



COURSE OUTLINE

1. **Course:** BCEM 393, Introduction to Biochemistry - Winter 2023

Coordinator(s)

| Name | Email | Phone | Office | Hours |
|------------------------|--------------------------------|--------------|---------------|---------------------------------|
| Dr. Brienne Burkinshaw | brienne.burkinsha1@ucalgary.ca | 403 220-5350 | BI 443 | Please email for an appointment |

Section(s)

Lecture 01 : MWF 11:00 - 11:50 in ST 148

| Instructor | Email | Phone | Office | Hours |
|------------------------|--------------------------------|--------------|---------------|---------------------------------|
| Dr. Brienne Burkinshaw | brienne.burkinsha1@ucalgary.ca | 403 220-5350 | BI 443 | Please email for an appointment |
| Dr Elmar Prenner | eprenner@ucalgary.ca | 220-7632 | BI 145 | TBA |
| Xiao Li | TBA | TBA | TBA | TBA |

To account for any necessary transition to remote learning for the current semester, courses with in-person lectures, labs, or tutorials may be shifted to remote delivery for a certain period of time. In addition, adjustments may be made to the modality and format of assessments and deadlines, as well as to other course components and/or requirements, so that all coursework tasks are in line with the necessary and evolving health precautions for all involved (students and staff).

In Person Delivery Details:

Lectures, labs, and assessments will be in-person. Lectures will not be recorded.

Re-Entry Protocol for Labs and Classrooms:

To limit the spread of COVID-19 on campus, the University of Calgary has implemented safety measures to ensure the campus is a safe and welcoming space for students, faculty and staff. The most current safety information for campus can be found [here](#).

Course Site:

D2L: BCEM 393 L01-(Winter 2023)-Introduction to Biochemistry

Note: Students must use their U of C account for all course correspondence.

There are six lab sessions over the semester. Each lab cycle is two weeks. Please see the table below for the start date of your scheduled lab section and the location. Visit the D2L site to read the lab introduction documents and the lab manual. Please submit the pre-lab assignment in the D2L dropbox before your first lab begins.

| Lab Section | Start Date | Room |
|--------------------|----------------------------------|-------------|
| B08 | Thurs Jan 12, 9:00 am - 11:50 am | BI 117 |
| B09 | Thurs Jan 12, 12:30 pm - 3:20 pm | BI 117 |
| B10 | Thurs Jan 12, 4:00 pm - 6:50 pm | BI 117 |
| B11 | Thurs Jan 12, 9:00 am - 11:50 am | BI 136 |
| B12 | Thurs Jan 12, 12:30 pm - 3:20 pm | BI 136 |
| B13 | Thurs Jan 12, 4:00 pm - 6:50 pm | BI 136 |
| B17 | Fri Jan 13, 1:00 pm - 3:50 pm | BI 117 |
| B18 | Fri Jan 13, 4:30 pm - 7:20 pm | BI 117 |
| B19 | Fri Jan 13, 1:00 pm - 3:50 pm | BI 136 |
| B20 | Fri Jan 13, 4:30 pm - 7:20 pm | BI 136 |
| B01 | Mon Jan 16, 1:00 pm - 3:50 pm | BI 136 |
| B02 | Mon Jan 16, 4:30 pm - 7:20 pm | BI 136 |
| B03 | Tues Jan 17, 9:00 am - 11:50 am | BI 136 |
| B04 | Tues Jan 17, 12:30 pm - 3:20 pm | BI 136 |
| B05 | Tues Jan 17, 4:00 pm - 6:50 pm | BI 136 |
| B06 | Wed Jan 18, 1:00 pm - 3:50 pm | BI 136 |

| | | |
|-----|----------------------------------|--------|
| B07 | Wed Jan 18, 4:30 pm – 7:20 pm | BI 136 |
| B14 | Thurs Jan 19, 9:00 am – 11:50 am | BI 136 |
| B15 | Thurs Jan 19, 12:30 pm – 3:20 pm | BI 136 |
| B16 | Thurs Jan 19, 4:00 pm – 6:50 pm | BI 136 |

For each in-person lab session please bring: a lab coat, safety glasses, paper and pen or a laptop/tablet (optional) for recording data, a calculator and the lab manual. Please wear closed-toe shoes.

