

**Illinois State University
Department of Chemistry
CHE 401.05**

**Advanced Chemistry Demonstrations: Redox, Electrochemistry and Solutions
3 credit hours**

Catalog Description:

Advanced Chemistry Demonstrations: Redox, Electrochemistry and Solutions

3 F, S, Sum CHE 301 or 401 (any other topics) or 402 or 403 or equivalent as prerequisite.

Topical analysis of current best practices in teaching redox, electrochemistry and solutions as they pertain to secondary school classrooms. A particular emphasis will be to connect content knowledge to modern demonstrations and teaching activities.

Instructor: Dr. Sarah Boesdorfer

Email: sbboesd@ilstu.edu

Phone: 309-438-7905

Online Office Hours: by appointment (Zoom or Skype sarah.boesdorfer@gmail.com).

Materials:

Required: Access to the ReggieNet Website

Required: Access to the Advanced Chemistry Demonstrations: Redox, Electrochemistry and Solutions Video Website (link available in Reggienet)

Contact Hours:

This course is a structured, self-paced course available online for 8 (*summer term*) or 16 (*fall/spring term*) weeks from the start date of the course. Each assignment, except the discussion and final project, will be available at the start of the course but will have specific deadlines for when they need to be completed.

Accommodations:

Any student needing to arrange a reasonable accommodation for a documented disability and/or medical/mental health condition should contact Student Access and Accommodation Services at 350 Fell Hall, (309) 438-5853, or visit the website: StudentAccess.IllinoisState.edu.

Course Overview and Objectives:

This course constitutes a survey course of ways in which we can understand and teach Redox, Electrochemistry and Solutions. A particular emphasis will be to connect content knowledge to modern demonstrations and teaching activities. Students will improve their chemistry content knowledge from the resource materials, as well as be expected to search local and internet-based resources for current best practices. Students will be introduced to demonstrations and teaching activities which engage them in a detailed examination of the ways in which current chemistry teachers deliver redox, electrochemistry and solutions demonstrations and class activities. Students will be exposed to and expected to master the demonstration activities taught in the course.

This course seeks to provide some answers to the following questions:

1. What is our current best understanding of redox, electrochemistry and solutions?
2. What are the safety considerations and risks associated with teaching redox, electrochemistry and solutions? How may redox, electrochemistry and solutions be taught safely in schools?
3. What is the role of the Next Generation Science Standards in determining how redox, electrochemistry and solutions are taught in schools?
4. What pedagogical techniques are appropriate for teaching redox, electrochemistry and solutions in secondary schools?
5. What are the challenges associated with teaching redox, electrochemistry and solutions?

Course Materials:

Videos

Students will be required to watch the following 11 video packages and supplemental assignments within the ReggieNet course. The video packages can be found on the Flinn Scientific website (link on Reggienet) and consist of three topics: Redox, Electrochemistry, and Solubility.

Redox (Package of Videos)

1. *Oxidation States*
2. *Activity Series of Metals*
3. *Copper, Silver, and Gold Redox Reactions*

Electrochemistry

1. *Voltaic Cells*
2. *Electrolysis Reactions*
3. *Electrolysis of Water*

Solutions and Solubility

1. *Saturated, Unsaturated, and Supersaturated Solutions*
2. *Properties of Solutions*
3. *Concentration of Solutions*
4. *Solubility Equilibria*
5. *Precipitation Reactions and Solubility Rules*

Articles

The following articles will be read for the discussion prompts and can be found inside ReggieNet.

- Bunce, D. M., VandenPlas, J. R., & Soulis, C. (2011). Decay of student knowledge in chemistry. *Journal of Chemical Education*, 88(9), 1231-1237.
- Cullen, D. M., & Pentecost, T. C. (2011). A model approach to the electrochemical cell: An inquiry activity. *Journal of Chemical Education*, 88(11), 1562-1564.
- Eaton, E. R., Boon, W. H., & Smith, C. J. (2001). A chemical base for engine coolant/antifreeze with improved thermal stability properties (No. 2001-01-1182). SAE Technical Paper.
- Krause, S. J. (2013). The Effect of a Visually-Based Intervention on Students' Misconceptions Re-lated to Solutions, Solubility, and Saturation in a Core Materials Course. *AGE*, 23, 1.
- Krause, S., & Tasooji, A. (2007). AC 2007-413: Diagnosing Students' Misconceptions

On Solubility And Saturation For Understanding Of Phase Diagrams. In *American Society for Engineering Education*.

- Laranjo, M.T.; and Amaral, S.T. *Chem. Educator* 2013, 18, 24–27, Determining the Solubility Product of Silver Acetate and Verifying the Common-Ion Effect – A General Chemistry Experiment *Chem. Educator*
<http://chemeducator.org/papers/0018001/18130024.pdf>
- Lee, H. S., Linn, M. C., Varma, K., & Liu, O. L. (2010). How do technology-enhanced inquiry science units impact classroom learning?. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, 47(1), 71-90.
- Lichter, J. Using YouTube as a Platform for Teaching and Learning Solubility Rules *J. Chem. Educ.*, 2012, 89 (9), pp 1133–1137 DOI:
<http://pubs.acs.org/doi/pdf/10.1021/ed200531j>
- NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.
- Williams, A. J., & Pence, H. E. (2011). Smart phones, a powerful tool in the chemistry classroom. *Journal of Chemical Education*, 88(6), 683-686.

