Chemistry, life, the universe and everything

Melanie M Cooper(1), cmelani@clemson.edu, 259 Hunter Chemistry Laboratories, Clemson University, Clemson SC 29634, United States.

Chemistry plays a central role in scientific understanding, and General Chemistry is the university course where most students begin – and end – their chemical education. It is where many teachers of physical science and chemistry learn most of their relevant chemistry, and as such is the course with the greatest impact on the public perception, knowledge and understanding of chemical principles.

There have been numerous calls for reform of chemistry education. White papers have been issued, committees convened, curricula developed, and tests written. Enormous amounts of time, energy, and money have been devoted to the reform of general chemistry, yet few are satisfied with the outcomes and little seems to have changed. Is there hope? We believe so. This presentation will focus on how and why an understanding of basic chemistry concepts is important for everyone, and how we might change our approach to chemistry education to achieve a deeper understanding.

"Chemistry of Air, Space, and Water": Ready-to-use resources from the Journal of Chemical Education

Erica K. Jacobsen(1), jacobsen@jce.acs.org, 1204 Richmond St., The Dalles OR 97058, United States; Norbert J. Pienta(2), norbert-pienta@uiowa.edu, 323J CB, Iowa City IA 52242, United States; Laura E. Slocum(3), lslocum@universityhighschool.org, 2825 W. 116th St., Carmel IN 46032, United States.

Chemistry has been described as "being all around us". This extends to areas that we may not immediately think of, including the air that we breathe here on the Earth's surface and interactions high into our atmosphere and beyond. The chemistry of these topics can be integrated into the curriculum using already available teaching materials, including hands-on activities that use low-cost materials from grocery and hardware stores. Presenters will share several ready-to-use resources from the Journal of Chemical Education (JCE) related to the meeting's "Chemistry of Air, Space, and Water" theme. As time permits, participants will experience a hands-on JCE Classroom Activity related to the theme, and learn about materials such as using Kool-Aid powdered drink mix to discuss air pollution, the use of the movie October Sky, and more.

ACS in Colorado: Programs for your classroom and beyond

Greta Glugoski-Sharp(1), Greta_Glugoski-Sharp@smnet.org, 4545 South University Boulevard, Englewood CO 80113, United States; Sandra J Smith(2), smiths@d11.org, 301 North Nevada Ave., Colorado Springs CO 80903, United States.

This rapid-fire session will introduce participants to several programs for high school chemistry students and teachers. Information and experiences will be shared about high school chemistry clubs, Project SEED, National Chemistry Week, Chemistry Olympiad, Chemists Celebrate Earth Day, and ACS High School Chemistry Awards.

Introduction to POGIL, Process Oriented Guided Inquiry Learning

Mary Bartholomew(1), mbartholomew@cherrycreekschools.org, 16100 E. Smoky Hill Rd, Aurora Colorado 80015, United States; Cheryl Paricio(1), 1 Smoky Hill High School, Aurora Colorado 80015, United States.

This high school program will introduce POGIL, Process Oriented Guided Inquiry Learning. POGIL is a student-centered strategy that focuses on core concepts and encourages a deep understanding. POGIL develops process skills such as critical thinking, problem solving, and communication through collaboration and reflection. Students are engaged in learning when given the opportunity to work together and to construct their own understanding.

Green chemistry: New eyes and new ideas in science

John C. Warner(1), john.warner@warnerbabcock.com, 100 Research Drive, Wilmington MA 01887, United States.

We constantly hear rumblings regarding the inability of scientists to innovate "like they used to". We hear about the hazards of chemistry and the desperate need to put society on a sustainable pathway. We scientists worry about the general public's lack of appreciation or ability to understand basic science. It is an inescapable reality that the next generation of students in chemistry will be living and working in a very different world than the previous generation. Despair is not an option. The future is brighter than ever. We need to attract the next generation of students into the optimistic promise of green chemistry. The evolution of Green Chemistry is happening around us. Industrial labs are embracing the principles and
Academic Departments across the country are reorienting their curriculum. This discussion will explain why students (and their middle school and high school teachers) need to know that they are essential to achieving a sustainable future. Albert Einstein once said that “No problem can be solved at the same level of awareness that created it”. We need a diversity of students that have new perspectives and new ideas, to help us chart our path forward.

CHED 6

Does age make a difference? Examining how middle school and college students learn from simulations

Emily B. Moore(1), emily.moore@colorado.edu, UCB 390, Physics Dept, Boulder CO 80309, United States ; Kelly Lancaster(1); Noah Podolfsky(1): Katherine Perkins(1). (1) Department of Physics, University of Colorado, Boulder CO 80309-0215, United States

The PhET project includes a collection of more than 100 research-based, interactive simulations – environments in which students can learn using scientist-like exploration and experimentation. While the simulations are designed and tested with undergraduate students, our recent studies of their use in middle school classrooms suggest that the simulations can be used effectively with 5th-8th grade students. In this talk, we present comparisons between undergraduate and middle school student use of chemistry simulations on the topics of: atomic structure, balancing chemical equations and states of matter. From these comparisons, we have extracted design principles for development of middle school simulations, as well as insights into the similarities and differences of learning the foundations of chemistry from 5th graders to college freshmen.

CHED 7

Can construct maps characterize student learning of big ideas: An examination of middle-school student learning of chemical reaction

Nirit Glazer(1), nirit.glazer@gmail.com, 2416 Stone Road, Ann Arbor Michigan 48105, United States ; Issa Salame(1), salame@sci.ccny.cuny.edu, 160 Convent Avenue, New York NY 10031, United States ; Samema Sarowar(1); Sazea Begumi(1). (1) Education, University of Michigan, Ann Arbor Michigan 48105, United States

Recent reports stress that students need to develop an integrated understanding of science, particularly with a focus on core concepts in science. This study characterizes 7th grade students' learning of a core idea in scientific literacy (chemical reaction) as they participate in a coherent curriculum. In this study I used construct maps (a graphical representation of a consecutive continuum of the understanding of a specific construct) to guide the development and analysis of assessment items aimed at finding evidence for learning and monitoring student progress in learning of a specific idea at specific points in the curriculum. In the presentation, I will describe the specific construct maps and the main findings in relation to their contribution to the field and its implications for teaching. For instance, teachers can use the construct maps to inform their lesson plans, to establish connections among sub-ideas that are taught, and to guide their assessment.

CHED 8

Understanding of atomic representations: Role of inquiry in learning

Issa Salame(1), salame@sci.ccny.cuny.edu, 160 Convent Avenue, New York NY 10031, United States ; Samema Sarowar(1); Sazea Begumi(1). (1) Chemistry, The City College of New York, United States

The objective of this study is to examine how inquiry-based learning influences students' interpretations and understanding of atomic representations. Developing conceptual understanding of atomic structure is essential to a better understanding and learning of chemistry concepts. This research study took place at the City College of New York as part of a summer enrichment program for rising tenth through eleventh grade students from New York City schools. The program is academically selective. The qualitative data presented here are based on an open-ended questionnaire that was given to the students on a pre and post inquiry-based instruction. Our data shows that students struggle with understanding of atomic structure and its representations, but tremendously improve as a result of being exposed to inquiry-based learning.

CHED 9

Shedding light on a well-worn teaching paradigm: Asking students to think about how to design a successful experiment and watching them learn why research in chemistry is valuable, creative, and fun

David A. Laviska(1), dlaviska@eden.rutgers.edu, 610 Taylor Road, Piscataway New Jersey 08854, United States ; Kathleen D. Field(1); Alan S. Goldman(1). (1) Department of Chemistry and Chemical Biology, Rutgers, the State University of New Jersey, Piscataway New Jersey 08854, United States

Secondary school and undergraduate chemistry students generally have limited understanding of the requirements of post-graduate study. While the respective chemistry curricula usually include well-researched and reliable classroom or laboratory experiments, these scripted exercises offer little insight into what it takes to be an independent researcher. After experimenting with several curricula for the high school classroom, our team of graduate students found unexpected and exciting rewards with a paradigm in which high school students are directed to design, conduct, and present the results of their own unique experiments, without a pre-determined methodology. Since students are seldom given the opportunity to be creative in the planning of experiments, the
process of independently forming a hypothesis and testing it sheds new light on a well-worn teaching model, and has proven to be an unexpectedly valuable pedagogical tool for both students and their teachers.

CHED 10
Research-inspired laboratory modules in general chemistry: Analysis of student perceptions and performance
Kurt Winkelmann(1), kwinkel@fit.edu, 150 West University Blvd, Melbourne FL 32901, United States; Monica H. Baloga(1); George Anquandah(1); Peter Cohen(1). (1) Department of Chemistry, Florida Institute of Technology, Melbourne FL 32901, United States

Research-inspired, multi-week inquiry modules were introduced to the general chemistry laboratory in order to improve students perceptions and knowledge of chemical research. Students completed a variety of surveys to determine their views and understanding at the beginning and end of the semester. Results gathered during the 2010 academic year show mixed results – in some cases students showed clear increases in overall confidence in their abilities as researchers but no change in other aspects of their views or abilities. Student groups include those who completed general chemistry I during their first semester of college as well as those who failed the course and enrolled again during the next semester. The vast majority of students are studying science and engineering, though not many students majored in chemistry. This presentation will describe a thorough analysis of the data and the survey instruments used.

CHED 11
Singapore student understanding of chemistry laboratory safety
Wendy E Schatzberg(1), wendy.schatzberg@gmail.com, 516 High Street, MS9150, Bellingham WA 98225, United States; Baohui Zhang(2). (1) Chemistry, Western Washington University, bellingham WA 98225, United States (2) National Institute of Education Singapore, Singapore

The analysis of what misconceptions are occurring with students is of importance from both the safety aspect and from science theory application. Students need to be able to apply scientific theory to laboratory work and be able to interpret science concepts to their own chemical safety considerations. Different countries may teach chemical safety in unique ways, and to develop an overall curriculum teaching students about chemical safety without the creation of alternative conceptions is vital. The impact of this research study was in identifying common misconceptions in Singapore to determine what may be causing students' misconceptions. This was done to increase the effectiveness of safety training in undergraduate laboratories by decreasing accidents due to student misconceptions. The central objective of the proposed research was to understand what alternate conceptions about chemistry and laboratory safety were prevalent within chemistry laboratory classes. The goal of the questionnaire was to assess the typical student's misconceptions about safety practices within a chemistry laboratory class. The questionnaire was analyzed by identifying key words and concepts for the given situations posed to the students.

CHED 12
Impact of graduate teaching assistants' conceptions on their students' academic performance in general chemistry
Tanya Gupta(1), tgupta@iastate.edu, 3051 Gilman Hall, Ames IA, United States; K. A. Burke(1); Thomas J. Greenbowe(1). (1) Chemistry, Iowa State University, Ames IA 50011, United States

Graduate teaching assistants play an important role in undergraduate laboratory instruction and small group recitation/ discussion sessions. In large classrooms where course professors teach in a class size of 150-200, students rely heavily on their teaching assistants to review the concepts and help them solve problems. In this study at a state university, graduate teaching assistants were interviewed on their approaches to problem solving in stoichiometry and thermochemistry. Preliminary findings indicate that some of the graduate students struggle with the problems in the same way as college freshmen. The study also sheds light on the impact of teaching assistants conceptions on specific problems on exams and the overall academic performance of their students.

CHED 13
Literature-based model for organic laboratory
Dell W Jensen(1), delljensen@augustana.edu, 639 38th Street, Rock Island IL 61201, United States; Richard M Narske(1). (1) Department of Chemistry, Augustana College, Rock Island IL 61201, United States

Traditional organic laboratory generally consists of a series of “cookbook” experiments that requires little or no engagement on the part of the students. POGIL, open inquiry-based, question-driven laboratories have addressed this issue and we will present a new literature-based model to add to the laboratory options. JCE's “In the Laboratory” was our inspiration and resource for this new model. Students are provided a selection of articles and are expected to read and interpret the article, develop an experimental procedure, reproduce the experiment and explain their results. Students complete a range of experiments covering various organic topics within laboratory guidelines. Students use formal reports based on the ACS Style Guide for scientific paper to communicate their results. Our assessment examines student
performance, SALG (Student Assessment of Learning Gains) data and student demographic information to evaluate the learning goals of our model.

CHED 14

Applying the principles and practices of green chemistry in undergraduate organic chemistry courses

Sudhir B. Abhyankar(1), sudhir@swgc.mun.ca, University Dr., Corner Brook NL, A2H 6P9, Canada. (1) Environmental Science- Chemistry, Grenfell Campus, Memorial University of Newfoundland, Corner Brook NL, A2H 6P9, Canada

Second and third year organic chemistry courses provide a great opportunity to teach the principles and practices of green chemistry in the lecture and the laboratory. We have designed and modified a number of experiments in which students carry out reactions under solid-state conditions, use microwave radiation to reduce reaction times, use greener solvents as well as use biomaterials to carry out stereoselective reactions. This presentation will outline the pedagogical approach of our efforts to green the undergraduate organic lecture and laboratory courses.

CHED 15

Greening your organic curriculum in lecture and laboratory

Andrew P. Dicks(1), adicks@chem.utoronto.ca, 80 St. George Street, Toronto Ontario M5S 3H6, Canada; Robert A. Batey(1). (1) Department of Chemistry, University of Toronto, Toronto Ontario M5S 3H6, Canada

This paper covers development and impact of green laboratory experiments and associated lecture material during the past seven years at the University of Toronto. Our published procedures focus on sustainability issues: low-solvent or solventless reactivity, water as a reaction medium, energy efficiency, organocatalysis, phase-transfer catalysis and transition-metal catalysis. They are presented in the context of synthesizing “real-world relevant” compounds: e.g. a non-steroidal anti-inflammatory analog. The experiments have been adopted at many other institutions around the world and have lead to creation of both a catalytic organic chemistry course and a Synthetic and Catalytic Chemistry undergraduate program. In addition, a unique textbook (“Green Organic Chemistry in Lecture and Laboratory”) will be published in August 2011 which is aimed specifically at organic and general chemistry instructors. The experienced contributors discuss concrete examples of green organic chemistry teaching approaches from both lecture/seminar and practical perspectives.

CHED 16

Undergraduate laboratory renaissance for organic chemistry

Rich Gurney(1), richard.gurney@simmons.edu, 300 The Fenway, Boston MA 02115, United States; Nancy Lee(1); Changqing Chen(1). (1) Department of Chemistry and Physics, Simmons College, Boston MA 02115, United States

Simmons College has undertaken a fundamental reengineering of the laboratory science program in chemistry, biology and physics. This redesign utilizes ongoing faculty research projects as the basis for course-based laboratory work. We will explain the concept, design, implementation, and assessment of this approach to organic chemistry laboratory instruction, in which green chemistry principles were designed as a primary foundational building block. The seminar will present in detail - the issues involved in redesigning a course laboratory around a research project, the difficulties encountered and the benefits accrued from this curricular redesign and the assessment results from the first three years of our W. M. Keck Foundation supported program.

CHED 17

Implementing green strategies in a traditional organic chemistry laboratory course

Robyn M Hyde(1), rhyde@westminstercollege.edu, 1840 S 1300 East, Salt Lake City UT 84105, United States. (1) Department of Chemistry, Westminster College, Salt Lake City UT 84105, United States

At most institutions, it is probably the Organic Chemistry Laboratory that generates the majority of the waste that must be disposed and usually at a significant expense. For students to learn the techniques commonly employed in an organic lab, they must have hands-on training that requires the use of good amounts of halogenated and non-halogenated materials. If work is done on micro-scale, this does lower the amount of waste however; students often then do not have enough material to work with. The green strategy that is employed at Westminster College is to reuse materials as much as possible. For example, most materials synthesized as part of the Organic Chemistry II laboratory are reused the next year in the Organic Chemistry I laboratory. Chemicals are continually recycled from year to year. It has been found that employment of this strategy has reduced the amount of material that is generated as waste and reduced the amount of money that is spent buying chemicals. Additionally, with the adoption of this strategy, it allows laboratory instructors the opportunity to talk about the environmental responsibility chemists have and how it is always important to continually improve techniques to advance the precepts of sustainability.

CHED 18

Designing a Lewis acid-based catalytic system for running the Diels-Alder reaction in water

Alexander Hildreth(1), hildreth.alex@gmail.com, 893 West St, Amherst MA 01002, United States; Rayane Moreira(1). (1)
We have attempted to design and test a novel dienophile for use in running aqueous, Cu(II)-catalyzed Diels-Alder reactions. Our system is based off one introduced by Otto and Engberts in 1996 and further explored by Ishihara et al. in 2006, in which a Cu(II) Lewis acid activates a trans double bond for Diels-Alder reaction by electron density withdrawal. The aqueous environment has been shown to greatly increase reaction speed over uncatalyzed trials in organic solvent, as well as impart greater enantioselectivity. We have attempted to further improve the enantioselectivity of Ishihara’s dienophile by imparting axial chirality through addition of a naphthalene ring.

CHED 19
Developing green Diels-Alder reactions for the undergraduate organic laboratory

Mark S. Erickson(1), ericksonm@hartwick.edu, 457 Johnstone Science Center, Oneonta NY 13820, United States . (1) Department of Chemistry, Hartwick College, Oneonta New York 13820, United States

Green chemistry topics are important additions to the undergraduate chemistry curriculum. As part of a continuing effort to green organic chemistry laboratory experiments, a classic Diels-Alder reaction using cyclopentadiene and maleic anhydride in hydrocarbon/ethyl acetate solvents was targeted for greening. Initial efforts that focused on replacing organic solvents with water resulted in a successful aqueous Diels-Alder reaction between cyclopentadiene and maleic acid, which proved to be a suitable experiment for a three to four hour laboratory period. To further green the experiment, volatile organic compounds (VOC’s) were eliminated by developing a Diels-Alder reaction between 2-furfuryl alcohol and maleimide, which was complete in less than two hours using both aqueous and solventless conditions. 2-Furfuryl alcohol showed an enhanced reactivity as a diene when compared to other monosubstituted furans.

CHED 20
Synthesis of an oxime dienophile for aqueous Diels-Alder reactions

Emma Shaffer(1), eyshaffer@gmail.com, 893 West Street, PO Box 304, Amherst MA 01002, United States ; Rayane Moreira(1), (1) Department of Natural Science, Hampshire College, Amherst MA 01002, United States

Our research is in developing a dienophile to participate in a catalytic cycle in which the Diels-Alder product is easily and selectively hydrolyzed to give a synthetically useful cycloadduct as well as a dienophile derivative. Although eventual hydrolysis is required in the system, it is important that it not occur prematurely. The imine bond can not hydrolyze before reaction occurs or the system will fail. We are currently in the process of synthesizing an oxime dienophile compound to be tested.

CHED 21
Nanotechnology laboratory activities for arts and communications students

Keith S Kostecka(1), kkostecka@colum.edu, 600 S. Michigan Avenue, Chicago Illinois 60605, United States . (1) Department of Science and Mathematics, Columbia College - Chicago, Chicago Illinois 60605, United States

At Columbia College - Chicago, students in art, drama, music, television, film/video, radio, journalism, dance, etc. are able to take the interdisciplinary laboratory centered course “Introduction to Nanotechnology”. In this course, students are introduced to the history of nanotechnology; properties of matter and the periodic table and how nanotechnology is, and will be, important in: self-assembly; lithography and nanofabrication; health and medicine; pollution clean-up; consumer applications and the potential risks of this science area. The students conduct laboratory activities on: proportional reasoning; forming gold nano-particles; silver nano-particle synthesis; preparation of polyurethane; nano-scale patterning using soft lithography; creation and spectroscopy of cadmium selenide quantum dot nano-particles; investigating antibiotic properties of silver; isolation of ferrofluid nano-particles; construction of a solar cell and assembly of a nanoparticle stained “glass window”. Utilization of AFM (atomic force microscopy) data from the University of Illinois at Springfield is also being investigated for inclusion into our curriculum.

CHED 22
The design and psychometric analysis of a GOB chemistry concept inventory
Corina E Brown\textsuperscript{(1)}, Corina.Brown@unco.edu, 3480 Ross Hall, Greeley CO 80639, United States ; Richard M Hyslop\textsuperscript{(2)}; Jack Barbera\textsuperscript{(3)}. (1) Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States (2) Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States (3) Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States

CHED 23

Producing educated citizens and consumers

David A Katz\textsuperscript{(1)}, dkatz@pima.edu, 2202 W Anklam Rd, Tucson AZ 85709, United States . (1) Department of Chemistry, Pima Community College, Tucson AZ 85709, United States

Is your non-major course a watered-down general chemistry course? Is it taught by full-time faculty or is it relegated to the newest member of the department or an adjunct teacher? What do you expect the students to gain from the course? Although a long-time teacher of the non-major chemistry course, this author has been developing and modifying two non-major chemistry courses, Chemistry and Society and Consumer Chemistry for over 15 years with the goal of producing scientifically literate individuals. Although textbooks were used previously, there were, in the author's opinion, no suitable textbooks to cover the range of topics desired. The Internet was still in its infancy without the diversification available today, but there were still many resources available. Currently, the courses are taught as hands-on lecture-laboratory courses without a textbook, relying on information in articles and links and laboratory experiments on the author's course web pages.

CHED 24

Experiential Chemistry: A unique laboratory course designed for non-majors

Marc L Richard\textsuperscript{(1)}, marc.richard@stockton.edu, PO Box 195, Pomona NJ 08240, United States ; Jonathan Griffiths\textsuperscript{(1)}. (1) Chemistry Program, The Richard Stockton College of New Jersey, Pomona NJ 08240, United States

The presentation of chemistry by an experiential approach can be particularly exciting for non-science majors. Over the years, chemical educators have developed hundreds of spectacular demonstrations designed to illustrate various chemical principles. Some of these are merely shown to students, whose only involvement is visual. Others are presented, without explanation, as “magic”. Still others are presented in such a sterile atmosphere that the excitement is frequently lost. Experiential Chemistry is an attempt to change the level of engagement with science by actively involving the student in every experiment.

To a large extent, the teaching of science concentrates on the early mastery of factual material before the students are allowed to explore the interesting problems. The approach used in this course reverses this traditional pattern. Students are first presented with a series of exciting experiments and are allowed to experience the excitement of chemistry. Once their curiosity has been aroused, once they ask, “Why?”, they are ready for an answer and to begin to work with the underlying chemical principles. Students in Experiential Chemistry work in the laboratory each day to develop an understanding of: the process of doing chemistry, the nature of chemists and chemistry, and the question asking, experimentation and communication skills essential for the practice of chemistry. The experiences, class discussions, and a variety of writing assignments give non-science students a unique and exciting introduction to chemistry and the practice of science.

CHED 25

Teaching an organic / biochemistry semester course to non-majors in the health science fields: Putting the biochemistry first!

Deanna L Warner\textsuperscript{(1)}, dwarnersalemstate.edu, 352 Lafayette Street, Salem MA 01970, United States . (1) Department of Chemistry & Physics, Salem State University, Salem MA 01970, United States

In the traditional two semester chemistry course sequence for non-majors in the health science fields, the first semester is devoted to general chemistry and the second semester is
devoted to a mixture of organic and biochemistry. In that second semester course, the organic chemistry portion is traditionally presented first to the student, followed by the biochemistry portion. Unfortunately this approach sometimes results in the loss of interest by the student, as no immediate, clear connection is established between chemistry and the health science fields. The focus of this presentation is to lay out a pathway to presenting the biochemistry portion of the course throughout the entire semester, with organic chemistry given a supporting role.

