Illinois State University
Department of Chemistry
CHE 401A06
Advanced Chemistry Demonstrations: Thermochemical Energy in the Chemistry Curriculum
3 credit hours

Catalog Description:

Advanced Chemistry Demonstrations: Energy in the Chemistry Curriculum
3 F, S, Sum *CHE 301, 401, 402 or 403 equivalent as prerequisite.* Topical analysis of current best practices and difficulties in teaching energy concepts in chemistry as they pertain to secondary school classrooms. A particular emphasis will be to connect content knowledge to modern demonstrations and teaching activities. Not for credit in the M.S. in Chemistry program.

Instructor:

Instructor: Dr. Sarah Boesdorfer **Phone:** (309) 438-7905
Office: 220 Julian Hall **E-mail:** sbboesd@ilstu.edu

Office Hours: **By Appointment** through Skype/Phone/Google Chat etc.

Materials:

Required: Access to the ReggieNet Course Website

Required: Advanced Chemistry Demonstrations: Energy Course Videos (available at link in Reggienet)

Required: Account with Peergrade (https://www.peergrade.io/). Instructions for joining the course in Peergrade will be available in Reggienet. (It is free to you)

Contact Hours:
This course is a structured course available online for 8 *(summer term)* or 16 *(fall/spring term)* weeks from the start date of the course. Each assignment 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 at StudentAccess.IllinoisState.edu.

Course Overview and Objectives:
This course constitutes a survey course of ways in which we can understand and teach Energy Concepts in Chemistry. Particular emphasis will be given 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 teaching activities and demonstrations, research of student learning, and energy concepts which engage them in a detailed examination of the ways in which current chemistry teachers deliver concepts of energy.

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

1. What is our current best understanding of concepts of energy in chemistry?
2. What are the safety considerations and risks associated with teaching Energy Concepts? How may Energy Concepts be taught safely in schools?
3. What is the role of the *National Standards and State Standards* and the *Next Generation Science Standards* in determining how energy is taught in chemistry courses?
4. What pedagogical techniques are appropriate for teaching energy in secondary school chemistry courses?
5. What are the challenges associated with teaching energy in the chemistry?

Required Student Tasks/Assignments:

Course Materials to Watch/Read:

Videos:

Set 1: (For Quiz #1)

- Flinn Video Package: Day in the Dark (1 episode)
    - Day in the Dark Demonstrations with Jamie Benigna

Set 2: (For Discussion #1)

- Flinn Video Package: Endothermic & Exothermic Reaction (5 episodes)
- Flinn Video Package: Energy in Combustion Reactions (5 episodes)

Set 3: (For Quiz #2)

- Flinn Video Package: Conservation of Energy (5 episodes)
- Flinn Video Package: Calorimetry (3 episodes)

Set 4: (For Quiz #3)

- Flinn Video Package: Enthalpy, Entropy, and Free Energy (4 episodes)

Set 5: (For Quiz #4)

- Ted-Ed Videos: (Links in Reggienet)
    - All the energy in the universe is… by George Zaidan and Charles Morton
    - The Chemistry of Cold Packs by John Pollard
- NSTA NGSS Webinars (Links in Reggienet)
    - Disciplinary Core Idea: Energy
    - Crosscutting Concept: Energy and Matter

Set 6: (For Quiz #5)

- Veritasium Video: (Links in Reggienet)
    - Misconceptions about Temperature
- Flinn Video Package: Temperature and Heat (4 episodes)

Readings: (Copies of all readings can be found in Reggienet)

For Discussion #2

- *Hazen, R. M., & Trefil, J. (2009).* Chapter 2: Energy. *Science matters: Achieving scientific literacy. Anchor.*
- American Association for the Advancement of Science. (1994). Energy Transformations. *Benchmarks for science literacy*. Oxford University Press.

For Discussion #3

- Cooper, M. M., & Klymkowsky, M. W. (2013). The trouble with chemical energy: why understanding bond energies requires an interdisciplinary systems approach. *CBE-Life Sciences Education*, *12*(2), 306-312.,
- Nagel, M. L., & Lindsey, B. A. (2015). Student use of energy concepts from physics in chemistry courses. *Chemistry Education Research and Practice*, *16*(1), 67-81.
- Becker, N. M., & Cooper, M. M. (2014). College chemistry students' understanding of potential energy in the context of atomic–molecular interactions. *Journal of Research in Science Teaching*, *51*(6), 789-808.

