Illinois State University  
Department of Chemistry  
CHE 401.03  
Advanced Chemistry Demonstrations: Kinetics, Equilibrium, and Acids and Bases.  
3 credit hours

**Catalog Description:**
Advanced Chemistry Demonstrations: Kinetics, Equilibrium, and Acids and Bases.
F, S, Sum  
CHE 301 or equivalent as prerequisite. Topical analysis of current best practices in teaching Kinetics, Equilibrium, and Acids and Bases as they pertain to secondary school classrooms. A particular emphasis will be to connect content knowledge to modern demonstrations and teaching activities.

**Instructor:** Dr. Allison Meyer  
**Email:** aameyer@ilstu.edu

**Materials:**

**Required:** Access to the ReggieNet Course Website

**Required:** Advanced Chemistry Demonstrations: Kinetics, Equilibrium, and Acids and Bases Course Package (available from Flinn Scientific E-Learning)

**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, except the midterms 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 Kinetics, Equilibrium, and Acids and Bases. 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 59 demonstrations and teaching activities which engage them in a detailed examination of the ways in which current chemistry teachers deliver Kinetics, Equilibrium, and Acids and Bases 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 Kinetics, Equilibrium, and Acids and Bases?
2. What are the safety considerations and risks associated with teaching the Kinetics, Equilibrium, and Acids and Bases? How may the Kinetics, Equilibrium, and Acids and Bases be taught safely in schools?
3. What is the role of the National Standards and State Standards in determining how Kinetics, Equilibrium, and Acids and Bases are taught in schools?
4. What pedagogical techniques are appropriate for teaching Kinetics, Equilibrium, and Acids and Bases in secondary schools?
5. What are the challenges associated with teaching Kinetics, Equilibrium, and Acids and Bases?

Required Student Tasks/Assignments:

1. Students are expected to read each of the following 9 articles from the Journal of Chemical Education and The Chemical Educator. These articles can be obtained within the ReggieNet course and will play a significant role in the two midterm assessments and final assessment for the course.

- Quílez, J. (2008). Students’ and teachers’ inability to transfer the molar concentration concept to aqueous equilibrium solutions. *Chemical Educator, 13*, 61-66. DOI: 10.1333/s00897082119a
2. Students are expected to watch each of the following 15 videos packages. For each video episode within the package there are a series of questions that must be answered.

Each video package has a series of questions that cover the individual episodes presented in that package. The lowest order (Knowledge and Comprehension) of the content questions are designed to ensure that students watch the video. The medium-order (Analysis and Application) and higher-order (Synthesis and Evaluation) questions may require the use of outside resources to generate correct answers.

Additionally, there are pedagogical questions. The lowest order (Knowledge and Comprehension) of the content questions are designed to ensure that students watch the video. The medium-order (Analysis and Application) and higher-order (Synthesis and Evaluation) questions may require the use of outside resources to generate correct answers or to consider the use of activity in their own classroom to determine the correct answer. Finally, there are questions that link the episode to the National Science Education Standards.

**Kinetics / Introduction to Reaction Rates**
- Wax Vapor Combustion in a Test Tube
- Sudsy Kinetics
- Silent Lecture
- Blue Bottle Experiment
- Dragon Breath in a Dust Can

**Kinetics / Rate Laws**
- Rate of Reaction of Sodium Thiosulfate and Hydrochloric Acid
- Iodine Clock Challenge
- How Does a Clock Reaction Work?

**Kinetics / Effect of Temperature on Reaction Rates**
- Reaction Kinetics in Blue
- Lightstick Kinetics

**Kinetics / Catalysis**
- Catalytic Decomposition of Hydrogen Peroxide
- Pink Catalyst
- Catalytic Oxidation of Acetone by Copper
- Magic Genie
- Inhibition of Hydrogen Peroxide
- Ostwald Oxidation of Ammonia

**Kinetics / Activation Energy**
- Smashing Thermit Reaction
- Racquetball Kinetics
- Fuel Cells in Eggshells
- Hand Blasters

**Kinetics / Reaction Pathways**
- Yellow-Blue Switcheroo
- The Funnel Chain
- Cobalt Catalyst and the Activated Complex
- Clock Reaction Race
Equilibrium / Exploring Equilibrium
- Overhead Equilibrium
- Common Ion Effect
- Common Ion Effect Revisited
- Silver "One-Pot" Demonstration

Equilibrium / Models and Simulations
- Equilibrium Demonstrations - The Good, the Bad, and the Ugly!
- Aquarium Analogy with Two Aquaria
- Aquarium Analogy with One Aquarium

Equilibrium / LeChatelier's Principle
- Temperature Equilibrium Tubes
- Upset Tummy? - MOM to the Rescue
- Cobalt Complex Ions
- LeChatelier's Principle and the Solubility of Carbon Dioxide

Acids and Bases / Introduction to Acids and Bases
- The pH is Right Game
- Velcro Gloves and Ball Set
- Indicator Sponge

Acids and Bases / Natural Indicators and Household Substances
- Red Cabbage Indicator
- Natural Indicators
- Goldenrod Messages and Name Tags

Acids and Bases / Acid-Base Indicators
- The "Rainbow Connection"
- Orange Juice and Strawberry Float
- The Sodium Spectrum
- Phenolphthalein is Pink in Base
- Disappearing Ink

Acids and Bases / Neutralization Reactions
- Multi-Use for MOM
- MOM and pH
- Large pH Tube
- pH Rainbow Tube
- Nonadditivity of Volumes

Acids and Bases / Weak Acids and Bases
- Hydrolysis of Salts
- Dry Ice Rainbow of Colors
- Battle of the Acids
- Ammonia Fountain with Bromthymol Blue
- Acidic, Basic and Neutral Salts

Acids and Bases / Buffers
- Bet on Buffers
- Buffering of Lakes
- Buffer Balancing Acts
Grading Scale

Grades in the course are based upon timely completion of each assessment associated with the Research articles and Video episodes.

- 90% – 100% = A
- 80% – 89% = B
- 70% – 79% = C
- 60% – 69% = D
- 0% – 59% = F

The point breakdown for the course is as follows:

- Video assessments: 330 points
- First Midterm: 100 points
- Second Midterm: 100 points
- Final Project: 198 points
- Total Points: 728 points

Assessment Schedule (Fall 2018)

All assignments are due at midnight central time on the following days unless otherwise specified within the course calendar in ReggieNet.

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