SYLLABUS BIBC 151, SPRING 2022

CHEMISTRY OF BIOLOGICAL INTERACTIONS

CLASSROOM AND TIME: Tata Hall 2303 and 2304; Wednesdays and Fridays, 12:30 PM - 4:20 PM
INSTRUCTORS: Alisa Huffaker, Eric Schmelz
INSTRUCTIONAL ASSISTANTS: Winnie Gong, Naser Khader
EMAIL: ahuffaker@ucsd.edu, eschmelz@ucsd.edu,

COURSE OVERVIEW: Complex interactions between organisms ranging from immunity to mate attraction have a chemical basis. Moreover, an evolutionary arms race in chemical biosynthesis is widely appreciated to have driven much of the planet's biological diversity. Plants and microorganisms are the dominant life forms on earth and a major source of natural product chemicals for the discovery of new pharmaceuticals. Interactions between photosynthetic and non-photosynthetic organisms range from antagonistic to mutualistic. This laboratory will explore the chemical basis of plant-microbial interactions and explore both specialized trace signaling molecules and highly abundant multifunctional natural products. Striking conceptual overlap and relevance to roles in humans will be emphasized. In this context, labs will enable the opportunity to explore biomolecules and organism interactions in a collaborative and multi-disciplinary environment. We will extract, quantify and test activity of plant and microbial biochemicals of ecological and medicinal significance and pursue cutting edge methods for discovery of new chemicals of interest as antimicrobials or pharmaceuticals.

COURSE LEARNING OBJECTIVES: You will learn essential concepts of chemistry-mediated biological interactions, practice fundamentals of the research process, and develop experience with a variety of practical methods related to small molecule discovery, extraction and analysis.

CONCEPTS:
- Mechanisms by which chemistry mediates complex biological processes and interactions between organisms
- Strategies for discovery of new pharmaceuticals (antibiotics) from plants and microbes
- How measurable chemical phenotypes can be rapidly linked to genotype

RESEARCH SKILLS:
- Reading and understanding scientific literature
- Writing in the format of a scientific manuscript
- Identifying scientific questions, forming hypotheses and proposing methodology to test hypotheses
- Oral presentation of a research proposal

METHODS:
- Extraction processes for small molecule purification
- Fundamentals of chromatography and analysis by mass spectrometry
- Basic summarization and statistical analysis of mass spectrometry data
- Analysis of small molecule function through a variety of assays
- Analysis of metagenome data to identify novel biosynthetic clusters for antibiotic discovery
- Use of association mapping to identify biosynthetic pathways for plant antimicrobials of interest

SCHEDULE

Meeting	Date	Topic	Practical Activity
1	March 30	Introduction to BIBC 151, 1.1 chemical analysis	Safety overview
2	April 1	1.2. Humans and salicylates, the first blockbuster pharmaceutical	Extraction of MeSA from Gaultheria
3	April 6	1.3 Signaling and ecological roles of salicylates	Analysis of Gaultheria GC data
4	April 8	1.4 Introduction to Mass Spectrometry **First journal club paper synopsis due**	Analysis of maize MeSA GC-MS data
5	April 13	2.1 Plant volatile metabolites: more than just perfumes	Treatment of maize leaves with peptide hormone
6	April 15	2.2 How plants perceive their world: activation of immunity **Module 1 Lab Report Due**	Trip to BFS to collect plant volatiles
7	April 20	2.3 Crossed alarm signals in nature: plants versus pests **Second paper synopsis due**	Collection of native plant volatiles, Quantitative analyses of maize volatile GC data
8	April 22	2.4 Ecological roles of volatiles; effects of timing and chemical diversity	Analysis of native plant volatile GC-MS data
9	April 27	3.1 Introduction to microbial metabolism: Competition for limited resources	Isolation of siderophores and testing of iron chelating activity
10	April 29	3.2 How unique biochemistry can help establish a niche **Module 2 Lab Report Due**	Assay of differential microbial use of unique carbon sources
11	May 4	3.3 Chemical warfare: microbe-produced antibiotics	Purification of an antibiotic and testing the spectrum of activity
12	May 6	3.4 Discovery of new microbe-derived antibiotics in the metagenome era **Third journal club paper synopsis due**	Bioinformatic discovery of biosynthetic gene clusters, Heterologous gene expression
13	May 11	4.1 Plant antibiotics: where is the silver bullet?	Eliciting antibiotic production, testing natural antifungal agents
14	May 13	4.2 Phytoalexins and anticancer drug discovery **Module 3 Lab Report Due**	Analysis of antibiotic results & finding new bullets
15	May 18	4.3 Biochemical complexity: divergent and convergent evolutionary processes	GC/MS analyses of complex chemical defenses

