

CHEM 4207 A, BIOG 4207 A, CHEM 5010 A for Fall 2026

Bio-Organic Chemistry

We, the people of the Faculty of Science at Carleton University, acknowledge that our campus is located on the traditional, unceded territories of the Algonquin Anishinabeg people. Miigwetch for your hospitality and stewardship of this territory and the teachings that come from it. We are grateful for this land, the air that we breathe, and the water that sustains us all as well as for the animals, plants and other living beings: these enable us to research, teach, mentor, support, study, and learn. We recognize our responsibility to our natural environment and to reconciliation with Indigenous peoples.

Course Instructor: David Sabatino

How to address me: Professor Sabatino

Email: david.sabatino@carleton.ca

Note: If you have a question or would like to talk with me, you can send an email, visit me during student hours (see below), or approach me after lecture.

Best Ways to be in Touch: in class, via email, or during student hours

Student Hours: Tuesday and Fridays 1:00 p.m. – 2:30 p.m. and by appointment

Office Location: SC 207 F

Class Location: TB 240.

Class Times: Tuesday & Thursdays, 4:05 p.m. – 5:25 p.m.

Prerequisites: CHEM 3201 or permission of the Department

Preclusions: BIOG 4207A and CHEM 5010A (cross-listed courses to CHEM 4207A)

Department/Unit: Department of Chemistry and Institute of Biochemistry

I. Course Materials: Students are not required to purchase textbooks or other learning materials for this course. The following resources are optional learning materials related to the course content.

The optional textbook selections for this course are also available in the library course reserves <https://library.carleton.ca/find/reserves>

1. John McMurry and Tadhg Begley, The Organic Chemistry of Biological Pathways, 2nd edition, 2016, Roberts and Company Publishers, ISBN-10: 193622156X | ISBN-13: 978-1936221561
2. John McMurry, Organic Chemistry with Biological Applications, 3rd edition, 2015, Cengage Learning, ISBN-10: 128584291X | ISBN-13: 9781285842912
3. Selected journal articles including but not limited to the Journal of Organic Chemistry, Accounts of Chemical Research, Journal of Medicinal Chemistry, Journal of Natural Products, Organic and Biomolecular Chemistry, ChemComm, Organic Letters and Bioconjugate Chemistry. Selected journal articles are accessible via our University library on-line electronic journals and periodicals ([MacOdrum Library | Carleton University](#)).
4. Additional literature information may be found at (www.pubs.acs.org) and search engines such as Scifinder, PubMed Online, Science Direct, Web of Science and Google Scholar.

II. Approach to study

1. Attend lectures, take class notes and ask questions. Review lectures notes before the next class. Keep pace with the lecture material on a weekly basis—avoid falling behind!
2. Do assigned problem set. Review answers and ensure responses are well understood.
3. If additional explanation is required, ask in class, during office hours or email questions.
4. Review and study your lecture notes and assigned problems prior to exams.

III. Course Learning Objectives and Outcomes

1. Develop a fundamental, molecular understanding of the structure-function relationships that govern the biological activities of biomolecules
2. Gain a deep understanding of the chemical reactions and mechanisms that drive the synthesis, functionalization and degradation/breakdown of biomolecules found in nature
3. Compare and contrast chemical synthesis vs biosynthesis methods of biomacromolecules
4. Survey the importance of biomolecules in medicinal chemistry, chemical biology and biotechnology applications

IV. Grading:

1. Assignments (20%), Tuesday October 20th and Tuesday December 1st, 2026

Description: there will be two (2) homework assignments, one prior to the mid-term and another before the final exam. Each will be worth 10% for a total of 20% of the final grade. The assignments will contain problem solving questions like those on the exams. Each assignment must be completed and submitted independently in class by the due dates.

2. Group Presentation (25%), Thursday and Thursday December 8th and 10th, 2026

Description: Students will be assembled into small groups (2-3 students) and will select a presentation topic in bio-organic chemistry based on a recent (past 2 years) publication as a research communication or letter (2-5p), approved by the course instructor. Students will be required to formulate a short 15-17 min PowerPoint presentation followed by a brief 5-10 min question/answer period.

