Introduction to Chemistry Education (Chem 387)

COURSE INFORMATION

Overview

This course is designed to serve as an introduction to pedagogy in the science fields, with strong emphasis on gaining experience in teaching chemistry as an *undergraduate teaching intern (TI)*. The course has two main components:

- Lecture – class will meet once per week for 80 minutes.
- Learning Session – as a "teaching intern in training," each student will hold a 1-hour session per week in the form of an office hour for General Chemistry 161

These two components will constitute the three (3) credits in the course, and each will count toward the letter grade.

Pre-Requisites

This course is by invitation only. Invitations are made based on success in General Chemistry I and II (01:160:161-162 OR 01:160:163-164) and interviewing for the TI positions.

Relationship to Chem 493/494

Chem 493/494 are Chemistry Teaching Internship courses for the Fall (493) and Spring (494) semesters. The activities and content focus of 493/494 are different from Chem 387. Students enrolled in 493/494 concentrate more fully on the practical application of peer mentoring; whereas students in 387 engage with formal pedagogical training. All students in the *Certificate in Chemistry Education* program will go on to take at least two credits of the Teaching Internship course following completion of the Chem 387 course. Because Chem 387 already includes one learning session as part of the course, students ***should not concurrently*** sign up for the fall Teaching Internship (01:160:493).

Course Goals

This course will provide students with the opportunity to

- Engage with primary, secondary, and tertiary literature in the fields of learning theory, educational theory and best practices, and STEM education research
- Discuss theories, concepts and principles in STEM education
- Apply pedagogical content knowledge (PCK) from science and chemistry education (and educational theory, in general) to weekly learning sessions with students enrolled in the General Chemistry course
- Analyze reports in the STEM education and chemistry education research (CER) literature and evaluate the usefulness, applicability, and transfer of these findings to the role of academic peer leader positions (e.g., chemistry teaching interns (TIs), tutors, and workshop leaders)
- Reflect on their knowledge of education and pedagogy and how they develop this knowledge over the course of the semester

- Reflect on their experiences as chemistry teaching interns, self-evaluate their sessions with students, and describe their growth and development as TIs over the course of the semester.
- Synthesize their own informed opinions, arguments, and ideas about chemistry education, chemistry pedagogy, teaching (from the perspective a TI), and student learning in chemistry and other STEM courses.
- Appreciate the concept of lifelong learning, and explore how their own thoughts and understanding of concepts related to teaching and learning evolve over time

Required Materials

- No textbook is required for the course. All assigned readings will be posted on Sakai.
- For each class, please bring:
  - Something to write with/on
  - A calculator
  - A folder or binder to keep all materials in
- It may be helpful at times to have a laptop, iPad, etc. in class, but this is not required

Students in the CCE Program will compile their work, including papers, activities, and assignments from class at the end of the semester. These documents will become a part of the teaching portfolio (See Part IV: Artifacts).

Classroom Etiquette

- No cell phones. Please silence them and put them away.
- No laptops are to be open when others are speaking. Laptops are for group work.
- Be respectful of each other. This means listening to the speaker and giving relevant, positive, constructive, and respectful feedback.
- Be respectful of all General Chemistry instructors and students. Always remain professional, calm, and polite when speaking to or about students, TIs, and faculty members.

Course Policies

- Students are expected to check Sakai or their email at least daily regarding this course. Sakai will serve as information central, but announcements will also be sent as emails.
- Absences or lateness will result in a deduction of points from the final grade. Students are to speak to an instructor privately, before the intended missed class, if they know they are unable to make it to class. Please note this does not guarantee an excused absence.

Special Needs

Specific accommodations may be made for students who require such support. Visit the Office of Disability Services in person or online (https://ods.rutgers.edu) to learn more about potential support and eligibility. Students should speak with an instructor as early as possible in the semester if there are any additional concerns.

Honors Credit
Students enrolled in the Honors program may receive Honors credit for this course by completing supplementary work. See the "Honors Track" below.

COURSE COMPONENTS

Participation – 15%
Individual – 5%
This course is designed to be an active learning environment. Student participation is essential. Students are solely responsible for coming to class prepared, which means having completed all readings and assignments and being prepared to discuss the readings, as well as current topics from the General Chemistry 161 course.
Group – 10%
Students will engage in group activities related to the readings during each class period. When working with a group, it is important to be sure that each member contributes and works well with the other members. Students within each group receive the same group participation grade, which depends on teamwork, creativity, and the ability to stay on task.

