CHM 461/561: Understanding the Complexities of Chemistry and STEM Learning

Spring 2025

Course Syllabus

This course serves as an introduction to the Discipline-Based Education Research discipline as an essential guiding source for the scholarship of teaching and learning in chemistry, as well as an introduction to frameworks that inform chemistry and science education research. Students will read and discuss chemistry/science education literature about how people learn chemistry/science and consider how to apply the constructs to support chemistry/science teaching and learning.

The prerequisite for this course are:

- CHM 461 (undergraduate students) - completion of CHM 228 Organic Chemistry Lecture II, CHM 292 Organic Chemistry, or equivalent, or permission from instructor.

- CHM 561 (graduate students) – graduate student in the Department of Chemistry or permission from instructor.

Course Information

Instructor: Dr. Justin M. Pratt
Beaupre Center 425F
justin.pratt@uri.edu

Student Support Sessions (office hours): By appointment. Students can schedule meetings/chats using this link
Groups will meet with Dr. Pratt at least once before leading a class discussion. Coordinating with group members prior to using the scheduling link is recommended. Students can also reach out via email

What are Student Support Sessions?
Some professors call these "office hours" meaning these are times professors are in their offices ready to help students. I call these Student Support Sessions as I feel the name is more descriptive – these are times I have set aside purposefully to support you in your chemistry & academic experiences. Please come to my office for support!

What happens in Student Support Sessions?
This is up to you! We can chat & get to know each other. We can discuss course material and help you. We can talk about school, life, future plans, etc. These sessions are entirely up to you and your needs. If the scheduled times don't work for you, please consider scheduling individual chats using this link. Remember, I am here to support you.

Learning Outcomes:
CHM 461 (undergraduate students): By the end of this course, students will be able to:

1. Identify & describe how chemistry education research methods and findings are related to underlying theories of learning through discussions and critiques of chemistry/science education literature.
2. Identify & describe how chemistry/science classroom experiences (e.g., laboratory experiments, demonstrations, classroom activities, etc.) relate to theories of learning through reflections & discussions with peers.
3. Demonstrate an introductory understanding of the application of theories of learning to instructional contexts by reflecting on five instructional materials (e.g., laboratory experiments, demonstrations, classroom activities, etc.) for one chemistry/science course, through the lens of learning theory(s) that exemplify the instructional approach(es).

CHM 561 (graduate students): By the end of this course, students will be able to:

1. Identify & describe how chemistry education research methods and findings are related to underlying theories of learning, based on discussions and critiques of chemistry/science education literature.
2. Identify & describe multiple learning theories related to classroom experiences (e.g., laboratory experiments, demonstrations, classroom activities, etc.) in a chemistry or science course through reflections & discussions with peers.
3. Demonstrate an advanced understanding of the application of theories of learning to instructional contexts by reflecting on eight instructional materials (e.g., laboratory experiments, demonstrations, classroom activities, etc.) for one chemistry/science course, through the lens of learning theory(s) that exemplify the instructional approach(es).

Course Format will be face-to-face instruction with social learning and active learning strategies – students will be expected to actively engage in all activities (see below for more details).

Required Materials: This course does not require any materials or textbooks. All necessary readings will be peer-reviewed journal articles and other publications, accessible via PDF on Brightspace.

Course Policies:

1. ***Attendance and participation*** are expected for all class sessions. In-class participation is a component of your overall grade; more details will be discussed in class and below.
2. ***Late work*** is typically not accepted. Special considerations will be made on a case-by-case basis.
3. ***Extra Credit*** is not usually offered. Special considerations will be made on a case-by-case basis.
4. ***The use of cell phones, laptops, or other electronic devices (other than scientific calculators) in class is limited to course-specific tasks.*** Using devices for non-course related tasks (e.g., social media, texting) will result in dismissal from class.
5. ***COVID-19 Health Considerations:*** *In this class, we will look to the Center for Disease Control (CDC) and URI policies for guidance on personal protective equipment (PPE) for COVID-19. Please understand that these guidelines can change on a daily basis. While our actions will be driven by data and science, we will err on the side of caution, often choosing a more conservative course of action as our understanding of the situation evolves. URI safety culture includes COVID-19 precautions and is intended to ensure the safety of the entire URI community.* ***To that end, all students and instructors are required to wear masks in lecture settings, regardless of current vaccination status.*** *Failure to follow safety policies will result in dismissal from class and receiving a zero for any missed work.*
6. ***Due to COVID-19 health considerations, DO NOT ATTEND class in person if you feel ill or under the weather in any way.*** Instead, you should get tested. Exceptions to the participation grade policies for illnesses will be considered on a case-by-case basis. See below for more details regarding URI's COVID/Viral Illness Policy.

