



## Chemistry 329: Fundamentals of Analytical Sciences

**Semester and Year:** Spring 2020

**Credits:** 4 credit hours

**Course URL:** <https://learnuw.wisc.edu/>

**Course Designations and Attributes:** Breadth - Physical Science; counts toward the Natural Science requirement; Level – Intermediate; L&S Credit - Counts as Liberal Arts and Science credit in L&S

### Meeting Times and Locations:

Lecture: MW 11:00-11:50 am in B371 Chemistry

Disc	Time	Room	Lab	Time	Laboratory Room
332	F 11:00-11:50 am	CHEM B387	632	TR 1:20-5:25 pm	MED SC CTR 5385
333	F 11:00-11:50 am	STERLING 2323	633	TR 1:20-5:25 pm	MED SC CTR 5385
334	F 11:00-11:50 am	CHEM 2307	634	TR 1:20-5:25 pm	MED SC CTR 5385

**Instructional Mode:** All face-to-face

**How Credit Hours Are Met:** CHEM 329 is a 4-credit class that meets each week for two 50-minute lectures, one 50-minute discussion, and two 4-hour laboratories. Over the course of the semester, students are expected to engage in at least 180 hours of learning activities, which includes class attendance, reading, studying, preparation, problem sets, laboratory reports, and other learning activities.

### INSTRUCTORS AND TEACHING ASSISTANTS

**Lecturer:** Dr. Linda Zelewski

**Office:** Chem 1325

**Email/Preferred Contact:** [zelewski@wisc.edu](mailto:zelewski@wisc.edu) (Please include “Chem 329” in the subject line.)

**Office Hours:** See Canvas.

**Laboratory Director:** Dr. Pamela Doolittle

**Office:** 535 Service Memorial Institute (SMI)

**Email/Preferred Contact:** [pam.doolittle@wisc.edu](mailto:pam.doolittle@wisc.edu)

**Office Hours:** Dr. Doolittle has an “open door” policy for meeting with students. Feel free to stop by her office, or email to set up an appointment when seeking help related to the laboratory portion of the course.

### Teaching Assistants:

Section	TA	Email
332/632	Connor Protter	protter@wisc.edu
333/633	Michael Sivanich	mksivanich@wisc.edu
334/634	Brandon Hacha	hacha@wisc.edu

**TA Office Hours:** See Canvas.

### COURSE DESCRIPTION

Fundamentals of chemical measurement in chemistry, biology, engineering, geology, and the medical sciences. Topics include equilibria of complex systems, spectroscopy, electrochemistry, separations, and quantitative laboratory technique. Lecture, lab, and discussion.

**Requisites:** Chem 104 or 109

### Course Learning Outcomes

Students will be able to

- Apply statistical methods for the evaluation of laboratory data
- Use calibration and sampling methods important to quantitative analysis
- Model chemical systems and experimental data using relevant quantitative, mathematical, and computational methods.
- Learn analytical methods based on titrations, separations, electrochemical measurements, and spectroscopy and interpret the results for chemical analysis
- Identify, formulate, and solve integrative problems using appropriate information and approaches.
- Develop skills in working collaboratively with others, both chemists and those from other disciplines, to solve problems and create new knowledge.

### GRADING

Below are the 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	450 points
9 Homework Assignments	90 points
TopHat	30 points
Discussion Participation	15 points
12 Pre-lab Quizzes	72 points
11 Standard Laboratory Reports	154 points
Laboratory Project	200 points

Grading will be based on the following 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.

## DISCUSSION SESSIONS

Attendance is required. Your TA will provide important pre-lab information as well as answer any questions you may have about labs, homework, or lecture material. To get the most from discussion section, you need to be prepared. It is your responsibility to communicate to your TA the concepts you do not understand and the skills you need to practice. You should ask your TA specific questions and make sure you understand the questions and the answers given by your TA and by fellow students. Bring your lab notebook and manual with you to discussion.

## LABORATORY SESSIONS

The laboratory sessions are a significant and inseparable part of this course.

**You must complete all of the labs and earn a minimum score of 60% on all laboratory assignments (combined prelab, lab report and project grades) in order to receive a passing grade in the course.**

**Laboratory Project:** For the Laboratory Project, you will be working in small groups to determine the concentration and speciation of iron in beer. More information regarding the project will be provided during the semester.

**Standard Labs:** 11 standard laboratory sessions related to the course content are designed to help you practice and gain proficiency in mastering course concepts, as well as develop specific laboratory techniques important to the field of analytical chemistry. Each of the standard labs is worth 20 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 (10 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.

**Pre-lab Quiz:** The primary goal of the pre-lab quiz is to prompt you to prepare for the lab beforehand and to test your knowledge and understanding of the concepts behind the standard experiments. 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 1:20 pm the day you are scheduled to do a lab. ***Quizzes must be completed before this time or you will receive zero points for the quiz.***

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.*

### **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 for the eleven standard labs will consist of the carbonless copies of the relevant pages from your laboratory notebook and the completed (yellow) summary sheet from your lab manual. ***Laboratory reports are due to your TA the following scheduled laboratory period after you have completed the lab.*** Late lab reports will be penalized 2 points per day. 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 their mailbox.