Individuals/groups do not automatically start with full credit for participation each day, but, rather, earn their participation grades by being on time, demonstrating their preparedness, asking questions, participating in a discussion, and working with others. All participation assumes attendance.

Weekly Reflections – 15%
Reflections are due each Sunday by 11:59pm on Sakai. Students should reflect on both their time in class, as well as their learning session. Instructions and questions for students to address will be posted on Sakai each week.

In addition to submitting one's own reflection, students should comment on at least one of their colleagues' reflections per week. Comments should be relevant and meaningful, either by offering a suggestion, words of encouragement, asking questions, or other useful remarks. Students should submit their comments by the following Sunday each week.

Because reflections are essential to becoming more self-aware of one's own strengths and areas of improvements, the instructors will also post a reflection each week.

Learning Goals – 5%
Students will list their learning goals for the CCE and TI programs, which should include personal, professional, and academic goals. Goals should be unique to your situation and intended career path. For students in the CCE Program, this assignment will become Part I of the teaching portfolio.

Paper I: Learning Session Evaluation – 13%
Students will choose a fellow TI to observe during the peer TI's learning session and write a paper that addresses what happened during the session and how the session connects to the topics discussed in this class.

Midterm Assessment – 15%
The midterm will consist of entirely open-ended, short answer responses to questions about activities and readings from class. Many questions will ask about students' personal experiences and how they apply or evaluate to what they have learned.

Paper II: Teaching Philosophy – 20%
A Teaching Philosophy Statement describes the author's beliefs as a teacher about both teaching and learning. While all teaching philosophy statements are unique to the author and allow for relative flexibility in their structure, there are some guidelines that will be described for the assignment, and proper citations and references need to be included because this is a paper submitted as part of a course where students learn about educational theory and pedagogy. For students in the CCE Program, this paper will become Part II of the teaching portfolio.

Final Discussion Leadership Project – 17%
Students will be assigned to a group, and each group will lead a short discussion at the end of the semester on a topic related to education, STEM education, or chemistry education. The discussion should avoid solely presenting information, but, instead, should aim explaining enough about the topic such that all students can participate in an activity to engage with the content of that topic.

GRADING POLICIES

Resubmission Policy
With the exception of the Midterm, written assignments may be resubmitted once, within one week of receiving the grade, in order to earn back a maximum of half of the points that were not earned on the first attempt. For example, if a student receives an 80% on Paper I, he or she may resubmit it within one (1) week of receiving a grade to earn up to 10% back, resulting in a final grade of a 90%.

Extra Credit
Extra credit will not be given unless an extenuating circumstance warrants it. In all cases, extra credit will always be offered to the entire class.

Grading
Grades in the course will follow this scale:

A	B+	B	C+	C	D	F
90-100	85-89	80-84	75-79	70-74	60-69	<59

Due to the resubmission policy, final grades are **not** rounded up. If students have any questions or concerns about their grade, they should bring their question to an instructor immediately, rather than waiting until the end of the semester.

The end of the semester is not an appropriate time to request extra credit or reconsideration of a grade on an assignment.

HONORS TRACK

Students in the SAS Honors Program may opt to take this course for Honors credit. This decision must be made in the first week of class, and students will need to fill out a special form and submit it to SASHP. These students are expected to complete all of the aforementioned duties associated with this course, in addition to two other components:

Literature Review
A brief literature review will include an analysis of the current literature on a given topic. Students should pick a topic that they are interested in and submit it to the instructor for approval using the form listed on Sakai. Two students may not choose the same topic, so it is best to have a back-up plan. Students may choose an extension of any topic that was discussed in class, or, with the instructor's permission, a different topic that they may have come across. The paper should be approximately 5-8 pages, with quotations and citations.

Presentation of Preliminary Work
At the conclusion of the course, Honors students will present their preliminary findings to fellow TIs during a weekly TI meeting in any manner that they choose. The topic will be the same as that of the literature review proposal. The presentation should take approximately 10-15 minutes and will draw from the concepts and ideas presented within the literature review. A short Q&A session will follow the presentation, in which presenters will pose some of their own questions to the audience and answer any other questions that may arise from the Tis in the meeting. Each audience member will fill out an anonymous evaluation that presenters will review as formative assessment and can keep for their own records.

