

# Introductory Biochemistry Laboratory, CHEM 5720, Spring 2018, 3 Credits

Utah State University

Department of Chemistry and Biochemistry

Lab: Maeser Lab 148

Lecture: ESLC 046

|                     |  |
|---------------------|--|
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## Course Goals:

This course is designed to provide hands-on experience with techniques and concepts and approaches common to biochemistry research. This will be accomplished through a lecture and laboratory experience that will involve directed reading, design and performance of experiments, data analysis, and completion of laboratory reports. *Please note: This course is designated a Communication Intensive (CI) course. Therefore, the writing expectations are rigorous.* This course is intended to be taken concurrently with Chemistry 5710. Learning objectives include: (1) understanding standard molecular biology, protein expression and protein expression techniques typically used in biochemistry labs; (2) applying these approaches in a "real-life" research setting. The course is appropriate for all pre-health and pre-vet professionals, and those preparing for life science-oriented graduate programs and industrial careers.

## Prerequisites:

Concurrent enrollment in Chemistry 5710. Prior general chemistry and organic chemistry laboratory experience is expected.

## Texts:

There is no required textbook. All lecture notes will be posted on the course Canvas site.

## Canvas:

Information essential to the course will be available through the course Canvas webpage. This site is found at [canvas.usu.edu](http://canvas.usu.edu). Username = banner ID; Password = banner pin. Only students who are registered for the class will have access to the course pages.

## Grading:

This course will be graded based on the total points received for quizzes, laboratory notebook, laboratory reports, and the group project. The lowest quiz grade and the lowest notebook grade will be dropped. Final letter grades will be assigned based on the percentage of the total points possible with the following scale: A's 100%-90%, B's 89%-80%, C's 79%-70%, D's 69%-60%, F below 60%. Attendance at all of the assigned meetings is essential. **Make-up of any missed meeting will only be allowed for excused absences or at the discretion of the Professor.** Unexcused absences in the lab will automatically result in a 10 point deduction on the lab report. All laboratory reports turned in after the deadline will have 10% of the possible points deducted for the first day that it is late, with 10% of the possible points deducted for each additional day that it is late. All assignments are due on the deadline date at the beginning of your scheduled lab time.

**Graded Elements:** Following are the graded elements (with maximum possible points).

| Chemistry 5720 Spring 2018 Possible Points |  |             |
|--|--|-------------|
| Element                                    | Description  | Max. Points |
| Literature search assignment               | Assignment to be completed on second day of lab (Thurs, Jan 11)  | 15          |
| Pre-laboratory quizzes                     | Best 23 Quizzes of 24, worth 5 points each.<br>Due at 8:30 am each lab day.                                  | 115         |
| Daily laboratory notebook                  | Best 18 Notebooks of 19, worth 5 points each.<br>Due before leaving lab each day.                            | 90          |
| Laboratory reports                         | 10 experimental reports (see schedule below).<br>Due one week after completion of the laboratory at 8:30 am. | 260         |
| Group project                              | Includes written proposal and laboratory work (see description below)  | 400         |
| Quizzes from lectures                      | 3 quizzes held during lecture time. Worth 40 points each.  | 120         |
| Total                                      |  | 1000        |

## Assessment:

Assessment of the course will include a Course Evaluation (administered by USU) at the end of the course. Information from the Course Evaluation will be used to improve the course in subsequent years.

## Provisions:

This course will adhere to the USU Academic Policies and Procedures Manual found at the web site <http://www.usu.edu/policies/>. Any student with a disability who requires accommodation must contact the instructor. The disability must be documented by the Disability Resource Center. Course materials may be requested in alternative formats.

## Supplies:

Eye protection, lab coat, full-length pants, and closed-toe shoes are required in the laboratory. A laboratory notebook with carbon-copy pages is also required and may be purchased at the USU Bookstore. The lab fee is used for equipment and supplies, and for a small fraction of Teaching Assistant support

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### Pre-lab quiz (115 pts total)

A short pre-lab quiz will be posted on the Canvas website, and will be due by 8:30am lab each day. Late quizzes will not be graded.

### Laboratory notebook (90 pts total)

You are required to individually keep a laboratory notebook containing the title, date, objectives, materials and methods, and results for each experiment. Include tables for all dilutions and show all calculations in this section. Prepare the **title, objectives and procedures sections BEFORE coming to the laboratory!** It is also best to prepare tables for results ahead of time as well. Be sure to note any problems or observations in the results section. Such observations will aid in your discussion in the laboratory report.

