Structure and Properties Laboratory
Chemistry 150 L
Fall 2017

Instructor Professor Brenda Harmon **Office Hours** Mon & Wed 11:00 -12:00
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"*The job of the laboratory course is to provide the experience of doing science. By offering a genuine, unvarnished science experience, a lab course can make a student into a* **better observer, a more careful and precise thinker, and a more deliberate problem solver**. *And that is what education is all about*." - Miles Pickering

"In theory, there is no difference between theory and practice.
In practice, however, there is." - Jan van de Snepscheut

Required materials

- Pre-lab reading materials and background information will be made available via CANVAS. You should either print out the Canvas material for that lab or bring a device which can access it.
- **Carbon-copy notebook**
- **Safety glasses**

What will you be able to do at the end of this course?

You will work with your lab team to design and carry out an accurate quantitative analysis of uric acid, $C_5H_4N_4O_3$, on samples of urine using UV spectroscopy to determine if the urine is normal or abnormal. The amount of uric acid cannot be measured directly due to the interference of other compounds that are also present in urine. Consequently, you will need to use a more sophisticated indirect method of analysis.

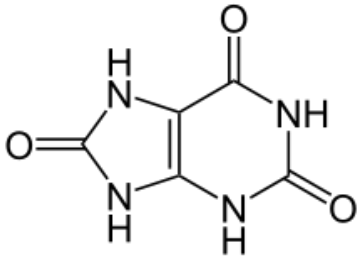

Figure 1. Molecular structure of uric acid


Figure 2. Urine sample
http://www.healthline.com/hlcmsresource/images/

An increased amount of uric acid in the urine often indicates gout, which is a common form of arthritis characterized by severe pain and tenderness in the joints. A uric acid urine test might also be used to monitor a patient undergoing chemotherapy or radiation treatment which can lead to an accumulation of uric acid in the body.

How will you know what to do?

Every week in lab, your group will be working together to use one or more of the necessary laboratory techniques and thinking skills to answer a scientific question. Over the course of the semester you will be repeating and combining techniques and skills, gaining the knowledge and attitudes necessary to use the important higher order thinking skill - **application**. The course design will require you to practice *thinking like a chemist* by applying content knowledge from the lecture course to problem-solving in real laboratory situations. Although you will be routinely working as part of a team and pooling class data, you will also be required to display personal responsibility by performing individual quality checks of certain laboratory techniques. Because you will be practicing and applying the necessary skills in multiple laboratory sessions and in different contexts, you will be prepared for the final challenge. Over time, you should develop some of the disciplined habits of mind that characterize scientific thinking.

The underlying chemistry concepts and big ideas taught through this course are important foundational skills, not just for chemistry majors, but for biology, biochemistry, neuroscience and medicine. Scientific inquiry skills are an important component of a liberal-arts education and are necessary for pursuing graduate work and professional degrees. Working in groups provides more potential for you to develop respect for others and self-respect for your own accomplishments. The group nature of the laboratory course provides the opportunity for you to exhibit and practice leadership skills.

In the rich teaching and learning environment of a laboratory course, I will be able to evaluate first-hand your ability to apply chemistry content, solve problems, show self-reliance, engage in inquiry, analysis, and scientific thinking skills, as well as work cooperatively as a valuable member of a team, demonstrate leadership abilities, prioritize time, and multi-task. These are all characteristics that are vitally important to future potential employers and admissions committees.

