

# Chemistry 327: Fundamentals of Analytical Science

Summer 2014

Lecturer: Dr. Linda Zelewski  
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Office: Chemistry 7108  
Office hours: See Learn@UW

Course Credit: 4 credit hours  
Lecture: MTWR 10:40-11:55 a.m. in B371 Chemistry  
Lab: MTWR 7:30-10:30 a.m.  
Web Site: <https://learnuw.wisc.edu/>

Laboratory Director: Dr. Pam Doolittle (room Chem 2303A, pssemrad@wisc.edu)

## REQUIRED MATERIALS

**Textbook:** *Exploring Chemical Analysis*, Fifth Edition, by Daniel C. Harris, W.H. Freeman and Company, 2013.

**Lab Manual:** *A Manual of Experiments for Analytical Chemistry, Spring 2014*, Department of Chemistry, UW-Madison. Laboratory manuals will be sold in the Chemistry building for \$5 (cash only).

**Lab Notebook:** Carbonless laboratory notebook with numbered, duplicate pages.

**Calculator:** A scientific or graphing calculator is required. Only calculators that are permitted on SAT or ACT tests may be used on exams. You may NOT use any stored information, programs, or applications on exams unless given explicit permission.

**Safety Goggles:** Industrial quality eye protection is required at all times when you are in the lab. Safety goggles that completely seal around the eyes and fit over regular glasses can be purchased from local bookstores.

**USB Drive:** A USB flash drive that will hold at least 2 GB is required for laboratory.

**Course Web Site:** Assignments, announcements, lecture notes, handouts and homework will be posted on our course web site. You will also use the web site to complete online pre-lab quizzes and to view your grades.

## SUGGESTED MATERIALS

*Solutions Manual for Exploring Chemical Analysis*, Fifth Edition, by Daniel C. Harris, W.H. Freeman and Company, 2012.

## COURSE ORGANIZATION

### LECTURE

Lectures organize the material, cover the basic principles of each topic, and present illustrations and demonstrations. A lecture is not intended to describe or explain everything you should learn; rather, it will indicate what topics it is important to study and provide some insight into those topics. Read the assigned sections of the textbook prior to lecture. Take notes during lecture to capture your understanding of what you heard and saw. After lecture, reread and study the appropriate pages in the textbook.

### Lecture Notes

A set of lecture notes, taken by one of the TAs, is available on Learn@UW. These notes are relatively complete; however, they will not replace your notes or the textbook.

### CLASSROOM ETIQUETTE

Cell phones should be turned off. While laptops are not prohibited in class, you will not have any need for them during lecture. Using the computer or other devices during class for activities not related to class (such as surfing the web, playing video games, texting, etc.) is both rude and distracting, not only for you, but for those who are sitting nearby.

### HOMEWORK

There will be 7 homework assignments. Each assignment has two parts. The first part is a list of problems from the textbook. Since worked out solutions to these problems can be found in the *Solutions Manual for Exploring Chemical Analysis*, these problems will not be collected or graded. The second part of the assignment will have problems that are to be worked out and turned in for grading.

When doing homework assignments, you may work independently or collaborate with others. If you choose to collaborate, you must still work out and hand in your own solutions. If you worked with other students, you must indicate on your paper who you worked with. In order to receive credit for homework you must clearly communicate your thought process and show all of your calculations. Write your TAs name and your section number on your assignment.

***Homework due dates and times are firm. Due to the compressed summer schedule, no late homework will be accepted.*** If there are extenuating circumstances, such as a serious illness or family emergency, please email Dr. Zelewski (and copy your TA) as soon as possible. Dr. Zelewski may consider an extension for extenuating circumstances.

### LABORATORY

Fundamentals of Analytical Science is an experimental science and the laboratory is a significant part of the course. You will perform twelve standard labs involving chemical analyses aimed at teaching you specific skills. The procedures for these experiments are provided in *A Manual of Experiments for Analytical Chemistry*. You will also spend one week conducting experiments for a Laboratory Project.

### Laboratory Project

For the Laboratory Project, you will be studying phosphorus in Lake Mendota. More information regarding the project will be provided later during the semester.

## Standard Labs

Each of the standard labs is worth 15 points and has three graded components. You must take the online Pre-lab Quiz on Learn@UW prior to coming to lab (6 points). You will be graded on the accuracy of your lab results (5 points). And your lab notebook will be graded for completeness and clarity (4 points). ***Please note that for some weeks each lab section has a different lab schedule.*** Be sure to check the schedule at the end of this syllabus so that you prepare for the appropriate lab and take the appropriate online Prelab Quiz.

