

CHEMISTRY 307: Biochemistry Laboratory (1 credit)

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Required Materials

Safety glasses, a bound laboratory notebook, and a scientific calculator.

Tentative Schedule

1. Introduction to course: rules, regulations, and discussion of first lab
2. Spectrophotometric Determination of Glucosamine
3. Gel Filtration Chromatography
4. Isolation of Casein and Determination of pI
5. Antioxidant levels in beverages
6. Carbohydrate Analysis
7. TLC of Flavors and Fragrances
8. Enzyme Kinetics: Chymotrypsin Cleavage of GPNA
9. Final Lab Exam

Experimental descriptions will be in the form of handouts.

Grading/Some rules and regulations

Each experiment will require submission of a laboratory report. The details of the lab report are discussed below. Each lab report will be worth 100 percentage points. The final lab exam will also be worth 150 percentage points.

Performance in lab and within groups will be monitored. Your lab instructor will note a student's performance with respect to such attributes as:

- compliance with safety rules
- competence with respect to lab techniques
- organization and efficiency when performing experiments
- general attitude in the lab and degree of cooperation and contribution when performing experiments with a partner

Points will be deducted from the laboratory report if the above conditions/criteria are not met. Point deductions will depend on the severity of the "offense (up to a maximum of 20%).

Each student will maintain a bound notebook. The notebook requirements are described below. There will be random notebook checks. An incomplete notebook – deemed so by the instructor – will result in a deduction from the lab report for the lab being completed at the time of the notebook check. A 10% deduction will be applied for incomplete notebooks.

At the end of the semester, there is a possible total of 750 percentage points. To compute the final grade, add points from all lab reports/final exams, divide by 750 and multiply by 100. The

grade will be some percentage between 0 and 100%. Final letter grade will be based on the following scale:

93-100 %	A	80-82.9%	B-	67-69.9%	D+
90-92.9%	A-	77-79.9%	C+	60-66.9%	D
87-89.9%	B+	73-76.9%	C	Below 60%	F
83-86.9%	B	70-72.9%	C-		

Some important information

We will be working in groups of three. For each experiment there will be a group leader who will also be the senior author for the laboratory report. Group members will rotate as group leader/senior author. With significant input from the other members of the group, the senior author will be responsible for putting the report together in final form. All members of the group should generate a rough draft of the lab report. All group members should then get together to share and discuss the rough drafts and decide how to put together the final write-up. The senior author will generate the final report and distribute to other members for review before submission.

For some experiments there may be a pre-lab assignment. Follow the instructions of the instructor as to when to hand in the pre-lab. All pre-lab assignments should be completed individually following the Honor Code.

Some labs may run overtime or require some additional time outside of the regularly scheduled lab period.

It is hoped that you will feel the need of a cooperative spirit in attempting to secure the most knowledge in a limited space and time. The laboratory relies heavily on cooperative learning and peer interaction to be successful.

Attendance Policy

Attendance in the laboratory is MANDATORY. If due to circumstances beyond your control, you are unable to do an experiment at your scheduled time, it may be possible to perform the experiment during another scheduled lab period. The student should understand that making up missed experiments causes some difficulties. You may not work in the laboratory alone. Scheduling the make-up lab must be done in cooperation with the instructor. Any unexcused absence results in a zero for that lab.

Any absence from a lab session requires a valid written excuse from;

1. a doctor, dentist, or school nurse in case of illness
2. The Dean of Students office in the case of family emergency
3. The student giving a satisfactory and reasonable explanation in writing as to why the lab was missed.

If these procedures are not followed, no make-up exam will be given and the student will receive a zero for the missed lab.

Note then, that it is your responsibility to contact your instructor regarding the make-up of all missed work. Failure to do so within two days of the original date will result in a grade of 0 for that exercise.