3. Mid-term exam (25%), Tuesday November 3rd, 2026

Description: in-class mid-term exam will cover lecture topics on Carbohydrates, Nucleic Acids, Amino Acids, Peptides and Proteins

4. Final exam (25 %), December 12th-23rd, 2026, location: TBD

Description: final exam will cover lecture topics on Lipids, Terpenes, and Heterocycles

5. In class participation (5%)

V. Class Schedule (*tentative*)

Week 1: September 10th

Topics: Welcome to Bio-Organic Chemistry

- Course introduction
- Syllabus review

Week 2: September 15th and 17th

Topics: Introduction to Bio-Organic Chemistry

- Organic Chemistry of Biomolecules
- Molecular Structure and Stereochemistry of Biomolecules
- Acid-Base Properties and Buffers
- Reactions and Mechanisms in Biological Chemistry

Week 3: September 22nd and 24th

Topics: Carbohydrates

- Classifications, Structure and Stereochemistry
- Monosaccharides, Oligosaccharide and Polysaccharides: acetal chemistry and the formation of glycosidic bonds
- Solid-phase oligosaccharide synthesis: entry into automated synthesis
- Biosynthesis of oligosaccharides
- Carbohydrate derivatives and bio-conjugation: applications in glycobiology

Week 4: September 29th and October 1st

Topics: Nucleic Acids

- Structure and chemical properties of nucleic acids
- Vorbruggen *N*-glycosylation: preparation of nucleosides and analogs
- Synthesis of biologically active nucleosides and nucleotide derivatives
- Template synthesis: enzymatic vs chemical ligation and polymerization methods
- Automated solid-phase synthesis of (modified) oligonucleotides
- Oligonucleotide bioconjugation: application to therapeutic oligonucleotides
- Semi-synthesis and biosynthesis (epigenetic modifications) of nucleic acids

Week 5: October 30th and October 2nd

Topics: Amino Acids

- Structure, Stereochemistry and Acid-Base Properties
- Classical chemical synthesis of Amino Acids (*eg.* Gabriel, Strecker, Reductive Amination reactions)
- Modern synthetic methods: Asymmetric synthesis (solution vs solid-phase)
- *C* and *N*-terminal modifications: an introduction into protecting group chemistry
- Un-natural amino acid synthesis: amino acid mimicry
- Amino acid catalysis (chiral auxiliaries and organocatalysts)

Week 6: October 6th and 8th

Topics: Peptides

- Structure, Stereochemistry and Biology
- Protecting groups and coupling reagents in peptide synthesis
- Solution vs Solid-Phase Peptide Synthesis (Boc vs Fmoc Approach)
- Synthesis of peptidomimetics and bioconjugation of peptides

- Peptide catalysis
- Peptide drugs

Week 7: October 13th and October 15th

*Topics: **Proteins***

- Protein Structure-Function Properties
- Total Chemical Synthesis of Proteins: Native Chemical Ligations, Staudinger Ligation, Oxime/Hydrazide Ligations, Click Chemistry Ligations
- Bio-orthogonal Synthesis of Protein Derivatives
- Protein Bioconjugation, Ligation and Labelling Strategies
- Application to Un-natural Protein Synthesis
- Protein Semi-Synthesis and Biosynthesis Methods

Post assignment 1.

Week 8: October 20th and 22nd

Assignment 1 due

- Assignment Review
- Mid-Term Exam Tutorial

Week 9: October 27th and 29th

No Lectures: Fall Break!

Week 10: Tuesday November 3rd, 2026

- ***Tentative date for in-class mid-term exam***

Mid-term will cover topics from weeks 3-7 (inclusive) on Carbohydrates, Nucleic Acids, Amino Acids, Peptides and Proteins

November 5th: In-class mid-term exam review

Week 11: November 10th and 12th

*Topics: **Lipids***

- Types of lipids
- Triacylglycerols, phospholipids and steroid chemical synthesis
- Waxes and Oils-conversion of carboxylic acids to esters and ester hydrolysis
- Lipid bioconjugation
- Asymmetric synthesis of bio-active lipids
- Chemoenzymatic synthesis of lipids
- Cationic lipids
- Steroid (bio)synthesis