Meeting	Date	Topic	Practical Activity
16	May 20	4.4 Discovery of genes underlying bioactive plant chemicals **Fourth journal club paper synopsis due**	Preparing chemical samples for association mapping
17	May 25	4.5 Overview of Association mapping	GC/MS analyses and association mapping using TASSEL
18	May 27	4.6 Genome navigation and analysis of candidate genes **Module 4 Data summary due**	Web-based databases and omic resources for hypothesis testing
19	June 1	Presentation workshop day	
20	June 3	**Final Presentations**	

COURSE INFORMATION

BRING TO LAB EACH DAY:

1. Lab notebook (can be spiral bound, doesn't have to be fancy)
2. Lab coat (can purchase at bookstore)
3. UV blocking safety glasses (also at bookstore)
4. Pen (lab notes must be in ink)
5. Proper attire (long pants, closed-toed shoes - see safety notes in Lab Manual)

LAB SAFETY TRAINING: You MUST successfully complete the Biology Lab Safety Training and Assessment before the first lab session: https://dbsportal3.ucsd.edu:3443/safetytraining/

GRADING

POSSIBLE EARNED POINTS FOR THE QUARTER:

190 points	Active class participation
90 points	In-class problem sets (18)
120 points	Lab reports (4)
40 points	Literature synopses (4)
40 points	Final Presentation
480 points	**Total**

Grades will be assigned based on points earned using the scale listed on the right.

GRADING SCALE:

≥ 432 points (90%)	A
≥ 418 points (87%)	A-
≥ 403 points (84%)	B+
≥ 384 points (80%)	B
≥ 370 points (77%)	B-
≥ 355 points (74%)	C+
≥ 336 points (70%)	C
≥ 322 points (67%)	C-
≥ 288 points (60%)	D

ASSESSMENT

ACTIVE CLASS PARTICIPATION (190 POINTS): Modern scientific research is both detail-oriented and a highly collaborative process. Reflecting this, we will work in teams to collect and analyze research data, and we will pursue many experiments in which data will be generated by each group for shared analysis by the entire class. For this reason, it is critical that each member of the class is mindfully engaged at the bench and properly recording their experiments. As fellow student collaborators, you are relying on one another as a team. To obtain full points for participation, you need to (a) work constructively with your

research team, (b) share work equitably among your group, (c) properly record your experiments in your lab notebook, and (d) follow procedures to work safely in the lab.

IN CLASS PROBLEM SETS (90 POINTS): To reinforce the learning objectives for the day, each class will include 3 to 4 short answer questions that cover the primary concepts covered. You will be given these questions at the beginning of class and are encouraged to work collaboratively with your lab partner and others to answer them. Problem sets are to be submitted to the instructors at the end of lab each day. Answer keys will be posted on Canvas after class. We will complete 18 problem sets worth 5 points each.

LAB REPORTS (120 POINTS): To develop analytical and writing skills, in this course we will write brief reports for each module. Reports are to be a maximum of three single-spaced pages, and will be structured to have three sections: (1) question asked and hypothesis formed (2) a results section defining the outcome of your experiment(s) and including any graphs/figures you generated of your data, (3) a discussion section detailing whether the results upheld your hypothesis, how your results fit with our other knowledge about the topic and what line of study could be useful for the future. Lab reports for each module will be due one week after completion of the module. While discussion and sharing of information and ideas with other students in the class is encouraged, and some of the data and analysis to be presented will reflect the work of others in addition to your own, the reports themselves must be your own work. The course is organized into four learning modules, and you will be responsible for submitting a lab report for each module. Each report will be worth 30 points.

SCIENTIFIC LITERATURE SYNOPSES (40 POINTS): To develop familiarity with reading scientific literature and to lean more detail about course topics, we will read and discuss four papers this quarter. For each paper, you will write a brief synopsis of the paper to hand in in class on the day it is discussed. Two papers we discuss will be reviews of the field, whereas two will be manuscripts describing original work. For review papers, please summarize the main premises laid out by the paper. For original manuscripts, please summarize (1) the research question, (2) the experimental approach and (3) conclusions. The synopsis should be no more than one single-spaced page (a clear and detailed paragraph is sufficient. There will be a total of 4 synopses due, with each worth 10 points.

