CHEM 4581
Biochemistry Laboratory I

Course Syllabus

Fall 2015

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Office Hours
Mondays, 4 – 5 pm
Tuesdays, 2 – 4 pm

COURSE OBJECTIVES

The primary objectives of this course are for students to:

1. Remember fundamentals of the structure and function of biological macromolecules taught in CHEM 4511
2. Comprehend approaches for experimentally investigating biochemical problems and recognize their pros and cons
3. Perform biochemical investigations
4. Analyze biochemical data
5. Evaluate the merit of biochemical results
6. Be able to design biochemical experiments without a prescribed protocol
7. Respect and uphold a culture of safety through awareness of chemical safety measures and best practices
8. Identify carcinogens, mutagens, and neurotoxins commonly used in biochemistry laboratories

Topics covered in this course include methods for the isolation, purification, and characterization of proteins, nucleic acids, carbohydrates and lipids, and manipulation of macromolecular structures from databases using contemporary visualization software.

CLASS MEETINGS

Lectures:	Mondays	2:05 – 2:55 pm	Mason Building, 3132
Labs:	Tuesdays and Thursdays	1:05 – 6:55 pm	Boggs 267

PREREQUISITES

CHEM 3511 (Survey of Biochemistry) or 4511 (Biochemistry I)
CHEM 3371 (Organic Chemistry Laboratory) or 3380 (Synthesis Laboratory II)

TEXT

- No official text is required
- Recommended resource: *Fundamentals of Biochemistry* by Voet, Voet, and Pratt
- Additional background reading material may be provided

HONOR CODE

All students are expected to follow the Georgia Tech Honor Code.

PLAGIARISM

Using the words or work of another as if it were one's own is plagiarism. Plagiarism is inappropriate in this laboratory and in all other situations, and is a violation of the Georgia Tech Honor Code. Here are some steps to help you avoid plagiarism:

- Do not quote others in the text of your laboratory reports. Instead, practice developing mature technical writing skills by expressing your ideas in your own words.

- Do not copy chemical structures, chemical reactions/mechanisms, or any other artwork from others, particularly published work (even if cited) and definitely other students. Published work is copyrighted and should not be reprinted as part of laboratory reports without explicit permission from the editor.

- Do not use a past, present or potentially future peer's laboratory report as a role model. The tendency to copy phrases, expressions, data and/or ideas is too prevalent. Such collaborations are not authorized.

- Occasionally experimental work in this laboratory will be done in teams or groups. While data may be shared, perform data analyses independently and write your laboratory reports independently.

- Work on all assignments independently unless you have been given explicit permission to collaborate by the instructor!

EQUIPMENT AND SUPPLIES REPLACEMENT

In the event that glassware, plasticware, equipment and supplies are damaged or broken by students, the student must pay for the replacement of those items with his/her Buzz Card. Students are expected to report any damage, destruction or other incidents involving equipment, materials and supplies to the teaching assistant and/or instructor.

ABSENTEEISM

Attendance in lectures is strongly encouraged. Please report to each laboratory class on time. In the event of an unforeseen absence, please contact the instructor as soon as possible. Opportunities to make up missed laboratory experiments might not be feasible, but the Instructor will work with students to address any exceptions. If a student is absent for any reason, he/she should email Dr. Peek and the teaching assistant(s) as soon as possible. Late assignments will only be accepted at the discretion of the instructor. Typically prompt written documentation will be required to justify the acceptance of late assignments as a result of absenteeism.

GRADING

The overall grading scheme for this course is as follows:

30%	Laboratory Reports	
	GMO Project Laboratory Report will count twice in the final averaging.	
30%	Laboratory Performance/Conduct	
15%	Laboratory Notebook Maintenance	*****New Fall 2015: LabArchives Electronic Notebook*****
10%	Homework	
10%	GMO Project Presentation	
5%	Class Participation Assignments	

Final grades will be computed based on the grading scheme above. Final letter grades will be issued according to the following delineation:

A	90 – 100%
B	80 – 89%
C	70 – 79%
D	60 – 69%
F	<60%

1. LABORATORY REPORTS

The purpose of the laboratory report is to communicate experimental work in writing. The educational goal is to help students learn and practice expressing their ideas and describing their work in a professional manner. With this in mind, the requirements for the structure of the laboratory report are similar to those for peer-reviewed scientific literature.

