

CHEM 4930/5880

Learning Theories in Chemistry Education

University of North Texas, Department of Chemistry

Spring 2022



COURSE INFORMATION

Course Description

This course serves as an introduction to the field of Chemistry Education Research (CER) as an essential guiding source for the scholarship of teaching and learning chemistry, as well as an introduction to the learning theories that inform CER. Students will read and discuss literature on how current research findings regarding how people learn chemistry can be applied to improve both chemistry instruction and the learning of chemistry. Students will also explore how theories of cognition can inform learning objectives and assessments in chemistry learning environments. This course is appropriate for students currently engaged in discipline-based education research as part of an undergraduate or graduate degree, those interested in pursuing academic careers at the secondary and postsecondary levels, and those broadly interested in scholarship related to teaching and learning in the sciences. The prerequisite for this course is completion of CHEM 2380, Undergraduate Organic Chemistry II. An interest in science/chemistry education is also encouraged prior to enrollment.

Course Meeting Time and Location

Time: Wednesday 1:00 – 3:50pm

Location: CHEM 105

Instructor Information

Dr. Molly Atkinson

Office Location: CHEM 265

Email: Molly.Atkinson@unt.edu

Phone Number: 940-565-3550

Office Hours (Drop-In Hours): Wednesdays from 11:30am – 12:30pm in CHEM 265. Come with specific questions about the course, problems, or whatever you might need. You do *not* need to make an appointment to come to office hours.

Communicating with your Instructor

My preferred method of contact is through email, which you can also access through Canvas. Consider posting any questions you may have to the Q&A Discussion Board on Canvas. Generally, if you have the question, someone else will as well. I also routinely communicate with the class as a whole through announcements in Canvas; be sure to set up your Canvas page so that you receive push notifications. Any assignments that require grading will be completed within 2 weeks of the submission date. If there are any delays to this, an announcement will be posted to Canvas.

Course Materials (Textbook and Other Resources)

No textbook will be required for this course. All necessary readings will be accessible via PDF download from Canvas.

Course Objectives

By the end of this course, students will be able to:

- Identify how chemistry education research methods and findings are related to underlying theories of learning, based on discussions and critiques of chemistry science education literature
- Identify how learning theories can be applied to the instructional materials (laboratory experiments, demonstrations, classroom activities, etc.) of a science/chemistry course
- Generate a portfolio containing developed instructional materials (laboratory experiments, demonstrations, classroom activities, etc.) within one science/chemistry course that exemplifies the learning theories covered in the course

Course Requirements and Calendar

Date	Module in Canvas	Content Focus	Discussion Leaders
Jan 19	Week 1	Introduction to the Course: Theoretical Frameworks and How Students Learn	Dr. Atkinson
Jan 26	Week 2	Constructivism and Piaget	Dr. Atkinson
Feb 2	Week 3	The Neuroscience of Learning	
Feb 9	Week 4	The Information Processing Model and Cognitive Load Theory	
Feb 16	Week 5	Representational Competence	
Feb 23	Week 6	Meaningful Learning	
Mar 2	Week 7	Misconceptions / Alternative Conceptions and the Resources Framework	Dr. Atkinson
Mar 9	Week 8	Midterm: Portfolio Presentations and Portfolio Draft Due	
Mar 16		No Class: Spring Break	
Mar 23		No Class: ACS Spring 2022 National Conference	
Mar 30	Week 9	Critical Theory	
Apr 6	Week 10	Metacognition	
Apr 13	Week 11	Perry's Scheme of Cognitive Development	
Apr 20	Week 12	Growth Mindset	
Apr 27	Week 13	Self Theories	Dr. Atkinson
May 4	Week 14	Portfolio Presentations and Final Portfolio Due	

COURSE GRADING

This course will be graded on the following scale:

- A (90-100% possible points)
- B (80-89% possible points)
- C (70-79% possible points)
- D (60-69% possible points)
- F (59% or lower possible points)

Assessments (See Course Assignment Descriptions Below for Details)

- 10% – Reading Assignments and Participation in Discussions
- 10% – Reading Reflections
- 20% – Serving as a Discussion Leader
- 30% – Portfolio (15% midterm, 15% final)
- 30% – Portfolio Presentations (15% midterm, 15% final)