**Laboratory Conduct:** Safety goggles and proper attire must be worn at all times in the laboratory. Your lab begins at 1:20 pm, and it is essential that you arrive on time so that you do not 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.

**Special Laboratory Accommodations:** Students requiring special accommodations in lab should contact the laboratory director, Dr. Pam Doolittle ([pam.doolittle@wisc.edu](mailto:pam.doolittle@wisc.edu)) before the first lab meets.

### **REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS**

- **Textbook:** Quantitative Chemical Analysis, Ninth Edition, by Daniel C. Harris, W.H. Freeman and Company, 2016.
- **Lab Manual:** A Manual of Experiments for Analytical Chemistry – Spring 2020, Department of Chemistry, UW-Madison. Lab manuals will be sold in Chemistry room 1375 Tuesday, January 21 through Friday, January 31 from 8:00 am to 4:30 pm. The cost for the manual is \$20. Payment is by WiscCard only.
- **Lab Notebook:** Carbonless laboratory notebook with numbered, duplicate pages. Alpha Chi Sigma (AXE), a professional co-ed chemistry fraternity founded here at UW-Madison, will be selling suitable lab notebooks in chem 1375.

- **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.
- **Personal Protection Equipment:** Industrial quality eye protection is required at all times when you are in the lab. Indirectly vented safety goggles that completely seal around the eyes and fit over regular glasses can either be purchased from local bookstores or from Alpha Chi Sigma in chem 1375. You're also required to wear a laboratory coat at all times in lab; lab coats will be available for purchase in chem 1375 if you need one. You should transport your lab coat in a sealed plastic bag, such as a 1-gallon Ziploc.
- **Top Hat Software:** We will be using the Top Hat classroom response system in class. You will be able to submit answers to in-class questions using Apple or Android smartphones or tablets (via the Top Hat app), laptops (via their website), or through text message. For directions on how to set up a TopHat account go to <https://kb.wisc.edu/59937>. TopHat registration is \$16 for one semester, \$20 for one year or \$54 for life. Our Chemistry 329 course join code is 864553.
- **USB Drive:** A USB flash drive that will hold at least 2 GB is required for laboratory.

## EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

Exam 1: Thursday, March 5, 2:00-4:00 pm, room TBA

Exam 2: Thursday, April 9, 2:00-4:00 pm, room TBA

Exam 3: Friday, May 8, 12:25-2:25 pm, room TBA

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 one week prior to the exam.

## HOMEWORK & OTHER ASSIGNMENTS

Homework is critical to success in this class and on the exams. When doing homework assignments, you may work independently or collaborate with others, but you must work out and turn in your own solutions. If you cannot work out the problems yourself after completion of the homework, you will not gain the proficiency required to solve the problems on the exams within the timeframe of the exam. In all homework assignments, you must explain your thinking and show your work to receive full credit. Homework is graded based on completion. It is your responsibility to check the key to determine if your answer is correct. Homework assignments will usually be due at the beginning of lecture. ***No late homework assignments are accepted. This is a strict deadline.***

## ATTENDANCE POLICY

Your attendance at all scheduled classes (lecture, discussion and lab) is mandatory and essential for success in the course. However, circumstances occasionally occur where you may need to miss a class.

**Planned Absences:** If you need to miss class for a religious observance, a UW athletic commitment, graduate school interview or some other legitimate reason, you must make arrangements to make up the missed work ***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 before the deadline if you will be absent on the day it is due.***

**Serious Illness/ Family Emergency:** If you are seriously ill or experiencing a family emergency and are unable to attend lab, inform your TA via email and copy Dr. Zelewski. If you need an extension on your homework due to a serious illness or family emergency, arrangements must be made with Dr. Zelewski **before** the homework due date.

## **RULES, RIGHTS & RESPONSIBILITIES**

See the Guide to [Rules, Rights and Responsibilities](#).

## **ACADEMIC INTEGRITY**

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to [studentconduct.wiscweb.wisc.edu/academic-integrity/](http://studentconduct.wiscweb.wisc.edu/academic-integrity/).

## **ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform Dr. Zelewski and their TA of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. We will work either directly with you or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.

## **DIVERSITY & INCLUSION**

**Institutional statement on diversity:** "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." <https://diversity.wisc.edu/>