Week 12: November 17th and 19th

Topics: Terpenes

- Types of terpenes and terpenoids
- Prostaglandins and Eicosanoids
- Chemical Synthesis (eg. Citral, Dipentene, Geraniol, α -Terpineol, α -Pinene, Menthol, Camphor)
- Selective functionalization
- Asymmetric synthesis and catalysis (eg., chiral auxiliaries and organocatalysts)
- Natural product synthesis (eg., prostaglandins, polyketides and non-ribosomal peptides)

Week 13: November 24th and 26th

Topics: Heterocycles

- Structures, Classification and Acid-Base properties
- Purine and Pyrimidine chemical synthesis-application to nucleic acids
- Alkaloid synthesis: pyrroles, pyridines, imidazoles, lactams and indoles
- Furans and Thiophenes and the multi-functional heterocycles
- Chemical Synthesis of Heterobicycles: quinolines, indoles and purines

Post assignment 2.

Week 14: December 1st and 3rd

Assignment 2 due

- Assignment 2 review.
- Final Exam Tutorial

Week 15: December 8th and 10th

Group presentations

Final Exam Period: December 12th – 23rd

Tentative dates for final exam

Location: TBD

Final exam will cover topics from weeks 11-13 (inclusive) on Lipids, Terpenes, and Heterocycles

V. Course Policies

Attendance:

All lectures will begin promptly at the scheduled time. Do not be late or you may not be admitted to that class period.

1. Absences:

In-class lectures will provide the necessary information for successful performance on assignments and exams. Students are responsible for getting the lecture notes from their classmates and review the lecture materials in the event of an absence.

2. Makeups and Lateness:

Are only permissible with the approval from the instructor. If approved, the student will have one additional week to complete the task. A grade of 0 will be administered if the student does not complete the make-up task within the allotted time period.

Please use the [Academic Considerations Form](#) for any circumstances where you require and are permitted to hand in late or missed work.

3. Distance Exams:

Students who are studying remotely or are varsity athletes with in-person tests or exams can apply to write their exam off-campus if they will be at least 160 km away from campus on the exam day and meet the course requirements for distance exams. There is a fee for this service, and all exams must be proctored. Apply for a distance exam at [Distance Exams - Scheduling and Examination Services](#). The application deadline for this term is September 24, 2026.

Instructor Responsibilities:

Instructor will be responsible for giving the lectures in an organized and clear manner. The instructor will also be responsible for addressing student questions during and after the lectures, including tutorials and office hours. The instructor will also prepare the course assignments and examinations. Teaching assistants (if applicable) will aid in the administration, proctoring and evaluation of assignments and exams. If anything is unclear or misunderstood, ask your instructor that is here to help! Instructor questions may be asked during lectures or email questions that will be later addressed. Participate in office hours and tutorial sessions held by the instructor. Schedule appointments by email if scheduling conflicts with office hours and tutorial sessions.

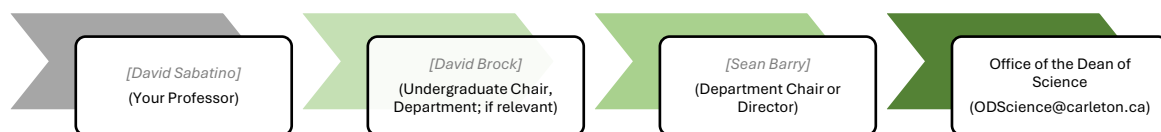
Student Responsibilities:

Students will be responsible for attending the in-class lectures, taking notes and asking questions. Students also have the responsibility for obtaining lecture notes from classmates for any missed lectures, which should be reviewed before the next class. Keep pace with the lecture content on a weekly basis. Students have the responsibility for completing the assignments by the due dates and reviewing the answers to ensure they are well understood. Carefully review and study the lecture notes on a weekly basis and prior to exams. Students have the responsibility for attending and completing the exams on their scheduled dates. Students will also be responsible for participating in and contributing equally to the group presentations. For additional explanation ask questions in class, attend office hours or email questions.

Student Concerns:

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during office hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note: You can also bring your concerns to [Ombuds services](#).



