: Basic Concepts and Design (chp 15) – sections 15.1 to 15.4 with one exclusion **Assignments to complete** • Achieve - Chp 15 Reading Quiz (15 questions) **2%** **Complete before 11:30pm on Oct 18**	**Lab 3.2** Purification of bovine liver lactate dehydrogenase: SDS-PAGE gel preparation and protein content determination by the Bradford method **Watch** • How to make an SDS-PAGE gel (5 min) • Bradford total protein concentration assay – with explanation - microplate (14 min) **Read** • Lab 3 week 2 - Instructions • Lab Report Template for Lab #3 **Assignments to complete** • Prelab assignment 3.2 **0.8%** **Due on Oct 10 (Thu sections) or Oct 11 (Fri section)** • Lab Report 2 **2.7%** **Due on Oct 10 (Thu sections) or Oct 11 (Fri section)** **Assignments from previous weeks due this week** • Lab report 2 2.7% **Due on Oct 10 (Thu sections) or Oct 11 (Fri section)**
7 Oct 14 to Oct 18	FALL STUDY WEEK **Oct 14 is Thanksgiving Day!**	FALL STUDY WEEK
8 Oct 21 to Oct 25	Watch D2L • HbA1c and Diabetes (Dr. Floriano) 17 min HHMI Biointeractive • Molecular structure of fat (17 slides) Summary notes (pdf) • Carbohydrates and Glycoproteins (chp 11) • Lipids (chp 12) Read Achieve EBook • Carbohydrates (chp 11) - sections 11.1 to 11.4 • Lipids and Cell Membranes – sections 12.1 to 12.3 Assignments to complete • Achieve - Chapter 11 Homework (15 questions) 2% • Achieve - Chapter 12 Reading Quiz (8 questions) 2% **Complete both before 11:59pm on Oct 25**	**Lab 3.3** Purification of bovine liver lactate dehydrogenase: SDS-PAGE of bovine liver crude lysate and purified LDH **Watch** • How to run an SDS-PAGE gel (5 min) • How to stain an SDS-PAGE gel (6 min) **Read** • Lab 3 week 3 - Instructions • Lab Report Template for Lab #3 **Assignments to complete** • Prelab assignment 3.3 **0.8%** **Due on Oct 24 (Thu sections) or Oct 25 (Fri section)** • Formal Lab Report 3 **4.8%** **Due on Nov 7 (Thu sections) or Nov 8 (Fri section)** **Assignments from previous weeks due this week** • Preliminary report for Lab 3 1.4% **Due on Oct 24 (Thu sections) or Oct 25 (Fri section)**

9 Oct 28 to Nov 1	**Summary notes (pdf)** • Cell membranes (chp 12) • Transport across membranes (chp 13) **Read** Achieve EBook • Lipids and Cell Membranes - sections 12.4 to 12.6 • Membranes, Channels and Pumps - sections 13.1 to 13.4 with exclusions **Assignments to complete** • Achieve - Chapter 12 Reading Quiz (6 questions) **2%** • Achieve - Chapter 13 Reading Quiz (8 questions) **2%** **Complete both before 11:59pm on Nov 1**	**Lab 4** Carbohydrate content of fruit **Watch** • Test for reducing compounds using 3,5-DNS (5 min) **Read** • Lab 4 Instructions • Lab Report Template for Lab #4 **Assignments to complete** • Prelab assignment 4 – **0.8%** **Due on Oct 31 (Thu sections) or Nov 1 (Fri section)** • Lab Report 4 **2.7%** **Due on Nov 14 (Thu sections) or Nov 15 (Fri section)**

10
Nov 4
to
Nov 8
 	
Last day to drop classes Nov 8
	Watch
	• Achieve – Problem Solving Video - Arsenate poisoning and tracking ATP generation through glycolysis (3:29 minutes)
	
	• HHMI BioInteractive
	  • Glycolysis (6 min)
	  • Pyruvate Dehydrogenase (3 min)
	
	Summary notes (pdf)
	• Membrane proteins (chp 12, 13 and chp14)
	• Glycolysis and Gluconeogenesis (chp 16)
	
	Read
	Achieve EBook
	• Signal-transduction pathways (chp 14) - section 14.1 and 14.2
	• Glycolysis and Gluconeogenesis sections 16.1 to 16.4 with exclusions.
	