Try to keep your notebook as neat as possible. Mistakes are made and are common, but be neat about crossing-out “wrong” sections. **DO NOT ERASE!!!** Always write in **INK!!** A research notebook must be organized and neat such that ANYONE could pick it up and repeat your work without any questions (and hopefully get the same results and observations). Laboratory notebooks are scientific records and can be submitted as evidence in court trials, so learn now how to keep a neat, detailed (but succinct) notebook!

The carbon-copy pages of your notebook must be turned in at the end of lab each day – BEFORE you leave the lab.

### Laboratory Reports (260 pts total)

You are required to submit your own laboratory report for each experiment. **You are encouraged to discuss your results with your lab partner, but the writing must be your own.** The report is generally due one week after the last day of the experiment at 8:30 am, and will be submitted through the Canvas website. (The one exception is the first lab report, which is due the following Tuesday.) Some experiments will be completed in a single day, while others will take multiple days to complete. Accordingly, some laboratory reports will require more effort and will be worth more points than others (see table below). **Grading will be based on a detailed rubric posted on the Canvas website. Review it carefully!!!** A formatted template will be provided to help with writing your lab reports. Specific instructions will be given with each lab. However, each report must contain the following elements:

**Title:** The title should include experiment number, experiment name, the date(s) performed, the due date, your name, and the name of your lab partners.

**Objective/Introduction:** This is a brief summary of the objective or purpose of the experiment.

**Methods:** DO NOT reproduce the experimental protocol that was handed out to you. Describe what you did using complete sentences (in past tense). If part of the procedure is a repeat of a method used in a previous lab (e.g. running an SDS or agarose gel), it is sufficient to state that the procedure “was performed as described previously in experiment X.” However, if you modified the procedure in any way, you must explain what the modification was.

**Results:** All results must be described with complete sentences in paragraph format. Whenever possible, results should also be presented in a table or as a graph and inserted into the lab report as figure with a figure legend.

**Discussion:** Succinctly summarize your results. Address any unexpected observations. The discussion section of the lab report should describe in detail what your results mean and the implications they might have on future experiments. With each lab protocol you will be given several questions or problems that you should address while discussing the results of your experiment. The answering of these questions should be done in discussion format (paragraphs and complete sentences), rather than an enumerated list.

| Chemistry 5720 Laboratory Report Schedule |  |  |          |        |
|---|--|--|----------|--------|
| Lab #                                     | Experiment   | Due date                                   | Lab days | points |
| 1   | Solutions and dilutions                              | 1/16                                       | 1        | 15     |
| 2   | Bioinformatics                                       | 1/23                                       | 1        | 15     |
| 3   | PCR  | 1/30                                       | 2        | 30     |
| 4   | GFP cloning  | 2/8  | 3        | 40     |
| 5   | Protein Expression                                   | <i>Report included in project proposal</i> |          |        |
| 6   | Size Exclusion Chromatography                        | 3/3  | 2        | 40     |
| 7   | Restriction digest                                   | 3/13                                       | 1        | 20     |
| 8   | ELISA  | 3/17                                       | 1        | 20     |
| 9   | Enzyme Kinetics                                      | 4/17                                       | 2        | 40     |
| 10  | Lysozyme Crystallization and Structure Determination | 4/26                                       | 3        | 40     |

## Group Project (400 pts total)

In contrast to most of the lab experiments, the Group Project (protein purification) will not be given a detailed protocol. Instead, you will be expected to work with your lab partner(s) to develop a protocol to successfully purify an unknown protein. In other words, this will be very much like a real research lab experience. You will be provided with a DNA construct and the sequence for that construct. The rest is up to you. The goal is to obtain > 90% pure protein, as judged by SDS-PAGE. You are also required to determine the final amount of your purified protein using a spectrophotometric assay. Five lab days are dedicated for this project, but it may require additional time (outside of the normal class time) depending on your planning, preparation, and the behavior of your protein.

There will be several graded components for this project. A brief summary is included below. Details will be provided in class.

- **Project proposal.** (150 pts) This is a detailed description of your project justification, strategy, and timeline. The protein expression experiment must be fully described as part of the project justification/preliminary data. An itemized list of required chemicals and reagents is also required. Revisions may be requested by the TA and/or the instructor before you are allowed to begin the experiment.
- **Proposal Q&A.** (20 pts) As a group, you will be required to meet with the TA and/or instructor to answer specific questions about your proposal. Each member of the group will receive a separate grade.
- **Lab notebook.** (25 pts) As with the other labs, you will be expected to keep a lab notebook each throughout the project. Each member of your group will turn in their own notebook at the end of the project.
- **Protein purification.** (50 pts) Full credit will be given to those who obtain 90% purity or better.
- **Final report.** (135 pts) The report will be similar to other lab reports, but only one report will be submitted for each group. Consequently, it is expected that the report will be more detailed than those submitted for the other labs.
- **Team evaluation.** (20 pts) Each member of the group will evaluate the contributions of every other member of the group. If it becomes apparent that some individuals contributed more to the project than others (as judged by the evaluations and observations by the TA and instructor), the final grades for the project will be adjusted accordingly.

