Chemistry 467L, Chemical Biology Laboratory
Syllabus, Fall 2020

Overview

CHEM 467L is intended for upper division undergraduates interested in gaining exposure to the area of Chemical Biology. It is a laboratory course that explores the principles of chemical biology through experiments that focus on the interactions of small molecules with bio-macromolecules such as proteins, DNA, and RNA. In this semester, you will work on the interaction between a set of small molecule ligands, theophylline and caffeine, and an RNA molecule called the "Theophylline Aptamer". Three inter-connecting multi-session labs are included, covering chemical modification of small molecule ligands, characterization of ligand/RNA interaction *in vitro*, and controlling gene expression *in vivo*.

This class emphasizes on: (i) integrating learning from prior classes within the Chemistry/Biochemistry curricula; and (ii) analyzing data in a sufficient depth; and (iii) presenting data and conclusions in a logical, clear, and succinct manner.

Specific for Fall 2020: With restrictions due to COVID-19, this class will be taught on-line. The physical experiments will be carried out by the TA and filmed. The recording and the resulting data will be provided to you for analysis. Weekly Zoom meetings will be held for the class to discuss experimental design, data analyses, conclusions drawn from the data, and information learned. Updated syllabus and schedule will follow. While this is no ideal, we expect to meet our learning objectives. You are also encourage to consider taking this class at a later time, when it is offered in person.

Instructor Professor Peter Z. Qin
Office: TRF 119, Email: pzq@usc.edu
Office Hours: Tuesdays 1 – 2 pm [via Zoom]

TA Yukang Liu
Office: TRF 111, Email: yukangli@usc.ede

Location & Time

- Synchronous on-line Zoom Lectures & Discussions, Thursdays, 2:00 – 3:30 pm
- Materials and recordings accessible asynchronously via Blackboard class site

Pre-requisite: CHEM 322b or CHEM 325b

Co-requisite: CHEM 300

Required Materials

- Laboratory Manual

Manual and References

1. Chemical Biology Laboratory Manual, USC Department of Chemistry.
2. You should read the primary reference articles as indicated below prior to starting each lab:

Lab 1: Zajac, M.A., Zakrzewski, A.G., Kowal, M.G. and Narayan, S. (2003) "A Novel Method of Caffeine Synthesis from Uracil." *Synthetic Communications*, 33, 3291-3297.

Lab 2: Jucker, F.M., Phillips, R.M., McCallum, S.A. and Pardi, A. (2003) "Role of a Heterogeneous Free State in the Formation of a Specific RNA−Theophylline Complex." *Biochemistry*, 42, 2560-2567.

Lee, S.M., Zhao, L., Pardi, A., and Xia, T. (2010) "Ultrafast dynamics show that the theophylline and 3-methylxanthine aptamers employ a conformational capture mechanism for binding their ligands." *Biochemistry*, 49, 2943–2951.

Lab 3: Ceres, P., Garst, A.D., Marcano-Velázquez, J.G. and Batey, R.T. (2013) "Modularity of Select Riboswitch Expression Platforms Enables Facile Engineering of Novel Genetic Regulatory Devices." *ACS Synthetic Biology*, 2, 463-472.

Sambrook and Russell, "Molecular Cloning", 3rd Ed.

Grading

Assignments	**Points**
3 Laboratory Reports	150 each
Term Paper	150
Total	**600**

- Three laboratory reports, each due as indicated in the "Schedule" section. All written materials must be typed. See Laboratory Report Guidelines for more information. Late lab reports will be accepted up to 1 week late. 10 points per day will be deducted from late reports for the first 4 days, and 45 points total will be deducted from the total score for days 5-7. Late lab reports will not be accepted after 1 week past the due date. There are no regrades for lab reports.
- A term paper describing results from all three labs in a comprehensive fashion. The paper should be written in the style of an article of *J. Am. Chem. Soc.*, and is due two weeks after the last lab session. See Term Paper Guidelines for further instruction.

Safety

[This section is omitted as class is on-line]

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to Dr. Qin as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. SCampus (https://policy.usc.edu/scampus/), the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A. Should there be any suspicion of academic dishonesty and violation of stated policy, students will be referred to the Office of Student Judicial Affairs and Community Standards (https://sjacs.usc.edu/) for review and discipline.

It is the student's ethical responsibility as emerging professionals to appropriately use and handle Zoom recordings, asynchronous recordings, or other academic materials and to keep personal information shared in class private. Students are not permitted to create their own class recordings without the instructor's permission. Violations of these policies will be met with the appropriate disciplinary sanction. As stated under the existing SCampus policies regarding class notes (https://policy.usc.edu/scampus-part-c/):

> "Notes or recordings made by students based on a university class or lecture may only be made for purposes of individual or group study, or for other usual non-commercial purposes that reasonably arise from the student's membership in the class or attendance at the university. This restriction also applies to any information distributed, disseminated or in any way displayed for use in relationship to the class, whether obtained in class, via email or otherwise on the internet, or via any other medium. Actions in violation of this policy constitute a violation of the Student Conduct Code, and may subject an individual or entity to university discipline and/or legal proceedings."

Laboratory Schedule (subject to revision)

Week	Date	Location	Topics
1	Aug. 20	Zoom	Orientation; Introduction to Lab 1
2	Aug. 27	Zoom	Lab 1: Chemical Synthesis of Caffeine from Theophylline; (A) Caffeine synthesis
3	Sept. 3	Zoom	Lab 1: Chemical Synthesis of Caffeine from Theophylline; (B) Product workup & Characterization by HPLC
4	Sept. 10 report 1 due	Zoom	Lab 2: Characterization of Ligand Binding by Theophylline Aptamer (A) Fluorescence detection of aptamer/ligand binding
5	Sept. 17	Zoom	Discussion: Data Processing; Preparation of Lab Report [Lab 2(B): Determination of Kd]
6	Sept. 24	Zoom	Lab 3: In Vivo Control of Gene Expression (A) Transformation of E. Coli. with theo/metE plasmid
7	Oct. 1 report 2 due	Zoom	Lab 3: In Vivo Control of Gene Expression; (B) Cell culture with different ligands Discussion: Term paper
8	Oct. 8	Zoom	Lab 3: In Vivo Control of Gene Expression; (C) Quantify GFP expression in the presence of different ligands
9	Oct. 15	Zoom	Review & Term Paper Prep.
10	Oct. 22	Zoom	Term Paper Due