Grading Procedures:

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

Although grades are not the ultimate measure of your knowledge, abilities, or potential as a human being, they are useful guides to you and to others. Your individual accomplishments and understanding will be recognized by the letter grade you earn in this course.

Final course grades will be assigned as follows:

A	94-100%	**C+**	77-79%
A-	90-93%	**C**	74-76%
B+	87-89%	**C-**	70-73%
B	84-86%	**D+**	67-69%
B-	80-83%	**D**	60-66%
		F	<60%

Course Assignments:

- **Reading Assignments & Participation in Discussions (10%)**
  - Reading Assignments: Each week, we will meet to discuss research publications from the chemistry/science education literature focused on theories of how people learn and the application of that research to improve chemistry/science instruction & learning. Reading assignments will be posted on Brightspace. Students should come to class fully prepared, having carefully and critically read and reflected upon the assigned readings.

  - Participation in Discussions: You should actively participate in discussions and analyze the assigned readings each week during class. This will be evaluated by your contributions during class in the form of questions/comments related to the readings. Below are some questions that you might consider while reading and reflecting on the reading assignments; while you do not need to *formally* respond to these questions, you are encouraged to use them to prepare for the literature discussion during class. This list is not exhaustive, and every question may not apply to all readings:
    - *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 (10%)** - *Submitted to Brightspace 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 3 following questions:
        - *What are the main points of these readings?*
        - *What information in the reading did you find surprising or new, and why?*
        - *Were there any portion(s) of the readings that were confusing? If so, why?*

    - Why Reading Reflections? These reflections are designed to help you engage more deeply with (and construct new meaning from) the course materials. The reflections also provide the instructor with detailed information about what you learned in this course and will help guide class preparations with the goal of helping develop a community of learners.

    - Rubric for the Evaluation of Submitted Reading Reflections:
        - 2 points Responses to questions are submitted on time, are labeled, and clearly indicate careful reading and deep reflection.
        - 1 point 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 (20%)**
    - Students in this course will lead several discussions of their assigned learning theories during the semester. Students will be grouped into teams (size dependent on the overall class size) as Discussion Leaders for their assigned topic/week. Dr. Pratt will assign all students their respective topic/week after the first class meeting.
    - As a Discussion Leader, you will be expected to present a summary of, and personal thoughts/ideas, related to the reading(s) assigned for your particular learning theory/topic. 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 readings(s)). Your presentation should include classroom activities that embody the learning theory/topic, 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 <u>as a team</u> with Dr. Pratt at least one week before their presentation to present a <u>detailed plan</u> 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 will be available on Brightspace and will be due by the beginning of the following class meeting.

- **Reflective Portfolio (30%)**
    - As part of this course, you will develop a reflective portfolio of activities/resources (e.g., lecture materials, demonstrations, simulations, assessments) that exemplify the learning theories/topics discussed in this class that can be used as future classroom teaching materials. This portfolio should be geared towards a specific course, such as: general chemistry, organic chemistry, introductory biology, etc.
    - For CHM 461 (undergraduate students) – You are expected to reflect on 5 activities/resources for your portfolios, connected to 5 learning theories/topics. 2 are due at the Midterm (Portfolio Draft).
    - For CHM 561 (graduate students) – You are expected to reflect on 11 activities/resources for your portfolios, connecting all 11 learning theories/topics. 5 are due at the Midterm (Portfolio Draft).
    - Final Portfolios are due on the last day of class, as indicated in the course calendar. Portfolios (both Draft at Midterm and Final Portfolio) should be presented neat and orderly. Midterm submissions will be virtual on Brightspace, while Final Exam submissions will be physical copies in 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 your activities and reflections for your portfolio.

- More details and expectations will be provided in class. In general, students will gather teaching and learning resources into a Portfolio; each resource will be accompanied by an in-depth reflection that summarizes the resource/approach, how theory(s) are embedded into the structure or purpose of the resource, and a critique of the resource's overall alignment with theory(s).