Equity Diversity & Inclusion:

The University of Calgary is committed to creating an equitable, diverse and inclusive campus, and condemns harm and discrimination of any form. We value all persons regardless of their race, gender, ethnicity, age, LGBTQIA2S+ identity and expression, disability, religion, spirituality, and socioeconomic status. The Faculty of Science strives to extend these values in every aspect of our courses, research, and teachings to better promote academic excellence and foster belonging for all.

The Biological Sciences Equity Committee acknowledges there are persistent barriers that prevent such accessibility and hinder our progress towards EDI. Our representatives (faculty, staff, postdocs, graduate and undergraduate students) are committed to addressing any concerns and work towards proactive solutions that enact necessary change within the department. To submit anonymous questions, comments or concerns regarding EDI related issues, please reach out to our Chair, Constance Finney (constance.finney@ucalgary.ca), or a committee representative of your choice at <https://science.ucalgary.ca/biological-sciences/about/equity-diversity-and-inclusion>

2. Requisites:

See section [3.5.C](#) in the Faculty of Science section of the online Calendar.

Prerequisite(s):

Chemistry 351; and Biology 311 and admission to a Major offered by the Department of Biological Sciences or the Neuroscience Major or a primary concentration in Biological Sciences in either the Natural Sciences or Environmental Science Major. Or, Chemistry 351, and Medical Science 341, and admission to either the Biomedical Science or Bioinformatics Major.

Antirequisite(s):

Credit for Biochemistry 393 and 341 will not be allowed.

3. Grading:

The University policy on grading and related matters is described in [F.1](#) and [F.2](#) of the online University Calendar.

In determining the overall grade in the course the following weights will be used:

| Course Component | Weight | Due Date (duration for exams) | Modality for exams | Location for exams |
|---|--------|---|--------------------|---|
| Lab Reports (6 x 3%) ¹ | 18% | Ongoing | | |
| Pre-Lab Assignments (6 x 0.5%) ² | 3% | Ongoing | | |
| Memory quizzes (5 x 1%) ³ | 5% | Ongoing | | |
| In classtime Quiz 1* ⁴ | 12% | Feb 01 2023 | | |
| In classtime Quiz 2* ⁵ | 12% | Mar 01 2023 | | |
| In classtime Quiz 3* ⁶ | 12% | Mar 29 2023 | | |
| In class-time Quiz 4 ⁷ | 12% | Apr 12 2023 | | |
| Registrar Scheduled Final Exam | 26% | Will be available when the final exam schedule is released by the Registrar | in person | Will be available when the final exam schedule is released by the Registrar |

¹ Lab reports are due 7 days (168 hours) after the start of your assigned lab session. The final lab report (#6) is a shortened assignment due by the end of the lab session to accommodate end of term.

² Pre-lab assignments must be uploaded to the D2L dropbox before the start of your assigned lab session.

³ Memory quizzes are at the beginning of lab sessions 2, 3, 4, 5 and 6.

⁴ This assessment will occur during the scheduled lecture.

⁵ This assessment will occur during the scheduled lecture.

⁶ This assessment will occur during the scheduled lecture.

⁷ This assessment will occur during the scheduled lecture.

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

| | A+ | A | A- | B+ | B | B- | C+ | C | C- | D+ | D |
|---------------------------|------|------|------|-----|-----|------|------|-----|-----|------|------|
| Minimum % Required | 92 % | 86 % | 82 % | 78% | 74% | 70 % | 66 % | 62% | 58% | 54 % | 50 % |

This course will have a Registrar Scheduled Final exam that will be delivered in-person and on campus. [The Final Examination Schedule](#) will be published by the Registrar's Office approximately one month after the start of the term. The final exam for this course will be designed to be completed within 2 hours.