	Assignments to complete
	• Achieve – Chp 14 Reading Quiz (8 questions) **2%**
	• Achieve – Chp 16 Case Study: Sudden Onset (16 questions) **2%**
	Complete both before 11:59pm on Nov 8
		Lab 5 Lipids – Iodine number determination and lipase activity
		
		Watch
		• Estimation of Iodine Value of Fats and Oils - Amrita University (5 min)
		
		Read
		• Lab 5 Instructions
		• Lab Report Template for Lab #5
		
		Assignments to complete
		• Prelab assignment 5 **0.8%**
		Due on Nov 7 (Thu sections) or Nov 8 (Fri section)
		
		• Lab Report 5 **2.7%**
		Due on Nov 28 (Thu sections) or Nov 29 (Fri section)
		
		Assignments from previous weeks due this week
		• Formal Lab Report 3 4.8%
		Due on Nov 7 (Thu sections) or Nov 8 (Fri section)

11
Nov 11
to
Nov 15
	Watch
	• Overview of TCA and oxidative phosphorylation (Dr. Floriano) 16 min
	• HHMI BioInteractive
	  • Citric Acid Cycle (6 min)
	  • Electron Transport Chain (4 min)
	  • ATP Synthesis (2 min)
	
	Summary notes (pdf)
	• TCA cycle (chp 17)
	• Oxidative phosphorylation (chp 18)
	
	Read
	Achieve EBook
	• The Citric Acid Cycle (chp 17) - sections 17.1 to 17.4 with exclusions
	• Oxidative Phosphorylation (chp 18) - sections 18.1 to 18.4 and 18.6, with exclusions
	
	Assignments to complete
	• Achieve – Chp 17 Homework (18 questions) **2%**
	• Achieve – Chp 18 Case Study: The Narrow Window (Home Work) (16 questions) **2%**
	Complete both before 11:59pm on Nov 15
		No labs!
		
		Assignments from previous weeks due this week
		• Lab Report 4 2.7%
		Due on Nov 14 (Thu sections) or Nov 15 (Fri section)

12 Nov 18 to Nov 22	**Watch** • Pentose Phosphate Pathway (JJ Medicine, Youtube) 12:26 min **Summary notes (pdf)** • Pentose phosphate pathway (chp 20) **Read** Achieve EBook • The Calvin Cycle and the Pentose Phosphate Pathway (chp 20) - sections 20.3 to 20.5 (**excludes** the Calvin cycle) **Assignments to complete** • Achieve – Chp 20 Homework (8 questions) **2%** **Complete before 11:59pm on Nov 22**	**MIDTERM EXAM 2** **Opens Thu Nov 21 at 11:30hr EDT** **Closes Fri Nov 22 at 17:30hr EDT**
13 Nov 25 to Nov 29	**Summary notes (pdf)** • Synthesis and transport of cholesterol and TAGs (chp 26) **Read** Achieve EBook • The Biosynthesis of Membrane Lipids and Steroids (chp) - sections 26.1 to 26.4 HHMI BioInteractive • How the body uses fat (26 slides) NCBI Bookshelf • Reproductive steroid hormones: synthesis, structure and biochemistry - Jackson LM, Parker RM, Mattison DR, editors. The Clinical Utility of Compounded Bioidentical Hormone Therapy: A Review of Safety, Effectiveness, and Use. Washington (DC): National Academies Press (US); 2020	**No labs!** **Watch and Read are part of the Final Exam materials** **Assignments from previous weeks due this week** • Lab Report 5 2.7% **Due on Nov 28 (Thu sections) or Nov 29 (Fri section)**

	Assignments to complete • Achieve - Chapter 26 Reading Quiz (10 questions) **2%** **Complete before 11:59pm on Tue Nov 26**	
14 Dec 2 to Dec 6	FINAL DAY OF CLASSES Dec 3th (Tue) EXAMINATIONS PERIOD Dec 6 2022 - Dec 16	**Final Exam encompasses all materials from Week 1 to Week 13!**
15 Dec 9 to Dec 13	EXAMINATIONS PERIOD Dec 6 2022 - Dec 16 Marks due on Dec 20	