



Chemistry 758 – Chemistry Education Research Fall 2024

Instructor: Professor Ryan Stowe

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Office: CHEM B221

Instructor Availability: by appointment

Course Website: <https://canvas.wisc.edu/courses/323166>

Credits: 2

Meeting Time and Location: TR 9:55-10:45am; Room CHEM 5431

Instructional Mode: Face-to-face

How Credit Hours are Met: The credit standard for this course is met by an expectation of a total of 90 hours of student engagement with course learning activities (at least 45 hours per credit). This includes 27 50-minute class periods throughout the fall semester and carries the expectation that students will work on course activities (reading, writing, studying, etc.) for about 2-3 hours out of the classroom for every class period. The syllabus includes additional information about meeting times and expectations for student work.

OFFICIAL COURSE INFORMATION

Course Description: An introduction to chemistry education research focused on the goals of chemistry learning and how (or whether) these goals are instantiated in formal chemistry courses. Readings will span policy documents that articulate national STEM education needs, research articles describing ways of improving chemistry learning, and accounts of how communities use science to take action against environmental injustice. This course will challenge conventional wisdom that chemistry learning makes one a better thinker, profits national competitiveness, and equips communities to better tackle daily life challenges. As these goals are explored, a more complicated and uncertain picture of chemistry-in-school will emerge. Working through these nuances will enable frank appraisal of the chemistry education we have and conceptualization of more useful and equitable approaches to chemistry learning. No prior experience with coursework in the learning sciences is assumed. Appropriate for students engaged in discipline-based education research as part of a graduate degree, those interested in pursuing academic careers, and those broadly interested in scholarship related to teaching and learning.

Course Requisites: Graduate/professional standing

Course Options: 50% Graduate Coursework Requirement

Course Learning Outcomes:

- Identify and critique common claims about the importance and value of learning chemistry
- Describe and critique different ways in which researchers have attempted to evaluate “improvement” in chemistry learning
- Describe and discuss ways in which communities or individuals reason with and about chemistry in a concrete setting

REPRESENTATIVE LIST OF TOPICS

Week 1 – Why should students learn chemistry?
Week 2 – Chemistry for better thinking
Week 3 – Chemistry for national prosperity
Week 4 – Chemistry for civic engagement
Week 5 – The chemistry classes we have
Week 6 – How we assess learning
Week 7 – How we think about “improvement”
Week 8 – Who defines “better thinking” and who should?
Week 9 – Should we be training more chemists?
Week 10 – How do people reason about chemistry in daily life?
Week 11 – A case for attending to epistemology
Week 12 – How has (and should) chemistry education approached equity and justice?
Week 13 – Case study: chemistry for social justice
Week 14 – Class chosen topic

Weeks 15 will be dedicated to student presentations. The topic for Week 14 will be chosen by the class. Possible topics include: chemistry learning in informal environments, critical counterstories in undergraduate STEM, science learning in prisons, etc.

REPRESENTATIVE ASSIGNMENTS LIST (distributed over the semester)

Preparation for and participation in class discussions. Each week we will discuss readings that address various aspects of science education research. Students are expected to come to class prepared and ready to participate actively in class discussions, having carefully and critically read the assigned text(s).

Reflective reading journal. Students will be expected to write weekly written reflections on the assigned readings, which will be periodically reviewed (once every three weeks). Most weeks, you will use a general template for reflections (described below). Some reading assignments will also have more specific guiding questions to reflect on in your journal.

Lead discussant. Students will be asked to facilitate a discussion related to one of the course readings/topics during the latter half of the semester. Core readings will be provided by Ryan, but students are encouraged to identify supplementary materials and develop strategies for actively engaging the whole class.

Self-Study. When making claims about ways in which chemistry learning can be helpful in daily life, it is often useful to reflect on how and why employ molecular-level reasoning while

navigating the world. This assignment requires you to explore an aspect of out-of-school your life that brings you into contact with chemistry. By “out-of-school” I mean “not related to your work as a graduate student”.

Critical evaluation of research. As will become apparent as the semester unfolds, stated goals for chemistry education do not always align with our approaches to designing and assessing chemistry learning. For this assignment, you will assess alignment between the goals, methods and implications of a federally-funded project related to chemistry learning.

GRADING

Your final grade for the course will be determined using the following scale, with the meaning of each grade paraphrased below:

A (92-100%): Excellent performance shown consistently in all aspects of the course

AB (88-91%): Good performance with high achievement in most of the course

B (82-87%): Adequate performance reflecting a basic understanding of the material

BC (78-81%): Adequate performance with some deficiencies

C (70-77%): Minimal performance with serious deficiencies

D (60-69%): Unsatisfactory performance

F (<60%): Very unsatisfactory performance

The success of this course will depend upon our shared responsibility to develop an active and respectful intellectual exchange. While attendance is required, it is only the first step toward meaningful participation. You are expected to come to class fully prepared to engage in lively, pointed, and collegial discussion and analysis of the week's assigned reading.

