Chem 441 **Biochemistry Laboratory** Spring 2022 **Course syllabus** Dr. Mills

**Instructor:** Dr. Stephen Mills **Office:** Logan 103D **Phone:** 745-3307 **Email:** millss4@xavier.edu

**Office Hours:** Mon: 1-2 pm, Tues, Thurs: 11am-noon, and by appointment (e-mail or see me during/after class to set up time).

*E-mail is the best way to contact me outside of class or office hours.*

**Lab Meeting:** Wednesday 2:30 PM – 6:30 PM Logan 102

**Textbook:** *Biochemistry Laboratory: Modern Theory and Techniques* by Rodney Boyer (2nd Ed.) (2012) Pearson Higher Education ISBN 978-0-13-604302-7 (required)

*Experiments in Biochemistry* by Shawn O. Farrell and Lynn E. Taylor (2006) Cengage Learning ISBN: 978-0-495-01317-4 (provided by instructor)

BASIL Lab instructions (provided)

**Lab Notebook:** OneNote Notebook

**Corequisite:** Chem 440 (Biochemistry Lecture)

**Other items:** *You are required to bring safety goggles to each class.*

**Online:** Canvas (https://canvas.xavier.edu) and Microsoft Teams **Final Exam:** Mon, May 2, 2 – 3:50 PM

**Introduction:** Welcome to Chem 441! In this course, you will learn techniques fundamental to performing biochemical research. Techniques in Biochemistry are diverse, so you’ll get a chance to learn some new skills and to apply skills you have used before (in Gen. Chem or O. Chem for example) to the study of biological macromolecules. I intend for this lab to feel more like a research lab experience than a teaching lab. So, I expect you to come to lab prepared, as you would approach time doing research. I also expect you to think about what you are doing and why, as you would while doing research. You will keep your notebook more like a research notebook; you will analyze your data very soon after collecting it and present it as you would present research results. *I expect you to perform the experiments successfully*, so you may need to repeat measurements if something did not work well the first time. *This lab is not about following each step in the protocol and calling it done* (as you may have done in previous labs). Instead, it’s about performing the experiments successfully, whatever that takes.

As part of the lab, we will use several Bioinformatics exercises to identify proteins with known structures but undefined functions. These exercises will focus on finding previously unknown proteases. Our goal will be to assign function to some of these proteins. As we are doing these exercises, we will learn some basic lab skills. My intent is that we identify several putative proteases and then express, purify and characterize these proteins. These exercises will involve protein purification, followed by techniques in protein characterization and enzyme kinetics. Running the course this way will give you hands-on time with instruments and equipment, opportunities to interpret novel data and design experiments, and will help you gain confidence in your practical problem solving skills. While it is important that you get good results, which should be similar to what might be in the literature, I am far more interested that you interpret the results that you get before you compare to what might be previously known.

1

Chem 441 **Biochemistry Laboratory** Spring 2022 **Course syllabus** Dr. Mills

**Learning Outcomes:**

1) Design and implement experimental procedures.

2) Evaluate, analyze, and interpret a series of experimental results related to a problem using appropriate scientific and laboratory principles.

3) Demonstrate safe laboratory practices.

4) Demonstrate a facility with basic biochemical and molecular biology techniques and equipment.

5) Keep a complete and organized notebook.

6) Evaluate problems that impact laboratory analysis and take corrective action as appropriate. 7) Perform necessary calculations and prepare multi-component buffered solutions. 8) Purify and characterize a protein.

9) Select and employ appropriate spectroscopic techniques in the characterization of biomolecules.

10) Prepare a well-written, complete and accurate laboratory report for each experiment, incorporating appropriate theory and analysis.

**Attendance Policy:** Attendance is mandatory since this is a laboratory course. Excused absences can only include: (1) Official University or academically related events approved by the instructor, or (2) Illness, if you provide a doctor’s note. For non-illness related absences you must inform the instructor at least 48 hours in advance, and provide supporting documentation. In the event of an unexcused absence from the laboratory, you will not be allowed to make up the session and you will not receive credit for that part of the lab. Continued absence from class may result in a failing grade or you will be asked to withdraw from the class.

**Grading:** Written work must be handed in by the time and date announced by the instructor. Late material will be accepted with a **10% per day** penalty. Since you will be working in groups, you will keep a single group notebook. You will do your own prelab assignment each week. Some weeks you will do an individual write-up but most weeks, you will turn in a single write-up for your group. Each group will decide how to divide up the work for the write up, but all are responsible for understanding the data and its analysis. This laboratory class is focused on learning experimental techniques –

understanding *how* they work, working independently and as a group, carrying out data analysis and obtaining quality results. Experiment submissions will be graded on these factors, preparation for class, and clarity and accuracy of data presentation.

**Grade Breakdown:** This is a preliminary breakdown of how I plan to grade the course but I reserve the right to adjust these percentages depending on how the semester goes.

A. Experiment Submissions: 60%

B. Notebooks & Lab Performance 20%

C. Exams (2) 20%

Total 100 %

**A. Experiment Submissions:** Experiment submissions will be of several different types. There will be weekly data analysis reports (DARs), BASIL summaries and Summary Reports. There will also be pre-lab and post-lab questions to answer.

2

Chem 441 **Biochemistry Laboratory** Spring 2022 **Course syllabus** Dr. Mills

*1. Pre-lab Preparation:* You will need to prepare your notebook before lab so that you are ready for the day’s experiment. Some days you will also need to prepare an excel spreadsheet or something like that. Look at the data analysis document for what you will need. In addition, you will need to do the pre lab exercises, which are intended to help prepare you for the lab work and allow you to carry out your work in lab more effectively.