Required Assignments:

1. **Quizzes (3 quizzes):** You will be responsible for *passing a quiz* over each of the energy video packages. Each quiz will consist of 25 questions. Approximately half the questions will focus on content and the other half will focus on pedagogy and safety. You need a 90% on the quiz to consider it passed. You may take it as many times as you need until you pass or the due date is reached.
2. **Discussions (7 Discussions):** You are expected to engage in a thoughtful conversation with classmates over course materials. Each discussion will have a leader who will help guide the conversation. *See Reggienet for full description of discussion requirements.*
3. **Discussion Leader:** Each group member will serve as a weekly discussion leader one time during the semester. Discussion leaders start and encourage the discussion along with provide the entire class a summary of your groups discussion once the discussion time has ended. *See Reggienet for full description of discussion requirements.*

4. Discussion Reflection (2 Reflections):

5. Final Project

The Next Generation Science Standards are designed to encompass the minimum expectations for what all students should know leaving high school. The topics of this course are likely beyond the *explicit* scope of NGSS. However, the NGSS and its Science and Engineering Practices and Cross-Cutting Concepts provide a good foundation and framework for teaching these concepts. The final project will focus on integrating course topics with NGSS.

6. Professionalism

You are expected to

- Be positive, patient, and approachable.
- Work hard- be effective and efficient when assuming responsibilities.
- Work collaboratively with your peers and educational professionals.
- Be respectful to your peers, professionals, and students.

- Be open to advice and suggestions from peers and professionals.
- Be punctual- Complete assigned tasks on time.

Course Evaluation:

ReggieNet will be used to post whether an assignment or task has Met Expectations (1 / 1) or Not Met Expectations (0/1) with the exception of quizzes which require a 90% or better to meet expectations.

To receive **an A** in this course a student will:

- Actively participate in the course by meeting expectations for all quizzes and discussions, though up to one may not meet expectations.
- Meet Expectations as the Discussion Leader for 1 discussion
- Write Discussion Reflections which meets expectations in all categories from the rubric.
- Create Final Project which meets expectations in all categories from the rubric.
- Display all aspects of professionalism throughout the course.

To receive **a B** in this course a student will:

- Actively participate in the course by meeting expectations for all quizzes and discussions, though up to one may not meet expectations.
- Struggle in one of the following areas:
 - Meet Expectations as the Discussion Leader for 1 discussion
 - Write Discussion Reflections which meets expectations in all categories from the rubric.
 - Create Final Project which meets expectations in all categories from the rubric.
 - Display all aspects of professionalism throughout the course.

To receive **a C** in this course, a student will:

- Struggle in two of the following areas
 - Actively participate in the course by meeting expectations for all quizzes and discussions, though up to one may not meet expectations. [At least 7 out of 10 must be at meets expectations level]
 - Meet Expectations as the Discussion Leader for 1 discussion
 - Write Discussion Reflections which meets expectations in all categories from the rubric.
 - Create Final Project which meets expectations in all categories from the rubric.
 - Display all aspects of professionalism throughout the course.

To receive **a D** in this course a student will:

- Struggle in three of the following areas
 - Actively participate in the course by meeting expectations for all quizzes and discussions, though up to one may not meet expectations. [At least 6 out of 10 must be at meets expectations level]
 - Meet Expectations as the Discussion Leader for 1 discussion
 - Write Discussion Reflections which meets expectations in all categories from the rubric.
 - Create Final Project which meets expectations in all categories from the rubric.
 - Display all aspects of professionalism throughout the course.

To receive an **F** in this course a student will:

- Fail to meet the requirements to receive a D.

AND/OR

- Participation in the course through quizzes and discussions is 50% or less at met expectations level, no matter what other course work.

Due Dates: All assignments due at 11:55pm CST on dates below

Week	Day	Assignment Due
2	F	Quiz 1 and Quiz 2 Due
3	M	Discussion #1 Begins
	W	
	F	Discussion #1 Ends
4	M	Discussion #2 Begins
	W	<i>Discussion Leader #1's Summary Due</i>
	F	Discussion #2 Ends
5	M	
	W	<i>Discussion Leader #2's Summary Due,</i>
	F	Quiz 3 Due
6	M	Discussion Reflection Due, Discussion #3 Begins
	W	
	F	Discussion #3 Ends
7	M	Discussion #4 Begins
	W	<i>Discussion Leader 3's Summary Due</i>
	F	Discussion #4 Ends
8	W	Discussion #5 Begins
	F	<i>Discussion Leader 4's Summary Due</i> Discussion #5 Ends
9	M	Discussion #6 Begins
	W	<i>Discussion Leader 5's Summary Due</i>
	F	Discussion #6 Ends
11	M	Discussion #7 Begins
	W	<i>Discussion Leader 6's Summary Due</i>
	F	Discussion #7 Ends
12	M	
	W	<i>Discussion Leader 7's Summary Due</i>
	F	
13	M	Discussion Reflection Due
	W	
	F	Final Project Due
14		
15	F	Resubmission of Final Project Due <i>if needed.</i>