CHED 26

Helping the non-science major recognize the scientist buried within

Jack Hayes(1), jhayes@sfccmo.edu, 3201 W 16th St, Sedalia Missouri 65301, United States. (1) State Fair Community College, Sedalia Missouri 65301, United States

The non-major chemistry course at State Fair Community College has undergone several evolutions, which have resulted in several positive outcomes. By implementing larger blocks of time for meetings, application of a studio-learning environment, a web-enhanced curricula, and a focus on scientific reasoning we have been successful in helping open majors realize the potential of a science career and the value of scientific research. By the end of the semester in addition to typical chemistry outcomes, the learners can (limited by content knowledge) find and evaluate primary literature; they can locate and summarize MSDS’s and they design research projects. Even more pleasing to the institution is the increased awareness of science as a career choice evidenced by the number of declared science majors and anecdotal evidence from alumni personally communicating their choice of a science career.

CHED 27

Expanding the walls of the classroom

Brian Hatak(1), BHatak@jps.k12.co.us, 2201 E Dry Creek Rd, Littleton CO 80122, United States. (1) Arapahoe High School, Littleton CO 80122, United States

Over the past few years multiple tools have been developed which allow a classroom teacher to expand the learning cycle outside of the classroom in structured and meaningful ways. This presentation will focus on uses of two classroom tools to expand the learning time. First, some uses of Moodle will be presented. Moodle is an open-source classroom management system with different tools that can be used to further student learning and shape classroom planning. Additionally, Google documents provide a user-friendly format for gathering and sharing class information and content. Moodle and Google documents can be used along with traditional classroom presentations or with differentiated learning classrooms to further learning and understanding. This conversation will center on some methods aimed at keeping students engaged in the learning cycle.

CHED 28

Visible spectroscopy in the chemistry classroom

Sally B Mitchell(1), sbmitchell2@gmail.com, 6400 Fremont Road, East Syracuse NY 13057, United States; Dick McGraw(2). (1) Department of Chemistry, East Syracuse Minoa High School, East Syracuse NY 13057, United States (2) Molecular Spectroscopy, Thermo Scientific, San Jose CA 95134, United States

Visible spectroscopy in the chemistry classroom will introduce the high school teacher to the history, theory and applications of spectroscopy. This talk will help to tie the high school curriculum to the applications of instrumentation available to us today.

CHED 29

Redesigning the laboratory investigation: Integrating inquiry into chemistry

Cece Schwennsen(1), cschwennsen@gmail.com, 1960 Cate Mesa Rd., Carpinteria CA 93013, United States; Angela R Powers(2). (1) Cate School, Carpinteria CA 93013, United States (2) Metropolitan State College of Denver, Denver CO 80217-3362, United States

Learn how tried-and-true chemistry laboratory activities can be transformed into investigations that engage students while helping them to develop abilities for and understandings about inquiry. Scientific inquiry is an essential component of national, state, and local science standards. Few chemistry texts, however, provide targeted instruction about inquiry or practice in the skills and abilities necessary to do inquiry, so teachers are often responsible for integrating inquiry into the curriculum. Guided inquiry is now viewed as a more appropriate instructional strategy for everyday use. The process of transforming chemistry laboratory activities into investigations that allow students the opportunity to develop understandings about inquiry and enhance investigative skills will be demonstrated and discussed.

CHED 30

Using PhET Interactive Simulations integrated into high school chemistry

Patricia Loeblein(1), ploeblei@jeffco.k12.co.us, UCB 390, Boulder CO 80309, United States. (1) Physics Education Technology, University of Colorado Boulder, Boulder CO 80309, United States

I will share my experience with writing and incorporating PhET Interactive Simulations into my chemistry classes and how my experience working on the project has influenced my course design and pedagogy. The PhET Interactive Simulations Project has developed over 90 simulations for teaching and
learning introductory physics, chemistry, biology and earth sciences. These research-based simulations create animated, interactive, game-like environments that are designed to engage students in active thinking, encourage experimentation, and help develop visual and conceptual models of physical phenomena, emphasizing their connections to everyday life. The simulations are free, and can be run from the PhET website (http://phet.colorado.edu). In this workshop, you will learn about the research that helped establish the set of inquiry guidelines that I use; learn about the simulations and the research that supports their use; see the different ways to use the simulations in class or for homework; and learn how to use the guidelines to select good lessons or write your own. A few of the chemistry simulations are: Salts and Solubility, Gas Properties, and Reactions and Rates. Funding for chemistry is allowing the development of several more. In addition, there is a translation tool that has allowed the simulations to be translated into over 50 languages.

CHED 31

BioPlastics: Going from synthetic to natural based polymer plastics

Sherri Conn Rukes(1), scrukes@comcast.net, 708 West Park Ave, Libertyville IL 60048, United States . (1) Chemistry / Polymer Ambassador, Libertyville High School, Libertyville IL 60048, United States

With the ever changing advancements in technology, our society has becomes more aware of our natural resources and what it has been doing to our planet. The focus has changed from not just making things better, lighter, stronger, etc., but to making items more earth friendly. For example, traditional plastics are now being converted to more earth friendly options. This presentation will talk about the various types of bioplastics, how they are made, understand the terminology that is used with bioplastics as well as learn how to make them in your own classroom.

CHED 32

Teaching the organization of the periodic table for understanding

Jodye I. Selco(1), jiselco@csupomona.edu, 3801 W. Temple Ave., Pomona CA 91768, United States . (1) Center for Excellence in Mathematics and Science Teaching, California State Polytechnic University, Pomona, Pomona CA 91768, United States

Chemistry is difficult to learn because it is impossible to actually "see" what happens at an atomic level. A new method for teaching how the periodic table is organized has been developed that is accessible to even the youngest students and their teachers. Participants place atomic models with the valence electrons explicitly displayed, onto a periodic table to make visible both the organization of the periodic table, and

why the chemistry of elements within a family are similar. In this way, all modalities of learning and ability levels are accommodated. The activities are based on the 5E’s template: engage, explore, explain, extend, and evaluate.

CHED 33

Pop culture in the chemistry classroom

Elizabeth K Mitchell(1), ekmitche@syr.edu, 1-014 Center for Science and Technology, Syracuse New York 13244, United States . (1) Syracuse University, Syracuse NY 13244, United States

Do you want to get your students more interested in your chemistry curriculum? Learn how to relate topics to different areas of popular culture through music, movies, and books.

CHED 34

Integrated Chemistry-Biology as a two-year science sequence in high school

Marco Pagnotta(1), pagnost@d-e.org, 315 - E Palisades Avenue, Englewood NJ 07631, United States ; Nancy Males(1), malesn@d-e.org, 315 - E Palisades Avenue, Englewood NJ 07631, United States ; Jane Park(1); Donald McNeil(1). (1) Science, Dwight-Englewood School, Englewood NJ 07631, United States

We have recently developed a new approach to teaching Chemistry and Biology in an integrated two year sequence that was based, in part, on a three year model that we had been using for nearly 15 years. Our new approach uses chemistry as the underpinnings to explain biological functions. A hallmark of this approach is the early introduction of molecular biology with an emphasis on molecular architecture. This approach asks students to think visually in order to begin to see structure – function relationships. In addition to an overview of our topic sequence, the advantages and disadvantages of this approach to teaching chemistry with biology will also be discussed, as well assessment opportunities and laboratory exercises that stress the interrelatedness of these subjects. Integrating Biology and Chemistry in a first exposure science course in high school provides students with the tools to make and understand connections between these disciplines.

CHED 35

The flipped classroom

Aaron Sams(1), asams@wpsdk12.org, 151 N. Baldwin St., Woodland Park CO 80863, United States . (1) Science Department, Woodland Park High School, Woodland Park CO 80863, United States

The greatest gift we can give students is the ability to learn independently. In the flipped classroom, students take responsibility for their learning, conduct experiments, watch video podcasts, work on assignments, interact with the class Moodle site, have one-on-one discussions with their teacher,
and are tutored by cadet teachers. Students work through content at their own pace.

Part of meeting the learning needs of each student involves scheduling flexibility. This is possible in the Flipped classroom by leveraging vodcasting technology to deliver content. The class schedule is not dictated by the teacher's content delivery schedule. Each student masters objectives in ways that are meaningful to them and when it is appropriate for them.

A benefit of this paradigm is that all students learn. Struggling students are given extra help to master content while advanced students are allowed to accelerate. Every student is now required to master the content before progressing.

**CHED 36**

Assessing and enhancing students’ scale literacy in introductory chemistry

Karrie Gerlach(1), ander225@uwm.edu, 3210 N. Cramer St., Milwaukee WI 53211, United States; Peter Geissinger(1); Kristen Murphy(1), (1) Department of Chemistry and Biochemistry, University of Wisconsin-Milwaukee, Milwaukee WI 53211, United States

Grasping scale outside the visual realm can be difficult with regards to the very small. Students in chemistry are required to begin thinking about concepts in chemistry on a particle level. The development of a student’s scale conception outside of the concepts of chemistry has been noted as an important component of a student’s overall science literacy. Research shows that students need to continue cultivating their understanding of scale beyond their elementary and secondary education years. Two instruments have been developed to assess students’ scale literacy. In addition, in-class and supplemental activities have been developed to enhance scale literacy and more in-depth studies of scaling skills by novices and experts have been conducted using a head-mounted eye-tracking system and the results of these studies will be reported.

**CHED 37**

Comparing teachers’ and students’ perceptions of the complexity of general chemistry learning content

Karen Knaus(1), karen.knaus@ucdenver.edu, 1200 Larimer St., Campus box 194, Denver CO 80217-3364, United States. (1) Department of chemistry, University of Colorado Denver, Denver CO 80217-3364, United States

A strong theoretical basis and research in several fields has taught us that perception is important to the learning process. How well do teachers’ perceptions of the complexity of general chemistry learning content match their students’ perceptions? This project is a quantitative study involving the comparison of students’ and teachers’ perceptions of the complexity of general chemistry learning content using a designed learning objective content inventory. Preliminary data from this study demonstrates that novice general chemistry teachers appear to think more like their students in terms of the complexity of learning content than seasoned teachers (those with more years of teaching experience). In addition, teachers with more years of experience seem to think more like their students in only specific areas. Does our “blind spot” for understanding how students think about general chemistry learning content grow as we become more seasoned teachers? Project development and project outcomes will be shared in this interactive talk.

**CHED 38**

Differential item functioning on multiple choice general chemistry assessments

Lisa K Kendhammer(1), lkk@uwm.edu, 3210 N. Cramer St., Milwaukee Wisconsin 53211, United States; Kristen Murphy(1), (1) Department of Chemistry and Biochemistry, University of Wisconsin - Milwaukee, Milwaukee Wisconsin 53211, United States

The use of testing to determine student grades imparts an imperative that tests be fair and objective. When subgroups of equal proficiency perform differently on an assessment item (where equivalent proficiency students should have equivalent probability of answering an item correctly) this is called differential item functioning (DIF). General chemistry items based on possible DIF were studied for persistence, the extent of persistence and if varying content and construct affect the persistence. Additionally, the use of internally and externally relevant measures of proficiency matching will be presented. To examine for underlying causes of DIF items, they were coded into semi-structured interviews using an eye tracker. The pupil diameter, time on task, and fixations on areas of interest were analyzed to better understand the students’ problem-solving process. Using the class-wide analysis and semi-structured interviews it is hoped that persistent DIF items will be better recognized and understood.

**CHED 39**

Nomenclature through adaptive learning technology

Robert Wataru Kojima(1)(2), kojima@chem.ucla.edu, 607 Charles E Young Dr E, Los Angeles CA 90095, United States; Burke Tim(2); Christine Massey(3); Phil Kellman(2); Arlene A. Russell(1), (1) Department of Chemistry and Biochemistry, University of California, Los Angeles, Los Angeles CA 90095, United States (2) Department of Psychology, University of California, Los Angeles, Los Angeles CA 90095, United States (3) Institute of Cognitive Research, University of Pennsylvania, Philadelphia PA 19104, United States

Computer-based learning activities offer great potential to adapt the flow of factual information to optimize individual learning progress. Here we describe research and efficacy of a computer based chemical nomenclature learning module.
utilizing an adaptive learning algorithm that dynamically sequences learning items based on an individual learner’s accuracy and speed of response. By combining continuous, embedded assessment with a number of laws of learning, these algorithms allow for the improved efficiency of factual learning such as ion names, as well as perceptual learning and pattern recognition in ionic compound formula synthesis. We will describe the experimental design, results, and analysis of the use of adaptive learning module in teaching nomenclature.

CHED 40

Changes in general chemistry students' misconceptions

William R. Robinson[1], wrobin@purdue.edu, 560 Oval Drive, West Lafayette IN 47907, United States; Douglas R. Mulford[2], (1) Department of Chemistry, Purdue University, West Lafayette IN 47907, United States (2) Department of Chemistry, Emory University, Atlanta GA 30322, United States

A recent analysis of the pretest and posttest answers of 928 first semester general chemistry students on the Chemistry Concepts Inventory (Mulford and Robinson, J. Chem. Educ., 2002) showed that many of the misconceptions about first semester topics held by these students are not as firmly fixed as might be expected. The patterns of responses show that on average 27% to 48% of misconceptions were not firmly held. On average 48% of these students changed their responses (32% to incorrect responses). For questions with scores less than 50%, 19% of responses were correct pre and post, 33% were incorrect pre & post, and only 16% switched from incorrect to correct. We will describe the analysis used and the most commonly held beliefs regarding these topics.

CHED 41

Student responses to a series of symbolic and particulate questions related to the dissolution of ionic solids in water

Michael J. Sanger[1], mjsanger@mtsu.edu, MTSU Box 68, Murfreesboro TN 37132, United States; Basil M. Naah[3], (1) Department of Chemistry, Middle Tennessee State University, Murfreesboro TN 37132, United States

Based on a list of misconceptions identified by student interviews, we created a series of particulate level animations depicting the process of dissolving ionic compounds in water. Students were asked to choose the best answer from the multiple-choice particulate questions and from the analogous symbolic balanced chemical equations. This presentation will focus on the differences in student responses based on the question type (symbolic or particulate), the picture type (animated or static), the order the questions were asked (equations first or second), and the type of subscript(s) appearing in the chemical formulas (monatomic or polyatomic ions).

CHED 42

Students’ cognitive processing and comprehension of macroscopic and particulate representations

Vickie M. Williamson[4], williamson@tamu.edu, Texas A & M University, College Station Texas 77843-3255, United States; David N. Rapp[5], rapp@northwestern.edu, 220 Annenberg Hall, 2120 Campus Drive, Evanston IL 60208-2710, United States; Scott R. Hinze[6]; Kenneth C. Williamson[7]; Mary J. Shultz[8]; Ghislain Deslongchamps[9], (1) Department of Chemistry, Texas A & M University, College Station Texas 77843-3255, United States (2) Department of Psychology & School of Education and Social Policy, Northwestern University, Evanston IL 60208-2710, United States (3) Construction Science Department, Texas A & M University, College Station Texas 77843-3137, United States (4) Department of Chemistry, Tufts University, Medford MA 02155, United States (5) Department of Chemistry, University of New Brunswick, Fredericton N.B. E3B 5A3, Canada

This experiment explored whether cognitive abilities influence the processes and products of students’ use of visualizations. First-semester general chemistry students were given a pretest to determine prior knowledge. Students were selected with a mix of high and low prior knowledge. These college chemistry students completed: (1) a battery of tests measuring reasoning ability, spatial ability, and need for cognition and (2) an eye-tracking session, in which students viewed three simulated experiments dealing with fluids at the macroscopic and particulate levels of representation. During the simulations, students’ eye movements were tracked to determine what representations the students were viewing. After viewing the simulation, participants selected an explanation for the result of the experiment in a multiple-choice scenario. Spatial abilities correlated with the type of information participants attended to, as measured with an eye tracker, and the identification of appropriate scientific particulate-level explanations.

CHED 43

Green chemistry in the inorganic synthesis lab

Kurt R Birdwhistell[10], birdwhis@loyo.edu, 6363 St. Charles Ave, New Orleans LA 70118, United States; (1) Chemistry, Loyola University New Orleans, New Orleans LA 70118, United States

We have rapidly and safely synthesized molybdenum and tungsten carbonyl complexes in our labs by using microwave energy and Phase Transfer Catalysis (PTC). This talk will discuss our current lab experiment where students synthesize several group six carbonyl complexes of the type M(CO)2L2, where L=dppe, dppm, dppp, 2PPh3, and M=Mo, W. We will present data on these syntheses including: microwave time and temperature, solvents, reagents, and product results. We will compare our data to other traditional metal carbonyl syntheses and other microwave syntheses. This lab allows us
to talk about microwave synthesis and phase transfer catalysis in the context of green chemistry. We will discuss other pedagogic outcomes of the lab such as multinuclear NMR.

CHED 44

Isolation of biodiesel from used coffee grounds in the undergraduate organic chemistry laboratory

Sheryl A Rummel(1), sad270@psu.edu, 211B Whitmore Lab, University Park PA 16802, United States. (1) Department of Chemistry, The Pennsylvania State University, University Park PA 16802, United States

Traditional biodiesel isolation in the undergraduate organic laboratory has been accomplished with used vegetable oil. It was recently discovered that spent coffee grounds are a viable alternative source for biodiesel. This concept has been adapted as an isolation/synthetic laboratory activity for undergraduate students in organic chemistry lab at Penn State. Students first either brew their own coffee or obtain spent coffee grounds from an on-campus source. Triglycerides are isolated from the grounds and are subsequently transesterified into fatty acid methyl esters (FAMES) using one of three methods: traditional KOH base catalyzed transesterification, sulfuric acid catalyzed transesterification, and/or a greener transesterification using an immobilized lipase enzyme. The FAMES present in the coffee biodiesel are identified and quantified using GC and GC-MS. Students learn about biodiesel and green chemistry practices through this laboratory exercise.

CHED 45

Green conversion in the general chemistry laboratory – infusing green guided inquiry labs throughout a student’s introductory experience in chemistry

Lea Padgett(1), lea.padgett@armstrong.edu, 11935 Abercorn St., Savannah Georgia 31419, United States; Will E. Lynch(1), Will.Lynch@armstrong.edu, 11935 Abercorn St., Savannah Georgia 31419, United States; Delana Nivens(1), delana.nivens@armstrong.edu, 11935 Abercorn Street, Savannah Georgia 31419, United States; Todd Hizer(1); Clifford Padgett(1); Joshua Smith(1); Catherine MacGowan(1); Yvonne Roach(1). (1) Department of Chemistry and Physics, Armstrong Atlantic State University, Savannah Georgia 31419, United States

This presentation will focus on our yearlong progress to improve interest, commitment and performance of undergraduate students in general chemistry by incorporating a completely green laboratory experience. After years of using traditional verification labs with no intrinsic green value, we decided to use green themes to capture student attention and improve their learning outcomes. Overarching goals of this project include increasing the interest and hence the number of majors in chemistry, creating a community of “green scholars” at AASU, and raising the awareness of environmental and sustainability issues, while reducing waste and implementation costs. The experiments are based on environmentally relevant topics and each includes one or more of the 12 Principles of Green Chemistry. The topics explored include soil analysis, water pollution, green synthesis and stoichiometry, biodiesel, acid rain, air pollution, and fuel cells, each of which illustrates one or more of the major theoretical aspects of general chemistry. Our two semester inquiry experience culminates in a green chemistry research experience for every student enrolled. The challenges, student outcomes and assessment information we have accumulated to date will be presented.

CHED 46

Preliminary investigation on changes in student engagement and attitude through greening the analytical chemistry course

Angelica Reyes(1), angelica.reyes@sdstate.edu, Box 2202, Brookings SD 57007, United States; Matthew Miller(1); Brian Loguer(1); Douglas Raynie(1). (1) Department of Chemistry and Biochemistry, South Dakota State University, Brookings SD 57007, United States

Much of the current literature regarding greening undergraduate chemistry education includes modification of existing laboratory experiments as well as other methods of altering the curriculum, but there is little information regarding the impact of green chemistry literacy on student social engagement in and attitude on environmental issues. This investigation monitors student engagement and attitude during and after the infusion of green chemistry into the analytical course curriculum. Currently, the chemistry curriculum at South Dakota State University (SDSU) does not include any substantial content regarding green chemistry. However, students enrolled in analytical chemistry will be given the opportunity to take part in a laboratory and lecture course that supplements analytical chemistry with green chemistry content. Preliminary results from initial surveys of analytical chemistry students will be presented describing the baseline of student engagement and attitudes.

CHED 47

Green Chemistry as an upper level elective at Worcester State

Meghna Dilip(1), mdilip@gmail.com, 486 Chandler Street, Worcester MA 01602, United States. (1) Department of Chemistry, Worcester State University, Worcester MA 01602, United States

In the spring of 2011 a semester-long standalone green chemistry course was offered at Worcester State University to chemistry majors as an upper level elective. The course was also part of the environmental chemistry concentration. No textbook was assigned; instead students used research
articles and selected chapters from books. Labs were conducted within the 1 hr lecture period to emphasize some of the principles. The motivation for a standalone course, the format and contents of the course will be presented. A survey was given to every student at the end of the semester to assess if their perceptions of green chemistry changed after taking the course. The survey also included questions concerning student’s ability to study without a textbook and their opinion about the lab activities. The results of this survey will be discussed. Overall efforts at the University and planned future efforts in green chemistry and sustainability will be presented.

CHED 48
A systems alternative to the traditional topical approach: Using environmental systems to introduce chemistry at the majors level
Frederick D. Tabbut(t)(1), tabbutff@evergreen.edu, 2700 Evergreen Parkway, Olympia WA 98505, United States . (1) Department of Scientific Inquiry, The Evergreen State College, Olympia WA 98505, United States
An approach will be described which uses a sequence of environmental systems to introduce topics typically covered in an introductory course for majors. Two large scale systems are used: the flow of water from a glacier to the ocean and the flow of energy from the sun to the earth. Chemically, both start as simple systems and become progressively more complex. But by just covering sufficient material to understand the particular aspect of the system being examined, all of the topics in a majors course can eventually be covered. In fact, because environmental systems are more complex than those created in the laboratory, students gain a deeper understanding and since the systems raise their interest they are quite willing to expend the effort needed to achieve that goal.
This approach will soon be published with accompanying interactive video of experiments and field sampling.

CHED 49
Marrying battery chemistry and materials science in a course focused on lithium batteries in advanced electric vehicles
Mark A Benvenuto(1), benvenma@udmercy.edu, 4001 W. McNichols, Detroit MI 48221-3038, United States ; Mark Schumack(1); Saeed Siavoshani(2). (1) Chemistry & Biochemistry, University of Detroit Mercy, Detroit MI 48221-3038, United States (2) Dow Chemical, Auburn Hills MI 48078, United States
The University of Detroit Mercy’s College of Engineering & Science has recently launched and offers a certificate program on advanced electric vehicles, at the masters’ level. One course, taught by the authors, is titled, “Energy Storage Systems.” The course begins with a broad view of battery-powered vehicular transportation, and focuses towards lithium-based batteries for automobiles. In developing the course, the instructors found existing reference textbooks and other university courses did almost nothing to couple discussions of lithium batteries with a cradle-to-user or cradle-to-grave scenario of the materials for such batteries. One aim of this course is to attempt to remedy that. The marriage of the basic battery chemistry and the materials science is presented here, as is initial student feedback.