Note: In order to pass the course, students will be required to pass the laboratory component of the course by achieving 50% or more on the laboratory component.

*Should the university mandate remote learning, all quizzes will be synchronous and online at the scheduled time.

Should the university mandate remote learning, the final exam will be a 2 hour synchronous and online exam with 50% buffer time, and scheduled by the registrar.

The University of Calgary offers a [flexible grade option](#), Credit Granted (CG) to support student's breadth of learning and student wellness. Faculty units may have additional requirements or restrictions for the use of the CG grade at the faculty, degree or program level. To see the full list of Faculty of Science courses where CG is not eligible, please visit the following website: <https://science.ucalgary.ca/current-students/undergraduate/program-advising/flexible-grading-option-cg-grade>

4. Missed Components Of Term Work:

The university has suspended the requirement for students to provide evidence for absences. Please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations.

In the event that a student legitimately fails to submit any online assessment on time (e.g. due to illness etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date. Absences not reported within 48 hours will not be accommodated. If an excused absence is approved, one possible arrangement is that the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course. This option is at the discretion of the coordinator and may not be a viable option based on the design of this course.

If a student misses a scheduled in-classtime quiz, the weight of the quiz will be shifted to the cumulative final exam.

5. **Scheduled Out-of-Class Activities:**

There are no scheduled out of class activities for this course.

6. **Course Materials:**

Required Textbook(s):

Tymoczko, John L., Berg, Jeremy M., Gatto, Gregory J., and Stryer, L., *Biochemistry: A Short Course Fourth Edition*: Macmillan.

The laboratory manual and lecture note outlines will be available from the D2L course site for download.

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC [ELearning](#) online website.

7. **Examination Policy:**

No aids are allowed on in-person tests or examinations. Non-programmable calculators will be permitted.

Students should also read the Calendar, [Section G](#), on Examinations.

8. **Approved Mandatory And Optional Course Supplemental Fees:**

There are no mandatory or optional course supplemental fees for this course.

9. **Writing Across The Curriculum Statement:**

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section [E.2](#) of the University Calendar.

10. Human & Living Organism Studies Statements:

Students will not participate as subjects or researchers in human studies.

See also [Section E.5](#) of the University Calendar.

STUDIES IN THE BIOLOGICAL SCIENCES INVOLVE THE USE OF LIVING AND DEAD ORGANISMS. Students taking laboratory and field-based courses in these disciplines can expect involvement with and experimentation on such materials. Students perform dissections on dead or preserved organisms in some courses. In particular courses, students experiment on living organisms, their tissues, cells, or molecules. Sometimes field work requires students to collect a variety of living materials by many methods, including humane trapping.

All work on humans and other animals conforms to the Helsinki Declaration and to the regulations of the Canadian Council on Animal Care. The Department strives for the highest ethical standards consistent with stewardship of the environment for organisms whose use is not governed by statutory authority. Individuals contemplating taking courses or majoring in one of the fields of study offered by the Department of Biological Sciences should ensure that they have fully considered these issues before enrolling. Students are advised to discuss any concern they might have with the Undergraduate Program Director of the Department.

Students are expected to be familiar with [Section SC.4.1](#) of the University Calendar.

11. Reappraisal Of Grades:

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See [Section I.3](#) of the University Calendar.

- a. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **ten business days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall submit the Reappraisal of Graded Term work [form](#) to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. See sections [I.1](#) and [I.2](#) of the University Calendar
- b. **Final Exam:** The student shall submit the request to Enrolment Services. See [Section I.3](#) of the University Calendar.