***YOU MUST COMPLETE ALL OF THE LABS AND EARN A MINIMUM SCORE OF 60% ON ALL LABORATORY ASSIGNMENTS (COMBINED PRELAB QUIZ AND LAB REPORT GRADES) IN ORDER TO RECEIVE A PASSING GRADE IN THE COURSE.***

## Pre-lab Quiz

Prior to taking the pre-lab quiz, read about the experiment in the lab manual and prepare your notebook pages. You should be familiar with the overall concepts of the experiment and the methods used in the experiment. You should also understand the procedure and how to do the calculations you will need to do with the raw data.

You may attempt the quiz twice and your highest score will appear in the grade book. Note that there is a time limit (usually 30 minutes) for each attempt. The clock begins timing once you start the quiz and you cannot stop and come back later in the day to finish, so be prepared to complete the entire quiz once you begin. Most quizzes have questions that involve calculations, so you should have a calculator, scratch paper, pencil, and your lab manual available when you attempt a quiz.

Check your lab schedule to make sure you are attempting the correct quiz. Quiz ending dates and times have been set-up by section and are set to end at 7:25 a.m. the day you are scheduled to do a lab. **Quizzes must be completed BEFORE this time or you will receive zero points for the prelab quiz.** UW-Madison network maintenance is periodically scheduled during the hours of 10:00 p.m. to 8:00 a.m., during which time Learn@UW is not available. Scheduled maintenance is not an excuse for not completing the prelab quiz on time.

When taking a quiz, ***do not include units when entering numbers for computational questions.*** The auto-grade feature will not recognize the units and it will mark your answer wrong. In all other parts of the course (lab notebook, homework, exams, etc.) you should always include units. Also be sure to enter the correct number of significant figures for a calculated answer. ***An error in the number of significant figures will result in an incorrect answer and zero points for your answer.***

Please notify the laboratory director, Dr. Doolittle (pssemrad@wisc.edu), or Dr. Zelewski (zelewski@wisc.edu) promptly if you can't access your quiz and/or if your ending date or time is incorrect for a particular quiz. Make sure to include your TAs name and laboratory section number in your email message.

## Laboratory Notebook

Your lab notebook should include the following:

- Overview of the experiment or purpose statement
- Experimental procedure
- Relevant chemical reactions

- Raw data from all measurements
- One complete sample calculation including units and proper significant figures
- Results and summary section

The first three items and tables for the raw data should be prepared ahead of time. Sample calculations should be outlined ahead of time and doing so may help you with the prelab quiz. Your results and summary section should be brief. In addition to your final results, it should include comments on whether your data are reasonable and/or any problems that occurred that could affect your results. Someone else should be able to repeat the experiment based on what you've written in the notebook. For more guidelines on proper record keeping, consult the lab manual and section 2-2 of the textbook.

### **Laboratory Reports**

Your laboratory report will consist of the carbonless copies of the relevant pages from your laboratory notebook and the completed (yellow) summary sheet from your lab manual. You will be graded on the accuracy and precision of your results and the quality of your notebook record. See “Laboratory Report Grades” on Learn@UW for more detailed information on how laboratory reports will be graded.

***Laboratory reports are due to your TA at the beginning of the following laboratory period after you have completed the experiment.*** When a lab report is due on a “Problem Solving Session/ Finish Labs” day, the report is due to your TA at 8:30 a.m. A penalty of two points per day will be deducted if you submit your report late. Late lab reports placed in your TA’s mailbox must be accompanied by an email message sent prior to submitting the report. Failure to email your TA may result in additional points lost if your TA does not know to look for your report in his/her mailbox.

### **Laboratory Conduct**

Safety goggles and proper attire must be worn at all times in the laboratory. Your lab begins at 7:30 a.m., and it is essential that you arrive on time so that you don’t miss important information. Points will be deducted from your lab score for unsafe or inadequate conduct including, arriving late, not wearing goggles, not cleaning up spills promptly, and not cleaning your lab area before leaving the lab. ***Notify your TA as soon as possible if you must miss a lab for any reason.***

## **ACADEMIC MISCONDUCT**

It is expected that all students will conduct themselves with honesty, integrity, and professionalism. Any student caught cheating on an exam will receive an F in the course. This penalty includes incidents such as looking at another student's paper during an exam or altering an exam after it has been graded and then submitting it for re-grading. Any student caught cheating on a lab or homework assignment (for instance, copying another person's work or fabricating data) will receive a zero for that assignment. A second infraction will result in an F for the course. More information on what constitutes academic misconduct and UW policies on handling misconduct can be found at:

<http://www.wisc.edu/students/saja/misconduct/UWS14.html>.