CHED 50
Affirming the two-year college as a legitimate pathway to the baccalaureate and beyond and to careers in the chemical sciences, engineering and education
Onofrio Gaglione(1), oggag@aol.com, 10082 Prairie Dove Avenue, Las Vegas Nevada 89117-7713, United States . (1) Department of Physical Science, College of Southern Nevada, Las Vegas Nevada 89146, United States
The existence of research in two-year colleges is examined. How did we get to today and who helped us get there? Recent developments and headlines that thrust two-year colleges into the spotlight as a legitimate pathway to STEM baccalaureate degrees and beyond leading to careers as professional technicians, scientists, engineers and educators are discussed with an historical perspective. Where do we go from here and what do two-year colleges need to get there, are suggested. Innovative enrichment of the chemical sciences curricula via undergraduate research, internships, poster presentations at professional meetings and standardized ACS examinations in General and Organic Chemistry are recommended in order to increase student retention and insure success in undergraduate transitions. Student recruitment both external and in-house must be monitored to keep it at a level that insures sustainability of the chemistry programs. A bibliography of relevant, recent journal, C&EN and newsletter articles are included.

CHED 51
Supporting student transfer with undergraduate research experiences that bridge the two-year and four-year college
Thomas B. Higgins(1), tbhiggins@ccc.edu, 30 East Lake Street, Chicago IL 60601, United States ; Morna R. Brothers(1). (1) Department of Physical Sciences, Harold Washington College, Chicago IL 60601, United States
Student transfer from the community college can be a daunting experience without adequate support and preparation. This talk will discuss how a bridging undergraduate research experience that begins at a community college and leads to a summer research internship at a four-year college can ease transfer shock and support student success. Effective practices that support transfer, such as teaching students critical research skills, helping students choose the proper...
courses, and developing peer and faculty-support networks, will be presented. Suggestions for receiving institutions will also be described. Case studies of students who have successfully transferred and earned four-year degrees will be discussed. These experiences draw from the presenters' observations and assessments while leading a five-year, NSF-supported Undergraduate Research Collaborative project that has supported 284 community college student researchers, approximately half of whom had done research with a four-year partner and have transferred.

CHED 52

Creating a cohort of STEM students via an NSF grant that promotes undergraduate research at Queensborough Community College

Paris Svoronos(1), psvoronos@qcc.cuny.edu, 222-05 56 Avenue, Bayside NY 11364, United States. (1) Department of Chemistry, Queensborough Community College, Bayside NY 11364, United States

The Queensborough Bridge Grant involves both the biology and chemistry departments of a community college (Queensborough Community College-CUNY) and a senior college (Queens College-CUNY) as well as a major research institution (Brookhaven Laboratory). The project aims at increasing the number of STEM students via a seamless academic transition upon graduation from the junior and transfer to the senior college. Undergraduate participation of freshmen in research projects have led to professional (ACS and MACUB) conference presentations and publications of research findings to peer-reviewed journals. Other activities include attending and summarizing talks of seminar speakers and group tutoring that have created a "learning community cohort" among STEM students. Participation in summer and winter programs at Brookhaven National Laboratory, as well as other internships with the Food and Drug Administration (FDA) and the Division of Environmental protection (DEP) of New York City enhance the academic grooming of students. The number of students involved has increased dramatically since the inception of the grant.

CHED 53

Bridging the gap from community colleges to the 4-yr college and beyond: The STEPS program best practices with "non-traditional", urban, commuter students

Rosemarie D Walker(1), walkern@mscd.edu, Campus Box 52, PO Box 173362, Denver CO 80217-3362, United States; Terry Williams(2); Todd Bergren(3); Adela Cota-Gomez(4); Connie Gabel(5); Linda Lockwood(6); Jeff Simpson(6). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217-3362, United States; (2) Department of Science, Community College of Denver, Denver CO 80217-3363, United States; (3) Department of Science, Community College of Aurora, Denver CO 80220, United States; (4) Division of Pulmonary Sciences and Critical Care Medicine, University of Colorado Anschutz Medical Campus, Aurora CO 80045, United States; (5) Department of Psychology, Metropolitan State College of Denver, Denver CO 80217-3362, United States; (6) Department of Biology, Metropolitan State College of Denver, Denver CO 80217-3362, United States

The STEPS (Strides Towards Enhancing Professions in Science) Program, a collaboration between Metropolitan State College of Denver (MSCD) and two local 2-yr colleges, Community College of Aurora (CCA) and Community College of Denver (CCD), which shares the Auraria Campus with MSCD seeks community college students with both an interest and aptitude in science, who need insight into new options plus encouragement and support to aim higher than a certificate or associate degree. These students are given supplemental instruction (SI) in gateway courses and when necessary individual tutoring to help them excel academically. They are put through a brief but rigorous training that permits them to take up paid internships in active research labs throughout the Metro region during the academic year and summer. Students are also provided opportunities to attend professional meetings to present their research, network, learn about nonlocal undergraduate research experiences, and explore employment options and graduate schools.

CHED 54

Mapping undergraduate research activities with subject content in lower-division science and mathematics courses

David R. Brown(1), dbrown@swccd.edu, 900 Otay Lakes Road, Chula Vista California 91910, United States. (1) Department of Chemistry, Southwestern College, Chula Vista California 91910, United States

Course offerings at two-year colleges (2YCs) are primarily limited to those included in the first two years of traditional science and mathematics curricula (lower-division courses). With relatively small class sizes taught exclusively by faculty and substantial student-faculty interaction, courses offered at 2YCs are known for their high-quality of instruction. Educational experiences for students at 2YCs can be enhanced through undergraduate research activities that promote the ability to recognize connections between seemingly disparate subjects, deepen understanding of fundamental concepts, foster critical thinking and broaden the student vision of the role of a scientist in society. This presentation will include examples of undergraduate research projects undertaken at Southwestern College and will illustrate connections between student learning in traditional lower-division coursework and in the research laboratory.
Research experience for Chemical Technology students: Identifying and addressing the factors that impact student success

Douglas J. Schauer(1), dschauer1@ivytech.edu, 3101 S. Creasy Lane, Lafayette IN 47905, United States. (1) Department of Chemical Technology, Ivy Tech Community College, Lafayette Indiana 47905, United States

The benefits of research experience for undergraduate students are well established. However, these experiences are not typically available to students enrolled in Chemical Technology programs. Because such programs are aimed at preparing students for work as technicians, less emphasis is placed on critical thinking, scientific communication, and experimental design; skills that are essential to career advancement, and are often developed in the course of undergraduate research. Described herein is an analysis of the steps taken in developing a successful undergraduate research program with Chemical Technology students. Issues to be addressed include (a) factors impacting success, (b) project design, (c) metrics, and (d) administrative support.

Pathways to chemical education technology and careers

Neal Hudson Phillip(1), neal.phillip@bcc.cuny.edu, 2155 University Avenue, Bronx NY 10453, United States; Thomas Brennan(1), Thomas.Brennan@bcc.cuny.edu, 2155 University Avenue, Bronx NY 10453, United States; Panayiotis Meleties(2), (1) Chemistry & Chemical Technology, Bronx Community College, Bronx NY 11236, United States (2) Office of the Dean of Arts & Sciences, York College/CUNY, Jamaica NY 11451, United States

This paper describes the experiences of the authors with the NSF Funded Pathways to Chemical Education Technology and Careers (PCTEC), an NSF funded grant between York College, Bronx Community College, Queensborough Community College and Kingsborough Community College. PCTEC seeks to better prepare students for Chemical Technology careers and to allow for the seamless transition of chemical technology students from High School to the four-year institution. One of the main components of the PCTEC is a paid summer internship that allows students to work at various internship sites around New York City. Over the past three years, over 120 students have successfully completed the internship. The paid internship helps increase student retention and graduation rates. The PCTEC grant has been very successful in providing students with a source of funding and with valuable skills that facilitates their future employment in a Chemical Technology field.

Undergraduate research at a two-year college: An integrated approach

Kaveh Zarrabi(1), kaveh.zarrabi@csn.edu, 6375 W. Charleston Blvd., Las Vegas NV 89146, United States. (1) Physical Sciences, College of Southern Nevada, Las Vegas NV 89146, United States

Undergraduate research at the community college could be the stepping stone into the world of science. Higher retention and transfer of students to a four year institution are only one of the benefits of such a program. The challenges of starting and maintaining an effective undergraduate research program could be met by a systematic approach. Undergraduate research at the College of Southern Nevada has been offered as “two consecutive courses” since the mid-90s. Each course is offered with variable credits (1-3) per semester, and could be offered by different faculty members in the department. Initiation of undergraduate research at the two-year college setting has its own challenges and benefits. Curriculum development for research classes and introduction of undergraduate research during the second semester of OCHEM will be discussed. Optimizing department resources by team building within and with other departments will also be discussed, as will selection of topics for research as they relate to community issues. We will also discuss strategies to be used for student recruitment. The challenges as well as the benefits of research in the chemistry program at Community College of Southern Nevada will be discussed as a successful model over the last decade.

Blending high impact teaching strategies to engage community college students in research

Nidhi Gadura(1), NGadura@qcc.cuny.edu, 222-05 56th Ave, Bayside New York 11364, United States. (1) Biology Department, Queensborough Community College, Bayside New York 11364, United States

Queensborough Community College is one of the six community colleges of City University of New York. It is an open admissions college with a diverse student body that is 25% Black 26% Hispanic, 24% White and 24% Asian. Most of QCC students are non-traditional, first generation college students. In the biology department, particularly challenging is the over 50% attrition rate for first semester general biology classes and an overall lack of career oriented students. With these grim statistics in mind, the call to action was to create an engaged-learning environment, and provide state of the art molecular biology lab access to students in order to promote student success. Given the lack of research space, it became imperative to blend in the research components with the teaching goals. Grant money was secured to update equipment for a capstone biotechnology course. Honors and
Service Learning components were added to increase student retention and recruitment into research projects. Student success can be seen by number of regional and national student presentations made as well as awards won. The impact of this model at a community college setting will be discussed.

CHED 59

Model of interdisciplinary undergraduate research experiences at a community college
Kalyn Shea Owens(1), kowens@sccd.ctc.edu, 9600 College Way N, Seattle WA 98103, United States; Ann J. Murkowski(1), (1) Department of Chemistry, North Seattle Community College, Seattle WA 98103, United States

In response to the clear need for authentic, engaging research experiences for undergraduates early in their academic career, North Seattle Community College has designed and implemented a model that provides rich interdisciplinary research experience for its science students. The model has progressed from a one quarter seminar style research experience that centered on a common theme, to a year-long research-based program that integrates general chemistry with college biology, and currently exists as a multi-year research opportunity for science students across campus. Conducting student-centered research in the unique setting of a community college has provided both unexpected challenges and rewards, and the experience clearly illustrates the importance of strong institutional support and rich collaboration between both faculty members and outside experts.

CHED 60

Special events honoring famous chemists, meetings and conventions
Ronald Hill(1), hillwright@mac.com, 7590 West Caley Drive, Littleton CO 80123, United States; Daniel Rabinovich(2), (1) Retired, United States (2) Department of Chemistry, The University of North Carolina at Charlotte, Charlotte NC 28223, United States

This exhibit will highlight special events and philatelic souvenirs honoring famous chemists, meetings and conventions, such as The Pittsburgh Conference and national American Chemical Society (ACS) meetings. Postal ephemera and correspondence related to various companies and the chemical industry will also be on display.

CHED 61

Marie and Pierre Curie and the semipostal stamps of 1938
Ronald Hill(1), hillwright@mac.com, 7590 West Caley Drive, Littleton CO 80123, United States; Daniel Rabinovich(2), (1) Retired, United States (2) Department of Chemistry, The University of North Carolina at Charlotte, Charlotte NC 28223, United States

By the late 1930’s, a number of scientific societies had been formed in many countries dedicated to the study, control and cure of cancer. One of the pioneer societies in this effort was l’Union Internationale Contre le Cancer (l’UICC) in France. By 1937 the l’UICC had gathered among its members 92 organizations representing 52 countries. However funds for research were scarce and urgently needed. Political forces at that time were quite unstable and unpredictable especially in Europe and among the Western powers. Raising much needed funds without the benefit of universal mass media necessitated finding some other method to create interest and to encourage public generosity. France and 21 of its colonies issued special stamps with an added surcharge to raise funds for the L’UICC. The exhibit shows the French issued stamps plus those from other countries.

CHED 62

Stamps of Cuba honoring Cuban science and medicine
Ronald Hill(1), hillwright@mac.com, 7590 West Caley Drive, Littleton CO 80123, United States; Daniel Rabinovich(2), (1) Retired, United States (2) Department of Chemistry, The University of North Carolina at Charlotte, Charlotte NC 28223, United States

A wide range of stamps honoring prominent scientists from Cuba and other countries, including Dr. Carlos Finlay, who discovered the causes of Yellow Fever, André Voisin, French Biochemist who assisted in the development of Cuban agriculture and research, Dr. Pedro Kourí Esmeja, who created the Institute of Tropical Medicine at the University of Havana, and Dr. Tómas Romay Chacón, physician and scientist who introduced the smallpox vaccine in Cuba in 1804, will be presented. In addition, the role of chemistry in advancing sugar production in Cuba will be described.

CHED 63

Joseph Priestley: Events of his life and scientific achievements
Ronald Hill(1), hillwright@mac.com, 7590 West Caley Drive, Littleton CO 80123, United States; Daniel Rabinovich(2), (1) Retired, United States (2) Department of Chemistry, The University of North Carolina at Charlotte, Charlotte NC 28223, United States

Philatelic material showcasing Priestley's laboratory in Northumberland, Pennsylvania, the founding of the American Chemical Society, the U.S. postage stamp issued on April 13, 1983, and other subjects related to chemistry as featured on post cards, postal stationery, and commemorative items, will be displayed.

CHED 64

Joseph Priestley house: A philatelic celebration
stamps

Chemical philately: A perforated potpourri of postage displayed.

The majority of stamps showing women scientists depict about half of these are sh on by far the greatest number; more than 80. A selection of been honored with postage stamps. Marie Curie has appeared on the fifteen women Nobel laurates in science, twelve have

Philadelphia to the Joseph Priestley House. This exhibit is a philatelic celebration of these meetings.

An illustrated compendium of scientific glassware appearing on postage stamps

Depictions of chemical glassware found on postage stamps are arranged in the format of a chemical glassware catalog. The 130 stamps used to illustrate the "catalog" are only a fraction of the well over 500 that are available. The most common type of glassware that appears on stamps is a retort even though they have not been commercially available for over 40 years. Exceedingly accurate reproductions of glassware by some artists allow for the identification of specific types. Condensers of the Allihn, Graham and Liebig design can be found. Globe, pear and pressure-equalizing separatory funnels are shown.

Women scientists appearing on postage stamps

Of the fifteen women Nobel laureates in science, twelve have been honored with postage stamps. Marie Curie has appeared on by far the greatest number; more than 80. A selection of about half of these are shown. More than 30 other women have also been specifically identified on stamps. The vast majority of stamps showing women scientists depict unidentified individuals usually in a laboratory setting. A selection of this type of stamp from 40 different countries is displayed.

Chemical philately: A perforated potpourri of postage stamps
ECHD 70

EYCN: The European Young Chemists' Network

Viviana S. Fluxa(1), viviana.fluxa@eycn.eu, Fakultät für Chemie und Pharmazie LMU, Butenandtstr. 5-13 Haus F, Munich BAYERN 81377, Germany; Cristina Todasca (1); Aurora A Walshe (1); Guillaume Poisson (1); Lineke Pelleboer (1); Malgorzata M Zaiz (1). (1) Younger Members[apos] Division of EuCheMS, EYCN, www.eycn.eu, Germany

EYCN is the younger members' division of European Association for Chemical and Molecular Sciences, EuCheMS. Encouraging and fortifying the network between younger members of EuCheMS, EYCN brings a large number of countries to a single voice for younger chemists and the chemical sciences in Europe with over twenty member societies. In a global world, Internet technologies are crucial to stay in touch without borders; allowing EYCN members to connect and collaborate in international teams. Different events are organized with the mutual target of bringing chemistry closer to the everyday life and promote it at a professional and educational level. It is the pursuit to enlarge the network and keep the engine of connection and cooperation working. EYCN is the communication platform of younger chemists in Europe.

ECHD 71

Fermentation science in a global society with a study abroad flavor

Casey C. Raymond (1), Casey.Raymond@oswego.edu, 219 Snygg Hall, Oswego NY 13126, United States; Jeffery A. Schneider (1), (1) Department of Chemistry, SUNY Oswego, Oswego NY 13126, United States

Over the past seven years we have developed and taught a course that explores the interdisciplinary impact of fermentation and distillation science on the global society. The science of fermentation is connected with history, culture, art, and other facets of a global society and students develop an understanding of these connections throughout the course. This presentation will address the development of this course as well as student experiences during the course's study abroad component in Belgium, the Czech Republic, the Netherlands, and Scotland.

ECHD 72

Second annual Independence Science learning a new direction (ISLAND) conference on disability

Cary A Supalo (1), csupalo@purdue.edu, 560 Oval Dr., West Lafayette IN 47907, United States. (1) Department of Chemistry, Purdue University, West Lafayette IN 47907, United States

This conference will be held on the Purdue University campus in West Lafayette, Indiana on Friday, November 4, 2011, and seeks to provide a venue for educational researchers to present their work on technology and teaching methodologies for instruction in chemistry and other sciences to students with disabilities. Assistive technology vendors will also be present to show their products and services available to empower persons with disabilities to participate in science, technology, engineering, and mathematics (STEM) fields of study. This conference will also provide a mechanism for educational researchers to form collaborations and partnerships and to share their research results in this specialized subject matter. The ISLAND conference on disability is the first conference devoted to teaching science to students with print disabilities. Conference participants are being sought to present their research and to learn about work that is being done in this specialized area.

ECHD 73

Green qualitative analysis laboratory

Joy Logan (1), slogan@oswego.edu, 219 Snygg Hall, Oswego NY 13126, United States; Casey C Raymond (1); Jeffery A Schneider (1), (1) Department of Chemistry, SUNY Oswego, Oswego NY 13126, United States

Many general chemistry qualitative analysis experiments generate significant amounts of waste. In an attempt to alleviate this we are developing a new laboratory experiment to teach qualitative analysis with the use of commercially available soft drinks. Students develop their skills through the testing of known solutions that allow for the creation of a qualitative analysis flowchart. The students are then provided an unknown beverage sample to analyze using the techniques learned and results found during the analysis of knowns. By comparing results to literature values, the identity of the unknown was determined.

ECHD 74

Analysis of biodiesel content in commercial diesel blend: An inquiry-based multi-component analytical chemistry lab

Z. Vivian Feng (1), feng@augsburg.edu, 2211 Riverside Ave, Minneapolis MN 55454, United States. (1) Department of Chemistry, Augsburg College, Minneapolis MN 55454, United States

The potential of replacing petroleum fuels with renewable biofuels has drawn significant public interests in recent years. Therefore lecture and laboratory material closely relate to these topics are especially inspiring to students. By Feb 2011, together with more than 10 other states, Minnesota has implemented a mandate requiring all commercial diesels to contain a minimal of 5% of biodiesel (B5 mandate). In these series of inquiry-driven experiments, students pursued the question of whether the selected commercial diesel samples have met the B5 mandate by conducting analysis using a
variety of instrumental methods, such as normal phase HPLC, ¹H-NMR, ATR-FTIR and GCMS. In this process, students were fully engaged in the entire process of sample collection, methods development, conducting measurements, and data analysis. The project challenged students to think critically by comparing and contrasting the strengths and weaknesses of these techniques for quantitative analysis, and helped them develop an appreciation to work with “real” samples from our daily lives.

CHED 75

Determination of Fe content of some food items by FAAS:
A guided-inquiry learning experience in instrumental analysis laboratory

Sayo O Fakayode¹, fakayodesa@wssu.edu, 601 Martin Luther King Jr. Drive, W.B. Atkinson Bldg., Winston-Salem NC 27110, United States; Angela G. King²; Mamudu Yakubu¹; Abdul K. Mohamméd¹; David A. Pollard¹. (1) Department of Chemistry, Winston-Salem State University, Winston-Salem NC 27110, United States; (2) Department of Chemistry, Wake Forest University, Winston-Salem NC 27109, United States.

Guided-inquiry (GI) based laboratory experiments are increasingly been used as a more effective teaching strategy in promoting students’ learning and to enhance the critical thinking and problem solving skills of college students in the chemical sciences. Consequently, the overall goal of this study is to redesign an Instrumental Analysis laboratory course by incorporating GI-based experiments to improve the basic understanding of analytical chemistry principles. The results of a GI hands-on analysis of Fe in some common food items including plantains, spinach, lima beans, oatmeal, frosted flakes, tilapia fish and chicken using flame atomic absorption spectroscopy (FAAS) in Instrumental Analysis laboratory will be presented. Hands-on experience using FAAS for food analysis allows students to better understand the principles and practical operation of FAAS, which they have already learned in their Instrumental Analysis lecture course. The students particularly enjoyed working as teams on their food analysis projects. Moreover, the GI food analysis experiment approach considerably improved the overall student success rate in and enthusiasm for the Instrumental Analysis laboratory course, facilitating overall student success in the course.

CHED 76

Utilizing instrumentation building to teach analytical chemistry

Karen L. Steelman¹, ksteel@uca.edu, Laney Hall, Conway AR 72035, United States. (1) Department of Chemistry, University of Central Arkansas, Conway AR 72035, United States.

My undergraduate research laboratory at the University of Central Arkansas utilizes an oxygen glow discharge to convert organic material in archaeological and environmental samples to carbon dioxide for accelerator mass spectrometry radiocarbon measurement. In order to increase sample throughput, undergraduate students designed a custom-built plasma system using Conflat fittings, with a single radio frequency generator and a turbomolecular vacuum pump. Our initial goal was to build two separate sample chambers, with the ability to add additional chambers as desired. USGS coal (¹⁴C-free) and ANU sucrose (modern) radiocarbon standards were used to test the accuracy and precision of results. Students learned instrumentation design, vacuum technology, electronics, plasma chemistry, experimental design, and statistics – all topics that serve the field of analytical chemistry.

CHED 77

Assessing the impact of a new general chemistry GC-MS laboratory experiment using a SALG online questionnaire and a supplemented California Chemistry Diagnostic Test

John W. Keller¹, jwkeller@alaska.edu, 900 Yukon Dr, Fairbanks AK 99775-6160, United States. (1) Department of Chemistry and Biochemistry, University of Alaska Fairbanks, Fairbanks AK 99775-6160, United States.

A new GC-MS experiment for general chemistry uses automated headspace sampling to study water samples contaminated with volatile halogenated organic compounds (HVOCs). It was expected that students would gain increased understanding of isotope concepts and GC-MS technology, show greater appreciation of the role of chemistry in environmental health issues, and express more interest in science careers or advanced educational goals. We assessed whether these goals were met using (1) an anonymous web-based Student Assessment of their Learning Goals (SALG) survey before and after the lab, and (2) the California Chemistry Diagnostic Test (CCDT) supplemented by an additional isotope question, which was given in the 1st and 14th weeks of the semester. The surveys showed that students’ understanding of isotopes and GC-MS technology improved. However, because of the short time frame of the experiment and surveys, little change was observed in student career goals.