Laboratory Notebook

A data notebook is essential in any scientific investigation. In it one records experimental procedures, observations, results and thoughts on the experiment. The notebook is a systematic and accurate record of all observations and data. The notebook should be a bound notebook, rather than a loose leaf notebook or a tear off pad. Pages should be consecutively numbered and dated. All entries in notebook should be in ink. Notes and observations made during the course of the experiment should be written directly on the notebook, not copied from other papers. Laboratory notebooks are not works of art so there is no need to “copy over neatly” notes taken on a separate sheet of paper to make the notebook pretty. Information can be lost or altered in the copying. This does not mean your notebook should be a mess and not able to be followed by fellow researchers. A neat notebook is certainly an asset. Planning how you will record information may help you to keep a neater notebook. Obviously mistake will be made when recording data. If a correction is made, a line should be drawn through the incorrect value and the correction written beside it.

Crucial to the usefulness of any data notebook is the faithful recording of observations and results. There are no wrong results or experiments that did not work. There are unexpected results, flaws in experimental design, error in procedure, faulty techniques and instrumental errors, but for an intelligent researcher, there is something to be learned from every experiment or exercise. Identification of the source of error and redesign of an experiment is crucial to scientific investigation. Without a good notebook, one cannot figure out what went wrong, because one cannot remember all the details of experiments. Without a good notebook, one also may not be able to replicate results which is an essential part of most scientific investigations. In addition, results of experiments must be communicated to the scientific community by publishing in journals, books, on the Web and by oral presentations. To publish results, it is mandatory to rigorously document those results. Moreover, in the industrial world, patent rights and liability are based on an accurate keeping of records.

The suggested format for the laboratory notebook is:

Leave a few pages blank at the beginning of the notebook so that a Table of Contents can be added as the notebook is used.

Your laboratory notebook should contain enough information such that a competent scientist would be able to work from your notes and obtain the same results.

The following format is suggested:

1. **Date** – Each page should list the date of the described work.

2. **Title** – Give the title of the experiment or exercise on the first page of the new experiment.
3. **Objective or Purpose** - Briefly state the purpose of the described experiment.
4. **Materials and Methods (Experimental)** – This section is a record of the procedures, materials and solutions necessary to accurately reproduce and subsequently verify the experiment.
5. **Results** – This section is a record of all observations, raw data, calculated data, calculations, graphs, photographs or whatever is appropriate to a particular experiment. Data and calculations must be legible, orderly, and completely labeled.
6. **Conclusions** – This is a short analysis of the findings. Are the results as expected? Account for unexpected results, point out possible sources of error, suggest improvements in the protocol, etc.
7. **References** - This section is a listing of any references used in writing the report.

Remember to put a left to right diagonal line thru any large area of a notebook page that is not used.

Laboratory Reports

Regardless of how ingenious an experiment is, any laboratory work that is not shared with the scientific community is of little scientific value and does little to advance the field. Thus, preparation of formal laboratory reports is an essential part of your scientific training. The laboratory reports are prepared as if they are scientific papers, but generally shorter and simpler than the real thing. Like a scientific paper, a lab report should describe your work in sufficient detail to allow the reader to understand and duplicate your experiments. It should be typed, double spaced, with 1 in margins. Proper spelling grammar, and syntax are an important part of any written document. The written sections of your report should be prepared with the same care you would take in a writing course. Your ideas should be clear and insightful; your paragraphs should be organized and coherent. Your sentences should be logical and grammatically correct.

The suggested format for the laboratory report is:

1. **Title** – This should contain the experimental title, senior author, junior authors, lab section and due date.
2. **Abstract** – This is a brief description of the project and results. It should state what was done, the major results, and the major conclusions. Despite its brevity, all important results should be noted. The abstract is sometimes the hardest part to write and is sometimes best to leave until last.
3. **Introduction** – This section gives the hypothesis and rationale behind the experiment and the minimum necessary background material to understand the hypothesis and rationale. It should be

written for an informed person with some chemistry background, but one who may not be an expert in the particulars of the experiment.

4. Experimental (Materials and Methods) – This section is a careful description of procedures, protocols, materials and solutions used in the experiment. There should be enough detail such that an informed reader can understand and duplicate the experiments.