- **Portfolio Presentations (30%)**
  - Midterm Presentations: In addition to submitting a Portfolio Draft, you will share two of the reflections from your portfolio during the Midterm Presentation indicated in the course schedule. *Midterm presentations will be virtual and submitted via Brightspace.*
  - Final Presentations: In addition to submitting your Final Portfolio, you will share two of the reflections from your portfolio (different from the activities shared at Midterm) during the final class of the semester, as indicated in the course schedule. *These presentations will be in person.*

Academic Integrity: You are encouraged to study together and to discuss information and concepts covered in class with other students. However, students are expected to be honest in all academic work. A student's name on any written work shall be regarded as assurance that the work is the result of the student's own independent thought and study. Work should be stated in the student's own words, properly attributed to its source. Students have an obligation to know how to quote, paraphrase, summarize, cite, and reference the work of others with integrity.

The following are examples of academic dishonesty:
- Using material, directly or paraphrasing, from published sources (print or electronic) without appropriate citation
- Claiming disproportionate credit for work not done independently
- Unauthorized possession or access to exams
- Unauthorized communication during exams
- Unauthorized use of another's work or preparing work for another student
- Taking an exam for another student
- Altering or attempting to alter grades
- The use of notes or electronic devices to gain an unauthorized advantage during exams
- Fabricating or falsifying facts, data or references
- Facilitating or aiding another's academic dishonesty
- Submitting the same paper for more than one course without prior approval from the instructors

COVID/Viral Illness Precautions Statement: The University is committed to delivering its educational mission while protecting the health and safety of our community. As members of the URI community, students are required to comply with standards of conduct and take precautions to keep themselves and others safe.
- Masks are required in all classrooms, laboratories, and spaces where direct academic instruction and research are taking place, unless the instructor or staff member expressly waives that requirement.
- We strongly recommend surgical or higher-grade masks where face coverings are required. Masks should be properly worn, well-fitting, and high quality.
- Students who do not comply with the classroom/lab masking requirement will be asked to leave class and will be reported through the Student Conduct process.
- Students who are experiencing symptoms of viral illness should NOT go to class/work. Those who test positive for COVID-19 should follow the isolation guidelines from the Rhode Island Department of Health and CDC.

If you are unable to attend class, please notify Dr. Pratt prior to the start of class at justin.pratt@uri.edu.

Anti-Bias Statement: I, and URI in general, respect the rights and dignity of each individual and group. We reject prejudice and intolerance, and we work to understand differences. We believe that equity and inclusion are critical components for campus community members to thrive. If you are a target or a witness of a bias incident, you are encouraged to submit a report to the URI Bias Response Team at www.uri.edu/brt. There you will also find people and resources to help.

Disability, Access, and Inclusion Services for Students: Your access in this course is important. Please send me your Disability, Access, and Inclusion (DAI) accommodation letter early in the semester so that we have adequate time to discuss and arrange your approved academic accommodations. If you have not yet established services through DAI, please contact them to engage in a confidential conversation about the process for requesting reasonable accommodations in the classroom. DAI can be reached by calling: 401-874-2098, visiting: www.web.uri.edu/disability, or emailing: dai@etal.uri.edu. We are available to meet with students enrolled in Kingston as well as Providence courses.

Academic Enhancement Center: The Academic Enhancement Center (AEC) offers face-to-face and online services to undergraduate students seeking academic support. Services are based out of Roosevelt Hall, the Carothers Library room LL004, and online. Peer tutoring is available for STEM-related courses through drop-in centers and small-group tutoring. The Writing Center peer consultants offer feedback focused on supporting undergraduate writers at any stage of a writing assignment. The UCS 160 course and one-to-one Academic Skills Consultations offer strategies for improving studying and test-taking skills. Complete details about each of these programs, up-to-date schedules, contact information, and self-service study resources are all available on the AEC website, www.uri.edu/aec