CHED 78

Using a Model-Observe-Reflect-Explain (MORE) laboratory module to help high school students develop molecular-level ideas about dissolution

Linda M Cummings¹, lcumming@asd20.org, 975 Stout Rd, Colorado Springs CO 80921, United States; Youngjin Song²; (1) Department of Science, The Classical Academy, Colorado Springs CO 80921, United States; (2) Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States.
The purpose of this study was to examine the effectiveness of the “Model-Observe-Reflect-Explain” (MORE) Thinking Frame in helping students conceptualize the dissolution of compounds at the molecular level. This study looked at pre-existing conceptions thirty-nine high school general chemistry students had about the dissolution of salt and sugar in water, then analyzed what effects the MORE lab had on their ideas. Student models were collected before and after the lab. Students were sometimes faced with conceptual conflict; this has shown to be an effective tool in teaching for conceptual change. The data was analyzed both quantitatively and qualitatively. The findings demonstrated that 1) the number of correct models increased after the MORE lab, 2) most misconceptions decreased, 3) some misconceptions persisted or increased, and 4) new misconceptions appeared. Examples of student models will be provided. Implications for teaching high school and college-level general chemistry are suggested.

CHED 79

Measuring student outcomes from long-term, research-based high school chemistry teacher professional development: Which content do students learn better?

Ellen Yeziere(1), yeziere@muohio.edu, 160 Hughes Laboratories, Oxford OH 45056, United States; Heather Bauman(1); Amanda Schachtel(1); Tommy Smith(1); Deborah Herrington(2), (1) Department of Chemistry & Biochemistry, Miami University - Oxford, Oxford OH 45056, United States (2) Department of Chemistry, Grand Valley State University, Allendale MI 49401, United States

Professional development (PD) is a popular mechanism for instructional reform in high school chemistry, and the quality of such PD is best measured by its effects on student outcomes. The Target Inquiry (TI) program at Grand Valley State University aims to improve the quality and frequency of inquiry instruction in high school chemistry and thereby help students develop deeper conceptual understanding of chemistry as well as scientific habits of mind. To date, 16 high school teachers have completed the 2.5-year program. Their students' content outcomes were measured using exams from the ACS Examinations Institute before, during, and after teacher participation in the program. For most of the teachers, their students' mean gain score (posttest – pretest) on the ACS exam improved as teachers progressed through the TI program. Further analysis of the test data was conducted to determine if there were particular content areas tested by the high school exam in which students' performance changed as their teachers progressed through TI. This more fine-grained analysis of student performance on individual items was conducted using logistic regression. Significant items varied by teacher; however, the topics of some items aligned with curricula developed by particular teachers during their participation in the TI program. Results from the analysis of students from four teachers over five years will be presented along with key implications for high school chemistry teacher professional development.

CHED 80

Research-based evidence for the content in a GOB chemistry course

Corina E Brown(1), corina.brown@unco.edu, 3440 Ross Hall, Greeley CO 80639, United States; Jack Barbera(2); Richard M Hyslop(3), (1) Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States (2) Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States (3) Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States

This project is a phenomenological study focused on the undergraduate “Fundamentals of Biochemistry” course that covers basic topics in general, organic, and biological (GOB) chemistry. The central objective of the research was to identify the main concepts of GOB chemistry relevant to the clinical practice of nursing. The collection of data was based on open-ended interviews of both nursing and chemistry teaching faculty as well as practicing nurses. From the resulting interview transcripts, three themes emerged: topics that are Important – have a direct application in the nursing clinical practice; topics that are Foundational – are not directly important for the nursing clinical practice but facilitate the understanding of the important topics; and topics that are Not Important – do not have a direct application or are not significant in the nursing clinical practice. Utilizing the data collected, a list of clinically relevant chemistry concepts was developed. This information can assist GOB chemistry instructors when designing and/or modifying one of these courses. Curriculum modification is a constant trade off between content and time; this work provides research-based evidence for the inclusion and exclusion of specific content.

CHED 81

Engaging students in scientific debate using arsenic-based DNA

Charity Flener Lovitt(1), charity.lovitt@bellevuecollege.edu, 3000 Landerholm Circle SE, Bellevue WA 98007, United States; Chris Barber(2), (1) Chemistry, Bellevue College, Bellevue Washington 98007, United States

In first-year chemistry classes, students rarely have enough scientific knowledge to rigorously debate the scientific merit of research reported in current journals. The recent research published on the possibility of arsenic based DNA, however, provides scientific debate accessible to students in the first-year chemistry curriculum. Students debated the plausibility of the scientists' results based on their knowledge of periodic properties such as effective nuclear charge, atomic radius, and
chemical reactivity. In a community college classroom, this activity sparked active debate and encouraged students to look beyond the book for chemical knowledge (without prompting from the instructor). This paper details student participation in the debate and gauges student learning.

CHED 82

Individual transitions from concrete operational to formal operational reasoning in general chemistry courses at a community college

Jerry P Suits\(^{(1)}\), jerry.suits@unco.edu, 3480 Ross Hall, Campus Box 98, Greeley Colorado 80639, United States; Valerie E Brinly\(^{(1)}\), (1) Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley Colorado 80639, United States

Previous research examining reasoning ability has focused on group gains in reasoning ability or correlations between reasoning ability and general chemistry performance. More significant information may be gained by examining transformation of reasoning ability in individuals. This study examined individual gains in reasoning ability in three levels of community college general chemistry courses using the Group Assessment of Logical Thinking (GALT). Thirty-seven students were given the GALT pre and post during one semester of general chemistry. Nine students in the three general chemistry courses increased their category of reasoning ability. Three students were interviewed; two began the semester with formal operational reasoning while the third student progressed from concrete operational to formal operational in a single semester. This student had previously completed introductory chemistry with concrete operational reasoning ability. A future study will further investigate and identify characteristics of students who progress in reasoning ability.

CHED 83

Playing with light: Adventures in optics and spectroscopy for honors/majors general chemistry

Marie N. van Staveren\(^{(1)}\), mvanstav@uci.edu, 1212 Natural Sciences II, Irvine CA 92697-2025, United States; Kimberly D. Edwards\(^{(1)}\), (1) Department of Chemistry, University of California, Irvine, Irvine CA 92697, United States

A lab was developed for use in an honors and majors general chemistry laboratory to introduce students to optics, spectroscopy, and the underlying principles of quantum mechanics. This lab includes four mini-experiments exploring total internal reflection, the tunneling of light, spectra of sparklers and colored candles, and emission spectra of gases. These mini-experiments were of a mixture of styles, from open ended inquiry, to more traditional cookbook experiments, and were chosen to echo my graduate research. In the accompanying lecture, students were given an overview of quantum mechanics, covering the uncertainty principle, wave-particle duality, and Schrodinger's Cat. They were also given an overview of spectroscopy, including a primer on what type of information can be gleaned from a spectrum.

CHED 84

Providing supplemental instruction about chemical concepts for general biology students

Randi Hogden\(^{(1)}\), rndal2@hotmail.com, Campus Box 171 PO Box 173364, Denver CO 80217-3364, United States; Patrick Bevins\(^{(2)}\); Michiko Nakajima\(^{(2)}\); Isaac Alldredge\(^{(2)}\); Connie Gabel\(^{(2)}\); Rosemarie Walker\(^{(2)}\), (1) Department of Biology, University of Colorado, Denver CO 80217, United States (2) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217, United States

Biology professors are tasked with ensuring that all students have a certain fundamental understanding of key chemistry concepts on which biological processes are based. Supplemental instruction to the professors' lectures provides an opportunity to reinforce essential chemical concepts. Focusing on conceptual learning in a group study environment has proved to be a successful approach in furthering students' depth of understanding. Specifically this occurs by continual reinforcement of vocabulary and chemical concepts primarily through visual group exercises that focus on larger biological concepts. Expecting students to grasp all the required chemical concepts after the lectures that open the course is a lofty goal that most students fall short of in some aspect. Continually revisiting the chemistry via supplemental instruction as it reappears in the course material has been well received by the students, who find the chemistry easier to grasp in the context of application in a biological system.
CHED 85

Building a learning community between general education chemistry and Tennessee history

Judith M. Iriarte-Gross(1), jiriarte@mtsu.edu, 1301 East Main Street, PO Box X161, Murfreesboro TN 37132, United States; Mary S. Hoffschweiler(2); Ashely M. Phillips(1); McKenzie L. Hale(1). (1) Department of Chemistry, Middle Tennessee State University, Murfreesboro TN 37132, United States (2) Department of History, Middle Tennessee State University, Murfreesboro TN 37132, United States

A new learning community consisting of two required classes, Tennessee history and general education chemistry, was offered for the first time at Middle Tennessee State University during the spring 2011 semester. This collaboration is catching the interests of non-major students who are sometimes nervous about taking a required science class and companion laboratory. The learning community includes a series of collaborative and laboratory exercises which focus on chemistry such as industrial pollution, agriculture and food production and energy from coal, hydro and nuclear processes. Additional topics include the making, drinking of, and the use of alcohols as fuels, evolution and country music. Hands-on activities, case studies, experiential learning and debates are used to encourage and assist non-majors in the learning of general education chemistry as well as Tennessee history. We will share what we learned as we developed this new collaboration for general education students.

CHED 86

Implementation of video reports as a novel alternate assessment in the undergraduate chemistry laboratory

Mitzy A Erdmann(1), merdmann@uab.edu, CHEM 201, 1530 3rd Ave South, BIRMINGHAM AL 35294-1240, United States; Joe L March(1). (1) Chemistry, University of Alabama at Birmingham, Birmingham AL 35205, United States

In order for laboratory exercises to be useful education tools, students must be engaged and involved in the experiments. Often students have little exposure to proper lab technique before enrolling in freshman labs, resulting in the most technically astute student carrying out the majority of the procedure. Due to large class size, it is sometimes difficult for a teaching assistant to ensure student involvement and equal participation among group members. We have required students to create video clips of themselves using proper laboratory techniques and submitting the videos into an online class management program (Blackboard Learn). These videos were recorded using equipment that students already own (cellular phones or inexpensive cameras). This poster will present our initial implementation, student attitudes toward the approach, and analysis of how the videos impacted laboratory techniques.

CHED 87

Electronic data collection in the biochemistry teaching laboratory: Updating experiments utilizing absorbance spectroscopy

Scott M Tremain(1), tremaism@uc.edu, 9555 Plainfield Rd, Blue Ash OH 45236, United States. (1) Department of Chemistry, University of Cincinnati - Raymond Walters College, Blue Ash OH 45236, United States

In the biochemistry laboratory curriculum, absorbance spectrophotometry is a vital component. Our traditional biochemistry experiments utilize single-wavelength spectrophotometers that are not capable of collecting absorbance spectra data efficiently. Furthermore, kinetic data cannot be readily recorded on a rapid timescale nor saved. The MeasureNet networked electronic data collection system consists of a central computer for recording and saving data from up to 15 student workstations. These workstations have various measurement probes for temperature, voltage, pH and pressure. In addition, a diode-array spectrometer attaches to the network enabling students to record and manipulate high-quality emission and absorption spectra. This project describes the incorporation of MeasureNet into a variety of biochemistry laboratory experiments. For example, colorimetric analysis, qualitative tests for amino acids and proteins, determination of protein concentration, enzyme kinetics, and isolation of phycocyanin. This work is written as laboratory experiments for hands-on teaching of concepts related to absorbance spectroscopy.

CHED 88

Partnering with industry in the undergraduate research laboratory and classroom

Kathryn D Kloepper(1), kloepper_kd@mercer.edu, 1400 Coleman Ave, Macon GA 31207, United States; Alexander M Ford(2); Dan Ma(2); R. Douglas Carter(2). (1) Department of Chemistry, Mercer University, Macon GA 31207, United States (2) KaMin LLC, Macon GA 31207, United States

We have developed a partnership between Mercer University and KaMin LLC, a local company in the kaolin industry. This relationship has enabled undergraduate students to perform industry-relevant research in the laboratory. There are many examples from the kaolin industry that may be utilized in such classes as general chemistry, instrumental analysis, inorganic chemistry, and quantitative analysis. There are also opportunities to incorporate kaolin-relevant experiments in advanced laboratory courses. Strategies to bring an industrial perspective to the research lab and classroom are presented.

CHED 89

NMR spectroscopy in the general chemistry laboratory

Allen M Schoffstall(1), amschoff@uccs.edu, 1420 Austin Bluffs Pkwy, Colorado Springs Colorado 80918, United States
Two experiments incorporating \textsuperscript{1}H NMR spectroscopy have been adapted for use in the general chemistry laboratory. In each experiment it is assumed that students have little or no prior knowledge about NMR theory or practice. Students are led through a practical introduction and are offered the opportunity to experience hands-on use of an Anasazi Eft-60 NMR spectrometer with the assistance of advanced students of the chemistry department. High school students have also been given the opportunity to do the experiments and to operate the instrument under the guidance of their high school instructor. Descriptions of the experiments and results will be presented.

CHED 90

What students see in an NMR spectra: Eye tracking applied to NMR questions

Joseph J Topczewski\textsuperscript{(1)}, joseph-topczewski@uiowa.edu, Chemistry building, Iowa City Iowa 52245, United States; Anna M. Topczewski\textsuperscript{(1)}; Norbert J. Pienta\textsuperscript{(1)}, (1) Chemistry, University of Iowa, Iowa City Iowa 52245, United States

The utility of NMR spectroscopy lies at a key cross road in organic chemistry, between theory and experimentation. Wrapped within a NMR spectrum, fundamental concepts like aromaticity, electronegativity, stereochemistry, and hydrogen bonding become real. Due to the importance of NMR, efficient and effective methods of instruction are paramount. This study utilized eye tracking software to monitor second semester organic chemistry students solving NMR problems. Graduate students in organic chemistry where used as a control group for comparison of novice (student) and expert (graduate) problem solving strategies. The direct measurement of problem solving techniques by eye tracking can provide subtle information about learner’s attention and cognitive processing through pattern analysis.

CHED 91

Thinking like a scientist in the organic chemistry teaching lab: Designing experiments to generate data for analysis and discussion

Peter J. Alaimo\textsuperscript{(1)}, alaimop@seattleu.edu, 901 12th Avenue, Seattle WA 98122, United States; Joseph M. Langenhan\textsuperscript{(1)}; Ian T. Suydam\textsuperscript{(1)}, (1) Chemistry, Seattle University, Seattle WA 98122, United States

Over the past few years we have worked to redesign our organic chemistry lab courses to better reflect the skills, habits and processes used by professional scientists. In an effort to train our undergraduate organic chemistry students to think like a professional organic chemist, we have redesigned our lab courses so that the experiments generate enough data to (i) give reliable and reproducible quantitative results, and (ii) enable us to improve the ways in which we teach our students to analyze and write about their data. Strategies for achieving these goals will be presented.

CHED 92

Impact on student retention and learning in an “organic-first” curriculum

Rajeev S Muthyala\textsuperscript{(1)}, muthy004@umn.edu, 300 University Square, 111 South Broadway, Rochester MN 55902, United States; Kevin M. Bucholtz\textsuperscript{(1)}, bucholtz_km@mercer.edu, 1400 Coleman Ave., Macon GA 31207, United States

The introduction of organic chemistry in the first year, to alleviate some of the problems associated with general chemistry courses, is gaining in popularity. However, it is unclear from the limited assessment data published thus far how supplanting general chemistry with organic chemistry – a course notorious for content overload and high attrition rates – can positively impact student retention and learning. Beginning in fall 2009 we implemented a new instructional strategy for first-year organic chemistry at the University of Minnesota Rochester (UMR): We combined elements from different student-centered pedagogies, organized content in a modular format and unified laboratory and classroom activities. In this poster, we present the impact of this new strategy on student retention and learning at UMR. A preliminary analysis of attitudinal surveys as well as of summative assessments using Bloom’s taxonomic framework will also be presented.

CHED 93

Indicator of success in organic chemistry: Don’t wait for a late inning rally

Kevin M. Bucholtz\textsuperscript{(1)}, bucholtz_km@mercer.edu, 1400 Coleman Ave., Macon GA 31207, United States

Like rooting for your favorite baseball team to hit a game-winning ninth-inning walk-off homerun, some students have a similar mentality in organic chemistry waiting for a late semester rally. Predicting student success in organic chemistry can be difficult because of wide ranges in student abilities, study strategies, and work ethics. At Mercer University, students are required to earn a C or better in Organic Chemistry I to continue on to Organic Chemistry II. After analyzing 6 years of data, a strong indicator of success in the matriculation into the second course of the sequence is the student’s performance on the first exam of Organic Chemistry I. Because of the cumulative nature of the course sequence, it is imperative that the fundamentals of the first exam are...
successfully mastered because it correlates well to success on future exams.

**CHED 94**
Probing chirality using a visual, handy, handed experiment  

**Jonny C.K. Quirke**(1), j.quirke@att.net, Mitch Maidique  
Campus, Miami Florida 33199, United States ; J. Martin E. Quirke(2). (1) Gulliver Schools, Coral Gables Florida 33146, United States (2) Department of Chemistry and Biochemistry, Florida International University, Miami Florida 33199, United States  
This presentation combines spectroscopic and density function calculation data with visual evidence of the differences between lactamide enantiomers. Photographic proof of the melting points was obtained by heating tubes containing equal weights of compound in a water bath on a hotplate rigged with a digital readout thermometer. The melted compounds are combined and co-crystallized. Then that melting point is obtained. A mixed melting point is carried out by mixing the enantiomers on a gloved hand. Body heat melts the mixture, whereas the individual enantiomers and co-crystallized sample do not melt at that temperature. This demonstrates that the enantiomers are different compounds even though they have many identical properties. Structural representations of the enantiomers include makeshift models such as fingers and fruit. They are included to show students how to make improvised models, when they do not have access to traditional molecular model kits.

**CHED 95**
Two-step synthesis of b-citronellyl tosylate from citronella  

**Cheryl M Mascarenhas**(1), cmascarenhas@ben.edu, 5700 College Road, Lisle IL 60532, United States . (1) Department of Chemistry, Benedictine University, Lisle IL 60532, United States  
The compound citronellal, one of the major components of citronella oil, can be converted to citronellyl tosylate in a two-step synthetic scheme: a reduction by sodium borohydride followed by a solvent-free tosylation reaction. The final product, b-citronellyl tosylate, is used as a perfume for laundry detergents and other cleaning products. Thus, from a pedagogical perspective, this project allows one to demonstrate synthetic utility while at the same time reinforcing two major concepts: reduction and tosylation. The two-step synthesis is tailored to a sophomore-level organic chemistry laboratory and is performed over a period of two weeks. The experimental design, execution and assessment data from the lab project will be presented.

**CHED 96**
Development of photographically friendly oxidations of primary and secondary alcohols  

**J. Martin E. Quirke**(1), j.quirke@att.net, Mitch Maidique  
Campus, Miami Florida 33199, United States ; Alina Mateo(1); Horacio A. Priestap(1); Jonny C.K. Quirke(2). (1) Department of Chemistry and Biochemistry, Florida International University, Miami Florida 33157, United States (2) Gulliver Schools, Coral Gables Florida 33146, United States  
The lack of pictorial evidence of the outcome of most reactions taught in core organic chemistry classes places visual learners at a disadvantage. We present versions of PCC oxidations of 1-propanol and 2-propanol that give visual proof of oxidation to propanal and acetone, respectively. The products are confirmed by distillation into tubes containing 2,4-dinitrophenylhydrazine (DNP), Jones’ reagent and Schiff’s reagent. Carbonyl formation is confirmed by formation of a yellow precipitate with DNP. The distilled propanal product turns Jones’ reagent green and Schiff’s reagent magenta. For ketones, no color change occurs with these reagents. Formation of propanoic acid by oxidation of 1-propanol with potassium permanganate is confirmed by distillation onto solutions of DNP, Jones’ reagent and phenolphthalein in base. The acid turns phenolphthalein colorless, but does not react with the other reagents. 2-Propanol is treated similarly for comparison.

**CHED 97**
Following in the footsteps of Domagk: Photographic demonstrations of the synthesis of prontosil and bioassay of its degradation products  

**J. Martin E. Quirke**(1), j.quirke@att.net, Mitch Maidique  
Campus, Miami Florida 33199, United States ; Lorenzo Menzel(2); Jonny C.K. Quirke(3). (1) Department of Chemistry and Biochemistry, Florida International University, Miami Florida 33199, United States (2) Department of Biological Sciences, Florida International University, Miami Florida 33199, United States (3) Gulliver Schools, Coral Gables Florida 33146, United States  
This presentation provides instructors with colorful examples of azo dye synthesis, the concept of the prodrug and bioassay that are placed in the context of drug discovery. Prontosil, an azo dye, was the first commercially available antibacterial antibiotic. Domagk established its efficacy using infected mice. Then it was used to treat humans, including President Franklin Roosevelt’s son and Domagk’s daughter. Bioassays produced peculiar results. Prontosil showed little activity until after it was ingested. Subsequent studies showed that it decomposed to sulfanilamide, the first of the sulfa drugs, which are currently used in the treatment of infections. We present the synthesis of prontosil from reaction of the diazonium salt of sulfanilamide and meta-phenylenediamine. The prontosil is reduced by

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CHED 94

Probing chirality using a visual, handy, handed experiment

**Jonny C.K. Quirke**(1), j.quirke@att.net, Mitch Maidique
Campus, Miami Florida 33199, United States ; J. Martin E. Quirke(2). (1) Gulliver Schools, Coral Gables Florida 33146, United States (2) Department of Chemistry and Biochemistry, Florida International University, Miami Florida 33199, United States

This presentation combines spectroscopic and density function calculation data with visual evidence of the differences between lactamide enantiomers. Photographic proof of the melting points was obtained by heating tubes containing equal weights of compound in a water bath on a hotplate rigged with a digital readout thermometer. The melted compounds are combined and co-crystallized. Then that melting point is obtained. A mixed melting point is carried out by mixing the enantiomers on a gloved hand. Body heat melts the mixture, whereas the individual enantiomers and co-crystallized sample do not melt at that temperature. This demonstrates that the enantiomers are different compounds even though they have many identical properties. Structural representations of the enantiomers include makeshift models such as fingers and fruit. They are included to show students how to make improvised models, when they do not have access to traditional molecular model kits.

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**Cheryl M Mascarenhas**(1), cmascarenhas@ben.edu, 5700 College Road, Lisle IL 60532, United States . (1) Department of Chemistry, Benedictine University, Lisle IL 60532, United States

The compound citronellal, one of the major components of citronella oil, can be converted to citronellyl tosylate in a two-step synthetic scheme: a reduction by sodium borohydride followed by a solvent-free tosylation reaction. The final product, b-citronellyl tosylate, is used as a perfume for laundry detergents and other cleaning products. Thus, from a pedagogical perspective, this project allows one to demonstrate synthetic utility while at the same time reinforcing two major concepts: reduction and tosylation. The two-step synthesis is tailored to a sophomore-level organic chemistry laboratory and is performed over a period of two weeks. The experimental design, execution and assessment data from the lab project will be presented.