Guidelines for Both Long and Short Laboratory Reports

- ❑ Laboratory reports must be stapled and submitted in hard-copy format to the instructor or TA directly. Do **NOT** leave reports in insecure places for them to be found by the TA at some unspecified time.

- ❑ Most long reports should not exceed **10 double-spaced pages**, excluding the cover page. The T7 RNA Polymerase (T7 RNAP) Purification and Characterization study involves a large amount of data analysis; therefore, the T7 RNAP report should not exceed **15 double-spaced pages**, excluding the cover page.

- ❑ Short reports should be written in memorandum format and should not exceed **3 single-spaced pages**.

- ❑ All laboratory reports should be written in grammatically correct English.

- ❑ All laboratory reports should be prepared using a clear font of size 12-point, with 1-inch margins on all sides.

- ❑ Reports should be submitted with print on only one side of the paper.

- ❑ In all laboratory reports, figures and/or tables should be included to highlight key results.
    - Figures should have figure legends (i.e. captions) describing the figure in sufficient detail underneath the figure.
    - Tables should have brief headings at the top of the table.
    - Font sizes of text for figure legends or tables may be 8-10 point in size. Figure legends (captions) and table headings may be single-spaced.

- ❑ All reports must show a statement of compliance with the Georgia Tech Honor Code and the student's signature.

- ❑ Optional Appendix: Students are welcome to provide an Appendix at the end of their laboratory report with any supplemental information.

  For example, electrophoretic gel images may be truncated for the report, while the full image may be provided in the Appendix, for the sake of integrity.

  Some laboratory reports will require substantial calculations to be made. Where relevant, students may provide an example calculation for the report and a complete set of calculations in the Appendix.

    - The appendix may be neatly handwritten.
    - The appendix will **not** be graded and may not be reviewed by the TA's at all. It is considered supplementary material that would be used to help the TA understand how certain computations were made.
    - Information reported in the appendix that should have been reported in the main body of the text will **not** be credited to the student.

Laboratory reports are due at the beginning of the laboratory session one week after scheduled completion of work as indicated by the schedule. The report must be given to a TA or instructor, and dated. Do not put reports in the instructor's mailbox or under his/her door to avoid misplacement of your report. Please staple all assignments submitted to TA's and/or the instructor. Students are responsible for supplying their own staples/stapler! **Late laboratory reports will not be accepted in general**; however, late laboratory reports might be accepted at the discretion of the Instructor only due to extenuating circumstances.

Specific Details for Long Reports

- ❑ Each page should be numbered, excluding the cover page.
- ❑ Laboratory reports should **NOT** be formatted with dual column text as seen in published journal articles.
- ❑ Long laboratory reports should have the following sections in order:

1. **Cover Page** – (Required) Provide the experiment title, author, partner's name (if applicable), date(s) experiment performed, date handed in, and the author's signature indicating that the laboratory report was the authentic work of the person whose signature is listed and that the Georgia Tech Honor Code was followed.

2. **Introduction** – Present background for the experimental work described. State relevant concepts and hypotheses and the objectives of the experiment. Refer to journal articles (**not web sites**) where you have read supportive background information.

3. **Experimental Procedures** – Summarize the specialized reagents and their sources and equipment used in the experiment. Generally describe methods used especially where deviations to the protocol were made. Include the level of detail commonly found in published research articles and, only when necessary, add additional details.

4. **Results** – Describe the data generated from the experiment **in words**. Then, present figures (including graphs) or tables of your data for emphasis and clarity. Each figure should have a figure legend underneath the figure - a statement describing the figure itself. Each table should have a table heading above the table. All figures should be clearly labeled. Results sections with insufficient text describing the results and/or key illustrations of data will merit very few possible points.