*2. Data analysis:* Rather than formal lab reports, mostly, you will provide a summary of your data and answer questions about that data. I will provide a document for the data analysis that you will fill in and submit through Canvas. You will turn in your reports as Word documents through Canvas and I will return them to you with comments through Canvas. You will also write several summary reports from your BASIL analysis and write a proposal for the experimental portion of the lab. Details on this will follow in class.

**B. Notebooks and Laboratory Performance:**

*1. Notebooks:* It is **expected** that your notebook will be kept current with the laboratory experiments. You may need data analysis in order to move to the next day in an experiment. Penalties will result if your notebook is not kept up to date, informative and sequential. You will keep an electronic notebook using OneNote for this lab. You should have different pages for each experiment, so it’s easy to find information. Experimental pages will look different from BASIL pages. That’s OK.

*2. Laboratory Performance:* You are expected to come to lab prepared for the day’s experiment. That means that you have done the required readings and pre-lab exercises and understand what you will be doing that day/week. You should have a good idea of the kind of data you will be collecting and what you will do with your results. Your grade in this category depends on being prepared for lab, and to a smaller extent, on successfully, and carefully, carrying out the experiment. It is not expected that you will perform each lab perfectly the first time, but it is expected that you are careful about your technique and improve. Since you will be working in groups, a significant portion of your lab performance grade will be decided by the other members of your group, based on the agreement you make at the beginning of the semester for how your group will divide up the work for the lab and write ups. Lab performance will also include working safely and contributing to running the lab (e.g. making necessary buffers/solutions for the class).

**C. Exams:** A midterm exam and final exam will be given on the dates indicated on the schedule. Both exams will be open notebook. The exams will evaluate your understanding of the theory behind the experiments, your ability to analyze results from the experiments and your ability to troubleshoot experiments that did not go according to plan.

**Penalties for incomplete work:** Point penalties will occur if you fail to hand in pre-lab exercises, data analysis reports, lab reports or notebooks when requested. These penalties will increase in accordance with how late the submission is made and may eventually result in zero points.

**Academic Misconduct Policy:** A zero grade will be given to any student violating the University Academic Honesty Policy. The student may appeal according to normal university procedures as stated in the University Catalog.

It is the responsibility of the student to inform the instructor at the beginning of the semester of any individual conditions, medical or otherwise, that may require special attention. Appropriate consideration will be given in these situations.

3

Chem 441 **Biochemistry Laboratory** Spring 2022 **Course syllabus** Dr. Mills

**Cell phone & other electronic devices policy:** During lab, cell phones may be used so long as they don’t disturb others or interfere with the lab. Other portable electronic devices should not interfere or distract from the lab. Headphones are NOT allowed during lab. With the exception of calculators, NO electronic devices may be used during quizzes or exams and you may be asked to leave class and forfeit your score (possibly resulting in a failing grade) if you attempt to do so.

**Copyright Policy**

Copyright laws and fair use policies protect the rights of those who have produced the material. To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit the library copyright Web page. You can also request copyright help from the library if you have specific questions.

Xavier University course sites contain copyrights held by the instructor, other individuals or institutions. Such material is used for educational purposes in accord with copyright law and/or with permission given by the owners of the original material. You may download one copy of the materials on any single computer for non-commercial, personal, or educational purposes only, provided that you (1) do not modify it, (2) use it only for the duration of this course, and (3) include both this notice and any copyright notice originally included with the material. Beyond this use, no material from the course web site may be copied, reproduced, re-published, uploaded, posted, transmitted, or distributed in any way without the permission of the original copyright holder. The instructor assumes no responsibility for individuals who improperly use copyrighted material placed on the web site.

4

Chem 441 Biochemistry Lab, Spring 2022

Preliminary Schedule

| **Week** | **Date** | **Pre-Lab Lecture** | **Wet Lab** | **In Silico Lab** |
| --- | --- | --- | --- | --- |
| 1 | 12-Jan | Check In  Intro to BASIL  SPRITE and Dali | Basic Skills Lab  Expt 1: Biochemistry Boot Camp | Protein Assignments |
| 2 | 19-Jan | Buffers and Solutions |  | Module 1: SPRITE  Module 4: Dali |
| 3 | 26-Jan |  | Expt 2: Buffers and solutions | Module 2: BLAST  Module 3: PFAM |
| 4 | 2-Feb | Spectrophotometers  Docking | Expt 3: Spectrophotometer | Module 5: Docking? |
| 5 | 9-Feb | Protein Expression |  | Proposal Writing |
| 6 | 16-Feb |  |  | Proposal Review and Report |
| 7 | 23-Feb |  | BASIL Module 6 Express proteins |  |
| 8 | 2-Mar | Protein Purification | BASIL Module 7: Purify Proteins |  |
|  | 9-Mar |  | No Lab: Spring Break |  |
| 9 | 16-Mar | Protein Concentration  Electrophoresis | Protein Concentration by two methods Expt 3a: Protein Concentration of LDH fractions |  |
| 10 | 23-Mar | Activity Tables  Purification Tables | BASIL Module 9: SDS page to assess purity |  |
| 11 | 30-Mar |  | BASIL Module 10: Protein Activity Assays |  |
| 12 | 6-Apr | Kinetics Review | BASIL Module 11: Enzyme Kinetics Assays |  |
| 13 | 13-Apr |  | Module 11 Continued  BASIL Module 1: Metalloproteases | ASSAM: MetalloProteases |
| 14 | 20-Apr |  | *DNA purification and Cell transformation with GFP* |  |
| 15 | 27-Apr |  |  |  |
| 16 | 2-May |  | **FINAL EXAM 2-4 pm** |  |