12. Other Important Information For Students:

- a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, [Mental Health Services Website](#)) and the Campus Mental Health Strategy website ([Mental Health](#)).
- b. **SU Wellness Services:** For more information, see their [website](#) or call [403-210-9355](#).
- c. **Sexual Violence:** The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email (syva@ucalgary.ca) or phone at [403-220-2208](#). The complete University of Calgary policy on sexual violence can be viewed [here](#).
- d. **Student Ombuds Office:** A safe place for all students of the University of Calgary to discuss student related issues, interpersonal conflict, academic and non-academic concerns, and many other problems.
- e. **Student Union Information:** [SU contact](#), Email your SU Science Reps: science1@su.ucalgary.ca, science2@su.ucalgary.ca, science3@su.ucalgary.ca,
- f. **Academic Accommodation Policy:**

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf>

Students needing an accommodation because of a disability or medical condition should communicate this

need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>.

Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, by filling out the [Request for Academic Accommodation Form](#) and sending it to Lisa Gieg by email imgieg@ucalgary.ca preferably 10 business days before the due date of an assessment or scheduled absence.

- g. **Misconduct:** Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional [Code of Conduct](#) and promote academic integrity in upholding the University of Calgary's reputation of excellence. Some examples of academic misconduct include but are not limited to: posting course material to online platforms or file sharing without the course instructor's consent; submitting or presenting work as if it were the student's own work; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; borrowing experimental values from others without the instructor's approval; falsification/fabrication of experimental values in a report. Please read the following to inform yourself more on academic integrity:

[Student Handbook on Academic Integrity](#)
[Student Academic Misconduct Policy](#) and [Procedure](#)
[Faculty of Science Academic Misconduct Process](#)
[Research Integrity Policy](#)

Additional information is available on the [Student Success Centre Academic Integrity page](#)

- h. **Copyright of Course Materials:** All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or [non-academic misconduct](#), in addition to any other remedies available at law.
- i. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPPA). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see [Legal Services](#) website.
- j. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction ([USRI](#)) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.

Course Overview

We will explore the structure and function of amino acids, carbohydrates, proteins, lipids, enzymes and nucleic acids. We will use this knowledge to create a framework to develop a deep understanding of biological processes such as carbohydrate metabolism, energy transduction, enzymatic reactions, and the biosynthesis of nucleic acid and proteins.

Course Learning Outcomes

By the end of this course, successful students will be able to:

- Compare and contrast the roles of van der Waals interactions, charge-charge interactions, hydrogen bonds, covalent bonds and the hydrophobic effect in the structures of biological molecules
- Describe the structures and physicochemical properties of amino acid, carbohydrates, lipids and nucleic acids
- Distinguish the four levels of protein structure and describe the folding and forces leading to these structures
- List, discuss, use and evaluate the major techniques used in separating proteins, including column chromatography and sodium dodecylsulfate polyacrylamide gel electrophoresis (SDSPAGE)
- Describe and experimentally examine how enzymes catalyze reactions, and how pH, temperature, inhibitors and allosteric regulators can affect their function using the principles of protein structure, Michaelis-Menten kinetics and allostery
- Distinguish between aerobic and anaerobic carbohydrate metabolism, and describe for each reaction the

flow of energy and matter, the purpose(s), the mechanism of catalysis and regulation, and the conditions under which the reaction occurs

- Explain how the chemical structures of DNA and RNA are utilized by the enzymes of replication, repair, transcription, and translation to regulate and express genetic information
- Demonstrate skills frequently used in biochemistry laboratories:
 - Dispense small volumes accurately using mechanical pipettes
 - Perform serial dilutions
 - Measure absorbance by visible spectroscopy
 - Use standard curves for quantification
 - Use chromatography and electrophoresis to separate biochemical molecules
 - Work as a team
 - Communicate biochemical experiments in written reports

Classroom Performance System

You may be asked to use Top Hat, a classroom performance system, during lecture times. Top Hat will be used for learning purposes only, and will not be used for course grades.