FINAL PRESENTATION (40 POINTS): To synthesize concepts and approaches learned over the course of the quarter, you will prepare an oral presentation of proposed research for a topic you find interesting in collaboration with your lab partner and a second group (groups of 4). Your topic may be an extension of a study we performed in class, or you may select an entirely different question focused on chemistry-mediated interactions in aquatic organisms, biomedicine, etc. A select library of manuscripts related to potential topics will be posted on TED for your consideration in designing your proposal. Presentations will be made on the final day of class (June 3rd) and should be 12-15 minutes in length, with an additional 5 minutes allocated for questions and discussion. Presentations should include: (1) a brief introduction to the background of the research area you've selected, (2) a clear statement of your research question and hypothesis and (3) an experimental outline of methods you would use to address this question and test your hypothesis. You will be required to prepare and use powerpoint slides in support of your presentation, and both partners are expected to share equally in development and presentation of your proposal. Two weeks prior to your presentation, you will be required to discuss an outline of your research question with the instructors for a few minutes in class. The final day of class before presentations (June 1st) will be dedicated to helping you finalize your proposal presentation with input from the instructors.

COURSE POLICIES

ATTENDANCE POLICY: Remember that **lab attendance is required – as per UCSD Biology policy, if you miss two labs, you will be dropped from the course.** If you arrive more than 20 minutes late or leave before completing the day's activities, this will count as an absence. One absence without a documented emergency will result in 3% reduction of your final grade. Two absences will result in being dropped from the course, unless it can be excused on the grounds of a documented medical or personal issue beyond your control (to be discussed with the instructor).

POLICY ON LATE ASSIGNMENTS: Lab reports and reading synopses are due in lab on the assigned date. For each day an assignment is late, you will lose 10% from your grade for that assignment. Please talk to us if emergency or illness precludes you from submitting on time. Important: you can use one grace-period for the quarter on any of the written assignments: that is, you can turn in the assignment up to 3 days late without the penalty. Use your grace period wisely!

ADD/DROP DEADLINES: Add/Drop deadlines are different for lab courses than lecture courses. Students who drop a Biology lab class after the end of the second class meeting will be assigned a "W." Additional details: http://biology.ucsd.edu/go/ug-labs.

ADMINISTRATIVE QUESTIONS: To drop/add a class or with other similar questions/issues, please go to the Biology Undergraduate Student Affairs Office, Pacific Hall, Room 1129.

UCSD POLICY ON ACADEMIC INTEGRITY: Cheating or academic dishonesty will not be tolerated and all academic work will be completed by the student to whom it is assigned without assistance. As defined by UCSD policy, academic dishonesty includes copying another student's work or allowing another student to copy your work. Any student caught or suspected of cheating will be reported to the UCSD Academic Integrity Coordinator and the Dean of the student's college. Confirmed cases of cheating will result in the student receiving an automatic F as their final grade as well as other disciplinary actions determined appropriate by the Academic Integrity Coordinator.

LETTERS OF RECOMMENDATION: Generally, we will write letters only for students who (a) receive an A in this course and (b) actively participate and engage with us. For a letter of recommendation to be meaningful, we must be able to observe your thought processes, ideas and enthusiasm for learning. Some ways you can demonstrate these qualities are to actively participate in class discussions and ask questions, offer your own ideas and interpretations of your results, and bring interesting papers or facts that are relevant to the material we are studying.

ADDITIONAL UCSD STUDENT RESOURCES (not specific to this course)

UCSD COVID19-SPECIFIC INFORMATION AND RESOURCES FOR STUDENTS:

STUDENT AFFAIRS COVID19 INFORMATION: A broad website with links to resources for supporting students during these challenging circumstances, including (but not limited to) resources for: Student Retention and Success, Remote Student Employment, Preparing for Remote Learning, Academic Support, Internet and Technology Access, Remote Library Resources, Accommodations for Students with Disabilities, Student Health and Mental Wellness Services, and Information for International Students, https://vcsa.ucsd.edu/news/covid-19-info.html

UCSD COVID19 GENERAL INFORMATION: https://coronavirus.ucsd.edu/

ASSISTANCE COPING WITH STRESS: If you are experiencing heightened feelings of anxiety, please contact Counseling and Psychological Services (CAPS), https://wellness.ucsd.edu/CAPS/Pages/default.aspx. Also see this helpful article from thisweek@ucsandiego with coping strategies and resources available from both UCSD and more generally:
https://ucsdnews.ucsd.edu/feature/coping-with-coronavirus-stress?utm_source=This+Week+Subscriber+List&utm_campaign=c2382a82da-THIS_WEEK_2020_03_26&utm_medium=email&utm_term=0_db568fca07-c2382a82da-92196685

ACADEMIC SUPPORT RESOURCES:

- Teaching and Learning Commons at UCSD: http://commons.ucsd.edu/students/index.html
- Supplemental Instruction: Scheduled sessions to support students in classes that many UCSD students find challenging. A list of supported classes and schedules may be found at: https://commons.ucsd.edu/students/supplemental-instruction/index.html
- Triton Achievement Partners: Drop-in tutoring for lower division math and chemistry courses. https://commons.ucsd.edu/students/math-science%20tutoring/index.html#Math-and-Chemistry-Tutoring
- Writing and Critical Expression Hub: See http://commons.ucsd.edu/students/writing/index.html. Writing mentors on staff (including some biology expertise and training in science writing) work with students to improve their writing skills while working on class writing assignments (e.g. lab reports!) and other writing projects. See their drop-in hours, and options for appointments.
- OASIS: Office of Academic Support and Instructional Services also offers tutoring, writing and mentoring support – see https://students.ucsd.edu/sponsor/oasis/ Each year, OASIS serves 3,000 students in language, math, science, study skills, and writing as well as peer counseling and peer mentoring. Located on the third floor of Center Hall, (858) 534-3760, oasis@ucsd.edu.

HEALTH AND COMMUNITY RESOURCES (IN ALPHABETICAL ORDER):

- Asian Pacific Islander Middle Eastern Desi American (APIMEDA) Programs and Services: APIMEDA Programs and Services encourages community development, enhances coalition building with and within the APIMEDA students, staff and faculty, fosters greater visibility for the diversity within the APIMEDA community, and helps students gain skills for success in their future careers. https://apimeda.ucsd.edu/index.html
- Black Resource Center: a campus community center that serves everyone at UC San Diego while emphasizing the Black experience. Promotes scholarship, fosters leadership, and cultivates community through the committed, collaborative effort and support of faculty, staff, and the broader UC San Diego community. http://brc.ucsd.edu/
- Counseling and Psychological Services: (CAPS) provides FREE, confidential, psychological counseling and crisis services for registered UCSD students. CAPS also provides a variety of groups, workshops, and drop-in forums. See http://caps.ucsd.edu/ and/or call (858) 534-3755.
- Cross-Cultural Center: strives for meaningful dialogues and context across all cultures, particularly those of underrepresented or underprivileged backgrounds. Offers supportive and educational

services through art, social and educational programs, workshops, and outreach. Welcomes creative venues for enhancing social consciousness and equity. http://ccc.ucsd.edu/

- Intertribal Resource Center (ITRC): focused on supporting Native American students and promoting educational access in our tribal communities. https://itrc.ucsd.edu/index.html
- LGBT Resource Center: provides a visible presence on campus and enhances a sense of connection and community among LGBT faculty, staff, students, alumni and the UC San Diego Community. http://lgbt.ucsd.edu/
- Office for the Prevention of Harassment & Discrimination (OPHD): provides assistance to students with concerns about bias, harassment, and discrimination. UCSD is committed to upholding policies regarding nondiscrimination, sexual violence and sexual harassment. Students have options for reporting incidents of sexual assault, dating violence, domestic violence, stalking and sexual harassment. Information about reporting options may be obtained at OPHD at (858) 534-8298, ophd@ucsd.edu, or http://ophd.ucsd.edu. Students may also receive confidential assistance at the Sexual Assault Resource Center at (858) 534-5793, sarc@ucsd.edu or http://care.ucsd.edu.
- Office for Students with Disabilities (OSD): works with students who have documented disabilities to provide reasonable accommodations. See https://disabilities.ucsd.edu/about/index.html or call 858.534.4382 and/or email osd@ucsd.edu. Students in need of disability accommodations for a UCSD course must provide their instructor with a current Authorization for Accommodation (AFA) letter issued by OSD. If you have an AFA, please arrange to meet privately with us during the first week of the quarter so we can discuss your accommodation. If you have any questions or concerns about a disability, please discuss with us!
- Raza Resource Centro: a lively space where students study, meet, write, get tutoring, and most importantly are in community. It is a space where Latina/Chicano organizations hold meetings, events and where culture, art, and academics interconnect. http://raza.ucsd.edu/
- Student Veterans Resource Center (SVRC): supports military-affiliated students in making the transition to campus life and facilitating their progress toward degree completion. The Center also provides opportunities for peer-to-peer support, mentoring and social networking. See https://students.ucsd.edu/sponsor/veterans/
- Women's Center: serves as a resource for the entire campus community while placing the experiences of diverse women at the center through resources provided, programming and learning opportunities facilitated, and dynamic community space. https://women.ucsd.edu/

There are many other resources available to you on campus. If you want to know more about where you can go for support, please let us know and we'll work together to identify useful resources!