Course Assignments

- **Reading Assignments and Participation in Discussions (100 points)**
 - **Reading Assignments:** Each week we will meet to discuss research publications from the science/chemistry education literature focused on theories of how people learn chemistry and the application of that research to improve both chemistry instruction and the learning of chemistry. Reading assignments for each week are posted in Canvas. Students should come to class fully prepared, having very carefully and critically read and reflected upon the assigned readings.
 - **Participation in Discussions:** You should be actively participating in the discussion and analysis of the assigned readings each week during class. This will be evaluated by the contributions during class in the form of questions/comments related to the reading assignments. Below are some questions that you might consider while you are reading and reflecting upon the reading assignments; while you do not need to *formally* respond to these questions, I encourage you to use them to reflect and prepare for discussion of the literature during class. This list is not exhaustive, and every question may not apply to every reading assignment in the course.
 - *How does this reading discuss the process of learning chemistry/science?*
 - *In the context of this reading, how does learning occur?*
 - *Who is impacted when learning does not happen, and how?*
 - *In the context of this reading, what do we expect students to know about chemistry/science, and why?*
 - *Reflect on your own experiences learning chemistry/science. What similarities/differences do you see reflected in this reading related to your own experiences of learning?*
 - *What are the noted strengths and weaknesses of this research? Are there limitations (both implicit and explicit)?*
 - *How does this reading translate evidence-based research into instructional practice in the chemistry/science classroom?*
- **Reading Reflections (100 points)**

Submitted through Canvas by the beginning of each class period

 - After completing each reading assignment, briefly write your thoughts (i.e., 2-3 sentences for each question, 4-6 sentences total) in response to 2 of the following 3 questions:
 1. *What are the main points of these readings?*
 2. *What information in this reading did you find surprising or new, and why?*
 3. *Were there any portions of the readings that you confusing? If so, why?*
 - Why Reading Reflections? These reflections are designed to help you engage more deeply with (and construct new meaning from) the material for this course. The reflections also provide me with detailed information about your own learning in this course, and that helps to guide my preparation for the course and helps us connect as a community of learners.
 - Rubric for Evaluation of Submitted Reading Reflections:
 - 10 points Responses to questions are submitted on time, are labeled, and clearly indicate careful reading and deep reflection.
 - 5 points Responses are not specific, do not clearly indicate reflection in some instances, and/or are late.
 - 0 points No response.

- **Serving as a Discussion Leader (200 points)**
 - Students in this course will lead several discussions of their assigned Learning Theories during the semester. Students will be grouped into teams (with the size of those teams depending upon the overall size of the class) as Discussion Leaders for their assigned Learning Theories. All students will be assigned their respective Learning Theories and dates by Dr. Atkinson in class on Wednesday, January 19th.
 - As a Discussion Leader, you will be expected to present a summary of, and personal thoughts/ideas related to, the reading(s) assigned for that particular Learning Theory. To promote discussion and engagement in the class with other students, you should present the content in an interesting way (without simply repeating facts from the reading(s)). Your presentation should include classroom activities that embody the Learning Theory, discussion questions, and information drawn from additional sources in the research literature to provide your classmates with suggested readings that they might use when developing their Portfolio (see below).
 - You may not have encountered a course that required you to instruct other students in this manner. Thus, Discussion Leaders should meet as a team with Dr. Atkinson at least one week before their presentation to present a detailed plan of their proposed class activities.
 - You will also complete a Self-Evaluation Form after you complete each class session as a Discussion Leader, including your thoughts related to areas you might improve when delivering content in the classroom. This Self-Evaluation Form is available in Canvas and will be due the day following class at 11am CST, submitted to Dr. Atkinson via Canvas.
 - The grading rubric for this portion is included on Canvas.

- **Portfolio (300 points)**
 - As part of this course, you will develop a portfolio of chemistry activities that exemplify the Learning Theories covered and can be used as classroom teaching materials. This portfolio should be geared towards a particular course, such as: general chemistry, organic chemistry, analytical chemistry, instrumental analysis, physical chemistry, biochemistry, etc. You may modify existing activities or create novel activities that align with the theories covered in this course.
 - CHEM 4930 (undergraduate student) portfolios should consist of 5 activities/lessons; 2 of these activities/lessons are due at Midterm (Portfolio Draft).
 - CHEM 5880 (graduate student) portfolios should consist of 8 activities/lessons; 4 of these activities/lessons are due at Midterm (Portfolio Draft).
 - Final Portfolios are due to Dr. Atkinson on the last day of class, as indicated in the course calendar above. Portfolios (Both the Draft at Midterm and Final Portfolio) should be presented in a neat and orderly way using a 3-ring binder.
 - While you are encouraged to discuss the course content with your classmates, *you are expected to submit your own individual portfolio*. You should not give help to or receive help from other students in any form when compiling activities for your portfolio.
 - Details related to the content and assessment of these portfolios can be found on Canvas.