Introduction to Chemistry Education (CHEM 387)

Fall 2018 Course Schedule

Class Meeting Time & Location: Fridays 12:00 PM - 1:20 PM, ARC 328

Instructors	Office	Office Hours (and also by appointment)	e-mail	phone
Mary Emenike	ARC 316	Tuesdays 11:45 am – 12:45 pm	mary.emenike@rutgers.edu	848.445.1672
Emily Atieh	CIPR 308	Fridays 1:45 pm – 2:45 pm	emily.atieh@rutgers.edu	862.571.3521

ASSIGNMENT AND DUE DATES

Below is a table of all assignments and due dates. For each (except the midterm) there will be a document with the assignment's directions and rubrics posted in the Resources folder on Sakai. For the midterm, the instructions will be provided only on the midterm itself. All assignments will be submitted via the Assignments module on Sakai.

All Class Due Dates:

Assignment	Due Date
Goals	Sunday 9/14; 11:55 pm
Paper I	Sunday 10/21; 11:55 pm
Midterm	*Available:* Friday 11/2; 8:00 pm *Due:* Thursday 11/8; 11:55 pm
Paper II	Wednesday 11/30 11:55 pm
Discussion Leadership Project	*Submit:* Thursday 12/6; 11:55 pm *Present:* Friday 12/7 (in class)

Honors Due Dates:

Assignment	Notes	Due Date
Honors Topics	• See list of possible topics • Submit top 3 choices in class • Only for students taking Honors credit	Fri 10/19; in class
Honors Presentation	• To be presented at a TI weekly staff meeting during the last 2 weeks of the semester	TBD
Honors Lit Review	• To be handed in at the time of your presentation	TBD

COURSE SCHEDULE

The schedule below provides a list of topics for the entire semester. Note that changes may be made during the semester to accommodate for inclement weather or other unexpected occurrences. All readings and other assignments are due *before* coming to class. In other words, students should read the select papers by the date listed in the first column.

Date	Topics	Readings Due
Week 1 9/07	Introduction to Course	**No Readings**
Week 2 9/15	Classroom Discourse & Effective Questioning	1. Knuth, R., Peressini, D., (2001). Unpacking the Nature of Discourse in Mathematics Classrooms. *Mathematics Teaching in the Middle School, 6*, 320-325. 2. Sousa, D. A., (2011) "Chapter 7: Thinking Skills and Learning" in *How the Brain Learns, 4th ed.,* (pp 250-267). Sage Publications.
Week 3 9/22	Meaningful Learning, Constructivism, & Neural Networks	1. Zull, J. E. (2002). "Chapter 6: What We Already Know," *The Art of Changing the Brain*, (pp. 91-110). Sterling, VA: Stylus Publishing. 2. Bretz, S.L., (2001). Novak's Theory of Education: Human Constructivism and Meaningful Learning. *Journal of Chemical Education, 78,* 1107 (pages 1 - 10).
Week 41 9/2	Alternate Conceptions	1. Zull, J. E. (2002) "Chapter 7: Only Connect!" *The Art of Changing the Brain,* (pp. 111-132). Sterling, VA: Stylus Publishing. **(READ ONLY pp. 111-127)** 2. Mulford, D.R., Robinson, W.R., (2002). An Inventory for Alternate Conceptions among First-Semester General Chemistry Students. *Journal of Chemical Education, 79*(6), 739-744.
Week 5 10/06	Multiple Representations	1. Johnstone, A.H., (1991). Why is science difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning*, *7*, 75-83. 2. Gabel, D. (2005). "Chapter 7: Enhancing Students' Conceptual Understanding of Chemistry through Integrating the Macroscopic, Particle, and Symbolic Representations of Matter," in N. J. Pienta, M. M. Cooper, T.J. Cooper (Eds.), *Chemists' Guide to Effective Teaching*, (pp. 77-87). Upper Saddle River, NJ: Pearson Prentice Hall ***(READ ONLY pp. 77-83)***
Week 6 10/13	Analogies in Teaching	1. Zull, J. E. (2002). "Chapter 7: Only Connect!" *The Art of Changing the Brain*, (pp. 111-132). Sterling, VA: Stylus Publishing. **(READ ONLY pp. 127-130)** 2. Glynn, S.M., Duit, R., & Thiele, R. B., (1995). "Teaching science with analogies: A strategy for constructing knowledge," in S.M. Glynn & R. Duit (Eds.), *Learning science in the schools: Research reforming practice*, (pp. 247–273). Mahwah, NJ: Erlbaum. ***(READ ONLY pp. 251-260)*** 3. Orgill, M., Bodner, G. (2005). "Chapter 8: The Role of Analogies in Chemistry Teaching," in N. J. Pienta, M. M. Cooper, T.J. Cooper (Eds.), *Chemists' Guide to Effective Teaching*, (pp. 90-111). Upper Saddle River, NJ: Pearson Prentice Hall. ***(READ ONLY pp. 90-102)***
Week 7 10/20	Mental Models & Conceptual Change	1. Nakhleh, M. B. (2001). Theories or Fragments? The Debate Over Learners' Naive Ideas About Science. *Journal of Chemical Education,* 78, 1107 (pages 1-8). 2. Redish E. F. (1994). Implications of Cognitive Studies for Teaching Physics, *American Journal of Physics, 62*(9), 796-803.

