CHEM 4930/5880
Learning Theories in Chemistry Education

University of North Texas, Department of Chemistry
Spring 2026

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: LANG 223

Instructor Information
Dr. Molly Atkinson
Office Location: CHEM 265
Email: Molly.Atkinson@unt.edu
Office Hours (Drop-In Hours): Mondays from 1:00–2:00pm 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 for this course is through email, which you can also access through Canvas. I also routinely communicate with the class through announcements in Canvas; be sure to set up your Canvas page so that you receive push notifications. Any assignments that require grading will aim to be completed within two weeks of the submission date. If there are any delays to this, I will do my best to keep the class updated.

Course Materials (Textbook and Other Resources)
No textbook will be required for this course. All necessary readings will be accessible via PDF.

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 14	Week 1	Introduction to the Course, How Students Learn	Dr. Atkinson
Jan 21	Week 2	Using Theory and Frameworks	Dr. Atkinson
Jan 28	Week 3	Constructivism	Dr. Atkinson
Feb 4	Week 4	Information Processing Model, Cognitive Load Theory	Dr. Atkinson
Feb 11	Week 5	Meaningful Learning, Misconceptions, Cognitive Resources	Dr. Atkinson
Feb 18	Week 6	Representational Competence	Group 1
Feb 25	Week 7	Pedagogical Content Knowledge	Group 2
Mar 4	Week 8	**Midterm: Portfolio Presentations and Portfolio Draft Due**	**ALL**
Mar 11		**No Class: Spring Break**	
Mar 18	Week 9	Self-Theories, Metacognition	Dr. Atkinson
Mar 25		**No Class: ACS Spring 2026 National Conference**	
Apr 1	Week 10	Communities of Practice	Dr. Atkinson
Apr 8	Week 11	Phenomenology, Phenomenography	Group 1
Apr 15	Week 12	Critical Theory	Group 2
Apr 22	Week 13	Theory of Change, Change Theory	Dr. Atkinson
Apr 29	Week 14	**Portfolio Presentations and Final Portfolio Due**	**ALL**

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 Perusall Submissions
- 10% – Participation in Class Discussions
- 20% – Serving as a Discussion Leader
- 30% – Portfolio (15% midterm, 15% final)
- 30% – Portfolio Presentations (15% midterm, 15% final)

Course Assignments

- **<u>Reading Assignments and Persuall Submissions</u> (10%)**

  Reading Assignments:

  Each week we will meet to discuss research publications from 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. You will use the Perusall application (on the left tab in Canvas) to read and annotate these readings as a class. Students should come to class fully prepared, having very carefully and critically read and reflected upon the assigned readings.

  Perusall Submissions:

  - After completing each reading assignment, each student should annotate each individual paper assigned with at least 5 substantive comments, using the Persuall application.
  - Why Persuall? This portion of the course is designed to help you engage more deeply with (and construct new meaning from) the material for this course. This also provides 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 Comments, Per Paper:
    - 10 points Comments are submitted on time, are labeled, and clearly indicate careful reading and deep reflection.
    - 5 points Comments are not specific, and/or do not clearly indicate reflection in some instances.
    - 0 points Does not reach the minimum of 5 substantive comments.
  - In addition, I encourage you to individually reflect on the following questions, so that you can be prepared to come to class and discuss each paper:
    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?*

- **<u>Participation in Class Discussions</u> (10%)**

  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 <u>not</u> 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?*

- **Serving as a Discussion Leader (20%)**
    - 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 the first day of class this semester.
    - As a Discussion Leader, you will be expected to present a summary of 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 engaging 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 when possible with Dr. Atkinson at least one week before their presentation to present a detailed plan of their proposed class activities. If you are not able to meet as a team, one person should be assigned to have this discussion with Dr. A.
    - 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 (30%)**
    - 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. Each activity in your 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 4 activities/lessons; 2 of these activities/lessons are due at Midterm (Portfolio Draft).
    - CHEM 5880 (graduate student) portfolios should consist of 6 activities/lessons; 3 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 via PDF.
    - 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 (or generative AI) 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 (30%)**
    - Midterm Presentations: In addition to submitting a Portfolio Draft (with 2 activities for undergraduate students and 3 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 4 activities for undergraduate students and 6 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.

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

First and foremost, I expect every person in my classroom to contribute to an inclusive and respectful environment. Intersections of identity 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.

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. *However*, each individual student is expected to submit their *own individual work* on all assessments and assignments, neither giving nor receiving help in any form. This includes the use of generative AI, which is prohibited unless explicitly instructed to use generative AI by Dr. Atkinson. Use of generative AI in any form will result in a grade of zero for that assignment. Continued use of generative AI on subsequent assignments may result in further disciplinary action. 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. All assignment 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 the 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 two 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. 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.

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. No headphones, earpods, earbuds, Airpods, etc. (bluetooth and/or wired) are allowed while in class, unless you have an approved accommodation to have them. If this is the case, please see the Office of Disability Access (ODA) to ensure that the appropriate paperwork has been filed. https://studentaffairs.unt.edu/office-disability-access. (It is literally my job to teach you. Please, please, please communicate your needs to ODA and myself so I can do this effectively!) Additionally, you should NOT be on TikTok, BeReal, Snapchat, YouTube, Instagram, Facebook, or any other social media platform while in class. Finally, taking photographs, video recordings, or audio recordings of me and/or materials without my explicit permission is NOT allowed.

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 DISHONESTY Students 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: a. 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 b. the knowing or negligent unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.

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 classroom, labs, discussion groups, field trips, etc. The Code of Student Conduct can be found at http://deanofstudents.unt.edu.

ADA STATEMENT The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with an accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request accommodations at any time, however, ODA notices of 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 accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the Office of Disability Accommodation website at http://disability.unt.edu. You may also contact them 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 the Canvas online system, including grading information and comments, is also stored in a safe electronic environment for one year. You have a right to view your individual record; however, information about your records will not be divulged to other individuals without the proper written consent. You are encouraged to review the Public Information Policy and the Family Educational Rights and Privacy Act (FERPA) laws and the university's policy in accordance with those mandates at the following link: http://essc.unt.edu/registrar/ferpa.html

STUDENT PERCEPTION OF TEACHING (SPOT) Student feedback is important and an essential part of participation in this course. The Student Perception of Teaching (SPOT) is a requirement for all classes at UNT. This short survey will be made available at the end of the semester to provide you with an opportunity to evaluate how this course is taught.

SUCCEED AT UNT UNT endeavors to offer you a high-quality education and to provide a supportive environment to help you learn and grown. And, as a faculty member, I am committed to helping you be successful as a student. Here's how to succeed at UNT: Show up. Find Support. Get advised. Be prepared. Get involved. Stay focused. To learn more about campus resources and information on how you can achieve success, go to http://success.unt.edu.