

**Illinois State University**  
**Department of Chemistry**  
**CHE 401.02**  
*(previously CHE 489.02)*

**Advanced Chemistry Demonstrations: Chemical Reactions, Stoichiometry and the Mole**  
**3 credit hours**

**Catalog Description:**

**Advanced Chemistry Demonstrations: Reactions, Stoichiometry and the Mole**

**3 F, S, Sum** *CHE 301 or equivalent as prerequisite.* Topical analysis of current best practices in teaching chemical reactions, stoichiometry and the mole as they pertain to secondary school classrooms.

**Instructor:**

**Email:**

**Materials:**

**Required:** Access to the ReggieNet Website

**Required:** Advanced Chemistry Demonstrations: Chemical Reactions, Stoichiometry, and the Mole Course Package (available from link within ReggieNet)

**Catalog Description:**

**Advanced Chemistry Demonstrations: Reactions, Stoichiometry and the Mole**

**3 F,S, Sum** *CHE 301 or equivalent as prerequisite.* Topical analysis of current best practices in teaching chemical reactions, stoichiometry and the mole as they pertain to secondary school classrooms. A particular emphasis will be to connect content knowledge to modern demonstrations and teaching activities.

**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 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 should contact Disability Concerns at 350 Fell Hall, 438-5853 (voice), 438-8620 (TTY).

**Course Overview and Objectives:**

This course constitutes a survey course of ways in which we can understand and teach chemical reactions, stoichiometry and the mole. 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 54 demonstrations and teaching activities which engage them in a detailed examination of the ways in which current chemistry teachers deliver chemical reactions and stoichiometry 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 chemical reactions and stoichiometry?
2. What are the safety considerations and risks associated with teaching the chemical reactions and stoichiometry? How may the chemical reactions and stoichiometry be taught safely in schools?
3. What is the role of the National Standards and State Standards in determining how the chemical reactions and stoichiometry are taught in schools?
4. What pedagogical techniques are appropriate for teaching the chemical reactions and stoichiometry in secondary schools?
5. What are the challenges associated with teaching the chemical reactions and stoichiometry?

### **Required Student Tasks/Assignments:**

**1. Students are expected to read each of the following 8 articles from the Journal of Chemical Education and The Chemical Educator. These articles can be accessed within ReggieNet and will play a significant role in the two midterm assessments for the course.**

Eichler J. F. *Chem. Educator* 2007, 5, 347–348, Using a Precipitation Reaction in a Guided-Inquiry Stoichiometry Laboratory <http://chemeducator.org/papers/0012005/12070347je.pdf>

Bird, L. *Chem. Educator* 2006, 6, 380-382 Stoichiometric Calculations Using Equivalent Molar Expressions. <http://chemeducator.org/papers/0011006/11060380lb.pdf>

Yang, S-P. *Chem. Educator* 2002, 1, 37-39 Household Products Used To Collapse Closed Containers and Demonstrate Avogadro's Law  
<http://chemeducator.org/papers/0007001/710037sy.pdf>

McMinn, D. *J. Chem. Educ.* 1984, 61 (7), p 591 Coffee, coins, and limiting reagents  
<http://pubs.acs.org/doi/pdf/10.1021/ed061p591.1>

Szabadvary, F. *J. Chem. Educ.* 1962, 39 (5), p 267 The birth of stoichiometry.  
<http://pubs.acs.org/doi/pdf/10.1021/ed039p267>

Treptow, R.S. *J. Chem. Educ.*, 2010, 87 (2), pp 168–171 Carbon Footprint Calculations: An Application of Chemical Principles <http://pubs.acs.org/doi/pdf/10.1021/ed8000528>

Oliver-Hoyo, M.T., Pinto, G., Llorens-Molina, J.A. *J. Chem. Educ.*, 2009, 86 (11), p 127 The Chemistry of Self-Heating Food Products. An Activity for Classroom Engagement  
<http://pubs.acs.org/doi/pdf/10.1021/ed086p1277>

Mills, K.V., Guilmette, L.W., *J. Chem. Educ.*, 2007, 84 (2), p 326 Thermochemical Analysis of Neutralization Reactions: An Introductory Discovery Experiment  
<http://pubs.acs.org/doi/pdf/10.1021/ed084p326>.

