

**Course Syllabus: Advanced Chemical Biology I (Chem 7037, Fall semester 2025)**

<b>Description</b>	<p>Chemists are able to create new molecules that have never existed in nature. We therefore play unique and important roles in scientific research, and I would argue that our skills are especially relevant in answering biological questions. Through the characterization of structures, mechanisms, and properties at the nanometer scale, chemists are poised to gain insights into the molecular underpinnings of life. The following are a sampling of the many provocative questions that will be discussed in this class:</p> <ul style="list-style-type: none"><li>• Can genetic information be stored in forms other than the double helix?</li><li>• Can proteins be made of more than the 20 canonical amino acids?</li><li>• Can we steer the course of evolution?</li></ul> <p>I will give you a glimpse of how chemists attempt to answer these (and many other) questions!</p>
<b>Requirements</b>	All students should have taken undergraduate level <i>Biochemistry</i> and <i>Organic Chemistry</i> .
<b>Objectives</b>	Students will appreciate the many ways chemistry can facilitate biological research.
<b>Learning Outcomes</b>	Students will learn about the state-of-the-art chemical tools that are useful in biological research.
<b>Required Readings</b>	Approximately 2 to 3 papers will be assigned each week, which amounts to a total of 20-plus papers throughout the semester. They will be part of the exams.
<b>Grading</b>	Midterm exam 35% <sup>[1]</sup> . Final exam 35% <sup>[1]</sup> . Oral presentation 10% <sup>[2]</sup> . Homework 10% <sup>[3]</sup> . In-class quizzes 10% <sup>[4]</sup> . Earn extra credits: Class participation (+2%) <sup>[5]</sup> . Wager on 2025 Nobel Prizes in Chemistry (+1%) and Physiology or Medicine Nobel Prizes (+1%) <sup>[6]</sup>

**Course Schedule**

Week	Date	Lectures and Guest <sup>[7]</sup> Lectures	Notes
1	09/01	Course overview. What is chemical biology	
1	09/04	Experiments relevant to understanding the origin of life	
2	09/08	Nucleobase, nucleoside, and nucleic acid	
2	09/11	Nucleic acid synthesis and synthetic mimics 1	Quiz 1
3	09/15	NGS technologies and their applications	Quiz 2
3	09/18	International conference	No class
4	09/22	RNA, aptamers, and ribozymes	
4	09/25	Classic directed evolution experiments 1 (SELEX)	
5	09/29	Teachers' Day	No class
5	10/02	Amino acids, peptides, and proteins	Quiz 3
6	10/06	Mid-Autumn Festival	No class
6	10/09	tRNA, rRNA, and translation	Quiz 4
7	10/13	International conference	No class
7	10/16	CRISPR and gene editing technologies	
8	10/20	Group A presentations / Group B homework due	
8	10/23	MID-TERM EXAM	
9	10/27	Discuss mid-term exam questions and answers	
9	0/30	PTM and bioconjugation methods	
10	11/03	Classic directed evolution experiments 2 (proteins)	
10	11/06	Noncanonical amino acid incorporation	Quiz 5
11	11/10	Protein degradation and PROTACs	
11	11/13	Secondary gene products (sugars and lipids)	Quiz 6
12	11/17	Secondary metabolites	
12	11/20	Structural biology basics 1	Manuel Maestre-Reyna
13	11/24	Super-resolution microscopy and live cell imaging	Quiz 7
13	11/27	Structural biology basics 2	Manuel Maestre-Reyna

14	12/01	Attend various name lectures <sup>[8]</sup> / Buffer time	
14	12/04	Glycochemistry and glycobiology	游景晴
15	12/08	Game show	
15	12/11	Group B presentations / Group A homework due.	
16	12/15	Office Hour (A521)	No class
16	12/18	FINAL EXAM	

===== Additional class information =====

**John Chu** (朱忠瀚, Professor) (02) 3366-8654 [johnchu@ntu.edu.tw](mailto:johnchu@ntu.edu.tw)  
**Chu-Ting Lee** (李筑婷, TA) (02) 3366-8653 [d11223107@ntu.edu.tw](mailto:d11223107@ntu.edu.tw)  
**Hours:** Mon. 13:20 – 15:10 and Thu. 13:20 – 15:10  
**Office hours:** Mon. 15:30 – 16:00 and Thu. 15:30 – 16:00 (Rm A521)  
**Language:** Lectures, exams, and student presentations will all be given in *English*  
Students must answer exam questions in *English* but may ask questions in *Chinese*  
**Class slides:** All class materials can be found on NTU COOL (<https://cool.ntu.edu.tw/login/portal>)

===== Notes =====

- [1] Things we talked about in class, the assigned reading materials, guest lectures, external lectures (see note 7), as well as presentations by your classmates, may all appear in the mid-term and final exams. You are allowed bring a piece of *A4 paper with your notes* on it to the mid-term and final exams (but not for in-class quizzes).
- [2] The class will be split evenly into two groups (A and B). Group A do oral presentations *on 10/20* and turn in their homework *on 12/11*; the schedule is the opposite for group B. Prepare a very short talk ( $\leq 4$  min.) with *one or two* slides only for your oral presentation. You may choose any topic in chemical biology. In the past, student often summarize the contents of a recent paper, but feel free to be creative!
- [3] Provide an example that ChatGPT gives an *incorrect* answer (screenshot) to your question. Then, do some research on this topic and provide the correct answer. No more than 2 pages.
- [4] There will be short, in-class quizzes ( $\leq 5$  questions) every now and then. You will need to memorize and draw the chemical structures of *nucleic acids* and *amino acids* in Quiz 2 (9/15) and Quiz 4 (10/09), respectively.
- [5] Class participation = ask questions / answer question / point out errors in the slides.
- [6] Send the TA the names of two scientists before midnight 9/30. Earn *+1%* for your *final overall grade* for each Nobel Prize win that you guessed correctly!
- [7] At least three named lectures are typically scheduled some time in Sep. to Dec., including the Sunney Chan Lecture (陳長謙講座), Yee Fong Chemistry Lecture (義芳化學講座), and KT Wang Bioorganic Chemistry Lecture (王光燦生物有機化學講座). They feature great talks relevant to Chemical Biology. You should go to *all of them* as the contents will be part of the final exam.
- [8] There will be two guest lectures. The first one is about structural biology by Professor Manuel Maestre-Reyna (馬左仲) of NTU Chemistry on 12/04 (Thu.) and 12/11 (Thu.); the second one is about glycochemistry and glycobiology by Professor Ching-Ching Yu (游景晴).