



Chemistry 329: Fundamentals of Analytical Sciences

Semester and Year: Fall 2019

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
311	F 11:00-11:50 am	CHEM B383	611	MW 1:20-5:25 pm	MED SC CTR 5385
312	F 11:00-11:50 am	CHEM B379	612	MW 1:20-5:25 pm	MED SC CTR 5385
313	F 11:00-11:50 am	CHEM B387	613	MW 1:20-5:25 pm	MED SC CTR 5385
314	F 11:00-11:50 am	CHEM 2377	614	MW 1:20-5:25 pm	MED SC CTR 5385
315	F 11:00-11:50 am	CHEM 2381	615	MF 1:20-5:25 pm	MED SC CTR 5360

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 2126

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

Office Hours: Monday 8:30-10:30 am, Thursday 11:00 am-1:00 pm, and by appointment.

Laboratory Director: Dr. Pamela Doolittle

Office: 535 Service Memorial Institute (SMI)

Email/Preferred Contact: 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	Preferred Email
311/611	Yasmin Alvarez-Garcia	alvarezgarci@wisc.edu
312/612	Suraj Omolabake	omolabake@wisc.edu
313/613	Fengrui Wang	fwang82@wisc.edu
314/614	Eli Larson	ejarson2@wisc.edu
315/615	Jiabao Guo	jguo245@wisc.edu

TA Office Hours: See Learn@UW

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
11 Pre-lab Quizzes	66 points
10 Standard Laboratory Reports	140 points
Laboratory Project	155 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 analyzing phosphorus concentrations in lake water and investigating factors that influence its concentration. You will work in a small group of four or five students and have eleven laboratory periods to conduct your experiments. Your group will communicate your results in written progress reports and in a final report. More information regarding the project will be provided during the semester.

Standard Labs: 10 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 prelab.***

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 ten 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 at the end of the laboratory period.*** If you are unable to complete the lab report by 5:25 pm, consult with your TA, who will give you an extension allowing you to turn in your report at the start of the following laboratory period. 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) 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 – Fall 2019, Department

of Chemistry, UW- Madison. Lab manuals will be sold in Chemistry room 1375 beginning Tuesday, September 3. The cost for the manual is \$25. 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 818584.
- **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: Monday, October 14, 1:20-3:20 pm, room TBA

Exam 2: Monday, November 18, 1:20-3:20 pm, room TBA

Exam 3: Monday, December 16, 10:05 am-12:05 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/.

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	LAB
1	W Sep 4	The Analytical Process	WF: Check in/Weighing
2	M Sep 9	Chemical Measurements	M: Volumetric Apparatus
	W Sep 11	Experimental Error	WF: Standardization of HCl
3	M Sep 16	Statistics	M: Standardization of NaOH
	W Sep 18	Statistics	WF: Determination of % KHP in a Mixture
4	M Sep 23	Spectrophotometry	M: Spectrophotometric Det. of Fe
	W Sep 25	Quality Assurance	WF: Project Planning Part 1
5	M Sep 30	Calibration Methods	M: Project Part 1
	W Oct 2	Spectrophotometry	WF: Project Part 1
6	M Oct 7	Spectrophotometry	M: Project Part 1
	W Oct 9	Ionic Strength and Activity	WF: Project Part 1
7	M Oct 14	Solubility	M: EXAM 1 (1:20-3:20 PM, ROOM TBA)
	W Oct 16	Acid-Base Equilibria	WF: COD/ Fluorescein (Rotation)
8	M Oct 21	Acid-Base Equilibria	M: COD/ Fluorescein (Rotation)
	W Oct 23	Acid-Base Equilibria	WF: Adventures with Buffers
9	M Oct 28	Acid-Base Titrations	M: ID of Unknown Weak Acid
	W Oct 30	Acid-Base Titrations	WF: Bromocresol Green
10	M Nov 4	Systematic Treatment of Equilibria	M: Project Planning Part 2
	W Nov 6	Systematic Treatment of Equilibria	WF: Project Part 2
11	M Nov 11	EDTA Titrations	M: Project Part 2
	W Nov 13	EDTA Titrations	WF: Project Part 2
12	M Nov 18	Electrochemistry	M: EXAM 2 (1:20-3:20 PM, ROOM TBA)
	W Nov 20	Electrochemistry	WF: Project Part 2
13	M Nov 25	Electrodes and Potentiometry	M: Project Part 2
	W Nov 27	Electrodes and Potentiometry	WF: No Lab
14	M Dec 2	Chromatography	M: Fluoride ISE/ Ag Electrode (Rotation)
	W Dec 4	Chromatography	WF: Fluoride ISE/ Ag Electrode (Rotation)
15	M Dec 9	Chromatography	M: Check out
	W Dec 11	Finish up and review	WF: No Lab
FINALS	M Dec 16	EXAM 3 (10:05 AM-12:05 PM, ROOM TBA)	