## GRADES

### Intended Grading Scale

Letter grades will be assigned at the end of the semester based on the following intended grading scale:

A	90.0%
AB	88.0%
B	80.0%
BC	78.0%
C	70.0%
D	60.0%

This scale *may* be adjusted downward at the end of the semester, depending on the overall class average. It will never be adjusted upward.

You will earn points based on how well you do on exams, homework and labs. Below are the tentative point values of items that will be graded. Adjustments to graded items and point values may be made during the semester if needed.

3 Midterm Exams @ 150 points each	450 points
7 Homework Assignments	~200 points
1 Instructional Prelab Quiz	6 points
12 Prelab Quizzes and Laboratory Reports	180 points
1 Laboratory Project	45 points
1 TA Evaluation	15 points

If no changes are made to the point values above, the total possible points at the end of the semester will be 896 points.

Your letter grade will be determined by calculating your final percentage using the formula:

$$\% \text{ score} = (\text{total points earned} / \text{total possible points}) \times 100\%$$

### Exams

Three two-hour exams will be given.

Exam 1:	Tuesday, July 1, 8:30-10:30 a.m.
Exam 2:	Tuesday, July 22, 8:30-10:30 a.m.
Exam 3:	Thursday, August 7, 8:30-10:30 a.m.

Exams are cumulative in the sense that many of the concepts covered in this course build on one another and a good understanding of earlier material is required for mastering later material. Objectives for each exam will be posted on Learn@UW the week before the exam.

### Review Your Grades

Your grades will be available on Learn@UW. Be sure to review your scores regularly and notify your TA promptly of any discrepancies. Do not wait until the end of the semester to request corrections.

## ATTENDANCE POLICY

Your attendance at all scheduled classes is mandatory and essential for success in the course. However, circumstances occasionally occur where a student must miss a class.

### Planned Absences

Students sometimes need to miss class for a religious observance, a UW athletic commitment, graduate school interview or some other legitimate reason. These are PLANNED absences and **any arrangements for making up missed work must be made a minimum of one week BEFORE the absence occurs.** Otherwise, the absence will be unexcused and you will receive a zero on the missed work. Homework must be turned in early (before the deadline) if you will be absent on the day it is due. If you must miss lab for a legitimate planned reason, let your TA know before the absence what day(s) you will be absent and the reason for the absence.

### Serious Illness

If you are seriously ill and are unable to attend lab, inform your TA via email and copy Dr. Zelewski. If you need an extension on your homework, arrangements must be made with Dr. Zelewski BEFORE the homework due date. Late homework cannot be accepted for any reason once the answer key is posted.

## SUGGESTIONS FOR SUCCESS

Many students find Chemistry 327 to be both challenging and rewarding. It is a four-credit course and you can expect to work hard. As an experienced college student, you have likely developed a style for studying and learning that works well for you. Below are some additional tips that if followed help many students succeed in this course.

- Attend all lectures, labs and problem solving sessions.
- Read the related material in the textbook *before* lecture. Some students find it helpful to take notes on what they've read.
- The textbook is not a novel! If you try to read it as such, you will likely fall asleep. The trick to successfully reading a technical book is to be an "active" reader. Have paper and pencil nearby and use it to write out solutions or solve equations. Try working examples without looking at the solutions.
- Review your notes after lectures. Reread the related material in the textbook. If there are parts you don't understand, seek help from an instructor or classmate.
- Solve lots of problems! Do all of the homework, plus extra practice problems. You will become more proficient and do better on exams if you have worked through lots of problems.
- If you often work in a group to do homework problems, be sure to balance that time with independent problem solving. You won't have the group with you during exams!
- Seek help promptly if you are confused or have questions. Your confusion will only be compounded by letting it slide. Keep up with the material as last minute cramming is not effective.

## STUDENTS WITH DISABILITIES

Students with documented disabilities (McBurney Students) or any special concerns should contact Dr. Zelewski as soon as possible so that appropriate accommodations can be arranged.