- **Portfolio Presentations (300 points)**
 - Midterm Presentations: In addition to submitting a Portfolio Draft (with 2 activities for undergraduate students and 4 activities for graduate students), you will share one of the activities from your portfolio during the Midterm Presentation indicated in the course schedule.
 - Final Presentations: In addition to submitting your Final Portfolio (with 5 activities for undergraduate students and 8 activities for graduate students), you will share one of the

- activities from your portfolio (different from the activity shared at Midterm) during the final class in the semester, indicated in the course calendar above.
- Details related to the content and assessment of these portfolio presentations can be found on Canvas.

Course Evaluation

Student Perceptions of Teaching (SPOT) is the student evaluation system for UNT and allows students the ability to confidentially provide constructive feedback to their instructor and department to improve the quality of student experiences in the course. **The SPOT evaluations will be available April 18 – May 5, 2022.**

This course has been adapted from Bretz, S. L., Miami University CHM 411/511 – Learning Theories in Chemistry. I thank Dr. Bretz for her insight on best practices for teaching and structuring a course focused on theories of how people learn chemistry.

COURSE POLICIES

Diversity and Inclusion

I expect every person in my classroom to contribute to an inclusive and respectful environment. Dimensions of diversity include sex, race/ethnicity, age, gender identity, sexual orientation, income, socio-economic status, political ideology, and primary language. Intersections of these dimensions must be valued in our classrooms, and my goal is to help you be successful in a classroom where everyone feels safe, respected, and welcome.

Face Coverings

UNT encourages everyone to wear a face covering when indoors (regardless of vaccination status) to protect yourself and others from COVID infection, as recommended by current CDC guidelines. Face covering guidelines could change based on community health conditions.

Assignment Policy

The due dates for all assignments can be seen through the Syllabus tab in Canvas. If due dates are changed, the class will be notified in class and through an announcement in Canvas.

Assessment Policy

You are encouraged to discuss chemistry and learning with your classmates in class. You must work together with your classmates as Discussion Leaders. *However*, each individual student is expected to submit their *own individual work* on all portfolio entries, portfolio presentations, and reading reflections, neither giving nor receiving help in any form. Course materials provided to you, including presentations, handouts, publications, etc. are copyright protected. Any document that you use/present must include the full reference information for that material (authors, title of publication/journal/book, year, volume, page numbers). When you adapt/modify published materials for use in this course, you still must include the full reference information. The dates of all assessment due dates are posted in Canvas. Please make note of them and plan accordingly. Make-ups will only be made in the event of documented university-excused absences. The instructor must be notified within 48 hours of the missed assignment and provided documentation. Prior notice, if possible, is best.

Instructor Responsibilities and Feedback

I will do my best to present the material in this class to you in a way that helps you understand, and I will do my best to help you be successful in this course. I will be available to you for questions, I will provide timely feedback on your work, and I will make sure that this course is an open, safe, and inviting place to learn about the theories that underpin student learning of chemistry. Feedback on performance can be

provided at any time through my office hours, or a scheduled appointment outside of posted office hours. All grades will be uploaded to Canvas within 2 weeks of the due date.

Late Work

Late work will not be accepted in this course, with the exception of documented university-excused absences. The instructor must be notified within 48 hours of the missed assignment and provided documentation. Prior notice, if possible, is best.

Attendance Policy

Attendance for the weekly class session is required. In order to assist with contact tracing, an assigned seating chart will be followed throughout the semester. Students are expected to attend class meetings regularly and to abide by the attendance policy established for the course. It is important that you communicate with the instructor prior to being absent, so that we can discuss and mitigate the impact of the absence on your attainment of course learning goals. Please inform the instructor if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community. If you are experiencing any symptoms of COVID-19 (<https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Team at COVID@unt.edu for guidance on actions to take due to symptoms of COVID-19, pending/positive COVID-19 test results, or potential exposure to COVID-19.

Classroom Behavior

Classes will begin/end as noted at the beginning of the syllabus; if you are late to class or anticipate having to leave early, please sit as close to the door as possible to minimize the disruption to the rest of the class. Disruptive behavior (such as talking, giggling, snoring, talking on a cell phone, playing on the Internet, or texting, etc.) will not be tolerated. Cell phones should be silenced during class. A student engaged in disruptive behavior can be asked to leave class immediately and can be suspended from class for a period of up to a week for the first offense, and longer if the behavior persists.

