Carleton University
Faculty of Science | Department of Chemistry
CHEM 4201, 5207, 5208
(Bio)Macromolecular Nanotechnology
Winter 2024
Syllabus

I. General Information

1. Instructor: David Sabatino, Ph.D.
Office: Steacie Building, Room 207F
Lab: Steacie Building, Room 329
e-mail: david.sabatino@carleton.ca
phone: 613-520-2600 ext. 4229
Office Hours: T, R: 3-4 PM, and by appointment

II. Course Meetings:

- Tuesdays (T) and Thursdays (R) 4:05 pm – 5:25 pm, location: Southam Hall (SA) 404

III. Course Description, Credits and Requisites:

- Biological and synthetic macromolecules related to nanoscale phenomena. Challenges and opportunities associated with natural and synthetic polymers on the nanoscale. Molecular recognition, self-assembled nanostructures, scaffolds and templates, functional nanomaterials, amphiphilic architectures, nanocomposites, and nanomachines. Applications to sensing, biomaterials, drug delivery, and polymer-based devices.
- Pre-requisites: CHEM 3600 (Introduction to Nanotechnology) or permission of the department.
- 0.5 credit
- Offered at the undergraduate level as CHEM 4201 and at the graduate level, with different requirements, as CHEM 5207, CHEM 5208, for which additional credit is precluded.
- Lectures three hours per week

IV. Course Materials:

- **Textbook Not Required**

1. Selected journal articles including but not limited to the Nature Nanotechnology, Science, Advanced Materials, PNAS, ACS Nano and Nano Lett, Nanoscale, Small, Biopolymers, (Bio)Macromolecules, ACS Applied Materials and Interfaces, ACS Biomaterials Science and Engineering, Organic and Biomolecular Chemistry, Organic Letters and Bioconjugate Chemistry. Selected journal articles are accessible via our University library on-line electronic journals and periodicals (MacOdrum Library | Carleton University).

2. 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.

V. Class Schedule and Topics *(tentative)*

Date	Lecture
Jan 9, 11	Welcome and Syllabus Review Lecture Topic: Supramolecular Chemistry Article Selection: *Advances in Applied Supramolecular Technologies* https://pubs.rsc.org/en/content/articlelanding/2021/cs/d0cs00948b
Jan 16, 18	Lecture Topic: Polymer Self-Assembly and Nanostructure Formation Article Selection: *Trends in Polymerization-Induced Self-Assembly* https://pubs.rsc.org/en/content/articlelanding/2020/py/d0py00455c
Jan 23, 25	Lecture Topic: Polymer Sorting and Single-Chain Polymer Assembly Article Selection: *Self-Assembly of H-bonded Gradient Copolymers* https://pubs.acs.org/doi/full/10.1021/acs.macromol.7b00070
Jan 30, Feb 1	Lecture Topic: Synthetic Polymer Hydrogels Article Selection: *Double Layer Synthetic Hydrogel Drug Delivery* https://www.nature.com/articles/s41598-021-88503-1
Feb 6, 8	Lecture Topic: Foldamers and Rotaxanes Article Selection: *Foldaxanes* https://pubs.acs.org/doi/10.1021/acs.accounts.2c00050
Feb 13, 15	Lecture Topic: Host-Guest Supramolecular Interactions Article Selection: *Supramolecular Host-Guest Interaction Interfaces* https://www.nature.com/articles/s41467-021-27659-w
Feb 20, 22	**Winter Break-No Classes**
Feb 27, 29	Lecture Topic: Biomimetics and Biomaterials Article Selection: *Synthesis and Applications of Biomaterials* Advances in the synthesis and application of self-assembling biomaterials - PubMed (nih.gov)
Mar 5, 7	Lecture Topic: Glycopolymers Article Selection: *Drug Delivery with Amphiphilic Glycopolymers* https://pubs.acs.org/doi/10.1021/acs.chemmater.8b01882
Mar 12, 14	Lecture Topic: Nucleic Acids Nanotechnology Article Selection: *Nucleic Acid Nanotechnology in CRSIPR/Cas9* Advances in the Integration of Nucleic Acid Nanotechnology into CRISPR-Cas System | SpringerLink
Mar 19, 21	Lecture Topic: Peptide Self-Assembly and Protein Nanostructures Article Selection: *Self-Assembled Peptide and Protein Nanomaterials* https://pubs.acs.org/doi/10.1021/acsbiomaterials.9b00408
Mar 26, 28	Lecture Topic: Amphiphilic Lipid Nanoparticles Article Selection: *Cationic Lipids Produce mRNA Nanovaccines* https://www.pnas.org/doi/10.1073/pnas.2005191118
Apr 2, 4	Lecture Topic: Nanotechnology in Living Systems Article Selection: *Engineering Virus-Like Particles as Biomedicines* Engineered virus-like particles for efficient in vivo delivery of therapeutic proteins - PubMed (nih.gov)
Apr 9	**Group Original Research Presentation**
Apr 13-25	**Final Exam Period- Submit Group Original Research Proposal**

VI. Course Requirements and Grading

Final grade distribution as follows:

1. **In-class quizzes (20%),**

   Description: At the beginning of each class, students will have 10 min to complete a series of questions (4-5) related to the lecture topic (*i.e.* selected journal article). The questions will be prepared and answers graded by the lecturer. There will be an assigned quiz for each lecture topic having equal value. Top 10 quizzes (out of 12) will be averaged to 20%.