Student Learning Outcomes

- **Make connections between the macroscale** (what you see, smell, and touch), **the microscale** (atoms, molecules, and ions), **and the representational** (symbols, formula, and equations).
- **Construct a valid and well supported scientific argument using claims, evidence, and reasoning.**

Fundamental laboratory skills:

- weigh samples - choose the right tool for the job
- use volumetric glassware to measure liquids- choose the right tool for the job
- prepare solutions
- perform dilutions
- calculate percent error, percent yield, percent loss
- demonstrate scientific record keeping skills (necessary for research and medical charts)
- recognize dangers and practice appropriate laboratory safety precautions
- safely handle and dispose of chemicals
- display ethical practices in recording evidence

Fundamental laboratory software skills:

- Microsoft Excel - create spreadsheets, tables, graphs, and perform calculations
- Spartan- molecular modeling
- ChemDraw

Experience using laboratory instrumentation:

- analytical balances
- pH meters
- UV/VIS spectroscopy
- XRD

Other exportable skills:

- prioritize time and multi-task to meet the needs of the laboratory time constraints
- display teamwork in group activities using interpersonal skills
- show self-reliance when working independently

Competencies:

These typically involve the integration of knowledge, skills, and attitudes in complex ways that require multiple elements of learning.

- Demonstrate a fundamental understanding of stoichiometry by applying some aspects of stoichiometry in the execution of the experiments and the final project.
- Construct and evaluate a calibration curve.
- Identify the variables in an experiment (independent, dependent, controlled, and uncontrolled variables)
- Identify important factors that affect the execution of an experiment (particularly in experimental design/redesign)
- Identify questionable data (data that does not follow the expected pattern)
    - Repeat/redesign trials that produce questionable data
- Analyze data and perform some fundamental aspects of statistical analysis, including the calculation of averages and standard deviations as well as assessing whether it is statistically valid to reject a data point.
- Select, organize, and effectively present qualitative and quantitative evidence.
- Identify and reflect on potential mistakes/issues/errors during the execution of the experiment

Grading Methods and Course Requirements

Lab notebooks	55%
Lab reports	15%
Quality checks	20%
In-lab Excel evaluation	10%
	100%

Laboratory notebooks

The notebook carbon copy pages you turn in for each experiment will be graded on a 100-point basis. See the Canvas documents on Notebooks. Notebook pages turned in late (not at the end of the lab session) will lose 10 points, and 10 additional points for every day late. There are 11 weeks of laboratory sessions. To encourage learning from feedback, the laboratory notebook grades will be worth an increasing percentage of the course grade over time.

- Experiments 1, 2, 3, and 4 (parts I and II) are worth **4% each**. total 16%
- Experiments 5, 6, 7 and 8 are worth **6% each** total 24%
- Experiment 9 (parts I and II of the final project) are worth **7.5% each** total 15%

Laboratory notebooks total 55%

Laboratory reports

To encourage learning from feedback, the laboratory report grades will be worth an increasing percentage of the course grade over time. See the Canvas document on lab reports for more information, including due dates. Lab reports are graded on a 100-point basis. Lab reports turned in late will lose 10 points, with 10 additional points for every day late. If you frequently turn in assignments late, the penalty will go up.

- Lab report 1 4%
- Lab report 2 5%
- Lab report 3 6%

Lab reports total 15%

Quality checks

To encourage personal responsibility, your accuracy and precision in performing important laboratory techniques will be evaluated.

- Quality check 1 3%
- Quality check 2 7%
- Quality check 3 10%

Quality checks total 20%

In-lab Excel evaluation

You will be given an in-lab Excel assignment in order to evaluate your proficiency in using this spreadsheet program. You will be given a laboratory scenario with a beginning question, a procedure, and raw data from a student notebook. You will make a claim, provide evidence (using Excel to create tables and/or graphs, and perform calculations with experimental data), and reasoning.

In-lab Excel evaluation 10%

Total lab course grade 100%

Excel and Spartan online modules and assignments

During the semester, you will be asked to complete four Excel and Spartan software online training modules and assignments through the CANVAS site to help you become proficient.

Pre-lab Quizzes
A 5-minute pre-lab quiz may be given at the beginning of some laboratory sessions to determine your level of preparation and readiness for lab.

Post-lab Quizzes
A 5-10 minute quiz may be given at the end of some laboratory sessions. These quizzes will cover the concepts behind the experiments or techniques just completed and may include concepts from previous experiments.