Checking Canvas and Email

Regarding dissemination of information, I exclusively use Canvas to email the entire class with reminders of deadlines, changes to classroom policies, etc. In addition, I post materials and grades on Canvas. Please make it a habit to check Canvas (and your email) at least twice a week. I will not respond to email received from non-UNT email address, especially concerning grade information. With a personal email address, I cannot be certain that it is you on the other end. As such, please use your official UNT email address to email me.

Syllabus Change Policy

In the event that any aspect of this course changes, the updated syllabus will be posted in Canvas. In addition, an announcement will be posted on Canvas and made verbally during the weekly class meeting.

UNT POLICIES

Academic Integrity Standards and Consequences

According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. Students in this course caught cheating or plagiarizing will receive a "0" for that particular assignment or exam. Additionally, the incident will be reported to the Dean of Students, who may impose further penalty. According to the UNT catalog, the term "cheating" includes, but is not limited to: a. use of any unauthorized assistance in taking quizzes, tests, or examinations; b. dependence upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; c. the acquisition, without permission, of tests or other academic material belonging to a faculty or staff member of the university; d. dual submission of a paper or project, or resubmission of a paper or project to a different class without express permission from the instructor(s); or e. any other act designed to give a student an unfair advantage. The term "plagiarism" includes but is not limited to: the knowing or negligent use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgment; and the knowing or negligent unacknowledged use of materials prepared by another person or agency engaged in selling of term papers or other academic materials.

ADA Accommodation Statement

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time, however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the Office of Disability Access website at <http://www.unt.edu/oda>. You may also contact ODA by phone at (940) 565-4323.

Emergency Notification & Procedures

UNT uses a system called Eagle Alert to quickly notify you with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). The system sends voice messages (and text messages upon permission) to the phones of all active faculty staff, and students. Please make certain to update your phone numbers at <http://www.my.unt.edu>. Some helpful emergency preparedness actions include: 1) know the evacuation routes and severe weather shelter areas in the buildings where your classes are held, 2) determine how you will contact family and friends if phones are temporarily unavailable, and 3) identify where you will go if you need to evacuate the Denton area suddenly. In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.

Retention of Student Records

Student records pertaining to this course are maintained in a secure location by the instructor of record. All records such as exams, answer sheets (with keys), and written papers submitted during the duration of the course are kept for at least one calendar year after course completion. Course work completed via Canvas, including grading information and comments, is also stored in a safe electronic environment for one year. Students have the right to view their individual record; however, information about student's records will not be divulged to other individuals without proper written consent. Students are encouraged to review the Public Information Policy and the Family Educational Rights and Privacy Act (FERPA) laws and the University's policy. See UNT Policy 10.10, Records Management and Retention for additional information.

Acceptable Student Behavior

Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic class, labs, discussion groups, field trips, etc. Visit UNT's Code of Student Conduct (<https://deanofstudents.unt.edu/conduct>) for more.

Access to Information – Eagle Connect

Students' access point for business and academic services at UNT is located at: my.unt.edu. All official communication from the University will be delivered to a student's Eagle Connect account. For more information, please visit the website that explains Eagle Connect and how to forward e-mail Eagle Connect (<https://it.unt.edu/eagleconnect>).

Student Evaluation Administration Dates

Student feedback is important and an essential part of participation in this course. The student evaluation of instruction is a requirement for all organized classes at UNT. The survey will be made available during weeks 13, 14 and 15 of the long semesters to provide students with an opportunity to evaluate how this course is taught. Students will receive an email from "UNT SPOT Course Evaluations via IASystem Notification" (no-reply@iasystem.org) with the survey link. For more info, please visit the SPOT website (<http://spot.unt.edu/>) or email spot@unt.edu.

Survivor Advocacy

UNT is committed to providing a safe learning environment free of all forms of sexual misconduct, including sexual harassment sexual assault, domestic violence, dating violence, and stalking. Federal laws (Title IX and the Violence Against Women Act) and UNT policies prohibit discrimination on the basis of sex, and therefore prohibit sexual misconduct. If you or someone you know is experiencing sexual harassment, relationship violence, stalking, and/or sexual assault, there are campus resources available to provide support and assistance. UNT's Survivor Advocates can assist a student who has been impacted by violence by filing protective orders, completing crime victim's compensation applications, contacting professors for absences related to an assault, working with housing to facilitate a room change where appropriate, and connecting students to other resources available both on and off campus. The Survivor Advocates can be reached at SurvivorAdvocate@unt.edu or by calling the Dean of Students Office at (940)-565-2648. Additionally, alleged sexual misconduct can be non-confidentially reported to the Title IX Coordinator at oeo@unt.edu or at (940)-565-2759.