For additional help, contact science student services:

Science Student Success Centre

3431 Herzberg Laboratories
1125 Colonel By Drive,
Ottawa, ON K1S 5B6

<https://sssc.carleton.ca/>

Phone: (613) 520-2600 Ext. 3111

VI. Academic Accommodations:

It is the policy and practice of Carleton University to promote equity, diversity and inclusion (EDI) in its learning environments. Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (<https://students.carleton.ca/course-outline/>).

If you have a documented disability, you may be eligible for reasonable accommodations in compliance with University policy. Please note, students are not permitted to negotiate accommodations directly with professors. To request accommodations or assistance, please self-identify with the Paul Menton Centre (PMC) for Students with Disabilities at the beginning of the semester.

For more information or to register for services, contact PMC at:

Paul Menton Centre
501 University Centre
1125 Colonel By Drive,
Ottawa, ON K1S 5B6
Email: pmc@carleton.ca
Phone: [613-520-6608](tel:613-520-6608)

PMC will help make special arrangements to meet your academic obligations during the term.

For more details, visit the Equity Services website:

carleton.ca/equity/wpcontent/uploads/Student-Guide-to-Academic-Accommodation.pdf

For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: carleton.ca/sexual-violence-support

VII. Information Technology Service Desk:

The first point of contact for any technology-related question or problem is Carleton University's Information Technology Service (ITS) Desk. Contact ITS by phone by calling 613-520-3700 or via e-mail at its.service.desk@carleton.ca

ITS is staffed by professionals Monday through Friday from 8 a.m. through 4:30 p.m. ITS provides phone support for most University applications, including Carleton Central, Brightspace Learning Management System, Carleton 360, Microsoft Windows, and the Microsoft Office suite.

For more tips and technical information, go to carleton.ca/its/chat

Statement on Chat GPT/Generative AI usage (See the *Sample Syllabus Statements for AI use in Courses* [document](#) for examples)

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

Minimal AI use in this course – Basic Assistance Only: Students may use AI tools for basic gathering of information, word processing functions, including grammar and spell checking (e.g. Grammarly, Microsoft Word Editor, Copilot). It is not necessary to document the use of AI for the permitted purposes. If you have questions about AI that isn't listed above, ask your instructor.

VII. Academic and Professional Integrity Policy:

Students are expected to follow the Academic and Professional Integrity Policy outlined in the Student Guide: [Carleton University's Academic Integrity Policy](#). The specific Academic and Professional Integrity Policy of Carleton University includes:

1. Dependability: candidates are reliable, timely, and consistent in their presence and preparation for courses at the university as well as their field settings.
2. Respect & Empathy: candidates are respectful in their address, writing, language, and physical space toward faculty, university staff, school personnel, peers, students in field.
3. Open-mindedness: candidates respect the context and experience of others; developing skills to use that information in classroom conversation, writing, and lesson planning.
4. Integrity: candidates submit original work, fully cite all sources associated with the development of their work (including information from the internet) and recognize that the university fully supports the use of anti-plagiarism software in support of academic integrity. (Original student work is expected. Any work containing plagiarized material will result in an automatic "0" for the assignment.)
5. Passion for the profession: the right for all students to have access to positive and productive learning environments, and a recognition that the teacher's dedication is to provide a thriving learning environment for all students.

Additional details about this process can be found on [the Faculty of Science Academic Integrity website](#).

VIII. Academic Honesty:

Lying, cheating and stealing are not tolerated in civilized society and in scientific work. While you will be encouraged to collaborate, you must follow directions regarding preparing your work independently.

1. Relevant examples of lying include but are not limited to signing in someone else's name on assignments and exams, falsifying documentation or statements to receive an excused absence and claiming to have completed an assignment that you did not complete.
2. Relevant examples of cheating include but are not limited to copying another student's assignment and purporting it as your own or collaborating with another student on an assignment or exam for which collaborating is prohibited.
3. Relevant examples of stealing include plagiarism (purporting another's work no matter the source as your own), removing any items from the classroom that you did not yourself bring in, taking materials from another student's work area without permission. Suspected academic dishonesty will be dealt with summarily and harshly.
4. Accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using artificial intelligence tools such as ChatGPT when your assessment instructions say it is not permitted.