If you miss a class, you are required to respond to two of your peer's written reflections for that class, in addition to contributing your own written reflection. To the extent possible, please notify me of your absence *in advance* via email. As a rule, you should also email me to check in following an absence.

Grades will be based on in-class participation (15%) and performance on assignments (85%). The percent contribution of each assignment to your overall grade is listed below:

10% - Serving as lead discussant

10% - Reflective reading journal

30% - Self-study

35% - Critical evaluation of research

Participation Grade Guidelines

A: This student never misses class, always completes assigned readings, and comes to class prepared to think carefully, making connections between readings and across topics. He or she is willing to take the lead in discussion periodically, posing interesting questions or taking risks by answering tough questions. He or she avoids dominating discussion, instead participating mindfully in discussion with other students, considering their ideas and responding thoughtfully and respectfully. He or she helps to create a sense of a shared conversation in the group as a

whole. This student shows passion for the work of the class and is committed fully to our work while in the classroom.

AB: This student does most of what an A student does, but may be slightly deficient in one area – for instance, he or she may be a conscientious reader and thinker who tends not to listen to other students or otherwise dominates conversation instead of engaging in productive deliberation. Or, he or she may have been late to class a few times, or may have missed a reading or two.

B: This student participates often, but not consistently. He or she may attend every class and do all the readings but avoids taking the lead in discussion, instead only responding to questions or adding periodically to others' ideas. This student may participate well, **but may have missed a class and failed to submit the makeup assignment.**

BC: This student may be a frequent but superficial discussion participant. The student may let shyness keep him or her from participating as fully as he or she should. At times the student may seem not to have done the readings, though he or she usually comes prepared.

C: This student is intermittently prepared for class (**e.g., participates well but has missed two classes without submitting a makeup assignment**). He or she may have flashes of brilliance, but rarely participates beyond the occasional superficial comment.

D: This student very rarely participates, and only in superficial ways.

F: This student **has missed three classes without submitting a makeup assignment** and/or attends most classes but never participates.

Details regarding each assignment in CHEM 758 can be found below:

Reading Reflections

After completing each reading assignment, write brief responses (*i.e.*, 2-3 sentences) in response to 2 of the following 3 questions:

1. What are the main points of this collection of readings?
2. What information in this reading did you find surprising or new? Why?
3. What portions of the reading did you find confusing? Why?

Reading reflections should be added to the appropriate Discussion thread on Canvas (*i.e.*, Week 2 Reading Reflection should contain question responses linked to week 2 readings). **Reading reflections are due at 9am each Tuesday. We will begin reflecting on readings during week 2 (first reflection due on 9/10/24).**

Why reading reflections?

To help us reflect more deeply on readings in this course, we will use reading reflections. These reading reflections are designed to help the reader engage with the material in a deeper way, and to construct new meaning from it. The reflections also have the advantage of providing me as the instructor with detailed information about your learning in the course. This not only helps

guide my preparation of course activities, but also helps connect us as a community of learners. Your response need not be long, but must clearly indicate careful reading and thoughtful reflection. Please respond to at least two of the three main questions listed above.

Rubric for Evaluation

10 points Responses to both questions are labeled and clearly indicate careful reading and deep reflection. Responses submitted on time.

5 points Responses are not specific, do not clearly indicate reflection in some instances, or are late.

0 points No response

Self-Study (300 points total)

For this assignment, you will first need to articulate an issue you encounter in your daily life for which thinking about molecules has been useful. You will then connect with a non-chemist in your network to ascertain how they might reason about similar issues. Finally, you will write a 3-4 page paper in which you unpack ways in which reasoning at the molecular level was helpful (or not) in understanding and possibly doing something about whatever issue you chose. Pieces of this assignment will be due throughout the semester. Due dates are as follows:

9/19/24 – (50 pts) Brief description of the issue you approach by reasoning with molecules.

10/1/24 – (100 pts) 1-2 pages describing how someone else in your network reasoned about similar issues. Pay especial attention to the extent to which molecular-level reasoning was employed by your interviewee and how their approach differed from yours.

10/15/24 – (150 pts) Final 3–4-page paper due; this should incorporate what you wrote for the first two parts of this assignment.

Critical evaluation of research (350 pts total)

For this assignment, you will assess alignment between the goals, methods and implications of a federally-funded project related to chemistry learning. There will be five parts to this project, listed with corresponding due dates below:

10/29/24 – (20 pts) Brief description of the project you will evaluate (found via [NSF Award Search](#))

11/5/24 – (40 pts) 1-2 pages describing project assumptions about the value and importance of chemistry learning and how these connect to project activities and implications

12/3/24 – (80 pts) Draft of 4-5 page paper critiquing alignment between goals, project activities, and the implications of these activities. Feedback will be provided within one week.

12/5/24 or 12/10/24 – (100 pts) ~15 minute presentation detailing your critical evaluation of research

12/18/24 – (110 pts) Final 4-5 page paper due

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

McBurney Disability Resource Center syllabus statement: “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 faculty [me] 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. Faculty [I], will work either directly with the student [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.” ([Windschitl, 2002](#))

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/>