Excel/Spartan assignments, pre/post lab quizzes +1% bonus

**The Excel and Spartan assignments and pre/post lab quizzes are not part of your course grade. You will be given a 1% bonus to your course grade if you have completed all 4 Excel and Spartan online assignments by the deadline and if you earn an 85% or higher on pre-and post-lab quizzes (you may drop the lowest quiz grade)*

Grades are based on percentages and usually assigned as follows:

93.0 and up	A	77.0 – 79.9	C+
90.0 – 92.9	A-	73.0 – 76.9	C
87.0 – 89.9	B+	70.0 – 72.9	C-
83.0 – 86.9	B	67.0 – 69.9	D+
80.0 – 82.9	B-	63.0 – 66.9	D
		62.9 and below	F

Attendance
The only acceptable reasons for missing a lab session are serious illness/emergency, a religious holiday, or a college-related activity (such as a field trip or a trip where you are representing the school). If you miss a lab for any other reason, you will receive a zero. If you do not follow the procedure below for obtaining permission for the absence, you will receive a zero regardless of the reason:

- In the case of a serious illness or emergency, you must let me know the reason BEFORE the day and starting time of the lab. If the reason is acceptable, you may be allowed to make up the lab another day that week or if that is not possible, we will make other arrangements.

- If you know you are going to need to miss lab for a religious holiday or a college-related activity, you must talk to me at least a week before the lab. You may be allowed to make up the lab another day that week or if that is not possible, we will make other arrangements.

- Only one lab may be missed (including any pre-approved reason) without a grade penalty.

Honor Code Policy
Lab sessions are a perfect place to promote and utilize collaborative learning. You are encouraged to discuss the experiments with others before lab and while in lab. However, your lab reports are to be **your work alone**. You should not work with another student after the lab is

over. Collaboration on any lab report is a violation of the Oxford College Honor Code and will be treated as such. This rule applies to any portion of reports from previous semesters as well as papers available over the internet. Your name on your lab report is your pledge that the work is yours and that you did not give or receive unauthorized assistance. The usual penalty for students who are found to have violated the honor code is an F in the course.

Accommodations

If you have a documented disability and have anticipated barriers related to the format or requirements of this course, or presume having a disability (e.g. mental health, attention, learning, vision, hearing, physical or systemic), and are in need of accommodations for this semester, I encourage you schedule a meeting to discuss this with me. You will also need to contact the Office of Access, Disability Services, and Resources (ADSR) to learn more about the registration process and steps for requesting accommodations.

If you are a student that is currently registered with ADSR and have not received a copy of your accommodation notification letter within the first week of class, please notify ADSR immediately by emailing Megan Bohinc at ADSROxford@emory.edu. Students who have accommodations in place are encouraged to coordinate a face to face meeting with me during the first week of the semester, to communicate your specific needs for the course as it relates to your approved accommodations. All discussions with ADSR and faculty concerning the nature of your disability remain confidential. For additional information regarding ADSR, please visit the website: equity.emory.edu/access.

Course Specific GEP Learning Outcomes

Students will be able to use scientific practices, attitudes, and inquiry skills to:

1. **Ask more meaningful questions.**
   Use questions to drive the design and execution of laboratory procedures and evidence collection.
2. **Question and examine evidence more rigorously.**
   a. Strive for accuracy and precision in measurement.
   b. Analyze and evaluate the *quality* of quantitative evidence using data analysis and simple descriptive statistics. Demonstrate skepticism when evaluating evidence.
   c. Give priority to evidence in making scientific conclusions.
3. **Use evidence in argument more effectively** (claims, evidence, reasoning)
   a. Communicate and justify conclusions, connecting evidence and conclusions using scientific knowledge.
   b**.** Determine sources of error in an experiment that are meaningful and make mathematical sense.
4. **Break down problem-solving processes and articulate what they are doing, why they are doing it, and where they might go next.**
   a. Design and carry out experiments; explain the purpose of each step in the overall context.
5. **Display increasing self-reliance, embracing challenge and revision as a necessary part of the inquiry process. **Mistakes and blind alleys are part of the nature of science.***