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

CHEMISTRY 329

LABORATORY SCHEDULE

FALL 2019

Week	Date	611 (MSC 5385) Yasmin Alvarez-Garcia	612 (MSC 5385) Suraj Omolabake	613 (MSC 5385) Fengrui Wang	614 (MSC 5385) Eli Larson	615 (MSC 5360) Meets M & F Jiabao Guo
1	2-Sep	Labor Day (No Lab)				
	4-Sep	Check-in/Weighing	Check-in/Weighing	Check-in/Weighing	Check-in/Weighing	Check-in/Weighing
2	9-Sep	Volumetric Apparatus	Volumetric Apparatus	Volumetric Apparatus	Volumetric Apparatus	Volumetric Apparatus
	11-Sep	Standardization of HCl	Standardization of HCl	Standardization of HCl	Standardization of HCl	Standardization of HCl
3	16-Sep	Standardization of NaOH	Standardization of NaOH	Standardization of NaOH	Standardization of NaOH	Standardization of NaOH
	18-Sep	Determination of % KHP	Determination of % KHP	Determination of % KHP	Determination of % KHP	Determination of % KHP
4	23-Sep	Spectrophotometric Det. of Fe	Spectrophotometric Det. of Fe	Spectrophotometric Det. of Fe	Spectrophotometric Det. of Fe	Spectrophotometric Det. of Fe
	25-Sep	Project Introduction/Planning	Project Introduction/Planning	Project Introduction/Planning	Project Introduction/Planning	Project Introduction/Planning
5	30-Sep	Project Part 1	Project Part 1	Project Part 1	Project Part 1	Project Part 1
	2-Oct	Project Part 1	Project Part 1	Project Part 1	Project Part 1	Project Part 1
6	7-Oct	Project Part 1	Project Part 1	Project Part 1	Project Part 1	Project Part 1
	9-Oct	Project Part 1	Project Part 1	Project Part 1	Project Part 1	Project Part 1
7	14-Oct	Exam 1 (1:20-3:20 pm, Room: TBA)				
	16-Oct	Chemical Oxygen Demand	Study of Fluorescein	Chemical Oxygen Demand	Study of Fluorescein	Study of Fluorescein
8	21-Oct	Study of Fluorescein	Chemical Oxygen Demand	Study of Fluorescein	Chemical Oxygen Demand	Chemical Oxygen Demand
	23-Oct	Adventures with Buffers	Adventures with Buffers	Adventures with Buffers	Adventures with Buffers	Adventures with Buffers
9	28-Oct	ID of an Unknown Acid	ID of an Unknown Acid	ID of an Unknown Acid	ID of an Unknown Acid	ID of an Unknown Acid
	30-Oct	Study of Bromocresol Green	Study of Bromocresol Green	Study of Bromocresol Green	Study of Bromocresol Green	Study of Bromocresol Green
10	4-Nov	Project Planning Part 2	Project Planning Part 2	Project Planning Part 2	Project Planning Part 2	Project Planning Part 2
	6-Nov	Project Part 2	Project Part 2	Project Part 2	Project Part 2	Project Part 2
11	11-Nov	Project Part 2	Project Part 2	Project Part 2	Project Part 2	Project Part 2
	13-Nov	Project Part 2	Project Part 2	Project Part 2	Project Part 2	Project Part 2
12	18-Nov	Exam 2 (1:20-3:20 pm, Room: TBA)				
	20-Nov	Project Part 2	Project Part 2	Project Part 2	Project Part 2	Project Part 2
13	25-Nov	Project Part 2	Project Part 2	Project Part 2	Project Part 2	Project Part 2
	27-Nov	Happy Thanksgiving (No Lab)				
14	2-Dec	Fluoride ISE	Ag Electrode Study	Fluoride ISE	Ag Electrode Study	Ag Electrode Study
	4-Dec	Ag Electrode	Fluoride ISE	Ag Electrode Study	Fluoride ISE	Fluoride ISE
15	9-Dec	Check out	Check out	Check out	Check out	Check out
	11-Dec	No Lab				