5. **Discussion** – State the overall conclusions from your experiment here. In cases where the work was hypothesis-based, the discussion should address the hypothesis directly. Discuss the significance, implications, comparisons of results to other work, etc. State and critically evaluate any assumptions that were made. Estimate the accuracy of your results. Discuss any observations that you found unusual or unexpected, and why they may have occurred. Note and discuss inconsistencies in your data that make drawing firm conclusions difficult. Discuss improvements that could be made in the laboratory hardware and apparatus that could improve your results.

6. **References** – List the references made throughout the text of the research article in the order in which you refer to them in the text. References are required, not optional! Reputable resources should be used as references. **Web sites are generally not reputable resources for a professional laboratory report.** Avoid referencing your Biochemistry textbook since it contains general information. Use the full-title reference formatting from the journal *Biochemistry* as shown in the example below.

EXAMPLE OF REFERENCE FORMATTING

Citation style for Nucleic Acids Research
http://www.oxfordjournals.org/our_journals/nar/for_authors/msprep_submission.html

Wang, X., Moualla, D., Wright, J. A., and Brown, D. R. (2010) Copper binding regulates intracellular alpha-synuclein localization, aggregation and toxicity. *J. Neurochem.* **113**, 704-714.

Specific Details for Short Reports

- ❑ Short reports should be written in memorandum format.
- ❑ Short reports should be single-spaced with spacing between paragraphs and should not exceed 3 pages.
- ❑ All pages (including the first page) should be numbered for short reports.
- ❑ The beginning prose of all short reports should explain the purpose of writing the memo and the goal of the experimentation.
- ❑ No cover page is required for a short report. Instead, students should include a memorandum header to communicate typical information on the cover sheet including:
    - To: Name of the TA
    - From: Name of the student
      Georgia Tech Honor Code statement
      Signature of compliance with the Georgia Tech Honor Code
    - Re: Title of Laboratory Report
    - Date: Due date

2. LABORATORY PERFORMANCE/CONDUCT

- ❑ Students are expected to have read the laboratory protocol for the day prior to reporting to class. Note: Be sure to review all links associated with a laboratory protocol.
- ❑ Students are expected to follow written procedures for conducting assigned experiments. Due to limitations in equipment, students must work with the TA/instructor in cycling through the laboratory work.
- ❑ Students are expected to work independently (or when necessary, with a laboratory partner).
- ❑ Students are responsible for the upkeep of their workstations. Be sure to restock all workstations at the end of each laboratory period. Students are not dismissed until their workstations have been inspected and approved by the TA.
- ❑ Be sure to clean all glassware before the end of the class period.
- ❑ Keep the balance and instrumentation areas clean and free from clutter.
- ❑ Be sure to report any malfunctions in equipment to the TA or instructor.
- ❑ All materials stored in the refrigerator, freezers, or at room temperature must be capped and clearly labeled including the chemical's name, date of preparation, name of the person who prepared the reagent, and its NFPA diamond information for safety.

- ❑ Follow all safety regulations and encourage others around you to work safely as well.

- ❑ Do not eat, drink, chew gum or have anything in your mouth while in the laboratory. Do not bring food into the laboratory. Do not leave unconsumed drink bottles including bottled water visible in the laboratory.

- ❑ Do not discard food trash in the laboratory.

Laboratory Safety and Specific Hazards
Most of the chemicals used in this laboratory are harmful if inhaled or ingested.

- ❑ **New Policy in Fall 2011**: Students must wear a laboratory coat at all time while working in the Biochemistry Teaching laboratory. The coat may be made of a 65%/35% polyester/cotton blend, 100% cotton, or any higher-grade safety fabric. Typical lab coats being sold on campus are full-length. Aprons will not suffice. Other requirements are described in detail in the Personal Protective Equipment and Laboratory Attire Policy (See T-Square→ Resources for PDF).

- ❑ Always wear safety glasses in the Biochemistry Laboratory! Reading eyeglasses no longer suffice as suitable safety protection for the eyes.

- ❑ Wear suitable clothing in the Biochemistry Laboratory. Natural fibers (such as cotton) are safest. Students should be clothed from the torso to the feet.