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Development of photographically friendly oxidations of primary and secondary alcohols

**J. Martin E. Quirke**(1), j.quirke@att.net, Mitch Maidique
Campus, Miami Florida 33199, United States ; Alina Mateo(1); Horacio A. Priestap(1); Jonny C.K. Quirke(2). (1) Department of Chemistry and Biochemistry, Florida International University, Miami Florida 33157, United States (2) Gulliver Schools, Coral Gables Florida 33146, United States

The lack of pictorial evidence of the outcome of most reactions taught in core organic chemistry classes places visual learners at a disadvantage. We present versions of PCC oxidations of 1-propanol and 2-propanol that give visual proof of oxidation to propanal and acetone, respectively. The products are confirmed by distillation into tubes containing 2,4-dinitrophenylhydrazine (DNP), Jones’ reagent and Schiff’s reagent. Carbonyl formation is confirmed by formation of a yellow precipitate with DNP. The distilled propanal product turns Jones’ reagent green and Schiff’s reagent magenta. For ketones, no color change occurs with these reagents. Formation of propanoic acid by oxidation of 1-propanol with potassium permanganate is confirmed by distillation onto solutions of DNP, Jones’ reagent and phenolphthalein in base. The acid turns phenolphthalein colorless, but does not react with the other reagents. 2-Propanol is treated similarly for comparison.

**CHED 97**
Following in the footsteps of Domagk: Photographic demonstrations of the synthesis of prontosil and bioassay of its degradation products

**J. Martin E. Quirke**(1), j.quirke@att.net, Mitch Maidique
Campus, Miami Florida 33199, United States ; Lorenzo Menzel(2); Jonny C.K. Quirke(3). (1) Department of Chemistry and Biochemistry, Florida International University, Miami Florida 33199, United States (2) Department of Biological Sciences, Florida International University, Miami Florida 33199, United States (3) Gulliver Schools, Coral Gables Florida 33146, United States

This presentation provides instructors with colorful examples of azo dye synthesis, the concept of the prodrug and bioassay that are placed in the context of drug discovery. Prontosil, an azo dye, was the first commercially available antibacterial antibiotic. Domagk established its efficacy using infected mice. Then it was used to treat humans, including President Franklin Roosevelt’s son and Domagk’s daughter. Bioassays produced peculiar results. Prontosil showed little activity until after it was ingested. Subsequent studies showed that it decomposed to sulfanilamide, the first of the sulfa drugs, which are currently used in the treatment of infections. We present the synthesis of prontosil from reaction of the diazonium salt of sulfanilamide and meta-phenylenediamine. The prontosil is reduced by
dithionite to form sulfanilamide. Prontosil and sulfanilamide are bioassayed against *Micrococcus luteus*, which was selected because it is a gram-positive, brightly colored bacterium that is widely used in basic microbiology classes.

**CHED 98**

Transition from organic chemistry to biochemistry in undergraduate laboratory – Hydrolysis of para-nitrophenyl esters under base-promoted versus enzyme-catalyzed conditions

Jaimeen D Majmudar(1), jmajmuda@purdue.edu, 575 Stadium Mall Drive, West Lafayette IN 47907, United States; Animesh V Aditya(1); Susan RH Holladay(1); G Marc Loudon(1). (1) Department of Medicinal Chemistry and Molecular Pharmacology, Purdue University, West Lafayette IN 47907, United States

Most undergraduate organic chemistry laboratory exercises revolve around basic laboratory techniques and applying them to carry out syntheses. While these exercises are pedagogically necessary and sufficient for an undergraduate laboratory setting, they fail to provide the students with a bigger picture of organic chemistry. Experiments that not only incorporate synthetic techniques but also integrate the relevant mechanistic aspects to understanding of biological systems are limited. To this end, we have developed a three-week guided enquiry laboratory module based on synthesis and hydrolysis of para-nitrophenyl (PNP) esters. In this exercise, students synthesize PNP esters of various substituted benzoyl chlorides and utilize them to study the kinetics of hydrolysis under base-promoted and enzyme-catalyzed conditions. They collaborate with their peers to analyze and understand how electronic and steric effects play a significant role in hydrolysis of PNP esters under different conditions.

The students observe that the kinetic trends of ester hydrolysis under base-catalyzed conditions are completely different compared to hydrolysis using pig liver esterase. Using mechanistic aspects of carbonyl chemistry, they rationalize the trends observed in base-promoted hydrolysis. An active site model of esterases is utilized to understand the trends in enzyme-catalyzed hydrolysis. The students develop a Structure-Activity Relationship (SAR) for the series of PNP esters. Overall, this laboratory module emphasizes on applying the basic concepts of organic reactivity to simple biochemical systems. The goal of this undergraduate laboratory module is to begin the transition from organic to biochemical, while simultaneously striving to enhance students’ appreciation of the two closely related disciplines.

**CHED 99**

Importance of the solid form in pharmaceuticals: Linking molecular structure to physical properties of Furosemide

Dea Herrera-Ruiz(1), dhererra@uaem.mx, Av. Universidad 1001 Chamilpa, Cuernavaca Morelos 62209, Mexico; Hugo Morales-Rojas(2), hugom@uaem.mx, Av. Universidad 1001 Chamilpa, Cuernavaca Morelos 62209, Mexico; Julio Cesar Espinosa-Lara(1); Herbert Hopfi(2). (1) Facultad de Farmacia, Universidad Autónoma del Estado de Morelos, Cuernavaca Morelos 62209, Mexico; (2) Centro de Investigaciones Químicas, Universidad Autónoma del Estado de Morelos, Cuernavaca Morelos 62209, Mexico

Physical performance of pharmaceutical solids is strongly related to the crystalline molecular structure. Most strategies to improve biopharmaceutical properties such as solubility and dissolution rate of drugs seek to change the solid form into new polymorphs, solvates, or salts. More recently, co-crystalline solids are also highly desired. In this contribution the molecular structures and physical properties of polymorphs, solvates and three new co-crystals of Furosemide are analyzed. These solid forms were obtained mainly by three methodologies: solid-solid phase transformation, grinding and crystallization from saturated solutions. Solids were characterized by means of X-ray diffraction (powder and single-crystal), solid state NMR (CP-MAS), FTIR and thermal analyses. Changes in their physical properties were correlated with modifications found at the molecular level for their crystalline forms.

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**CHED 100**

Helping students understand $Z_{eff}$: A data-driven exercise

Richard W. Schwenz(1), richard.schwenz@unco.edu, 501 20th St, Greeley CO 80639, United States; Robin T. Macaluso(1). (1) Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States

One challenge in teaching inorganic chemistry is to move past memorization of periodic trends and towards an understanding of periodic trends based on atomic structure. One way to assist this transformation is through the use of carefully chosen experimental data.

The electronic spectra of the alkali metals provide the opportunity to determine effective nuclear charge, $Z_{eff}$, and the degree of nuclear shielding for a number of simple, effectively single electron systems. The large number of spectral lines for the alkali metals allows for the calculation of $Z_{eff}$ for various $n$ and $l$ values of a single atom with a Rydberg-like energy formula. The resulting $Z_{eff}$ values can be compared to those obtained using Slater’s rules.

**CHED 101**

On instruction of pharmacokinetics in process dynamics: Subcritical damped oscillations in systems that obey
Krebs cycle kinetics and single compartment model for systems with Michaelis and Menten kinetics

Kal Renganathan Sharma(1), jyoti.kalpika@yahoo.com, Roy G. Perry College of Engineering, PO Box 519, MS 2909, Prairie View TX 77446, United States . (1) Department of Chemical Engineering, Prairie View A & M University, Prairie View TX 77446, United States

The integration of Michaelis-Menten kinetics results in a trancedental equation. The results are not in a form that is readily usable. A more usable form of the model solutions is developed. This was accomplished by using Taylor series expansion of dimensionless concentration u in terms of its derivatives. It can be seen that for short times the Taylor series expression evaluated near the origin up to the third derivative is a reasonable representation of the integrated solution. It can vary with the apparent volume, dosage, enzyme concentration, Michaelis constant and the desired accuracy level needed. The single compartment model solution was obtained by the method of Laplace transform. It can be seen from Figure 2.0 that the dimensionless drug concentration in the compartment goes through a maxima. The curve is convex throughout the absorption and elimination processes. The drug gets completely depleted after a said time. The curve is asymmetrical with a right skew.

The systems under absorption with elimination that obey the kinetics that can be represented by a set of reactions in circle were considered. A system of n simple reactions in circle was taken into account. The concentration profile of the reactants were obtained by the method of Laplace transforms. The conditions when subcritical damped oscillations can be expected are derived. A model was developed for cases when absorption kinetics exhibit subcritical damped oscillations can be expected. The solution was developed by the method of Laplace transforms. The solution for dimensionless concentration of the drug in single compartment for different values of rate constants and dimensionless frequency are shown in Figures 6.0-9.0. The drug profile reaches a maximum and drops to zero concentration after a said time. The fluctuations in concentration depends on the dimensionless frequency resulting from the subcritical damped oscillations during absorption.

CHED 102
Visualizing the Nernst equation and Galvanic cells via 3-dimensional surfaces
Md. Mainul Hossain(1), garon.smith@umontana.edu, 32 Campus Drive, Missoula Montana 59812-1006, United States ; Garon C. Smith(1); Patrick MacCarthy(2). (1) Department of Chemistry and Biochemistry, University of Montana, Missoula Montana 59812-1006, United States (2) Department of Chemistry and Geochimistry, Colorado School of Mines, Golden Colorado 80401, United States

A novel composition grid over a comprehensive range of solution activities/concentrations has been devised to illustrate the behavior of the Nernst equation and its application to Galvanic cells. Grid points represent the activity of the oxidized species on the y-axis and the activity of the reduced species on the x-axis. Calculated potentials from a pair of grid coordinates are plotted as a z-coordinate. The resulting surfaces show that for most compositions, a half-cell potential will not vary greatly from its E° value. Illustrations of Galvanic cells reactions involve paths across the surface. Typical electrochemical cells would include two surfaces, one for each half cell. Concentration cells can be described with two reaction paths on a single Nernst surface. The influence of each variable in the Nernst equation is illustrated in a series of supplemental surfaces.

CHED 103
Jerry Bell: Joyful chemist extraordinaire
Bassam Z. Shakhashiri(1), bassam@chem.wisc.edu, 1101 University Avenue, Madison WI 53706, United States . (1) Department of Chemistry, Wisconsin Initiative for Science Literacy, University of Wisconsin-Madison, Madison WI 53706, United States

A journey full of learning, mentoring and service: from Davenport, Iowa, to Harvard, to UC-Riverside, to Simmons College, to NSF, AAAS and ACS in Washington, D.C., and to UW-Madison. On the occasion of his 75th birthday, we salute Jerry for his contributions and accomplishments...and we look forward to more.

CHED 104
Jerry Bell and the craft of chemistry
Leonard J Soltzberg(1), lsoltzberg@simmons.edu, 300 The Fenway, Boston MA 02115, United States . (1) Department of Chemistry, Simmons College, Boston MA 02115, United States

A great painter possesses artistic imagination and creative drive, to be sure. But without mastery of the craft of painting, she would be but a dreamer. Similarly, a chemist must be able to envision molecules and reaction paths; but the craft of chemistry – hands-on laboratory craft – is also essential if the potential benefits of chemical research are to be realized. Jerry Bell’s teaching has stressed hands-on chemistry from his earliest endeavors. That vision has flourished at Simmons College, most recently in the Undergraduate Laboratory Renaissance project. This transformation recognizes that laboratory craft encompasses planning, organization and communication in addition to operational skills. We are systematically replacing expository laboratory experiments with course-based guided participation in ongoing faculty research projects. Three years of assessment data indicate that this
approach has a positive impact on student attitudes and achievement.

CHED 105

Opportunity, encouragement, support: Opening doors to careers in chemistry

Barbara Pressey Sitzman(1), sitzman@usc.edu, 19237 Berclair Lane, Tarzana CA 91356, United States . (1) Chemistry, Granada Hills Charter High School, Granada Hills CA 91344, United States

Jerry Bell led the first Dreyfus/Woodrow Wilson Institute for Chemistry Teachers at Princeton University. With this first and important experience, he opened the door to the professional chemistry community for this high school teacher. One such opportunity can dramatically impact a person’s professional life. I invite you to consider the nature of doors that can be “opened” and think about ways that we can increase opportunities for prospective chemists. Our support, encouragement and action are critical to the future of science in the United States.

CHED 106

What do you get by mixing birds, a bell, a snake, a clock, and seven mysteries?

Ron Perkins(1), ronperkins2@me.com, 7540 San Miguel Way, Naples FL 34109, United States . (1) Department of Chemistry, University of Wisconsin, Madison WI 53706, United States

A few times in each generation, a great teacher will appear who has the ability to engage others in making the abstract concrete and the complex simple; then, effortlessly demonstrate that one’s simple understanding is actually far from complete! In fact, it might be incorrect. I enter my conversations with Professor Bell with “full understanding”; I leave knowing that there is much more to be learned! Bell makes the study of chemistry exciting, active, and open. This is the sign of a truly Great Teacher!

CHED 107

Effectiveness of teacher professional development programs: Perception and reality

G. A. Crosby(1), g_a_c@gmx.net, PO Box 644630, Pullman WA 99164, United States ; J. L. Crosby(1). (1) Department of Chemistry, Washington State University (retired), Pullman WA 99164, United States

The authors have spent a quarter-century working with middle- and high-school teachers and students. Their activities were state-wide, regional, and international. Some of the programs were integrated with ACS Regional and National Meetings and DivCHED Biennial Conferences, while others were independent of any formal scientific society. The speaker will review the intent of such programs, the perception of success and failure, and some of the logistical, social and political difficulties encountered when running professional development programs.

CHED 108

Suggestions for simplifying general chemistry

Henry Bent(1), henry.abent@gmail.com, 5816 Solway Street, Pittsburgh PA 15217, United States . (1) None, Retired, United States

Chemistry’s hard. It’s new words for new concepts—a foreign language twice over. It can’t be made too easy. Presented will be remarks regarding SI prefixes, the two topics high school chemistry students say are the most difficult, the problems of atomic orbitals, helium in periodic tables, and VSEPR Theory, a new notation for dative bonds, a Valence Stroke Termination Rule, a simple route to Valence Sphere Models of Molecules, and a challenge: to teach chemistry in “The Grand Manner,” arguably the most distinctive thing that chemists can do, as chemists, for education. And the hardest.

CHED 109

Seeing (and hearing and tasting and smelling) is believing (perhaps)

Rodney Schreiner(1), schreiner@chem.wisc.edu, 1101 University Avenue, Madison WI 53706, United States . (1) Department of Chemistry, Wisconsin Initiative for Science Literacy, University of Wisconsin-Madison, Madison WI 53706, United States

What we know about the world, especially what we know through science, has come to us by means of our senses. Thus, to improve the reliability of our knowledge, we need to appreciate how our senses mediate physical stimuli to create our perceptions. Over the course of many years, I have worked with Jerry Bell to develop numerous “classroom” demonstrations of physical phenomena, including some that reveal aspects of perception. I will describe and present some of these latter types of demonstrations, in whose development Jerry has been essential.

CHED 110

Addressing the lack of prior knowledge in math skills with supplemental instruction for general chemistry

Matthew Lake(1), mjlake1@hotmail.com, Campus Box 52 PO Box 173362, Denver CO 80217-3362, United States ; Ryan Fitt(1); Michael Radulovich(1); Ralph McBride(1); Patrick Bevins(1); Connie Gabel(1); Rosemarie D Walker(1); Dustin Politca(1). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217-3362, United States

During the first semester of a Supplemental Instruction (SI) program on the Auraria campus in Denver, Colorado, SI Peer Leaders observed that the lack of prior knowledge in math skills was hampering the ability of the community college students to learn concepts in General Chemistry. The decision
CHED 111
Assessing physical chemistry undergraduate students’ interpretation of chemical kinetics equations

George Hudson(1), ghudson@siu.edu, Southern Illinois University Carbondale, Carbondale IL 62901, United States; Lichang Wang(1); Frackson Mumba(1,2). (1) Department of Chemistry and Biochemistry, Southern Illinois University Carbondale, Carbondale IL 62901, United States (2) Department of Curriculum and Instruction, Southern Illinois University Carbondale, Carbondale IL 62901, United States

Chemical education research shows that students often have difficulties in understanding the connection between mathematical equations and their physical interpretations as presented in chemistry textbooks. Although this is recognized as a difficulty very few studies have explored how undergraduate students interpret equations in physical chemistry. In particular, no study has explored how undergraduate students decode, encode and interpret equations related to chemical kinetics. Students’ ability to decode, encode, interpret and understand the meaning of the equations in chemistry is essential skill for success in chemistry courses. We will present the innovative way of assessing how chemistry students decode, encode and interpret equations related to chemical kinetics. The results and implications for chemistry teaching and learning will be presented and discussed.

CHED 112
Identifying undergraduate students’ mathematical skills, reasoning, and speed for chemical kinetics

George Hudson(1), ghudson@siu.edu, Southern Illinois University Carbondale, Carbondale IL 62901, United States; Lichang Wang(1); Frackson Mumba(1,2). (1) Department of Chemistry and Biochemistry, Southern Illinois University Carbondale, Carbondale IL 62901, United States (2) Department of Curriculum and Instruction, Southern Illinois University Carbondale, Carbondale IL 62901, United States

Several chemical education research studies have reported that undergraduate students' success in physical chemistry is partly dependent on their abilities to use and understand mathematics. Although this ability is not sufficient for success in physical chemistry it is necessary. Physical chemistry requires applying mathematical models and it is important for the students to have the ability to quickly manipulate mathematical expressions. To date, several studies have mainly looked at students' mathematical abilities for a chemistry course. Very few studies have reported or identified mathematical skills, reasoning, and speed required for specific physical chemistry topics. Our research group is investigating specific mathematical skills, reasoning, and speed among students required for chemical kinetics in our undergraduate physical chemistry courses. We will present results on undergraduate students' mathematical skills, reasoning, and speed required for chemical kinetics. Implications for chemistry teaching and learning will be discussed.

CHED 113
Identifying major factors that influence students’ satisfaction with their instructors

David Easter(1), de05@txstate.edu, 601 University Dr, San Marcos TX 78666, United States. (1) Department of Chemistry and Biochemistry, Texas State University, San Marcos TX 78666, United States

In conjunction with general course data and information from the Texas State University database, we have analyzed five years of student evaluation data that include responses from 12,000 students. Modeling suggests that 34% of variations between instructor student evaluation (ISE) section averages can be explained solely on the basis of student demographics and classroom data. When individual instructor characteristics are added to the variable set, 74% of variations between ISE section averages can be predicted by the model. We will summarize our research methodology and will identify the factors that most strongly influence instructor rankings in the model. Our findings will be of interest to instructors who would like to maximize student satisfaction without compromising academic standards or instructional effectiveness. The results will also be pertinent to administrators who assess teaching effectiveness and make personnel decisions accordingly.
impact on student achievement and retention in chemistry courses. However, there is lack of research on the impact of such programs on the people who are involved in providing supplemental instructional support to freshman students. In particular, we have not seen a study that has explored the impact of technology-based chemistry Structured Learning Workshops (SLW) on teaching assistants who are involved in delivering supplemental instructional to freshman chemistry students through such a support program. In the past four years, we have used SLW to provide supplemental instructional Freshman Chemistry for Science and Engineering majors. Our presentation will focus on how our technology-based SLW has impacted on Teaching Assistants' chemistry content, technology skills and pedagogical knowledge for freshman chemistry teaching. Implications for chemistry teaching and learning will be stated and discussed.

CHED 115
Impacts of faculty development workshops on the students of faculty attendees: A cross-case analysis
Cianán B. Russell\(^{(1)}\), cianan@gatech.edu, 901 Atlantic Drive, Atlanta GA 30332-0400, United States ; Sindhuja Padmanabhan\(^{(1)}\); Jingya Ying\(^{(1)}\); David M. Collard\(^{(1)}\). \(^{(1)}\)School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta GA 30332-0400, United States

The Center for Workshops in the Chemical Sciences (CWCS) is a summer faculty development program that hosts 8 to 12 workshops a year. The workshop programming is content-driven, focusing on providing faculty with laboratory-based experiences of the material and access to experts in the content area. A two-year evaluation of the impacts of the workshops on the students of the faculty participants was conducted during 2009 and 2010 with five faculty participants using classroom observations, student surveys, and faculty and student interviews. Each year at each institution was then used to construct a case study, and cross-case analysis was used to assess the impacts of workshops at each institution. Results of this study will be presented regarding the impact on students' experience of the courses, attitudes about their courses, and attitudes about science.

CHED 116
Charting a course through the chemistry workforce: Misdirected career decision-making among chemistry Ph.D. students
Heather Thiry\(^{(1)}\), heather.thiry@colorado.edu, 580 UCB, Boulder CO 80309-0580, United States ; Heidi G. Loshbaugh\(^{(1)}\), heidi.loshbaugh@colorado.edu, 580 UCB, Boulder CO 80309-0580, United States ; Sandra Laursen\(^{(1)}\), sandra.laursen@colorado.edu, 580 UCB, Boulder CO 80309-0580, United States . \(^{(1)}\)Ethnography & Evaluation Research, University of Colorado at Boulder, Boulder CO 80309-0580, United States

Beyond developing "great lab hands," chemistry Ph.D. students must develop knowledge about and skills for an array of potential careers. Yet learning about potential workplaces and how to choose among them is often left to hearsay and chance. This study explored Ph.D. professional socialization in three chemistry departments. In-depth interviews with nearly 100 students, faculty, administrators, and staff indicate that doctoral students have shallow or absent knowledge about their career options. Many students were ill-informed about the characteristics and expectations of potential work settings. Too often, the onus to provide career counseling was placed on faculty, yet most graduate advisers were ill-equipped to help students navigate the breadth of careers available to doctoral chemists. While some departmental or institutional measures helped expand students' awareness and career preparation, these measures were often inadequate to compensate for students' naiveté about career paths and their under-preparation in "soft" skills.

CHED 117
Investigation of Science Faculty with Education Specialties (SFES) within the largest university system in the United States
Seth D Bush\(^{(1)}\), sbush@calpoly.edu, 1 Grand Ave, San Luis Obispo California 93407, United States ; Nancy J Pelaez\(^{(2)}\); James A Rudd\(^{(3)}\); Michael T Stevens\(^{(4)}\); Kimberly D Tanner\(^{(5)}\); Kathy S Williams\(^{(6)}\). \(^{(1)}\)Department of Chemistry and Biochemistry, California Polytechnic State University, San Luis Obispo, San Luis Obispo California 93407, United States \(^{(2)}\)Purdue University, United States \(^{(3)}\)California State University, Los Angeles, United States \(^{(4)}\)Utah Valley University, United States \(^{(5)}\)San Francisco State University, United States \(^{(6)}\)San Diego State University, United States

Efforts to improve science education include university science departments hiring Science Faculty with Education Specialties (SFES), scientists who take on specialized roles in science education within their discipline. Although these positions have existed for decades and may be growing more common, few reports have investigated the SFES approach to improving science education. We present comprehensive data on the SFES in the California State University (CSU) system. We found that CSU SFES were engaged in three key arenas including K-12 science education, undergraduate science education, and discipline-based science education research. As such, CSU SFES appeared to be well-positioned to have an impact on science education from within science departments. There were two apparent pathways to becoming an SFES, those who were "Hired" as SFES and those who "Transitioned" to SFES roles from their initial faculty roles. However, there appeared to be a lack of clarity and agreement
about the purpose of these SFES positions. Across disciplines, almost 40% of CSU SFES were seriously considering leaving their positions. Our data suggest that science departments need explicit discussions about the role of SFES and strategies for supporting their professional activities. In addition, formal training in science education among CSU SFES was limited, suggesting a need for new training pathways for future and current SFES. A national study of SFES is underway in the United States, and we hope to provide additional data to highlight the SFES community and strengthen the conversation among stakeholders about the purposes and impact of SFES positions.

