Illinois State University
Department of Chemistry
CHE 401.01
(previously CHE 380.61)
Advanced Chemistry Demonstrations: Gas Properties, Laws, and Reactions
3 credit hours

Catalog Description:
Advanced Chemistry Demonstrations: Gas Properties, Laws, and Reactions
3 F, S, Sum *CHE 301 or 401 (any other topics) or 402 or 403 or equivalent as prerequisite.*
Structured analysis of current best practices in teaching gas properties and reactions as it pertains to secondary school classrooms. A particular emphasis will be to connect content knowledge to modern demonstrations and teaching activities.

Instructor:

Dr. Willy Hunter

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Materials:

Required: Access to the ReggieNet Course Website

Required: Advanced Chemistry Demonstrations: Gas Properties, Laws, and Reactions Course Video Website (https://www.flinnsci.com/gas-laws-properties-and-reactions/che401.01/)

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 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 Student Access and Accommodation Services at 350 Fell Hall, 309 438-5853 (voice), 309 438-8620 (TTY).

Course Overview and Objectives:
This course constitutes a survey course of ways in which we can understand and teach gas properties and reactions. 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 gas law 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 the nature of gases and gas reactions?
2. What are the safety considerations and risks associated with teaching the gas laws? How may the gas laws be taught safely in schools?
3. What is the role of the National Standards and State Standards in determining how the gas laws are taught in schools?
4. What pedagogical techniques are appropriate for teaching gas laws and properties in secondary schools?
5. What are the challenges associated with teaching the gas laws?

Required Student Tasks/Assignments:

1. Students are expected to read each of the following 5 articles from the Journal of Chemical Education and The Chemical Educator. For each article, there is a set of assessment questions within ReggieNet that must be answered.

K. E. Brown, A. Micklos, J. S. Carver, and W. J. F. Hunter, *Chem. Educator* 2004, 9, 220–223, A teaching plan for introducing gas properties
http://chemeducator.org/papers/0009004/940220wh.pdf

W. D. Bare* and L. Andrews, A demonstration of ideal gas principles using a football. *Journal of Chemical Education* • Vol. 76 No. 5 May 1999
http://www.jce.divched.org/Journal/Issues/1999/May/PlusSub/V76N05/p622.pdf

L. H. Adcock, The egg in the bottle revisited: Air pressure and Amontons' law (Charles' law) Vol. 75 No. 12 December 1998 • *Journal of Chemical Education*
http://www.jce.divched.org/Journal/Issues/1998/Dec/PlusSub/V75N12/p1567.pdf

H. Lin* and H. Cheng, The Assessment of Students and Teachers' Understanding of Gas Laws Vol. 77 No. 2 February 2000 • *Journal of Chemical Education.*

D. Davenport and R. Roe, Why Do We Teach Gas Laws? Volume 62 Number 6 June 1985 *Journal of Chemical Education.*

2. Students are expected to watch each of the following 13 videos packages. For each video package there are a series of questions that must be answered.

Each video package has content and pedagogical questions associated with it. 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 lowest order (Knowledge and Comprehension) of the pedagogical 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. Additionally, there are questions that link the episodes in each video package to the National Science Education Standards.

Properties of Hydrogen

Exploding Hydrogen Bubbles in your Hands
Combustion of Hydrogen
The Bottomless Bottle Explosion

Properties of Carbon Dioxide

Pouring and Siphoning a Gas
The Candle Snuffer
Carbon Dioxide Fire Extinguisher

Properties of Ammonia

Ammonia Fountain with Bromthymol Blue
Pink Panther Breath—Macroscale
Pink Panther Breath—Microscale
Solubility of Ammonia
How to Generate Ammonia Gas

Hydrogen and Oxygen Explosions

Fuel Cell Football
Pringle Can Rocket
Hindenburg Day

Dry Ice Demonstrations

Dry Ice Demonstrations
Dry Ice Color Show
Wet Dry Ice Labs

Flammability of Gases

Methane Mamba
Methane Bubbles
Big 4-Foot Burner
Flammable Vapor Demonstration

What is Pressure?

Can Crush
The Egg In and Out
Balloon in the Flask
Egg Sucker
A New Approach for the Balloon in the Flask

The Power of Pressure

Hydraulic Elevator
Board Breaker
A New Magdeburg Sphere
The Power of Air—Human Shrink Wrap
How Airplanes Stay Aloft

Introduction to Gas Laws

Gas Laws
Penney's Quick Silent Demos

Boyle's Law

Boyle's Law Lab

Pressure vs. Volume and Boyle's Law
Marshmallow in a Vacuum
Cartesian Diver-sions

Kinetic Molecular Theory and PVT

Instant Hot Air Balloon
Charles Law and Absolute Zero
Straw Pressure Popper
Kinetic Energy Demonstration
PTV Made Simple with Liquid Nitrogen

The Ideal Gas Law Applications

Target Gas Law Lab
Dust Blaster
Density of Gases

Diffusion of Gases

Rates of Diffusion
Gaseous Diffusion and Effusion
Gee Whiz Effusion of Gases

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:	370 points
Article assessments:	70 points
Final Project:	140 points
Total Points:	580 points

Assessment Schedule (Summer 2019)

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

Due Date:		Assignment:
June	12	Article 1; Quiz 1 & 2
	19	Article 2; Quiz 3 & 4
	26	Quiz 5; Quiz 6
July	03	Article 3; Quiz 7 & 8
	10	Article 4; Quiz 9 & 10
	17	Article 5; Quiz 11 & 12
	24	Quiz 13; **Final Project**
	26	*Final Peer Reviews*