2. **Article Presentation (40%),**

   Description: Students will have the choice of selecting a lecture topic and article from the class schedule. Students will be required to formulate a PowerPoint presentation (grad: 40-45 min and undergrad: 30-35 min) on the subject matter. This will be followed by a 15-20 min question/answer period and in-class discussion in the subsequent lecture period.

   The presentation must include:
   1. Title Page: Describing presentation title, name and date
   2. Table of Contents: Describing overall layout of the presentation
   3. Introduction: Providing background info leading to the current research
   4. Experimental: Describing the methods and techniques in the journal article
   5. Results and Discussion: Describing the key findings and impact
   6. Future Work and Directions: Describing the next logical steps to further the study
   7. Conclusions: Summary of the most important points
   8. References: Bibliography in ACS style

   Grading:
   1. Presentation style and format: 10%
   2. Knowledge and Comprehension: 10%
   3. Ability to review, critique and propose future directions: 10%
   4. Handling questions: 10%

3. **Group Original Research Proposal (40%)**

   Description: Students will be combined into groups and tasked to prepare a 15-20 min presentation on an original research proposal. This will be followed by a 10-15 min question & answer period. Students are encouraged to adopt the presentation format used for their article presentations. The grading scheme is as follows:

   Presentation (20%):
   1. Presentation style and format: 5%
   2. Knowledge and Comprehension: 5%
   3. Ability to review, critique and propose future directions: 5%
   4. Handling questions: 5%

In addition to the oral presentations, students are required to submit a 5 page type-written research proposal. The group original research proposal should include the following:

1. Title and Abstract: 1 page summary of the proposed research
2. Purpose and Objectives: Highlight the main goal and underlying research objectives
3. Design and Methods: Design of the research proposal and the methodology
4. Expected Outcome and Impact: Foreshadow potential results and impact to be made
5. References: Bibliography in ACS style
6. Budget: To include student stipends, materials, chemicals and instrumentation

Proposal (20%):

1. Title and abstract: 5%
2. Purpose, objectives and impact to be made: 5%
3. Research proposal: 5%
4. Feasibility: 5%

VII. Course Learning Outcomes

In this course, students will learn to:
1. Survey, review and assess the scientific literature on (bio)macromolecular nanotechnology
2. Develop a fundamental, chemical understanding of the principles that govern the functional activities of (bio)macromolecules
3. Improve presentation and writing skills of the scientific literature and research
4. Implement group learning activities related to research proposal development

VIII. Approach to study

Course expectations and study approach:
1. Attend lectures, take notes and ask questions. Read and review the articles before class.
2. Select your article early and start working on it soon. Avoid falling behind.
3. Assemble your group quickly and begin working on your proposal asap.
4. Ask questions and feedback from the course instructor during class and office hours.

VIV. Course Policies

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

1. Absences:
   Students are responsible for getting the lecture material from their classmates or review the lecture material 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.

Instructor Responsibilities:

Instructor will be responsible for managing the in-class lecture presentations. The instructor will also be responsible for addressing student questions during and after the lectures, including tutorials and office hours. The instructor will also aid in the preparation of the course requirements (e.g., student presentation and proposals). If anything is unclear or mis-understood, ask your instructor, that is here to help! Instructor questions may be addressed during lecture, email, office hours and by appointment.

Student Responsibilities:

Students will be responsible to attend lecture, participate in the course requirements, take notes and ask questions. Students also have the responsibility of obtaining lecture notes from classmates, for any missed lectures, which should be reviewed before the next class. Keep pace with the lecture material and review the selected lecture topics and articles on a weekly basis. If additional explanation is required, ask questions in class, attend office hours, email questions or schedule appointments if scheduling conflicts persist. 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

X. 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 in preparing 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 collaboration 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 or from another student's work area without permission.

XI. 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, via e-mail at its.service.desk@carleton.ca or chat carleton.ca/its/chat

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.

XII. Academic Accommodations:

It is the policy and practice of Carleton University to promote equity, diversity and inclusion (EDI) in its learning environments. If you have a documented disability you may be eligible for reasonable accommodations in compliance with University policy. To request accommodations or assistance, please self-identify with the Paul Menton Centre (PMC) for Students with Disabilities.

For more information or to register for services, contact PMC at:
501 University Centre
1125 Colonel By Drive,
Ottawa, ON K1S 5B6
Email: pmc@carleton.ca
Phone: 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**

XIII. Academic and Professional Integrity Policy:

Students are expected to follow the Academic and Professional Integrity Policy outlined in the Student Guide. These include:

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 and recognize that the university fully supports the use of anti-plagiarism software in support of academic integrity.
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.