- **STEM Tutoring** helps undergraduate students navigate a variety of 100 and 200 level STEM courses and a limited selection of BUS, STA, ECN, and CSC courses. The STEM Tutoring program offers free peer tutoring in-person and online. Students can select **occasional or weekly tutoring sessions** through the TracCloud system or visit the Drop-In Center, located in the Carothers Library lower level room LL004. The TracCloud application is available through URI Microsoft 365 single sign-on and more detailed information and instructions can be found at www.uri.edu/aec/tutoring.
- **Academic Skills Development** programs teach students how to manage time, study effectively, and address common academic challenges. **UCS 160: Success in Higher Education** is a one-credit course focused on developing strategic approaches to planning and studying. **Academic Consultations** are 1-on-1 meetings that help students identify and address individual academic challenges. Students can schedule an in-person or online consultation with David Hayes on Starfish.
- **Study Your Way to Success** is a self-guided web portal connecting students to tips and strategies on studying and time management related topics. For information or help with scheduling, contact Dr. Hayes directly at davidhayes@uri.edu.
- **The Undergraduate Writing Center** provides peer writing support to students in any class, at any stage of the writing process: from understanding an assignment and brainstorming ideas, to developing, organizing, and revising a draft. Writing consultations are available through 1) 25-or 50-minute **in-person appointments**, 2) synchronous **online appointments**, and 3) asynchronous **written feedback.** Synchronous appointments hosted by WCOnline are video-based, with audio, chat, document-sharing, and live captioning capabilities, to meet a range of accessibility needs. View availability and book online at www.uri.mywconline.com. For more information, visit www.uri.edu/aec/writing.
- **The Graduate Writing Center provides** writing support to all URI doctoral and master's students to foster continuing development of academic and professional writing skills necessary to succeed in graduate programs and academic or professional careers. Options include 1) one-on-one consultations, 2) writing focused workshops and programs, 3) writing groups, and 4) support for English Language Learners. For more information, visit https://web.uri.edu/graduate-writing-center/. View availability and book an appointment online at https://mywco.com/URIGradWC.

Brief Course Schedule:

Week	Date	Content Focus	Discussion Leader(s)
1	1/22	Introduction to Course & Theoretical Frameworks and How Students Learning	Dr. Pratt
2	1/29	The Neuroscience of Learning	Dr. Pratt
3	2/5	Chemical Observations and Abstract Concepts	**TBD**
4	2/12	The Chemistry Triplet and Working Memory	**TBD**
5	2/19	*Monday classes meet on a Wednesday* – **No CHM 461/561**	
6	2/26	Learning with Representations	**TBD**
7	3/5	Thinking, Feeling, and Doing Science	**TBD**
8	3/12	*Spring Break* – ***No CHM 461/561***	
9	3/19	The Development of Alternative Conceptions	**TBD**
10	3/26	*Pratt at ACS Meeting* – ***No CHM 461/561*** Midterm: Virtual Portfolio Presentations and Virtual Portfolio Draft Due	**ALL**
11	4/2	Impact of Power and Culture on Chemistry/Science Understanding	**TBD**
12	4/9	Students Thinking and Reflecting	**TBD**
13	4/16	Scientific Inquiry and Relativism	**TBD**
14	4/23	Self-Identities in the Chemistry/Science Classroom	**TBD**
15	4/30	*Last day of classes* Mindset in the Chemistry/Science Classroom	**TBD**
Final Exam Period	5/7 at 11:30 am	Similarities and Differences Across Constructs In-Person Portfolio Presentations and Physical Final Portfolio Due	**ALL**

Detailed Course Schedule with Reading Assignments

Week	Date	Content Focus & Reading Assignment(s) *approx. 30 pages/week*	Discussion Leader(s)
1	Jan. 22, 2025	**Introduction to Course & Theoretical Frameworks and How Students Learn** Bretz, S. L. (2017) "Finding No Evidence for Learning Styles," *J. Chem. Edu.*, 94, 825-826.	Dr. Pratt
2	Jan. 29, 2025	**The Neuroscience of Learning** Sousa, D. (2011) Chapter 1: Basic Brain Facts. In *How the Brain Learns* (4th ed., pp. 15–35). Thousand Oaks, CA: SAGE Publications. Sousa, D. (2011) Chapter 2: How the Brain Processes Information. *In How the Brain Learns* (4th ed., pp. 41–60). Thousand Oaks, CA: SAGE Publications. Macdonald, K.; Germine, L.; Anderson, A.; Christodoulou, J.; McGrath, L.M. (2017) Dispelling the Myth: Training in Education or Neuroscience Decreases but Does Not Eliminate Beliefs in Neuromyths, *Front. Psychol.*, 8, 1314. *Note: Sousa CH 1 and CH 2 are written in large font with large pictures and white space. It looks long, but it really isn't based on formatting.*	Dr. Pratt
3	Feb. 5, 2025	**Chemical Observations and Abstract Concepts** *Constructivism and Piaget* Herron, J. D. (1975) Piaget for Chemists: Explaining What 'Good' Students Cannot Understand, *J. Chem. Edu.,* 52(3), 146-150. Herron, J. D. (1978) Piaget in the Classroom: Guidelines for Applications, *J. Chem. Edu.,* 55(3), 165-170. Bunce, D. M. (2001) Does Piaget Still Have Anything to Say to Chemists? *J. Chem. Edu.,* 78(8), 1107.	**TBD**
4	Feb. 12, 2025	**The Chemistry Triplet & Working Memory** *Information Processing Model and Cognitive Load Theory* Johnstone, A. H. (2010) "You Can't Get There from Here," *J. Chem. Edu.*, 87(1), 22–29. Taber, K. S. (2013) Revisiting the Chemistry Triplet: Drawing Upon the Nature of Chemical Knowledge and the Psychology of Learning to Inform Chemistry Education, *Chem. Educ. Res. Pract.*, 14, 156–168. Cranford, K. N.; Tiettmeyer, J. M.; Chuprinko, B. C.; Jordan, S.; Grove, N.P. (2014) Measuring Load on Working Memory: The Use of Heart Rate as a Means of Measuring Students' Cognitive Load, *J. Chem. Edu.*, 91, 41–647.	**TBD**
5	Feb. 19, 2025	***Monday classes meet on a Wednesday – No CHM 461/561***	
6	Feb. 26, 2025	**Learning with Representations** *Representational Competence* Tsui, C Y.; Treagust, D.F. (2013). Introduction to Multiple Representations: Their Importance in Biology and Biological Education. In: Treagust, D., Tsui, CY. (eds) *Multiple Representations in Biological Education. Models and Modeling in Science Education*, vol 7. Springer, Dordrecht. Huinker, D. (Spring 2015) Representational Competence: A Renewed Focus for Classroom Practice in Mathematics, *Wisconsin Teacher of Mathematics*, 67(2), 4-7. Stull, A. T.; Gainer, M.; Padalkar, S.; Hegarty, M. (2016) Promoting Representational Competence with Molecular Models in Organic Chemistry, *J. Chem. Edu.*, 93, 994−1001.	**TBD**