## CHEMISTRY 327 LECTURE OVERVIEW\*

WEEK	DATE	TOPIC	TEXTBOOK CHAPTERS
1	Jun 16	Introduction, Analytical Method	0, 2
	Jun 17	Significant Figures, Chemical Measurements	1, 3
	Jun 18	Uncertainty, Statistics	3, 4
	Jun 19	Statistics	4
2	Jun 23	Statistics, Volumetric Analysis	4, 6
	Jun 24	Quality Assurance & Calibration Methods	5
	Jun 25	Spectrophotometry	18
	Jun 26	Spectrophotometry	19
3	Jun 30	Review	
	Jul 1	<b>EXAM 1</b> (8:30-10:30 a.m.)	
	Jul 2	Equilibrium, Solubility	1-5, 6-4
	Jul 3	Ionic Strength & Activities	12-1, 12-2
4	Jul 7	Laboratory Project	
	Jul 8	Acids and Bases	8
	Jul 9	Acids and Bases	8
	Jul 10	Acids and Bases: Buffers	9
5	Jul 14	Acid-Base Titrations	10, 12-5
	Jul 15	Acid-Base Titrations	10, 12-5
	Jul 16	Polyprotic Acids & Bases	11, 12-3
	Jul 17	Polyprotic Acids & Bases	11, 12-3
6	Jul 21	Review	
	Jul 22	<b>EXAM 2</b> (8:30-10:30 a.m.)	
	Jul 23	Systematic Treatment of Equilibria	12-4
	Jul 24	Systematic Treatment of Equilibria	12-4
7	Jul 28	Electrode Potentials	Appendix D, 14
	Jul 29	Electrode Potentials	14
	Jul 30	Electrode Measurements	15
	Jul 31	Electrode Measurements	15
8	Aug 4	Chromatography	21
	Aug 5	Chromatography	22
	Aug 6	Review	
	Aug 7	<b>EXAM 3</b> (8:30-10:30 a.m.)	

\*See Learn@UW for specific reading, homework, and laboratory assignments and due dates.

## CHEMISTRY 327 LABORATORY SCHEDULE

Week	Date	301	302
1	16-Jun	Check in/ Weighing Experiment	Check in/ Weighing Experimentt
	17-Jun	Glass Volumetric Apparatus	Glass Volumetric Apparatus
	18-Jun	Glass Volumetric Apparatus	Glass Volumetric Apparatus
	19-Jun	<i>Problem Solving Session*/ Finish Labs</i>	<i>Problem Solving Session*</i>
2	23-Jun	Preparation of Standard HCl and NaOH Solutions	Preparation of Standard HCl and NaOH Solutions
	24-Jun	Preparation of Standard HCl and NaOH Solutions	Preparation of Standard HCl and NaOH Solutions
	25-Jun	Chemical Oxygen Demand	Chemical Oxygen Demand
	26-Jun	<i>Problem Solving Session*/ Finish Labs</i>	<i>Problem Solving Session*/ Finish Labs</i>
3	30-Jun	Ascorbic Acid Method for Phosphorus Determination	Ascorbic Acid Method for Phosphorus Determination
	1-Jul	<b>EXAM 1</b>	
	2-Jul	Spike Recovery and Determining a Method Detection Limit	Spike Recovery and Determining a Method Detection Limit
	3-Jul	Chromatographic Analysis of a Mixture	High Performance Liquid Chromatography
4	7-Jul	<i>Problem Solving Session*/ Finish Labs</i>	<i>Problem Solving Session*/ Finish Labs</i>
	8-Jul	High Performance Liquid Chromatography	Chromatographic Analysis of a Mixture
	9-Jul	Project	Project
	10-Jul	Project	Project
5	14-Jul	<i>Problem Solving Session*/ Finish Labs</i>	<i>Problem Solving Session*/ Finish Labs</i>
	15-Jul	Project	Project
	16-Jul	Project	Project
	17-Jul	<i>Problem Solving Session*/ Finish Labs</i>	<i>Problem Solving Session*/ Finish Labs</i>
6	21-Jul	Adventures with Buffer Solutions	Adventures with Buffer Solutions
	22-Jul	<b>EXAM 2</b>	
	23-Jul	Study and Identification of an Unknown Weak Acid	Study and Identification of an Unknown Weak Acid
	24-Jul	Study and Identification of an Unknown Weak Acid	Study and Identification of an Unknown Weak Acid
7	28-Jul	A Study of Bromocresol Green	A Study of Bromocresol Green
	29-Jul	<i>Problem Solving Session*/ Finish Labs</i>	<i>Problem Solving Session*/ Finish Labs</i>
	30-Jul	A Spectrophotometric Study of Fluorescein	A Spectrophotometric Study of Fluorescein
	31-Jul	Silver Electrode Study of Equilibria	Silver Electrode Study of Equilibria
8	4-Aug	Fluoride Ion Electrode/ Check out	Fluoride Ion Electrode/ Check out
	5-Aug	<i>Problem Solving Session*/ Finish Labs</i>	<i>Problem Solving Session*/ Finish Labs</i>
	6-Aug	<i>No Lab</i>	<i>No lab</i>
	7-Aug	<b>EXAM 3</b>	

\*All Problem Solving sessions are in Chem 1371 from 8:30-10:30 a.m.