Course Policies

When corresponding by email, please include BCEM 393 in your subject line. We will respond within 24 hours on a weekday, and within 48 hours over the weekend. Please contact the course coordinator (Dr. Burkinshaw) for any lab-related or administrative issues. Attendance at laboratory sessions is mandatory. Please contact the course coordinator if you are unable to attend the laboratory session for valid reasons.

Tentative Schedule

| Date | Lecture Topic | Instructor | |
|----------|---------------------------------|--|------------|
| January | 9 | Introduction to the course and labs | Burkinshaw |
| | 11 | Acids/Bases/Buffers/Water | TBA |
| | 12-19 | Lab 1 Analysis of lipids in food | |
| | 13 | Amino Acids - Structures and properties | TBA |
| | 16 | Peptides and Proteins - Peptide bond and primary structure | TBA |
| | 18 | Peptides and Proteins - Secondary structure | TBA |
| | 20 | Peptides and Proteins - Tertiary and quaternary structure | TBA |
| | 23 | Protein purification | TBA |
| | 25 | Carbohydrates - Monosaccharides | Burkinshaw |
| | 26-Feb 2 | Lab 2 Purification of invertase | |
| | | Memory quiz on amino acid structures | |
| | 27 | Carbohydrates - Linking monosaccharides | Burkinshaw |
| | 30 | Glycoproteins and lectins | Burkinshaw |
| February | 1 | Quiz 1 - material from Jan 11 to Jan 23 | Burkinshaw |
| | 3 | Basic concepts about enzymes | Burkinshaw |
| | 6 | Enzyme kinetics | Burkinshaw |
| | 8 | Enzyme kinetics - Allosteric enzymes | Burkinshaw |
| | 9-16 | Lab 3 Invertase activity assay | |
| | | Memory quiz on carbohydrate structures | |
| | 10 | Enzyme mechanisms and inhibitors | Burkinshaw |
| | 13 | Classes of enzymes and chymotrypsin mechanism | Burkinshaw |
| | 15 | Example of an allosteric protein: hemoglobin | Burkinshaw |
| | 17 | Lipids | Prenner |
| | 20-24 | Term Break | |
| 27 | Membranes and membrane proteins | Prenner | |
| March | 1 | Quiz 2 - material from Jan 25 to Feb 15 | Burkinshaw |
| | 2-9 | Lab 4 Kinetics of b-Galactosidase | |
| | | Memory quiz on lipid structures | |
| | 3 | Digestion and Basic Concepts of Metabolism | Prenner |
| | 6 | Glycolysis | Prenner |
| | 8 | Fermentation and Regulation of Glycolysis | Prenner |
| | 10 | Gluconeogenesis | Prenner |
| | 13 | Preparation for Citric Acid Cycle & Citric Acid Cycle | Prenner |
| | 15 | Citric Acid Cycle (cont'd) | Prenner |
| | 16-23 | Lab 5 Energetics of a metabolic reaction | |
| | | Memory quiz on metabolic molecules | |
| | 17 | Ox Phos: The Electron Transport Chain | Prenner |
| | 20 | Ox Phos: ATP Synthesis | Prenner |
| 22 | Nucleic Acid Structure | Burkinshaw | |
| 24 | DNA Replication | Burkinshaw | |

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|-------|------------|--|------------|
| | 27 | DNA damage and repair | Burkinshaw |
| | 29 | Quiz 3 - material from Feb 17 - March 20 | Prenner |
| | 30-April 6 | Lab 6 DNA digest and electrophoresis Memory quiz on nucleic acid structures | |
| | 31 | Gene expression and RNA processing in eukaryotes | Burkinshaw |
| April | 3 | The genetic code and tRNA charging | Burkinshaw |
| | 5 | Protein synthesis and recombinant DNA techniques | Burkinshaw |
| | 7 | Good Friday | |
| | 10 | Easter Monday | |
| | 12 | Quiz 4 - material from March 22 - April 5 | Burkinshaw |

Electronically Approved - Jan 05 2023 12:03

Department Approval