**2. Students are expected to watch each of the following 12 videos packages. For each video package, there are a series of questions that must be answered.**

Each video package has 25-30 questions that cover the individual episodes presented in that package. There are a total of 11 assessments that cover the video packages (*note: the Limiting/Excess Reactants Package and Stoichiometry Package are short packages and have therefore been combined into the same assessment*). Each assessment has a variety of question sets associated with it. The first set of questions is content 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. The second set of questions is 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 is a set of questions associated with safety and linking the episode to the National Science Education Standards.

**Synthesis Reactions**

*Classifying Chemical Reactions—Synthesis*  
*Fuel Cells in Eggshells*  
*The Chef*  
*Reaction of Iodine and Aluminum*  
*"Underwater Fireworks" Reaction of Chlorine and Acetylene*

**Decomposition Reactions**

*Catalytic Decomposition of Hydrogen Peroxide*  
*Simple Electrolysis*  
*Elephant Toothpaste*  
*Production of Sodium Carbonate Lab*  
*Magic Genie*

**Single Replacement Reactions**

*The Floating Tin Sponge*  
*Foiled Again*  
*Smashing Thermite Reaction*  
*Safe Swimming with Sodium*

**Double Replacement Reactions**

*Classifying Chemical Reactions - Double Replacement*  
*Colorful Stalactites and Stalagmites*  
*Overhead Precipitation*  
*Solubility Patterns*  
*Carbide Cannon*

**Bob Becker's Favorite Combustion Reaction Demonstrations**

*Methane Mamba*  
*Flame Tornado & Water Jug Race*  
*An Egg-splosive Demonstration*  
*Flaming Vapor Ramp*  
*Wax Vapor Combustion in a Test Tube*

**Combustion Reactions**

*Ditto Rockets*

*Gun Cotton*  
*The Candle Snuffer*  
*Magnesium and Dry Ice*  
*The Hungry Dragon*

### **Combustion of Alcohols**

*Extreme Whoosh Bottle Trio*  
*Plenty Powerful Ping Pong Popper*  
*Big Time Ethyl Alcohol Explosion*  
*Canned Heat*  
*Giant Alcohol Cannon*

### **Reactions of Calcium Carbide—Combustion of Acetylene**

*Instant, Instant Coffee*  
*Flammable Ice*  
*Combustion of Acetylene*  
*Knock Your Socks Off*  
*Getting a Bang Out of Chemistry*

### **Introduction to The Mole Concept**

*Pie Demo*  
*Mole Lab*  
*Moles in Space*  
*Bomb Bag*

### **Mole Relationships and the Balanced Equation**

*Decomposition of Baking Soda*  
*Target Mole Lab*  
*Target Stoichiometry Lab*  
*Synthesis of Manganese(II) Chloride*

### **Limiting and Excess Reactants**

*Micro Rocket Lab*  
*Bottles and Caps - An Analogy to Stoichiometry*  
*Fuel Cell Football*

### **Stoichiometry in Combustion Reactions**

*Carbide Cannon*  
*Stoichiometry in Combustion of Acetylene*  
*Big Time Ethyl Alcohol Explosion*  
*Ethanol Explosion*

## **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:	315 points
First Midterm:	120 points
Second Midterm:	120 points
<u>Final Project:</u>	<u>140 points</u>

Total Points:

695 points

**Assessment Schedule (Spring 2019)**

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

<u>Due Date:</u>	<u>Assignment:</u>
Jan 30	Quiz 1
Feb 6	Quiz 2
13	Quiz 3
20	<b>Midterm 1</b>
27	Quiz 4, <i>Midterm 1 Peer Reviews</i>
March 6	Quiz 5
20	Quiz 6, <b>Midterm 2</b>
27	Quiz 7, <i>Midterm 2 Peer Reviews</i>
April 3	Quiz 8,
10	Quiz 9,
17	Quiz 10,
24	Quiz 11,
May 1	<b>Final Project</b>
8	<i>Final Project Peer review</i>