## CHEMISTRY 329 OVERVIEW\*

WEEK	DATE	LECTURE TOPIC	DATE	LAB
1	M Jan 20	<b>MLK Day No Classes</b>	T Jan 21	<b>No Lab</b>
	W Jan 22	The Analytical Process	R Jan 23	Check in/Weighing
2	M Jan 27	Chemical Measurements	T Jan 28	Volumetric Apparatus
	W Jan 29	Experimental Error	R Jan 30	Standardization of HCl & NaOH
3	M Feb 3	Statistics	T Feb 4	Standardization of HCl & NaOH
	W Feb 5	Statistics	R Feb 6	Det. of % KHP in a Mixture
4	M Feb 10	Quality Assurance	T Feb 11	Spectrophotometric Det. of Fe
	W Feb 12	Spectrophotometry	R Feb 13	Project
5	M Feb 17	Spectrophotometry	T Feb 18	Project
	W Feb 19	Calibration Methods	R Feb 20	Project
6	M Feb 24	Ionic Strength and Activity	T Feb 25	Project
	W Feb 26	Solubility	R Feb 27	Project
7	M Mar 2	Acid-Base Equilibria	T Mar 3	HPLC/ COD/ Fluorescein (Rotation)
	W Mar 4	Acid-Base Equilibria	R Mar 5	<b>EXAM 1 (2:00-4:00 pm, room TBA)</b>
8	M Mar 9	Acid-Base Equilibria	T Mar 10	HPLC/ COD/ Fluorescein (Rotation)
	W Mar 11	Acid-Base Titrations	R Mar 12	HPLC/ COD/ Fluorescein (Rotation)
9	Mar 16-20	<b>Spring Break</b>		
10	M Mar 23	Acid-Base Titrations	T Mar 24	Adventures with Buffers
	W Mar 25	Systematic Treatment of Equilibria	R Mar 26	ID of Unknown Weak Acid
11	M Mar 30	Systematic Treatment of Equilibria	T Mar 31	Bromocresol Green
	W Apr 1	EDTA Titrations	R Apr 2	Project
12	M Apr 6	EDTA Titrations	T Apr 7	Project
	W Apr 8	Electrochemistry	R Apr 9	<b>EXAM 2 (2:00-4:00 pm, room TBA)</b>
13	M Apr 13	Electrochemistry	T Apr 14	Project
	W Apr 15	Electrodes and Potentiometry	R Apr 16	Project
14	M Apr 20	Electrodes and Potentiometry	T Apr 21	Project
	W Apr 22	Chromatography	R Apr 23	Fluoride ISE/ Ag Electrode (Rotation)
15	M Apr 27	Chromatography	T Apr 28	Fluoride ISE/ Ag Electrode (Rotation)
	W Apr 29	Chromatography	R Apr 30	<b>Check out</b>
FINALS	F May 8	<b>EXAM 3 (12:25-2:25 pm)</b>		

\*See Canvas for specific reading, homework, and laboratory assignments and due dates.

Week	Date (TR)	632 (Connor Protter)	633 (Michael Sivanich)	634 (Brandon Hacha)
1	21-Jan	<i>No Lab</i>	<i>No Lab</i>	<i>No Lab</i>
	23-Jan	Check-in/ Weighing Experiment	Check-in/ Weighing Experiment	Check-in/ Weighing Experiment
2	28-Jan	Glass Volumetric Apparatus	Glass Volumetric Apparatus	Glass Volumetric Apparatus
	30-Jan	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions
3	4-Feb	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions
	6-Feb	Determination of % KHP in a Mixture	Determination of % KHP in a Mixture	Determination of % KHP in a Mixture
4	11-Feb	Spectrophotometric Determination of Fe	Spectrophotometric Determination of Fe	Spectrophotometric Determination of Fe
	13-Feb	Project Day	Project Day	Project Day
5	18-Feb	Project Day	Project Day	Project Day
	20-Feb	Project Day	Project Day	Project Day
6	25-Feb	Project Day	Project Day	Project Day
	27-Feb	Project Day	Project Day	Project Day
7	3-Mar	High Pressure Liquid Chromatography	Spectrophotometric Study of Fluorescein	Chemical Oxygen Demand
	5-Mar	<b>No Lab – EXAM 1 (2:00-4:00 pm, room TBA)</b>		
8	10-Mar	Chemical Oxygen Demand	High Pressure Liquid Chromatography	Spectrophotometric Study of Fluorescein
	12-Mar	Spectrophotometric Study of Fluorescein	Chemical Oxygen Demand	High Pressure Liquid Chromatography
9	17-Mar 19-Mar	<b>SPRING BREAK</b>		
10	24-Mar	Adventure with Buffers	Adventures with Buffers	Adventure with Buffers
	26-Mar	ID of an Unknown Weak Acid	ID of an Unknown Weak Acid	ID of an Unknown Weak Acid
11	31-Mar	Study of Bromocresol Green	Study of Bromocresol Green	Study of Bromocresol Green
	2-Apr	Project Day	Project Day	Project Day
12	7-Apr	Project Day	Project Day	Project Day
	9-Apr	<b>No Lab – EXAM 2 (2:00-4:00 pm, room TBA)</b>		
13	14-Apr	Project Day	Project Day	Project Day
	16-Apr	Project Day	Project Day	Project Day
14	21-Apr	Project Day	Project Day	Project Day
	23-Apr	Silver Electrode Study of Equilibria	Fluoride Ion Electrode	Silver Electrode Study of Equilibria
15	28-Apr	Fluoride Ion Electrode	Silver Electrode Study of Equilibria	Fluoride Ion Electrode
	30-Apr	<i>Checkout</i>	<i>Checkout</i>	<i>Checkout</i>