## Lecture quizzes (120 pts total)

Three quizzes (~20-30 minutes each) will be given during lecture time, and will focus primarily on topics discussed during lecture.

# Chemistry 5720 Laboratory Schedule – overview

## Spring 2018

| Month | Week | Monday – lecture<br>ESLC 046                                    | Tuesday – lab<br>ML148  | Thursday – lab<br>ML148  |
|-------|------|---|---|--|
|       |      | Lecture material online   |   |  |
| Jan   | 8    | Lecture – molecular biology                                     | Safety, Check-in<br>Literature assignment ( <i>due Wed</i> )  | <b>Lab 1.</b> Solutions and Dilutions  |
|       | 15   | <b>No classes</b><br><b>(Martin Luther King, Jr. Day)</b>       | <b>Lab 2.</b> Bioinformatics<br><b>Lab report 1 due</b>   | <b>Lab 3.</b> PCR (Day 1)  |
|       | 22   | Lecture – molecular biology                                     | <b>Lab 3.</b> PCR (Day 2)<br><b>Lab report 2 due</b>  | <b>Lab 4.</b> GFP Cloning (Day 1)  |
|       | 29   | Lecture – restriction analysis                                  | <b>Lab 4.</b> GFP Cloning (Day 2)<br><b>Lab report 3 due</b>  | <b>Lab 4.</b> GFP Cloning (Day 3)  |
| Feb   | 5    | Lecture – protein expression<br><b>Quiz – molecular biology</b> | <b>Lab 5.</b> Protein Expression (Day 1)  | <b>Lab 5.</b> Protein Expression (Day 2)<br><b>Lab report 4 due</b>            |
|       | 12   | Lecture – protein expression<br>analysis                        | <b>Lab 5.</b> Protein Expression (Day 3)  | <b>Lab 6.</b> Size exclusion<br>chromatography (Day 1)                         |
|       | 19   | <b>No classes</b><br><b>(President's Day)</b>                   | <b>(Monday Schedule)</b><br>Lecture – protein purification<br><b>Proposal submission due Wed.</b>         | <b>Lab 6.</b> Size exclusion<br>chromatography (Day 2)                         |
|       | 26   | Lecture – protein purification                                  | Group proposal Q&A session.<br><b>Revised proposal due Wed.</b>   | <b>Lab 7.</b> Restriction Digest<br><b>Lab report 6 due Sat (Mar 3)</b>        |
| Mar   | 5    | <b>Spring break</b>   | <b>Spring break</b>   | <b>Spring break</b>  |
|       | 12   | Lecture – protein purification                                  | <b>Lab 8.</b> ELISA<br><b>Lab report 7 due</b>  | Project prep time – No formal lab<br><b>Lab report 8 due Sat (Mar 17)</b>      |
|       | 19   | <b>Quiz – protein expression &amp;<br/>purification</b>         | <b>Group Project.</b> Protein Purification  | <b>Group Project.</b> Protein Purification                                     |
|       | 26   | Lecture – protein assays  | <b>Group Project.</b> Protein Purification  | <b>Group Project.</b> Protein Purification                                     |
| Apr   | 2    | Lecture – protein assays  | <b>Group Project.</b> Protein Purification  | <b>Lab 9.</b> Enzyme Kinetics (Day 1)  |
|       | 9    | Lecture – protein assays  | <b>Lab 9.</b> Enzyme Kinetics (Day 2)<br><b>Group Project final report due</b>                            | <b>Lab 10.</b> Lysozyme Crystallization<br>and Structure Determination (Day 1) |
|       | 16   | Lecture – protein structure<br><b>Quiz – protein assays</b>     | <b>Lab 10.</b> Lysozyme Crystallization<br>and Structure Determination (Day 2)<br><b>Lab report 9 due</b> | <b>Lab 10.</b> Lysozyme Crystallization<br>and Structure Determination (Day 3) |
|       | 23   |   | Clean-up day & check out  | <b>Lab report 10 due</b>   |