CHED 118

Integrating green chemistry into the wider context of sustainability

Terrence J. Collins(1), tc1u@andrew.cmu.edu, Institute for Green Science, 4400 Fifth Ave, Pittsburgh PA 15213, United States. (1) Department of Chemistry, Carnegie Mellon University, Pittsburgh PA 15213, United States.

Green chemists worldwide are helping to build the technical dimension of a sustainable civilization. So what is this “sustainability” we all talk so much about? What will it feel and look like when we get there? How are we going to get there as a people? What tasks belong to the chemists and how should they be prioritized? What are the complementary disciplines and how do green chemists collaborate with them? I will argue that we can “see” what sustainability is right now. That’s because sustainability is more about the direction we choose to follow than the destination we long to attain. Sustainability is a communal pursuit. It has the spiritual power to unite all of humanity in our much-divided world. Sustainability brings transgenerational justice to the center of the ethical stage and calls for long-term values to guide us in which technologies we develop, which we alter and which we wind down.

CHED 119

Green chemistry programs at University of Massachusetts Boston (UMB)

Wei Zhang(1), wei2.zhang@umb.edu, 100 William T Morrissey Boulevard, Boston MA 02125, United States. (1) Department of Chemistry, University of Massachusetts Boston, Boston MA 02125, United States.

UMB has a strong tradition on green chemistry. It is well-known for establishing the first Ph.D. program on Green Chemistry. Over a dozen students have received the Ph.D. degrees. UMB also has a Center for Green Chemistry to promote green chemistry related education, research, and international collaborations. Our recent activities on green chemistry will be highlighted in this presentation.

CHED 120

Berkeley center for green chemistry: An interdisciplinary approach to education, research and engagement.

Martin J. Mulvihill(1), marty_m@berkeley.edu, Berkeley Center for Green Chemistry, 324 Lewis Hall, Berkeley CA 94720, United States. (1) Berkeley Center for Green Chemistry, Berkeley CA 94720, United States.

To effectively advance green chemistry, new approaches are needed in the design of chemistries, the assessment of health and environmental risks, and the governance of the economy. This, in turn, requires new forms of collaborative, cross-disciplinary approaches to education and research. The interdisciplinary approach of the BCGC grows out of the recognition that the successful development—and adoption by society—of green chemistry hinges on the integration of knowledge in chemistry and engineering with an understanding of the health and ecosystem impacts of chemicals and the ways in which policy and law guide industrial innovation.

We seek to bring about a generational transformation in the design, production, and use of chemicals, materials, and products. We are working to realize this goal through innovations in education, research and engagement. We are integrating the chemical sciences, environmental health sciences, and the study of public and private governance into a cohesive educational program in green chemistry. We are developing innovative, cross-disciplinary curriculum for use in colleges and industry across the country. To date this approach has been applied to the redesign of the introductory chemistry labs which serve over 2500 students per year. A 3 unit graduate class, Green chemistry: An Interdisciplinary approach to sustainability has also been developed and taught to a group of 41 graduate students. To promote diverse academic engagement the class was cross-listed in business, engineering, public health, environmental science and chemistry.

CHED 121

Undergraduate laboratory renaissance for organic chemistry

Richard W. Gurney(1), richard.gurney@simmons.edu, 300 The Fenway, Boston MA 02115, United States. (1) Department of Chemistry, Simmons College, Boston MA 02115, United States.

Simmons College has undertaken a fundamental reengineering of the laboratory science program in chemistry, biology and physics. This redesign utilizes ongoing faculty research projects as the basis for course-based laboratory work. We will explain the concept, design, implementation, and assessment of this approach to organic chemistry laboratory instruction, in which green chemistry principles were designed as a primary foundational building block. The seminar will
present in detail - the issues involved in redesigning a course laboratory around a research project, the difficulties encountered and the benefits accrued from this curricular redesign and the assessment results from the first three years of our W. M. Keck Foundation supported program.

CHED 122

Fundamental chemistry courses for workforce development in clean energy: Hydrogen/fuel cells

Alla V. Bailey(1), avbsch@rit.edu, 85 Lomb Memorial Drive, Rochester New York, United States; Massoud J. Miri(1); Roman J. Press(1); K. S. V. Santhanam(1); Gerald A. Takacs(1).

(1) Department of Chemistry, Rochester Institute of Technology, Rochester New York 14623, United States

Our team developed educational components on clean energy and, in particular, hydrogen fuel cell technology. Among these is our textbook titled “Introduction to Hydrogen Technology” [1]. We also introduced, about three years ago, a new course with the same title offered by our Department of Chemistry. It includes a lab session, in which the students assemble a fuel cell and record its characteristics such as load curves and efficiency. More recently, we designed and started teaching this course in distance learning format causing further interest to students. For this online course, we use RIT’s MyCourses site for presentation slides, discussion forums, exercises and exams as pedagogic tools. We received a portion of a major grant focusing on the education of clean energy funded by NYSERDA (New York State Energy Research and Development Authority). As part of our continuing activities, we are developing a lab course consisting of eight experiments relating to hydrogen fuel cell technology.


CHED 123

Lessons learned, but not likely to be needed here again

Weslene Tallmadge(1), tallmadge@gannon.edu, 109 University SQ, Erie PA 16541, United States; Betty Jo Chitester(1); Matthew Heerboth(1). (1) Department of Chemistry, Gannon University, ERIE PA 16541, United States

Most faculty members will experience a complete renovation of chemistry labs only once in their careers. Although experienced with laboratory work and equipment, many faculty members do not have significant experience in laboratory renovations. The chemistry labs at Gannon University are used to serve an undergraduate population consisting of science majors, pre-professional students, and students in the health professions. Renovation of the chemistry labs and classrooms at our university led to many lessons learned. Significant planning and input from the department members occurred in the year leading up to the renovation. Faculty members know that they should consider laboratory layout, hood design, gas lines, electrical and other physical aspects. In retrospect, there were additional steps the faculty could have taken to ensure a smoother process. We will share our insights which may help to resolve unexpected difficulties arising during the renovation process.

CHED 124

From outmoded to modern chemical laboratories in one year!

Frank J. Torre(1), ftorre@spfldcol.edu, 263 Alden Street, Springfield MA 01109, United States; Julianne M Smist(1), jsmist@spfldcol.edu, 263 Alden Street, Springfield MA 01109, United States; (1) Department of Chemistry, Springfield College, Springfield MA 01109, United States

We will take you on a journey of an amazing transformation. Starting from outmoded chemistry laboratories, housed in the basement of a classroom-laboratory building built in 1961, to a modern rehabilitated science building in 2007. In the spring semester 2006, we were faced with packing up the chemistry laboratories, chemical stockroom, equipment and faculty offices to move to temporary quarters while the building underwent a renovation and addition. In January 2007, we unpacked and set up our new laboratories and offices.

CHED 125

Ideas and solutions for a major renovation to a small chemistry department: Experiences at Wayne State College (WSC)

David J Peitz(1), dapeitz1@wsc.edu, 1111 Main St., Wayne NE 68787, United States; Mary L Ettel(1), maettel1@wsc.edu, 1111 Main St., Wayne NE 68787, United States; Darius Agoumba(1); Paul A Karr(1). (1) Physical Sciences and Mathematics, Wayne State College, Wayne NE 68787, United States

WSC recently completed a total renovation of its chemistry laboratories; it was not a staged renovation which added unique issues. Ideas for storage solutions and modified lab activities were developed. The planning and implementation of everything from fume hoods to floors, to designing a flexible space for instrumentation will be presented. Non-traditional labs times, shared lab space, delaying upper-level labs and being pro-active in getting Sophomore and Junior students to take upper level courses early were effective in managing the chemistry program during renovation. Also, experiences dealing with a major disaster will be discussed. Improved lab floor plans with proper safety equipment allows for more diverse lab activities. The open and flexible design of the instrument lab supports our effort to introduce instrumental methods across the program. Lessons learned during the construction and suggestions for the renovation of other chemistry laboratories will be made.
CHED 126

Renovation of the University of Toronto undergraduate chemistry laboratories – what works and why

A P. Dicks\(^{(1)}\), adicks@chem.utoronto.ca, 80 St. George Street, Toronto Ontario M5S 3H6, Canada; Scott A. Mabury\(^{(1)}\); Michael Dymarski\(^{(1)}\), (1) Department of Chemistry, University of Toronto, Toronto Ontario M5S 3H6, Canada

This presentation describes recent extensive undergraduate laboratory renovation in the Chemistry Department at the University of Toronto. Our old teaching laboratories were ill-suited for modern instruction, and inefficient with respect to space utilization. The new laboratories have transformed the practical experience of over 700 chemistry program students per year and many more life science undergraduates.

Construction focused on re-design and modernization of space dedicated to different chemical sub-disciplines while accommodating both large first and second year courses, as well as advanced third and fourth year specialized courses.

Lower level courses requiring synthetic methodologies are now located in space containing “pods” where each pod houses 16 students and 8 fume hoods, each of which features a closed loop chilled water system and house vacuum amongst other services. A sense of what has worked and why, along with “if we could do that again” moments will be discussed.

CHED 127

Process for planning of new academic chemistry laboratories: Getting all the parties involved

Gerald L Zweerink\(^{(1)}\), zweerink@missouriwestern.edu, 4525 Downs Drive, St. Joseph [lt]Missouri 64507, United States; Leonard J Archer\(^{(1)}\), (1) Department of Chemistry, Missouri Western State University, St. Joseph Missouri 64507, United States

Organizational aspects beginning from the initial concept ideas to the creation of final construction documents will be covered for the addition and total renovation of an academic building for science and mathematics. Details of implementing a Project Kaleidoscope modeled process will be presented from the perspective of the Project Shepherd, including planning development involving the University President, Provost, and Dean, down to the individual departmental faculty users.

Development of the overall budget covering architectural planning, schematic designs, construction designs, equipment/furnishings and moving costs will be discussed. An explanation of how all campus constituencies were involved through the extensive use of committees will be outlined. The required phasing for initial new construction followed by complete renovation of existing facilities will also be detailed, especially regarding how it affects academic semester schedules.

CHED 128

Process for construction of new academic chemistry laboratories: It’s all in the details

Leonard J Archer\(^{(1)}\), archer@missouriwestern.edu, 4525 Downs Drive, St. Joseph Missouri 64507, United States; Gerald L Zweerink\(^{(1)}\), (1) Department of Chemistry, Missouri Western State University, St. Joseph Missouri 64507, United States

Outcomes and lessons learned by the science and mathematics faculty during the bidding and the phased construction of an addition and renovation yielding a 120,000 sq. ft. science and mathematics facility will be presented. Laboratory and classroom layout design features including the systems for mechanical, electrical, data distribution, ventilation, plumbing, lighting, water purification and instructional technology will be discussed. The process for inclusion of new chemistry instrumentation and miscellaneous supporting equipment into the construction costs will be covered.

Considerations made for the moving and temporary relocation of hazardous material management facilities and faculty offices during the renovation phase will be included. Many component details of the resultant building will be shown and discussed.

CHED 129

Lessons learned from the design, construction and operation of Regents Hall of Natural Sciences at St. Olaf College

Paul T Jackson\(^{(1)(2)}\), jackson@stolaf.edu, 1520 St. Olaf Avenue, Northfield MN 55057, United States; David G L Van Wylen\(^{(3)}\), (1) Department of Chemistry, St. Olaf College, Northfield MN 55057, United States (2) Department of Environmental Studies, St. Olaf College, Northfield MN 55057, United States (3) Department of Biology, St. Olaf College, Northfield MN 55057, United States

In 2008 St. Olaf College opened Regents Hall of Natural Sciences, a 195,000 gross square foot, USGBC LEED Platinum facility for biology, chemistry, physics, and psychology. The facility was the summation of a 10+ year process centered on a collaborative programmatic vision known as the “Seven I’s”. This presentation highlights the intentional design elements geared for 21st century science education and the challenges faced by the planning group. Early in planning the group wrestled with renovation/addition versus new construction, each with implications for the final product. We altered existing culture to move to an interdisciplinary organizational model and leverage shared research spaces. Innovative ideas were piloted in the old facility and successful elements incorporated into the new design. Green chemistry became a major design driver at the project’s midpoint and permitted us find novel ways to extend the life of an outdated facility during the project’s construction and move-in phases.
Expansion and renovation of the science and math center at Bridgewater State University: Embracing the good, and surviving the bad and the ugly

Edward J. Brush, ebrush@bridgew.edu, Park Avenue, Bridgewater MA 02325, United States; (1) Department of Chemistry, Bridgewater State University, Bridgewater MA 02325, United States

Bridgewater State University (BSU) is nearing completion of a LEED certified, $100M expansion and renovation of the Conant Science and Math Center, the largest building project in the Massachusetts state education system. The first planning meetings were held in December 2004, ground breaking in fall 2009, Phase I completion in summer 2011, and Phase II in summer 2012. This presentation will focus on the process we followed at BSU, and the “good, bad, and ugly” aspects that include: institutional vision for the STEM disciplines, establishing the building committee, how our departmental and institutional focus on sustainability and green chemistry influenced lab design, dealing with architects and institutional management, packing/moving/unpacking, and the new vision for chemistry. The vision for the BSU science and math center is of a living laboratory for sustainability science education that will provide new opportunities for engagement across disciplines, and with the regional community.

Stephenson Life Sciences Research Center at the University of Oklahoma: A creative purpose and layout

George B Richter-Addo, grichteraddo@ou.edu, 101 Stephenson Parkway, Norman OK 73019, United States; (1) Department of Chemistry and Biochemistry, University of Oklahoma, Norman OK 73019, United States

The Department of Chemistry and Biochemistry at the University of Oklahoma is almost a hundred years old. The original and still-functional building was completed in 1916, and the department expanded over time to occupy adjacent buildings completed in 1951 and 1971. Our research expansion outgrew our physical space. A decade ago, we embarked on a space assessment, a process that led eventually in our move in August 2010 to the new 160,000 Stephenson Life Sciences Research Center that features ample interaction spaces and open laboratory designs.

In this talk, I will present the various stages of the new building project development, and will highlight the role that students played in formulating designs of the spaces in the new building. I will highlight the importance of a strong department-university relationship that is critical to any new building project. I will also discuss issues such as faculty space assignments and laboratory placements.

Programs—and a man—for all seasons

Sylvia Ware, sacromware@verizon.net, 3714 Camden Street SE, Washington D.C. 20020, United States; (1) American Chemical Society, United States

I joined ACS staff as the first manager of the Office of High School Chemistry in 1979, when ACC had few activities for high school teachers and students, but was anxious to expand in this area. This expansion involved not only new staff activities, but growth within the member Division of Chemical Education, Inc., and a new committee at the governance level. Beginnings have always fascinated me, and I was fortunate then, and for the next 26 years, to have Jerry Bell as an advisor, a consultant, a staff member, but especially as a friend, as the Education Division grew to administer, not only new pre-college programs but also new undergraduate and graduate activities. This growth, and the role of Jerry Bell in ACS education programming will be discussed.

Four seasons of Chemistry: A Project of the American Chemical Society

Morton Z. Hoffman, hoffman@bu.edu, 590 Commonwealth Avenue, Boston Massachusetts 02215, United States; Dan Dill, (1) Department of Chemistry, Boston University, Boston Massachusetts 02215, United States

The ACS general chemistry book, which was written by a team led by Jerry Bell and had been class-tested and revised over the course of four years in its preliminary versions, was published by W.H. Freeman in 2004. The printed text and its web-based visualization supplements combined a sophisticated scientific approach, cooperative strategies, and active learning techniques with coverage of all the traditional general chemistry topics at a level appropriate for students with a background in chemistry from high school. It was adopted at approximately 50 institutions across the whole range of the academic spectrum, and was used for five years by a total of more than 3,500 students in CH101-102, the year-long general chemistry course for science majors and pre-medical students at Boston University. The evident success of the textbook and the potential impact it could have on the teaching of general chemistry led to the preparation of a Spanish-language version of the book (Química), which was marketed in Latin America, and to the development of plans for the preparation of a second edition. In 2007, the ACS Program Review Advisory Group (PRAG) recommended to the Society Committee on Budget and Finance (B&F) that the General Chemistry Project be terminated; B&F concurred and passed that recommendation on to the ACS Board of Directors, which voted to stop all work on the book as of the end of that year.
Que sera sera: Serendipity in a life in chemistry

Jerry A. Bell(1), j Bell@acs.org, University of Wisconsin-Madison, 1100 University Avenue, Madison WI 53706, United States . (1) Wisconsin Initiative for Science Literacy, Madison WI, United States

How many choices in a career are the result of careful planning and how many are based on seizing unanticipated opportunities? What schools do you attend? How do you find your first, or second, or third, or … job? Or do they find you? Why do you teach or carry out research the way you do? What kinds of service to your profession and/or society engage you? What or who are the influences at the pivot points in your career? I will try to provide brief (mercifully) answers that have brought a great deal of joy to my life in chemistry.

Team based guided-inquiry versus traditional lecture: Student success based on learning styles

Danae R. Quirk Dorr(1), danae.quirk-dorr@mnsu.edu, Ford Hall 241, Mankato MN 56001, United States; M. Hadley(2), (1) Department of Chemistry and Geology, Minnesota State University, Mankato, Mankato MN 56001, United States

Over three consecutive semesters, students were enrolled in an organic and biochemistry course designed for allied health majors. The course was divided into two sections, a traditional lecture section and a team based guided-inquiry section. Students in the traditional lecture section received the course materials via lecture, and students in the other section received the course materials through a team based guided-inquiry approach. Student learning styles were assessed at the beginning and at the end of each semester. Exam scores collected for analysis included standardized organic chemistry and biochemistry exams, as well as a cumulative pre-test and a post-test. Statistical analysis of the data collected showed that students in the team based guided-inquiry section had statistically significant higher organic and biochemistry standardized exam and cumulative post-test scores. In addition, in the team based guided-inquiry section, correlations between enhanced learning by students with particular learning styles were observed.

Guided inquiry -based instruction and its impact on critical thinking abilities of students

Tanya Gupta(1); tgupta@iastate.edu, 3051 Gilman Hall, Ames IA 50011, United States; Akash Mehta(2); K. A. Burke(3);
Thomas J. Greenbowe(1), (1) Chemistry, Iowa State University, Ames IA 50011, United States

Students in traditional laboratory instruction use the verification approach of experimentation. Students in a senior level chemistry course work are more experienced with chemistry as compared to college freshmen and sophomores. In this study we examine the critical thinking skills of freshmen students in a guided inquiry based laboratory in which the Science Writing Heuristic approach is implemented with senior level chemistry students using traditional verification approach by comparing the student laboratory reports at the two levels of college chemistry. It is hypothesized that students in guided inquiry-based laboratories have similar critical thinking skills in specific chemistry areas as students at the senior level who engage in traditional laboratory work. Are the students experiencing guided-inquiry instruction in the laboratory better critical thinkers than those students who instead use a more traditional approach? How does the critical thinking ability of students in guided inquiry-based Science Writing Heuristic laboratories compare to the students in a senior level tradition chemistry laboratory course? Preliminary findings of this study will be discussed.

CHED 140
Characterizing the thinking processes that general chemistry students engage in during invention activities that precede lectures

Dawn Rickey(1), rickey@lamar.colostate.edu, 1872 Campus Delivery, Fort Collins CO 80523-1872, United States ; Lisa Dysleski(1); Nancy E Levinger(1); Lydia T Tien(1); Ryan Trott(1). (1) Department of Chemistry, Colorado State University, Fort Collins CO 80523, United States (2) Department of Chemistry and Geosciences, Monroe Community College, Rochester NY 14623, United States

Based on an instructional model that has been demonstrated to enhance transfer of learning in other content domains, we have designed and implemented 10 sets of inventing-with-contrasting cases (ICC) activities for first-semester general chemistry. During ICC activities, students work with data sets that highlight contrasting cases to invent formulas, procedures, and other general rules that describe the cases presented. A key goal of our project is to determine how ICC activities influence general chemistry students’ engagement in key thinking processes. Thus, during implementations of these activities in general chemistry recitation sections in Fall 2010, we collected student responses to pre- and post-activity “clicker” questions, scans of all written work, and video recordings of nine groups of students each week. We also interviewed students at the end of the semester to probe their understanding of key concepts. In this presentation, we will discuss preliminary results of our analyses of these data.

CHED 141
Impact of combining online-homework and peer-assisted learning on general chemistry

Issa Salame(1), salame@sci.ccny.cuny.edu, 160 Convent Avenue, New York NY 10031, United States ; Nathan Hershberger(1); Olha Ivashkiv(1). (1) Chemistry Department, The City College of New York, New York NY 10031, United States

The results of science education research underscore the importance of enabling students to take an active role in their learning. The integration of online-homework and peer-assisted learning into general chemistry impacts the way students learn the content. Our research project examines the tailoring of learning experiences to the built-in interests of the students, and has the potential to cause a paradigm shift in chemistry teaching and learning. Students have demonstrated their facility with (perhaps addiction to) electronic communication in their daily lives, and willingly accept the online-homework as an alternative to the traditional studying of homework problems at the end of each chapter, and traditional problem solving techniques. This study took place at the City College of New York in the second part of a general chemistry course. We will present data that demonstrate combining online-homework and peer-assisted learning improves students' performance and attitudes towards the subject matter.

CHED 142
Implementation of supplemental instruction in a 2-yr to 4-yr urban consortium

Connie Gabel(1), cgabel@mscd.edu, Campus Box 52 PO Box 173362, Denver CO 80217-3362, United States ; Rosemarie D Walker(1); Terry Williams(2). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217-3362, United States (2) Department of Science, Community College of Denver, Denver CO 80217-3363, United States

In the Fall semester of 2010 the STEPS (Strides Toward Encouraging Professions in Science) Program initiated a Supplemental Instruction (SI) Program in biology and chemistry on the Auraria Campus. Students from the 4-year school Metropolitan State College of Denver, served as the Peer Leaders to the students at the 2-year school, the Community College of Denver. Students from the two colleges involved in the SI program are urban commuters who work and therefore spend limited time on campus; this proved to be a challenge for the scheduling of SI sessions that would be well attended. During the Fall semester the science departments were enduring a renovation, which added another challenge – finding space for SI sessions. This presentation will discuss how we successfully overcame these challenges to provide beneficial SI sessions in General and Organic Chemistry, and
further we will make recommendations for how others may replicate our results.

CHED 143

Using student created presentations to enhance the learning experience in a general chemistry course

Nichole L Powell(1), nichole.powell@emory.edu, 100 Hamill Street, Oxford GA, United States. (1) Division of Natural Sciences and Mathematics, Oxford College of Emory University, O GA 30054, United States

Current research in science education is centered around methods to improve the retention of course content and to cultivate a positive attitude towards science. Methods used to improve retention include collaborative learning and active learning that encourages the incorporation of concepts being taught. This study required students to solve challenge problems collaboratively and present a detailed explanation of the solution using the capture and presentation software “Camtasia Relay.” The results of this study as measured by course performance and attitudinal surveys will be presented.