Date	Topics	Readings Due
Week 8 10/27	Metacognition & Reflection	1. Zull, J. E. (2002) Chapter 9: Waiting for Unity, *The Art of Changing the Brain* (pp. 153-175). Sterling, VA: Stylus Publishing. 2. Tanner, K.D., (2012). Promoting Student Metacognition, *CBE: Life Sciences Education, 11*, 113-120.
Wk 8-9	**Midterm *(take home exam)***	***Available:* Friday 11/2; 8:00 pm** ***Due:* Thursday 11/8; 11:55 pm**
Week 9 11/03	Diversity, Equity, & Inclusion	1. Adams, M., & Zuniga, X. (2016). "Chapter 4: Core Concepts for Social Justic Education" in Teaching for Diversity and Social Justice, 3rd ed., (pp. 95-130). New York, NY: Routledge. ***(READ ONLY 95-105)*** 2. Paul, A. M., (2015). Are college lectures unfair?" *New York Times*, published 9/12/2015, available at: https://www.nytimes.com/2015/09/13/opinion/sunday/are-college-lectures-unfair.html
Week 10 11/09	Epistemology	1. Finster, D. C., (1989). Developmental Instruction: Part 1: Perry's Model of Intellectual Development, *Journal of Chemical Education*, *66*(8), 659-661. 2. 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, *Chemistry Education Research and Practice, 11*, 207–211.
Week 11 11/17	Learning Cycles	**All students read:** 1. Zull, J. E. (2002) Chapter 2: Where We Ought to Be, *The Art of Changing the Brain*, (pp. 13-29). Sterling, VA: Stylus Publishing. **Students in Group A read:** 2. Etkina, E., Van Heuvelen, A., (2001). "Investigative Science Learning Environment: Using the process of science and cognitive strategies to learn physics." *Proceedings of the 2001 Physics Education Research Conference*, 17-20. **Students in Group B read:** 2. Tanner, K.D., (2010). Order Matters: Using the 5E Model to Align Teaching with How People Learn. *CBE: A Journal of Life Science Education,* 9, 159-164. **Students in Group C read:** 2. Spencer, J. N. (1999). New Directions in Teaching Chemistry: A Philosophical and Pedagogical Basis, *Journal of Chemical Education*, *76*(4), 566-569.
Week 12 11/22* (Wed)	Teaching Philosophy Statements & Presentation Preparation	**No Readings** ***Bring draft of your Teaching Philosophy Statement to class*** CHANGE IN CLASS DESIGNATION DAYS: FRIDAY CLASSES MEET ON WEDNESDAY
Week 13 12/01	Cooperative Learning & Group Discussions	1. Johnson, D. W., Johnson, R. T., (1992). Implementing Cooperative Learning. *Contemporary Education, 63*(3), 173-180. 2. Towns, M. H., (1998). How Do I Get My Students to Work Together? Getting Cooperative Learning Started. *Journal of Chemical Education, 75,* 67-69.
Week 14 12/08	**Class Presentations!**	**No Readings**