- ❑ Sandals, shorts and open-toed shoes are not permitted in the lab.

- ❑ Wear nitrile gloves when working with dangerous chemicals.

- ❑ Do not allow laboratory chemicals to enter your mouth or small cuts or scratches on your hands. Nitrile/latex gloves are available for daily use to avoid this problem and to prohibit contamination of laboratory experiments.

- ❑ Do not inhale powders or vapors. This is especially important when working with sodium dodecyl sulfate (SDS) powder, concentrated acids/bases, and mixtures of acrylamide and bisacrylamide solutions.

- ❑ It is good practice to wash your hands carefully before leaving the laboratory.

- ❑ Read and follow instructions.

Student performance in the laboratory will be monitored and evaluated each week in the following categories.

1. Promptness
2. Preparedness
3. Industriousness
4. Intellect
5. Reliability
6. Cooperation

More details about work ethic expectations will be given during the course introduction.

3. LABORATORY NOTEBOOK MAINTENANCE

At the interest of some students, we are pleased to announce that students in CHEM 4581 will maintain laboratory records in an electronic laboratory notebook (ELN) from Lab Archives at the reduced cost of $10.00 for the term. Instructions for access and use will be provided in class.

Lab Archives Resources

Customer Support	support@labarchives.com
Getting Started Video	http://www.youtube.com/watch?v=DmMd0AA8GG4
Web Site	https://mynotebook.labarchives.com
Technical Support	Lab Archives Help Page

The recording and organization of a permanent record of laboratory observations is as important a technique to master as any of the experimental methods you learn. The research notebook is a day-by-day record of the progress of experimental work. It should reflect the integrity and honesty of the experimenter as well as the clarity of his or her thought.

Electronic laboratory notebooks will include the following content worth 10 points each:

1. Experiment Title
2. Date on which work was conducted
3. Goal – what is the purpose of the experiment
4. Key materials and reagents used
    a. Identification of samples
    b. Sources of key reagents
    c. Make and model of specialized equipment – any instrument used for measurements should be included here
5. Experimental procedures: with sufficient detail so that someone else can repeat the experiment and generate your results
6. Experimental observations
7. Experimental results
8. Relevant data analysis
9. Preferably a conclusion statement – For example, “Experiment was successful” or “FAILED: Do not repeat as written”
10. Electronic signature and date

4. HOMEWORK

There will be periodic homework assignments given throughout the term. Homework is intended to foster critical thinking about the content and to prepare students for data analysis or other types of calculations that should be mastered.

5. GMO PROJECT PRESENTATION

Problem-based learning (PBL) is a contemporary approach for educating students with “real world problems” as a means of stimulating thinking and consolidating knowledge from a variety of disciplines in an effort to solve a problem or propose a strategy to solve a problem.

CHEM 4581 students will participate in a very short-term PBL experience involving determination of genetic modifications in a food of the student’s choice. Genetically modified organisms (GMO) in foods have some

characteristic features in DNA that are not present in natural foods. Students will have two days to complete their experimentation and will present their findings in a short presentation at the end of the term.

Day 1	Extraction of DNA from Food and PCR Amplification of DNA
Day 2	Electrophoretic Analysis of PCR Products
Day 3	Oral Presentation of Student Findings

Students should prepare a Power Point presentation and submit an electronic version of their talk to the instructor prior to the class period on the presentation day. The instructor and TA's will evaluate the project presentations. Presentations will be evaluated based on the following criteria.

1. Description of test sample
2. Support for hypothesis
3. Brief description of relevant experimental details
4. Clarity and accuracy of results and data analysis
5. Clarity and accuracy of conclusions
6. Appeal and effectiveness of visual aids
7. Communications skills (voice, stage presence, demeanor, etc.)
8. Handling questions

More guidance for preparing for the evaluation criteria will be provided later in the term.

6. CLASS PARTICIPATION

Students will be given assignments during some lecture periods and are expected to participate and engage in the learning activities. Academic performance on the assignments will have no bearing on the class participation grade. Class participation is merely graded based on student's participation on the assignment.