7	March 5, 2025	**Thinking, Feeling, and Doing Science** *Meaningful Learning* Bretz, S. L. (2001) Novak's Theory of Education: Human Constructivism and Meaningful Learning, *J. Chem. Edu.*, 78, 1107. Briscoe, C.; LaMaster, S. U. (1991) Meaningful Learning in College Biology through Concept Mapping, *The American Biology Teacher,* 53(4), 214-219. Grevholm, B. (2008). Concept Maps as Research Tool in Mathematics Education. In *Concept Mapping: Connecting Educators*, Proceedings of the 3rd International Conference on Concept Mapping*,* Tallinn, Estonia & Helsinki, Finland.	**TBD**
8	March 12, 2025	***Spring Break – No CHM 461/561***	
9	March 19, 2025	**The Development of Alternative Conceptions** *Misconceptions and the Resources Framework* Bodner, G. M. (1991) I Have Found You an Argument: The Conceptual Knowledge of Beginning Chemistry Graduate Students, *J. Chem. Edu.,* 68(5), 385–388. Hammer, D. (2000) Student Resources for Learning Introductory Physics, *Phys. Educ. Res., Am. J. Phys. Suppl.* 68(7), S52-S59. Tekkaya, C. (2002) Misconceptions as a Barrier to Understanding Biology, *Hacettepe University Journal of Education.* 23, 259-266. Neidorf, T.; Arora, A.; Erberber, E.; Tsokodayi, Y.; Mai, T. (2020). Review of Research into Misconceptions and Misunderstandings in Physics and Mathematics. In: *Student Misconceptions and Errors in Physics and Mathematics.* IEA Research for Education, vol 9. Springer, Cham.	**TBD**
10	March 26, 2025	***Pratt at American Chemical Society Meeting – No CHM 461/561*** **Midterm: Virtual Portfolio Presentation & Virtual Portfolio Draft Due**	**ALL**
11	April 2, 2025	**Impact of Power and Culture on Chemistry/Science Understanding** *Critical Theories* Mayo, P. M. (2007) Critical Theory. In *Theoretical Frameworks for Research in Chemistry/Science Education.* Eds. Bodner, G.M.; Orgill, M. 233-250. Morton, T. (2022) Critical Race Theory and STEM Education. In *Oxford Research Encyclopedia of Education.* Oxford University Press. Morton, T. (2023) Critical Race Theory and its Relevance for Chemistry, *Nature Chemistry.* 16, 1043-1046. <u>Optional (for those interested):</u> Scheuermann, N. L. ; Idlebird, C.; Kukday, S.; McCracken, V. J.; Bradley, R. E.; Bergan-Roller, H. (2024) University Biology Classrooms as Spaces for Anti-racist Work: Instructor Motivations for Incorporating Race, Racism, and Racial Equity Content, *CBE—Life Sciences Education.* 23(4), 1-23.	**TBD**
12	April 9, 2025	**Students Thinking and Reflecting** *Metacognition* Rickey, D.; Stacy, A. M. (2000) The Role of Metacognition in Learning Chemistry, *J. Chem. Edu.*, 77(7), 915–920. Cook, E.; Kennedy, E.; McGuire, S. Y. (2013) Effect of Teaching Metacognitive Learning Strategies on Performance in General Chemistry Courses, *J. Chem. Edu.*, 90, 961–967. Stanton, J. D.; Dye, K. M.; Johnson, M. (2019) Knowledge of Learning Makes a Difference: A Comparison of Metacognition in Introductory and Senior-Level Biology Students, *CBE—Life Sciences Education.* 18(2), 1-13.	**TBD**