CHED 144

Using performance-based contract grading to increase student success in general chemistry and general education courses

Seth Friese(1), sfriese@salisbury.edu, 1101 Camden Ave, Salisbury MD 21801, United States; Anita Brown(1), arbrown@salisbury.edu, 1101 Camden Ave, Salisbury MD 21801, United States; Gail Welsh(2), (1) Department of Chemistry, Salisbury University, Salisbury MD 21801, United States (2) Department of Physics, Salisbury University, Salisbury MD 21801, United States

In an effort to improve student success and to address the D,W, F rate, we have used performance-based contract grading (PBCG) in General Chemistry I, a course largely populated by science majors, and in Physical Science, a course largely populated by general education students. PBCG focuses on teaching students how to learn science by formalizing existing recommendations for study habits into a contract. Signing the contract is optional for students. A student who signs the contract may earn a course grade via the traditional method, or the student may receive a C for completing the items identified in the contract. A detailed description of the contract and how the PBCG was tailored to our classes will be presented. The initial results of the performance-based contract grading with science major versus non-science majors will be compared and discussed in addition to how these experimental courses compare to historical success rates.

CHED 145

Collaborate to accelerate a sustainable future

Theresa Kotanchek(1), TGKotanchek@dow.com, Michigan Operations, 1776 Building, Office C-1, Midland MI 48667, United States; Dawn L. Shiang(2), (1) Department of Sustainable Technologies and Innovation Sourcing, The Dow Chemical Company, Midland MI 48674, United States

The Dow Chemical Company is setting the standard for sustainability by working on the world’s biggest challenges – energy, climate change, water, food, housing, transportation and health - and when we do that, it’s not just good for the planet, it’s good for business. With over 96 percent of manufactured products enabled by chemistry, world challenges are best solved through collaborations where there is diversity of resources, expertise and experience. Dow recognized the need to collaborate early on and is a leader in advancing all aspects of sustainability, openly collaborating with customers, suppliers, communities, civil society, governments and universities. For the latter, Dow has established key partnerships with universities and is creating programs that enable us to solve not only the challenges of today, but those of tomorrow – including helping to instill sustainable principles of development for the next generation of scientists and engineers.

CHED 146

Green chemistry education: Connecting industry to communities

Amy S. Cannon(1), Amy_Cannon@BeyondBenign.org, 100 Research Drive, Wilmington MA 01887, United States; Rachel Pokrandt(1), (1) Beyond Benign, Wilmington MA 01887, United States

The education of a scientist is an essential piece to implementing and advancing green chemistry. Through K-12 educational programs, along with college student and faculty programs, Beyond Benign helps to bring green chemistry education to life for its industrial partners. By designing curriculum geared towards an industrial sector, or by linking local schools to industry plant sites, Beyond Benign is a partner for both educators and industry. This presentation will describe Beyond Benign’s unique programs for connecting communities through K-12 education, workforce development and community outreach.

CHED 147

CGCC: A provincial Center in Green Chemistry and Catalysis in Canada

André B. Charette(1), serge.leger@umontreal.ca, Université de Montréal, 2900 Édouard Montpetit Blvd., Montreal QC H3C 3J7, Canada; Hélène Lebel(1); Chao-Jun Li(2), (1) Department of Chemistry, University of Montreal, Montreal QC H3T 1J4, Canada (2) Department of Chemistry, McGill University, Montreal QC H3A 3R1, Canada
This talk will present the FQRNT Centre in Green Chemistry and Catalysis, its members and its mandate. The Centre regroups 44 top researchers in Green Chemistry and catalysis. The members represent all the major universities in Québec. The Center provides financial support for technical and professional staff and it promotes exchanges and interactions not only between the researchers but also with the industries that may be interested in novel Green technologies.

CHED 148

Green chemistry and sustainability at Bridgewater State University: Teaching, research and outreach across disciplinary lines

Edward J. Brush(1), ebrush@bridgew.edu, 131 Summer Street, Bridgewater MA 02325, United States. (1) Department of Chemistry, Bridgewater State University, Bridgewater MA 02325, United States

Bridgewater State University (BSU) is a signee of the American College and University Presidents Climate Commitment, and has made a commitment to integrate sustainability in our curriculum, research opportunities, outreach and operations. Our campus-wide sustainability initiatives have provided new opportunities to educate the campus community about green chemistry, and an increased institutional emphasis on multidisciplinary engagement has opened the door for productive green chemistry research projects involving non-science majors. We are also engaging freshmen science majors in green chemistry research projects, and are building cohorts of STEM pre-service teachers to participate in K-12 green chemistry outreach programs through their introductory chemistry courses. These initiatives will contribute to the preparation of our future teachers, researchers, government officials, and entrepreneurs who will address key issues related to sustainable development and the impacts of chemicals and chemical products on human and environmental health.

CHED 149

Using discourse to enhance student understanding of physical chemistry

Renee Cole(1), rcole@socket.net, E331 Chemistry Building, Iowa City IA 52242-1294, United States. (1) Department of Chemistry, University of Iowa, Iowa City IA 52242, United States

Discourse is an important way in which students develop an understanding of scientific concepts. In a POGIL (process oriented guided inquiry learning) classroom, students learn in an environment that allows them to engage in discourse with peers and/or the instructor. Toulmin analysis provides a mechanism for documenting the collective production of meaning and provides an empirical basis for examining the quality of classroom discourse and for reflecting on instructional design. There are some challenges to POGIL in physical chemistry related to the use of calculus and derivations. Students often do not attach meaning to the symbolism used in physical chemistry and struggle with some of the mathematical techniques. Insights from ten years of implementing POGIL in physical chemistry as well as results from research analyzing class discussions in thermodynamics will be used to suggest strategies to enhance student understanding of physical chemistry in both the lecture and the laboratory.

CHED 150

Physical hemistry symbolic documents in the JCE digital library

Theresa Julia Zielinski(1), tzielins@optonline.net, 400 Cedar Avenue, West Long Branch New Jersey 07764, United States. (1) Department of Chemistry, Medical Technology, & Physics, Monmouth University, West Long Branch New Jersey 07764, United States

For 10 years the original SYMMATH collection or almost 100 documents to support student learning in physical chemistry resided at Monmouth University. This site will close in June 2012. This collection is now available at http://www.chemeddl.org/alfresco/service/org/chemeddl/symmath/framelet?guest=true. The format of the JCE Digital Library site is the same as that of the original site. There are two types of documents. First, the peer reviewed documents with abstracts published in JCE can still be found at http://www.jce.divched.org/JCEDLib/SymMath/index.html and require a JCE subscription. Second, documents with copyrights held by authors are still free at the digital library site. Most documents function with the latest version of Mathcad. Updated and revised documents may be sent to me at tzielins@optonline.net. I thank John Moore, Jon Holmes and other members of the JCE Digital Library team for support during the translation period through the JCE Digital Library project, NSF DUE 062303.

CHED 151

Group break-out activities: encouraging student engagement in first semester Physical Chemistry

Amy E Palmer(1), amy.palmer@colorado.edu, UCB 215, Boulder CO 80309, United States. (1) Chemistry and Biochemistry, University of Colorado, Boulder CO 80309, United States

This talk will discuss efforts to encourage student engagement in first semester undergraduate Physical Chemistry (thermodynamics). Over the past 4 years I have developed a series of break-out activities that were integrated into a typical 50-student lecture class. These break outs were designed as group activities and involved both conceptual and quantitative questions. This talk will discuss examples of these activities,
students’ perception, and the impact on students’ attitudes and learning. I will also highlight challenges and lessons learned over the last 4 years of transforming a traditional lecture based class into a more interactive format.

CHED 152

Implementation of group-interactive strategies in the Physical Chemistry II lecture course

David Easter(1), de05@txstate.edu, 601 University Dr, San Marcos TX 78666, United States. (1) Department of Chemistry and Biochemistry, Texas State University, San Marcos TX 78666, United States

Physical Chemistry II—covering kinetics, quantum mechanics, and spectroscopy—has historically been taught at Texas State University by a lecture approach that incorporated relevant “clicker” questions into each presentation. An “experimental” approach was implemented this spring, with the goal of maximizing the strengths of the interactive and lecture approaches, while minimizing their respective weaknesses. A complete set of class materials was developed. Student handouts provided nearly as much information as would have been covered via lectures. During class, students were engaged in group discussion and problem solving, with occasional “interruptions” for groups to report their conclusions. Occasionally the reporting process uncovered a fundamental misunderstanding that could be clarified by the instructor. We will summarize outcomes—based primarily on differences from previous (lecture-based) classes. Areas of comparison will include: (1) student evaluations; (2) amount of material covered; (3) final exam performance; and (4) WF rates.

CHED 153

Learning work of gases in a physical chemistry course; deriving formulae, PVT-space pathways, and syringe observations

Ron L Fedie(1), fedie@augsburg.edu, 2211 Riverside Ave., Minneapolis MN 55454, United States. (1) Department of Chemistry, Augsburg College, Minneapolis MN 55454, United States

A 3-dimensional approach to learning conventional thermodynamics is discussed, beginning with the 1st Law, \(\Delta U = q + w\). The idea of the work of expansion/compression of ideal gases has been more readily understood when the idea of traversing “\(P, V, T\)-space” is presented. It helps them create reversible paths (needed for thermo. calculations). This also solidifies the idea that, for work to happen there must be an established path. When students realize that phases such as isothermal work or adiabatic work are just defining the pathway(s) in “\(P, V, T\)-space”, they now “see” the calculation. Another aide is to have them experiment with a 10.00mL syringe. Thus, this pedagogical communication will demonstrate 3 ways to have students understand thermodynamic “work” through: a.) derived equations and the calculated values, b.) viewing the area under the \(P, V\) function from “\(P, V, T\)-space”, and c.) actual observation of work in a syringe gas expansion. Through this exercise and comparison of work results, students gain the knowledge and practicality of defining reversible, calculable pathways and their immense importance to thermodynamics. They will get efficient at traversing “\(P, V, T\)-space”, and gain the confidence to be able to connect any initial and final point with reversible, calculable pathways, allowing them to determine the thermodynamic quantity of interest. After this exercise in work, the 2nd Law and Carnot Cycle are readily palpable in “\(P, V, T\)-space”. Complimentary plastic syringes will be given out for demonstration use and discussion purposes.

<table>
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<th>(P\text{(atm)}, V\text{(mL)}, T\text{(K)})</th>
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CHED 154

Abstract to concrete: Ways to make pchem more visually tractable

Laura Sremaniak(1), laura_sremaniak@ncsu.edu, P.O. 8204, Raleigh NC 27695, United States. (1) Chemistry, North Carolina State University, Raleigh NC 27695, United States

Physical chemistry content is inherently abstract and information from many courses has to be integrated in order for students to become successful problem-solvers. Taken either prior to, or incorporated within a physical chemistry course, computational chemistry software-based exercises of a more inquiry-guided form can help students discover trends and relationships between variables in all areas of physical chemistry. At North Carolina State University, a 2-semester computational sequence has been developed to give students a better basis before attempting physical chemistry. Results from class surveys and longitudinal data will also be presented.

CHED 155

QSAM WIKI – Quantum states of atoms and molecules wiki version

Theresa Julia Zielinski(1), tzielins@optonline.net, 400 Cedar Avenue, West Long Branch New Jersey 07764, United States. (1) Department of Chemistry, Medical Technology, & Physics,
Monmouth University, West Long Branch New Jersey 07764, United States

Since 2005 QSAM has been a part of the JCE Digital Library collection at http://www.jce.divched.org/JCEDLib/LivTexts/pChem/JCE2005p1880_2LTXT/QuantumStates/Index.htm. This Living Text has been translated into wiki format and can be found at http://wiki.chemeddl.org/index.php/Quantum_States_of_Atoms_and_Molecules. The wiki format mirrors the original text and retains all the chapters, chapter sections and chapter links, numbered equations, exercises, problems, and activities. Final editing will be completed by October 2011. At that time a second review of the wiki files will begin. At that time the original QSAM Living Text at the JCE Digital library will be updated to a second edition. Beyond minor corrections, the second edition will have several new or updated Mathcad templates. I thank John Moore, Jon Holmes and other members of the JCE Digital Library team for support during the translation period through the JCE Digital Library project, NSF DUE 0632303.

CHED 156

Interactive engagement strategies for teaching chemical thermodynamics

Robert Parson\(^{(1)(2)}\), Robert.Parson@Colorado.edu, UCB 215, Boulder CO 80309-0215, United States; Thomas Pentecost\(^{(3)(2)}\), (1) Department of Chemistry and Biochemistry, University of Colorado at Boulder, Boulder CO 80309-0215, United States (2) Science Education Initiative, University of Colorado, Boulder CO 80309-0215, United States (3) Department of Chemistry, Grand Valley State University, Allendale MI 49401-9403, United States

As a part of our activities supported by the CU Science Education Initiative, we have explored the use of interactive engagement in the thermodynamics component of Physical Chemistry. These strategies include peer instruction (clicker concept tests followed by small group and full-class discussion), "Just in Time Teaching", in which open-ended questions are posed to students online before each class, and in-class small-group activities. Assessment was based on a concept survey developed specifically for the course content, the CLASS (Colorado Learning Attitudes about Science Survey), and student interviews. The results suggest that the adoption of these strategies has led to significant improvements in student conceptual learning and has had a positive impact on student and faculty attitudes towards the course. In addition to selected results from the assessments, this presentation will included a discussion of practical aspects of implementing these strategies and sustaining their use once adopted.

CHED 157

Teaching physical chemistry as a modeling course

Jodye I. Selco\(^{(1)}\), jiselco@csupomona.edu, 3801 W. Temple Ave., Pomona CA 91768, United States. (1) Center for Excellence in Mathematics and Science Education, California State Polytechnic University, Pomona, Pomona CA 91768, United States

Physical chemistry as a science attempts to build models for the way things work in the world around us. Why not use this context to teach the course as well? Specific examples and student responses will be presented.

CHED 158

Adventures of the Lone Rangers: The benefits and challenges of being the sole physical chemist in a chemistry department

Crystald D Bruce\(^{(1)}\), cbBruce@erskine.edu, PO Box 338, 2 Washington Street, Due West South Carolina 29639, United States; Allison Calhoun\(^{(2)}\), calhoua@whitman.edu, 345 Boyer Avenue, Walla Walla WA 99362, United States. (1) Department of Chemistry, Erskine College, Due West SC 29639, United States (2) 345 Boyer Avenue, Whitman College, Walla Walla WA 99362, United States

Many small public institutions and private liberal arts colleges have only one physical chemist in a department. Those of us in that position enjoy the responsibility and autonomy guaranteed by this situation; however, this isolation prevents easy camaraderie with others that share our passions. In this talk, we will address some of the challenges of being a PChem Lone Ranger and how physical chemists in various settings have overcome those challenges. One method, of course, is to gather at ACS National Meetings, so we look forward to making new acquaintances during this symposium.

CHED 159

Development of 'green' extraction techniques for the analysis of diclofenac in plants to study bioaccumulation of a pharmaceutical

Kristin Damian\(^{(1)}\), kdamian@uccs.edu, 1420 Austin Bluffs Parkway, Colorado Springs CO, United States; Janel Owens\(^{(1)}\), jowens2@uccs.edu, 1420 Austin Bluffs Parkway, Colorado Springs CO, United States. (1) Department of Chemistry and Biochemistry, University of Colorado Colorado Springs, Colorado Springs CO 80918, United States

There has been sustained interest in determining the presence, transport, and fate of pharmaceuticals in environmental samples. Recent studies have established that pharmaceuticals can be taken up by plants, including crops. The aim is to determine if diclofenac, which finds use in human and veterinary medicine, can bioaccumulate in plants. Spinach was chosen as a model plant to develop a protocol for
extracting the diclofenac using 'green' chemistry techniques prior to analysis with high performance liquid chromatography with UV-Vis detection. Spinach was grown hydroponically and diclofenac applied through leaves and roots to study how application of the compound affects bioaccumulation patterns. Future research includes analysis of additional pharmaceuticals such as carbamazepine and estradiol and using other model plants such as lettuce and green onions.

CHED 160

Development of 'green' extraction techniques for the analysis of chlorogenic acid in peaches

Kiley Jones(1), kcard@uccs.edu, 1420 Austin Bluffs Parkway, Colorado Springs CO 80918, United States; Eric Mobley(2), emobley@uccs.edu, 1420 Austin Bluffs Parkway, Colorado Springs CO 80918, United States; Janel Owens(3), jowens2@uccs.edu, 1420 Austin Bluffs Parkway, Colorado Springs CO, United States. (1) Department of Chemistry and Biochemistry, University of Colorado Colorado Springs, Colorado Springs CO 80918, United States

Recent studies have indicated that chlorogenic acid, a secondary plant metabolite found widely in fruits and vegetables, may have important health benefits. It was recently shown that peaches and plums contain significant concentrations in their skins. The goal of this work is to develop a 'green' method for efficient extraction and analysis of this compound from fruits with minimum waste. In this method, solid phase extraction (SPE), to be used as a 'gold standard' extraction method, with microwave heating was used prior to analysis by high performance liquid chromatography with UV/Vis detection at 326 nm. A method using microwave heating and dispersed liquid-liquid microextraction is now being developed. In preliminary studies, the extraction by SPE was optimized to achieve recoveries of 112.8% of a 10 µg/mL chlorogenic acid spike (n = 3). Future work will be directed towards analysis of chlorogenic acid in organically versus conventionally grown peaches.

CHED 161

Effect of cooking on the antioxidant potential of various peppers

Brian Ogendi(1), bogendi@jsu.edu, 700 Pelham Rd N, Jacksonville AL 36265, United States; Nixon Mwebi(1). (1) Physical & Earth Sciences, Jacksonville State University, Jacksonville AL 36265, United States

Peppers contain large amounts of antioxidants. These chemicals, such as polyphenols (e.g., flavonoids), and are linked to protection against several coronary heart disease, stroke, and some forms of cancer. The burning sensation in peppers is primarily due to capsaicin, which eases pain, such as that associated with arthritis and muscle strain. Some studies indicate that heating may lower the antioxidant potential of peppers, others claim that heat has little to no effect on the antioxidant potential. Here, a systematic approach employing two UV-Vis spectroscopic techniques: the ferric reducing antioxidant power (FRAP) and the free radical trap 2, 2-diphenyl-1-picrylhydrazyl (DPPH) were used to quantify and monitor the effect of various cooking methods on the antioxidant potential of sweet, mild and hot peppers. Our results indicate that this antioxidant potential is reduced the most by boiling and the least by microwaving. These effects may be dependent on the type of pepper.

CHED 162

Rational design of cysteinyl peptide ligands as chelators of mercury(II)

Jeremy Brooks(1), schwemleinmn@wssu.edu, 601 M.L. King, Jr. Drive, WBA Science Bldg rm 309, Winston-Salem NC 27110, United States; Maria Ngu-Rudd(1); Brent Rudd(1). (1) Chemistry, Winston-Salem State University, Winston-Salem NC 27110, United States

Mercury is a bioaccumulative toxic pollutant that can make its way up the food chain. Due to its harmful neurotoxic effects, it is essential to pursue effective therapeutics to remove it from the body. Current clinical chelation therapy of mercury poisoning generally uses thiol compounds, including cysteine. This study is undertaken to develop a better understanding of the interactions of mono-, di-, tri-, and tetra-cysteine containing peptide ligands with mercury(II). Their mercury(II) binding affinities and associated thermodynamic parameters are evaluated by isothermal titration calorimetry (ITC). The results show that peptide ligands containing two cysteine residues can serve as "double anchors" to accommodate the coordination sites of mercury(II). However, the distance between these residues did not significantly affect their binding affinity for mercury(II). Increasing cysteinyl residues on the peptide ligand provided entropic benefits for mercury(II) binding. The preparation of some cysteinyl peptides by microwave-assisted solid phase peptide synthesis will be presented.

CHED 163

Analysis of rare earth elements in a sodium peroxide fusion matrix using ICP-AES

Thomas J Gately(1), tgately@mines.edu, 1500 Illinois Street, Golden CO 80401, United States; James Ranville(1); Thomas Wildeman(1). (1) Department of Chemistry and Geochemistry, Colorado School of Mines, Golden Colorado 80401, United States

The detection of Rare Earth Elements (REE) by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) has long been problematic. Also, in many analytical situations, the REE are in solid materials that have to be fused with sodium peroxide or lithium metaborate to solubilize them.
Beryllium was chosen as an internal standard due to its strong emission lines. Furthermore, it is usually in low abundance in REE matrices and does not produce interfering lines. The complex overlapping emission wavelengths of the REE required extensive spectral corrections to accurately analyze the samples. Once the spectral corrections were in place the detection limit of REE was below 0.5 ppm and limit of quantification was at or below 2 ppm for all elements. REE ICP-AES analysis was found to give accurate results, even in solutions with large concentrations of fusion salts, therefore it is useful for analyzing REE in a complex matrix.

CHED 164

Immunoextraction of nicotine from serum samples using MagnaBind® beads to create a standard curve for nicotine quantification

Taylor L Carlson(1), moserac@unk.edu, 905 W. 25th St., 201A Bruner Hall, Kearney NE 68849, United States; Annette C Moser(1), moserac@unk.edu, 905 W. 25th St., 201A Bruner Hall, Kearney NE 68849, United States; Jessica J Baillie(1), (1) Department of Chemistry, University of Nebraska at Kearney, Kearney NE 68849, United States

When measuring clinical serum samples, it is desirable to create a standard curve from ‘blank’ plasma samples. Unfortunately, small amounts of some compounds are naturally present in serum and prohibit the creation of a standard curve. One solution to this problem is to use immunoaffinity extraction coupled with magnetic bead technology to remove the undesired components from the serum prior to creating the standard solutions. Nicotine is a common compound found in human plasma even in nonsmokers. In this project, nicotine was stripped from human plasma using MagnaBind® magnetic beads coupled with an anti-nicotine antibody. Removal of the nicotine was verified by GC-MS. Additionally the binding capacity and binding efficiency of the MagnaBind® beads was studied.

CHED 165

Determination of various energy drink components using reversed-phase chromatography: An upper division undergraduate lab experiment

Corey W Willicott(1), moserac@unk.edu, 905 W. 25th St., 201A Bruner Hall, Kearney NE 68849, United States; Annette C Moser(1), moserac@unk.edu, 905 W. 25th St., 201A Bruner Hall, Kearney NE 68849, United States; Bobbi A Stromer(1); Jared Loschen(1); Danielle Policarpio(1), (1) Department of Chemistry, University of Nebraska at Kearney, Kearney NE 68849, United States

Due to the increased popularity of energy drinks among college students, a method to separate and quantify caffeine, riboflavin (vitamin B2), niacinamide (vitamin B3) and pyridoxine (vitamin B6) in energy drinks was developed for use in upper division undergraduate laboratories. In this method, the vitamins and caffeine were separated and quantified using high performance liquid chromatography (HPLC) with UV-vis detection on a 4.6 x 250 mm Spherisorb Amino 5-μm column using a methanol:phosphate buffer mobile phase.