For Discussion #4

- Venkataraman, B. (2017). Emphasizing the Significance of Electrostatic Interactions in Chemical Bonding. *Journal of Chemical Education*, *94*(3), 296-303.
- American Association of Chemistry Teachers [AACT]. (2017). What makes something feel warm? Retrieved from: https://teachchemistry.org/classroom-resources/what-makes-something-feel-warm
- AACT. (2017). Designing & Engineering a Faster Defroster. Retrieved from https://teachchemistry.org/classroom-resources/designing---engineering-a-fast-defroster
- Eisen, L., Marano, N., & Glazier, S. (2014). Activity-Based Approach For Teaching Aqueous Solubility, Energy, and Entropy. *Journal of Chemical Education*, *91*(4), 484-491.
- Tatsuoka, T., Shigedomi, K., & Koga, N. (2015). Using a Laboratory Inquiry with High School Students To Determine the Reaction Stoichiometry of Neutralization by a Thermochemical Approach. *Journal of Chemical Education*, *92*(9), 1526-1530.

Reference Articles for whole course:

- Bodner, G., Klobuchar, M., & Geelan, D. (2001). The many forms of constructivism. *J. Chem. Educ*, *78*(8), 1107.
- Eisenkraft, A. (2003). Expanding the 5E model. *The Science Teacher*, *70*(6), 56.
- Weaver, G. (2009). Teaching to achieve conceptual change. In N.J. Pienta, M.M. Cooper, & T.J. Greenbow (eds.), *Chemists Guide to Effective Teaching Volume 2* pp 35-48. Upper Saddle River N.J.: Pearson Education Inc.

Required Assignments:

1. **Quizzes (5 quizzes):** You will be responsible for *passing a quiz* over each of the energy video packages. Each quiz will consist of 15-25 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 (5 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. **Midterm Reflection:**
   You are expected to write a 1000-1500 word reflective midterm essay. You are also expected to provide a peer review of four of your classmates' papers. You can learn a lot from others, so peer reviews are important. Prompts for the essay will be posted within Reggienet. All papers and peer reviews will be submitted through Peergrade.

5. **Final Project**:
   You are expected to create/revise a lesson for their chemistry classroom related to energy. You are also expected to provide a peer review of two of your classmates' lessons. Prompts for the project will be posted within Reggienet. All papers and peer reviews will be submitted through PeerGrade.

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 a Midterm and Final which meets or exceeds expectations in all categories from the rubric.
- Provide thoughtful and complete Peer Reviews of midterms and finals as assigned.
- 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 a Midterm and Final which meets or exceeds expectations in all categories from the rubric.
  - Provide thoughtful and complete Peer Reviews of midterms and finals as assigned.
  - 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 a Midterm and Final which meets or exceeds expectations in all categories from the rubric.
- Provide thoughtful and complete Peer Reviews of midterms and finals as assigned.
- Display all aspects of professionalism throughout the course.

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

- Struggle in <u>three</u> 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 a Midterm and Final which meets or exceeds expectations in all categories from the rubric.
  - Provide thoughtful and complete Peer Reviews of midterms and finals as assigned.
  - 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.

<u>AND/OR</u>

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

<u>Due Dates: All assignments due at 11:59pm CST on dates below</u>

Week	Day	Assignment Due
1 (Jan10)		Classes Start
2 (Jan 17)	F	Quiz 1,
3 (Jan 24)	M F	Discussion #1 Begins Discussion #1- Last Posts
4 (Jan 31)	W F	*Discussion Leader #1's Summary Due* Quiz 2
5 (Feb 7)	F	Quiz 3
6 (Feb 14)	F	Quiz 4
7 (Feb 21)	M F	Discussion #2 Begins Discussion #2- Last Posts
8 (Feb 28)	M W	Work on Midterm *Discussion Leader #2's Summary Due*
9 (Mar 7)	**ISU Spring Break**	
10 (Mar 14)	M	Midterm Due
11 (Mar 21)	M F	Midterm Peer Review Due, Discussion #3 Begins Discussion #3 Last Posts
12 (Mar 28)	W F	*Leader #3's Summary Due* Quiz 5
13 (Apr 4)	M	Discussion #4 Begins,

	F	Discussion #4- Ends,
14 (Apr 11)	M W F	Discussion #5 Begins, *Leader #4's Summary Due* Discussion #5- Ends,
15 (Apr 18)	 W	Work on Final Paper *Leader #5's Summary Due*
8 (Apr 25)	M	Final Paper Due
Finals	M	Final Papers Peer Reviews Due