13	April 16, 2025	**Scientific Inquiry and Relativism** *Perry's Scheme of Cognitive Development* Finster, D.C. (1989) Developmental Instruction. Part I: Perry's Model of Intellectual Development, *J. Chem. Edu.*, 66(8), 659–661. Pavelich, M. J., Moore, W. S. (1996) Measuring the Effect of Experiential Education Using the Perry Model, *J. Engineering Educ.*, 85, 287-292. Wise, J. C.; Lee, S. H.; Litzinger, T.; Marra, R. M.; Palmer, B. (2004) A Report on a Four-Year Longitudinal Study of Intellectual Development of Engineering Students, *Journal of Adult Development*, 11(2), 103-110. Grove, N. P.; Bretz, S. L. (2010) Perry's Scheme of Intellectual and Epistemological Development as a Framework for Describing Student Difficulties in Learning Organic Chemistry, *Chem. Educ. Res. Pract.*, 11, 207–211.	**TBD**
14	April 23, 2025	**Self-Identities in the Chemistry/Science Classroom** *Affective Learning* Lewis, S. E.; Shaw, J. L.; Heitz, J. O. (2009) Attitude Counts: Self-Concept and Success in General Chemistry, *J. Chem. Edu.*, 86(6), 744–749. Young, C. B.; Wu, S. S.; Menon, V. (2012) The Neurodevelopmental Basis of Math Anxiety, *Psychol. Sci.*, 23(5), 492–501. Villfañe, S. M.; Garcia, C. A.; Lewis, J. E. (2014) Exploring Diverse Students' Trends in Chemistry Self-Efficacy Throughout a Semester of College-Level Preparatory Chemistry, *Chem. Educ. Res. Pract.,* 15, 114–127. Ballen, C. J.; Wieman, C.; Salehi, S.; Searle, J. B.; Zamudio, K. R. (2017) Enhancing Diversity in Undergraduate Science: Self-Efficacy Drives Performance Gains with Active Learning," *CBE—Life Sciences Education*. 16(4), 1-6. *Note: These articles include a variety of statistics, including high-level regression and other analyses. Focus on the background and results/discussion (i.e., what we can learn/apply from the results).*	**TBD**
15	April 30, 2025 *Last Day of Classes*	**Mindset in the Chemistry/Science Classroom** *Growth Mindset* Yeager, D. S.; Dweck, C. S. (2012) Mindsets That Promote Resilience: When Students Believe That Personal Characteristics Can Be Developed, *Educ. Psych.,* 47(4), 302–314. Limeri, L. B.; Carter, N. T.; Choe, J.; Harper, H. G.; Martin, H. R.; Benton, A.; Dolan, E. L. (2020) Growing a Growth Mindset: Characterizing How and Why Undergraduate Students' Mindsets Change, *Intl. J. STEM Educ.,* 7(35), 1–19. *Note: This article includes a variety of statistics. Focus on the background and results/discussion (i.e., what we can learn/apply from the results).* Optional (for those interested): Cavanagh, A. J., Chen, X., Bathgate, M., Frederick, J., Hanauer, D. I., Graham, M. J. (2017) Trust, Growth Mindset, and Student Commitment to Active Learning in a College Science Course, *CBE—Life Sciences Education*. 17(1), 1-23.	**TBD**
Final Exam Period	Wed. May 7 from 11:30-1:30 pm	**CHM 461/561 Final Exam Period:** **Wednesday May 7 from 11:30 am – 1:30 pm** *Similarities and Differences Across Constructs &* **In-Person Portfolio Presentations & Physical Final Portfolio Due**	**ALL**