5. Results – This section should contain the raw data in a clear and organized form, a summary of calculated data and an example of each calculation performed. This section presents the findings of the experiment in narrative form supplemented with figures, tables, diagrams, graphs, etc. The narrative should make reference to the figures and point out important points relevant to the hypothesis or rationale of the experiment. All figures must have complete legends, including a descriptive title and the info necessary to comprehend the figure.

6. Discussion – The discussion section contains a careful and thoughtful analysis and interpretation of the results. It is often the time to restate the hypothesis and reassess it in light of the experimental results. Data obtained should be compared to those reported in the literature, and sources or error should be discussed as well as possible future studies, if appropriate. If the experiment did not go as planned, what went wrong?

For some reports, you may want to write a combined Results and Discussion section as is sometimes found in scientific papers. However, this is not always easier than writing separate sections and should not be done in cases where there are a large number of figures.

7. References

Laboratory Safety

The following safety precautions must be observed in the laboratory. After you have read them, complete the last page of this handout and give it to the laboratory instructor. No student will be allowed to work in the lab without the signed attached sheet acknowledging understanding of safety rules.

1. Some form of eye protection is required at all times. Safety glasses, with side shields are best, but normal eyeglasses are permitted. Contact lenses are not to be worn in the laboratory. Serious damage to the eye can result. If you must wear contact lenses, then goggles must be worn as well.
2. Avoid wearing open-toed (or open-heeled) shoes and canvas shoes. Wear something that will protect the foot.
3. Wear old clothes, preferably nonsynthetic, that fit. Don't wear frilled or flared shirts. Lab coats or aprons are suggested.
4. Secure long hair and remove necklaces or scarves when working in the lab.

5. No smoking, food or drink is permitted in the lab at any time.
6. Note the locations of eye washes, fire extinguishers, showers, fire blankets, and exits.
7. Rinse any chemicals from eyes or off body immediately using eye washes, sinks, or showers depending on the spill.
8. Always pay attention to the instructor's advice regarding the potential hazards of any particular experiment.
9. Always come into the lab knowing what you will be doing. Read the procedure beforehand. Complete sections I and II in your lab notebook before the start of the lab. Take note of any special safety hazards associated with a specific experiment.
9. Never work in the laboratory alone.
10. Unauthorized experiments are prohibited.
11. Notify the instructor at once in case of accident or emergency.
12. Always wash hands and arms thoroughly before leaving lab. Get in the habit of periodically washing hands during the lab.
13. Be aware of the composition of all reagents being handled and handle appropriately. Consult MSDS if necessary.
14. Always consult the instructor if you have any doubts about starting or continuing a procedure.
15. Never taste or directly smell any chemicals.
16. Never pipet by mouth.
17. Never lean directly over a chemical reaction and do not point a test tube, sep funnel or reaction flask at a neighbor.
18. Never add water to concentrated acid. A violent reaction will occur. With caution, add acid to water.
19. Read the label on a reagent bottle twice before removing any chemicals. This helps to prevent accidents and unexplained results. In addition, chemicals located in the fume hoods are usually noxious or toxic. Remove them only with instructor permission.

20. Dispose of hazardous materials properly. Waste containers will be provided in the hood for these chemicals. Do not place other chemicals in these waste containers. Broken glassware should be disposed of in the container so designated. Do not put in waste paper basket.
21. Always check beakers and flasks for cracks before applying any heat. Otherwise, the vessel may shatter and the hot liquid can cause serious injury. Replace cracked or broken glassware immediately.
22. Always clean your lab area before you leave.
23. All material should be properly labeled with contents, your name, date, class, and experiment. Labeling is critical to avoid improper use or disposal of material. Containers without labels are a hazard.
24. Be familiar with the NFPA hazard labeling system. These labels appear on reagent bottles. Numbers in the zone range from zero to four with four being the most hazardous. The system is designed to instantly warn workers of hazard levels.
25. Pay attention to the experiment. If you need to leave the lab, notify the instructor and be sure that your experiment is being watched by a partner/neighbor or instructor.