CHED 166

Analysis of dye-halide interactions and dye analogues for the development of an aqueous halide selective indicator

Heather Robison(1), robison.110@buckeyemail.osu.edu, 100 W 18th Ave, Columbus OH 43210, United States; J. Clay Harris(1); Noel M Paul(1), (1) Department of Chemistry, The Ohio State University, Columbus OH 43210, United States

Interactions between organic dyes and halide ions were utilized to determine anion concentration using spectrophotometric methods. A survey of commercially available azo dyes was completed to evaluate the colorimetric properties in the presence of halide ions independent of pH. Based on these tests certain dye-halide interactions were quantified via determining limits of detection. Coupled with molecular modeling studies, such results have indicated structural and electronic features that may be imperative to anion sensitivity. Specifically, Sudan Black B revealed a unique spectral shift in the presence of bromide independent of solution pH. Synthetic modifications of Sudan Black B have been proposed and initial tests of such analogues have been positive for both bromide sensitivity and increased aqueous solubility. Ultimately, with the development of a halide selective indicator for aqueous solutions one could measure halide concentrations in numerous environments with high accuracy and precision at a much lower cost.

CHED 167

Evaluation of DNA recovery from chewing gum simulated forensic samples by seven DNA extraction methods

Kelly M. Gesick(1), kgesick@mscd.edu, CB 52, PO Box 173362, Denver CO 80217, United States; Kelly M. Elkins(1), (1) Chemistry Department, Metropolitan State College of Denver, Denver CO 80217, United States

The literature is nearly devoid of prior work on extracting DNA from chewing gum although this is a noted type of evidence submitted to crime labs as casework. Previous research has shown that the Chelex-100 method outperforms the phenol-chloroform-isooamyl alcohol (PCIA) method of DNA extraction. After validating the methods, DNA was extracted from simulated forensic samples (in triplicate) obtained at public places (e.g. bus stops) by anonymous donors using one of the following seven methods: PCIA, Chelex-100, Silicycle, silica, dialysis, DNA IQ™ (Promega), and QiaAMP™ (Qiagen). Real-time PCR was used to quantitate the extracted DNA using published TPOX primers and Promega and NIST commercial
human DNA standards. Six of the seven methods produced amplifiable DNA in the study.

CHED 168

Separation and identification of biosurfactants by RP-HPLC

Danielle E Montanari(1), kloeppekd@mercer.edu, 1400 Coleman Ave, Macon GA 31207, United States; Katherine L Miller(1); E. Leonardo Sastoque(2); Joseph W Kloeppe(3); Kathryn D Kloeppe(1). (1) Department of Chemistry, Mercer University, Macon GA 31207, United States (2) Department of Entomology and Plant Pathology, Auburn University, Auburn AL 36849, United States

Biosurfactants are microbial-produced compounds that are surface-active. Like chemical surfactants, biosurfactants contain both hydrophilic and hydrophobic portions. In contrast to most traditional chemical surfactants, biosurfactants are less toxic, biodegradable, and stable at a wider range of temperatures and pH. The goal of this work is to identify and characterize novel biosurfactants. This requires identification of bacterial strains that demonstrate biosurfactant activity, separation of the complex mixture of growth broth, and characterization of biosurfactant molecules. RP-HPLC was utilized to separate and identify biosurfactants produced by a strain of Bacillus subtilis that promotes plant growth and inhibits fungal plant pathogens. Strategies to achieve these goals as well as preliminary results are discussed.

CHED 169

Nutrient levels and GC/MS analysis of water from Kenya, Africa collected the summer of 2010

Chelsey A Williams(1), chelsey.williams@bobcats.gcsu.edu, 5163 Cobblestone Park Dr., Milledgeville GA 31061, United States; Catrena Lisse(1). (1) Department of Chemistry, Physics, & Astronomy, Georgia College & State University, Milledgeville GA 31061, United States

Water samples were taken from Kenya, Africa from rivers, concrete holding tanks, and rain water collection tanks. Each collections site was identified as a drinking water source for the inhabitants of that area. The water was collected from Narok, Morijo, and The Fig Tree Inn on the Masai Mara in the summer of 2010. Nutrient tests were done on the samples such as free and total chlorine and nitrate tests. The water samples were also tested using various analytical techniques such as turbidity and pH meters. The samples were also tested for volatile organic compounds (VOC's) using purgentrap GC/MS. From the data, a comparison was done on the amounts of VOC's from each source.

CHED 170

A molecular mechanics study of the binding of Th(IV), Pa(V), U(VI), Np(V), Pu(IV), Am(III), and Ac(III) to a model peptide

Garett Claassen(1), gclassen@huntingdon.edu, 1500 East Fairview Avenue, Montgomery AL 36106-2148, United States; Maureen K. Murphy(3), maureenm@huntingdon.edu, 1500 East Fairview Avenue, Montgomery AL 36106-2148, United States; Tiffany L. Dean(3); Samuel H. Griffin(1); Tamisha C. Lawson(1); John L. Sloan(1); Angelica D. Trammell(1); Ashlee Walters(1). (1) Department of Chemistry and Biochemistry, Huntingdon College, Montgomery AL 36106-2148, United States

We used HyperChem 7.0 and Spartan molecular mechanics software to examine the binding of a series of actinide ions to oxytocin, a model peptide. Minimized energies, dipole moments, and symmetry elements were calculated for actinide ion binding to oxygen and nitrogen-containing side chains of the nine amino acid sequence of the model peptide. Results from our studies will be compared to experimental studies of actinide ion binding to the iron-transport protein, transferrin. Our model study provides a theoretical template on which to build future studies of actinide ion binding to peptides and proteins.

CHED 171

Effect of Y419F mutation on inosine monophosphate dehydrogenase using computational methods

Ralph S Galega(1), rgalega@uccs.edu, 1420 Austin Bluffs Pkwy, Colorado Springs Colorado 80918, United States; Sonja B Braun-Sand(1); Raymond Schultz(1). (1) Department of Chemistry and Biochemistry, University of Colorado Colorado Springs, Colorado Springs Colorado 80918, United States

Inosine monophosphate dehydrogenase (IMPDH) catalyzes the rate limiting step in guanine synthesis, making it an attractive target for antiviral, anticancer, and immunosuppressive drugs. Some questions remain as to the mechanism used by the enzyme. IMPDH catalyzes the rate limiting step in the de novo synthesis of guanosine from inosine, and thus is a target for anti-cancer and immunosuppressive therapies. Severance of an enzyme-xanthosine monophosphate (E-XMP*) bond by the activation of a catalytic water molecule in the active site of the enzyme (Wat241) is the rate limiting step. Here we examine the roles of three active site residues, Asp264, Arg418 and Tyr419 in the wild-type enzyme, in the activation of this water to break the enzyme-substrate bond. We also examine the changes induced by a Y419F mutation. Computational methods used include the protein dipoles Langevin dipoles linear response approximation (PDL/S-LRA) method to calculate changes in pKs values of active site residues.
CHED 172
Site-directed mutagenesis of oxalate oxidase active-site residues involved in catalysis

Morgan Grant(1), mgrant22@students.kennesaw.edu, c/o Ellen Moomaw, 1000 Chastain Road MD 1203, Kennesaw Georgia 30144, United States; Eric Hoffer(1); Ellen Moomaw(1). (1) Department of Chemistry and Biochemistry, Kennesaw State University, Kennesaw Georgia 30144, United States

Oxalate oxidase (E.C. 1.2.3.4) catalyzes the oxygen-dependent oxidation of oxalate to carbon dioxide in a reaction that is coupled with the formation of hydrogen peroxide. Although there is currently no structural information available for oxalate oxidase from Ceriporiopsis subvermispora (CsOxOx), sequence data and homology modeling indicate that it is the first manganese-containing bicupin enzyme identified that catalyzes this reaction. Interestingly, CsOxOx shares greatest sequence homology with bicupin microbial oxalate decarboxylases (OxDC). The overlap extension method of site-directed mutagenesis has been used to probe amino acid residues that have been implicated to play a role in catalysis and reaction specificity. In this work, we describe the strategy and experimental results of site-directed mutagenesis experiments designed to probe amino acid residues involved in catalysis and reaction specificity.

CHED 173
Modifications to the Chelex DNA extraction method to reduce cost and extraction time

Michael D. Radulovich(1), radulovm@mscd.edu, CB 52, PO Box 173362, Denver CO 80217, United States; Kelly M. Elkins(1). (1) Chemistry Department, Metropolitan State College of Denver, Denver CO 80217, United States

The DNA extraction methods used in crime laboratories including Chelex-100, Phenol-Chloroform-ISOamyl Alcohol, dialysis, and commercial kits (e.g. Promega's DNA IQ™ and Qiagen's QIAamp) vary widely in terms of cost and extraction time. The 5% Chelex method is the cheapest but is time-consuming due to a recommended 6-8 hour, 56 °C incubation step. In this study, we evaluated the Chelex method for DNA recovery and amplifiability using reduced incubation times (thirty to ninety minutes) and overnight without Proteinase K. The results showed that any incubation time over sixty minutes and the procedure from which Proteinase K was omitted produced results similar to those produced using the standard method. The modifications to the procedure make the Chelex method easier to implement in forensic DNA biology or molecular biology classes in a typical 3-hour lab period. Further testing is being done on reducing the concentration of Chelex and using alternative chelating agents.

CHED 174
Effects of various 4- and 4'-monosubstituted chalcones and their diaryl-isoxazole derivatives on MCF-7 breast cancer cell cultures

Gabriela Alvarez(1), nichole.powell@emory.edu, 100 Hamill Street, Oxford GA 30054, United States; Quan Tran(1); Nichole L Powell(1). (1) Division of Natural Sciences and Mathematics, Oxford College of Emory University, Oxford GA 30054, United States

Chalcones (1,3-diphenyl-2-propen-1-one) are aromatic ketones that function as predecessors for many important biological compounds. The anticancer activity of chalcones has been found to be dependent on the presence, number, and positions of hydroxyl, methoxy, and halogen groups. Here we present the results of experiments to determine the effect of various 4 and 4'-monosubstituted chalcones and their respective isoxazoles on MCF-7 breast cancer cells and discuss the structure-activity relationship of the compounds.

CHED 175
Kinetic studies of pesticide-dependent DNA aptazymes

Anit K. Behera(1), abehera@slu.edu, 3501 Laclede Ave, St. Louis MO 63103, United States; Kennedy O. Alla(1); Rebecca Grout(1); Mengyu Han(1); Dana A. Baum(1). (1) Department of Chemistry, Saint Louis University, St. Louis MO 63103, United States

Utilizing in vitro selection, we identified DNA sequences that are dependent on the presence of a pesticide to catalyze the ligation of two RNA substrates. In order to characterize the resulting catalytic DNA sequences, we are investigating their kinetics in the presence and absence of the pesticides used during the selection process. By varying the pesticide concentration, we are analyzing the binding affinity of the target for the catalytic DNA sequences. We are also using related pesticides to determine the specificity of the aptazymes for their targets. These studies allow us to identify the optimum reaction conditions for the DNA aptazymes and provide information for future in vitro selection efforts. The results of our studies will be discussed.

CHED 176
Studies of a tyrosine mutant in the binding pocket of nitrophorin 2

Allena M Goren(1), agoren@email.arizona.edu, 1306 E. University, Tucson AZ 85721, United States; Robert E Berry(1); Hongjun Zhang(1); F. Ann Walker(1); Anabella Ivancich(2). (1) Department of Chemistry and Biochemistry, University of Arizona, Tucson Arizona 85721, United States (2) Centre d'Etudes de Saclay Institut de Biologie et des Technologies, Saclay, France
Nitrophorins are nitric oxide carrying proteins found in the saliva of Rhodnius prolixus, the kissing bug. This insect is a carrier of Trypanosoma cruzi, the protozoan that causes Chagas Disease. We have identified a residue in the heme pocket of Nitrophorin 2 that greatly affects the folding of the protein. The tyrosine residue at position 104 was studied, as it affects the protein stability and may be involved in the peroxidase activity and other properties of the protein. It has been determined that with the methionine that results from translation of the start codon not cleaved, the mutants of Y104 did not fold. Mutation at this position was studied in the more stable D1A construct, which allows the E. coli to cleave the N- terminus methionine. The mutants Y104F and Y104H have been characterized by NO and histamine binding, NMR spectroscopy, spectroelectrochemistry, EPR spectroscopy and stopped-flow kinetics.

CHED 177
Preliminary experiment for the extraction and purification of LDH from plant resources as an undergraduate Biochemistry lab

Catrina Mize(1), cdmize96@hotmail.com, 303 Englewood Dr NE, Jacksonville Alabama 36265-1970, United States ; Lauren Collins(1); Nagarajan Vasumathi(1). (1) Department of Physical and Earth Sciences, Jacksonville State University, Jacksonville AL 36265, United States

In Biochemistry undergraduate labs, students learn the process of enzyme extraction and purification process using the enzyme lactate dehydrogenase (LDH). Currently, beef heart is the source utilized for the procedure. Unfortunately, fresh sources of beef heart are not always readily available and the proteins are susceptible to degradation. Finding a plant based source of LDH that can easily be extracted will cut down on protein degradation as well as being a low cost alternative to mammalian LDH.

CHED 178
Kinetics of pure yeast hexokinase PII

Hong Luong(1), hluong@uccs.edu, 1420 Austin Bluffs Pkwy, Colorado Springs CO 80918, United States ; Mary Commerford(1); Joseph Bishara(1); Melissa Guzman(1); Sonja Braun-Sand(1). (1) Department of Chemistry and Biochemistry, University of Colorado at Colorado Springs, Colorado Springs CO 80918, United States

Pure yeast hexokinase PII purchased from Roche Diagnostics is used for comparison to yeast hexokinase PII expressed in collaboration with another group. Most of the studies done using yeast hexokinase have been performed on a mixture of isozymes, and we are interested in the differences between these isozymes. Therefore the pure isoforms are used in our studies. Using an assay activity, we have determined the kinetic values such as V_max, K_M, and k_cat for yeast hexokinase PII with a variety of substrates and inhibitors. Hexokinase isozymes are used here because they are of fundamental interest, as virtually all organisms metabolize glucose.

CHED 179
Determination of enzyme kinetics and inhibitors for hexokinase PII by ultraviolet-visible spectroscopy

Mary Commerford(1), mcommerf@uccs.edu, 1420 Austin Bluffs Pkwy, Colorado Springs CO 80918, United States ; Hong Luong(1); Jimi Miller(1); Joseph Bishara(1); Melissa Guzman(1); Sonja Braun-Sand(1). (1) Department of Chemistry and Biochemistry, University of Colorado at Colorado Springs, Colorado Springs CO 80918, United States

Cancer cells grow faster than the blood vessels that supply them with oxygen, creating a hypoxic environment. Because of this, their primary source of adenosine triphosphate to grow and reproduce is glycolysis. Hexokinase performs the first irreversible step in the glycolytic pathway. Finding an inhibitor to block human hexokinase could potentially starve cancer cells of needed energy, possibly causing apoptosis or necrosis. In particular, human hexokinase type II is often overexpressed in many cancers, and a potent inhibitor of this isozyme versus other human isozymes is desirable. We are trying to understand differences between the yeast isoforms as a starting point of understanding isozyme differences. Using hexokinase PII from Saccharomyces cerevisiae, enzyme kinetic studies were performed, using a UV-Vis spectrophotometer, to determine the maximum velocity (V_max), k_cat and the K_M of the enzyme. Glucosamine was tested to determine if it was a suitable competitive inhibitor.

CHED 180
Fluorescence spectroscopy study of Suwannee River fulvic acid complexation with Al(III) and comparative metal ions and bridging to negatively-charged herbicides

Elizabeth M. Traudt(1), etraudt@mscd.edu, CB 52, PO Box 173362, Denver CO 80217, United States ; Kelly M. Elkins(1). (1) Chemistry Department, Metropolitan State College of Denver, Denver CO 80217, United States

Fluorescence spectroscopy was used to probe the “bridging” interaction capability of metals including Al^3+ and Er^3+ on negatively-charged herbicides including 2,4-dichlorophenoxy-propionic acid (DCPPA) with negatively-charged Suwannee River fulvic acid (SRFA) at pH 2.0, 3.0 and 4.0. Fluorescence experiments on ternary solutions at pH 4.0 (above the pKa of DCPPA) clearly indicate that Al^3+ strongly interacts with SRFA-DCPPA as demonstrated by an isosbestic point in the emission spectra and a quenching of aluminum’s usual SRFA enhancement upon titration with the metal. For comparison, Er^3+ additions to SRFA-DCPPA at pH 4.0 resulted in significant fluorescence quenching and a blue shift in the emission maxima as compared to the SRFA-Er^3+ complex.
Following 20 hours of UV photoirradiation, the emission intensity was enhanced for both of the ternary complexes and further shifting was observed in the excitation-emission plots.

CHED 181

H₂Oconee & Beyond: What's in your water supply?
Allison E. Barfield(1), allison.e.bарfeild@gmail.com, 1260 Providence Dr., Lawrenceville GA 30044, United States; Ashley V. Collins(1), ashley.collins2@bobcats.gcsu.edu, 120 West Campus Dr., Apt. 6009, Milledgeville GA 31061, United States; Amber M. Pentecost(1), ampentecost@gmail.com, 120 West Campus Dr., Apt. 4112, Milledgeville GA 31061, United States; Chelsey A. Williams(1), chelsey.williams@bobcats.gcsu.edu, 5163 Cobblestone Park Dr., Milledgeville GA 31061, United States; Catrena H. Lisse(1), (1) Department of Chemistry, Physics and Astronomy, Georgia College, Milledgeville GA 31061, United States

A group of undergraduate chemistry majors monitored the water quality within the Oconee River Basin as a research project. On-site water testing kits and probes were used to test nutrient levels, temperature, pH, dissolved oxygen, conductivity, and turbidity. Global positioning systems technology was used to ensure exact testing locations for reproducibility. Water samples were collected using techniques following EPA guidelines to test samples in the laboratory. This poster highlights the conducted work from this semester and future plans for research next year.

CHED 182

Ongoing multifaceted and interdisciplinary investigation of the Jordan River
Neil R Bastian(1), neil.bastian@slcc.edu, 4600 South Redwood Road, PO Box 30808, Salt Lake City Utah 84130, United States; Michael Ferraro(1), mferraro@mymail.slcc.edu, 4600 South Redwood Road, Salt Lake City Utah 84130, United States; Peter Iles(1); Luther Giddings(1); Ron Valcarcel(1); Joe Warren(1); Mary Alvarez(1); (1) Department of Chemistry, Salt Lake Community College, Salt Lake City Utah 84130, United States

This project is an ongoing multifaceted and interdisciplinary investigation of the Jordan River. Samples of water from the Jordan River and adjacent ponds, riparian vegetation (e.g., cattail), and riparian area soils were collected along the river, from Utah Lake to the Great Salt Lake for studying the overall condition of the river, as well as with specific reference to sites where there may be waste and contaminants. GPS points of sample locations were taken and ArcGIS has been implemented to both map these locations and perform spatial analysis. Samples were examined with respect to temperature and dissolved oxygen at the sampling point. Samples were also analyzed by ICP-MS for 20 different metals. A study of bacterial types has commenced using Quantitative Polymerase Chain Reaction (qPCR) technique and degenerate oligonucleotide primers specific for 16S ribosomal RNA genes, to monitor the total number of bacteria per unit volume of water.

CHED 183

Enhancing biodiesel production by acidification and esterification of fatty acid soaps
Olga Y Ivasheva(1), oy.ivasheva@colostate-pueblo.edu, 220 Bonforte Blvd, Pueblo CO 81001, United States; Chevaun E Glover(1), chevaunglover@hotmail.com, 220 Bonforte Blvd, Pueblo CO 81001, United States; Amanda M Anaya(1); David L Dillon(1), (1) Chemistry, Colorado State University - Pueblo, Pueblo Colorado 81001, United States

Biodiesel is an important renewable fuel made primarily by transesterification of plant oils producing glycerol as a significant by-product. Most small-scale biodiesel operations use base-catalyzed transesterification reactions resulting in co-production of variable quantities of soap by-products as contaminants in the glycerol. These soaps correspond to long carbon chain fatty acids. We have investigated the recapture of the fatty acid portion of soaps accompanying glycerol by-product from canola seed biodiesel production. Our process involves acidification of crude glycerol, and subsequent methyl esterification of the free fatty acids to produce additional biodiesel. Based on preliminary experiments, additional biodiesel amounting to roughly 20% of the glycerol volume can be obtained from soaps in the crude glycerol by-product. This soap-derived biodiesel will be compared with production grade biodiesel on the basis of color, clarity, cloud point, density, viscosity, and IR. We hypothesize that the process described here can be used to increase commercial biodiesel production.

CHED 184

Sulfa drug degradation by ferrate(VI) oxidation: Application of a green oxidizing agent in the removal of pharmaceuticals from the environment
Kyle J. Czech(1), kjczech@cord.edu, 901 8th St S, Moorhead Minnesota 56562, United States; Graeme R. A. Wylie(1); Molly Haugen(1); Alex B. Jorgenson(1), (1) Chemistry, Concordia College, Moorhead Minnesota 56562, United States

Development of the latest generation of sulfa drug antibacterials has resulted in compounds with improved stability in the body. This improved stability has consequently caused sulfa drug concentrations to rise to detectable levels in public drinking-water sources. One method of degrading these compounds has been with strong oxidizing agents, but classical examples such as permanganate and dichromate exhibit toxic byproducts, thus there is demand for an eco-friendly alternative. The strong oxidizing agent ferrate(VI) is of considerable interest because it has great oxidizing potential but lacks toxic characteristics. Degradation studies of four sulfa...
Redox and spin-state tuning in iron triaza macrocyclic complexes

Azam S. Tolla(1), astolla@oakland.edu, 2200 N Squirrel Rd, Rochester MI 48309, United States; Slavica Stjepanovic(1), sstjapan@oakland.edu, 2200 N Squirrel Rd, Rochester MI 48309, United States; Atanu Banerjee(2); Reza Lolee(2); Ferman A. Chavez(2); William W. Brennessel(3), (1) Department of Chemistry, Oakland University, Rochester MI 48309, United States (2) Department of Physics and Astronomy, Michigan State University, East Lansing MI 48824, United States (3) Department of Chemistry, University of Rochester, Rochester NY 14627, United States

Metal complexes containing triazamacro cyclic ligands have been extensively studied due to their biologically relevant structures. One of the most studied members of this class of ligands is 1,4,7-triazacyclononane (tacn) due to the stability derived from three five-membered chelate rings. In this study, we examine the influence of expanding the ring size by one CH2 group (1,4,7-triazacyclodecane, tacd) and two CH2 groups (1,4,6-triazacycloundecane, tacud) on the magnetic and electrochemical properties of FeII bis-chelates. Iron(II) complexes of tacn, tacd, and tacud have been synthesized and fully characterized. Redox studies on these complexes reveal [Fe(tacud)2](OTf)2 is a stronger oxidant than [Fe(tacn)2](OTf)2 and [Fe(tacd)2](OTf)2. In addition, magnetic studies show that [Fe(tacud)2](OTf)2 is a purely high spin complex under ambient conditions whereas [Fe(tacn)2](OTf)2 and [Fe(tacd)2](OTf)2 exhibit spin equilibrium.

Selenium and tellurium compounds can adopt different geometries depending on their oxidation states. Brøndmo et al. (Acta Chem. Scand., A29(1975)93) grouped the existing geometries for divalent selenium and tellurium compounds with chalcogen ligands into five classes. Class V compounds (compounds with bidentate chalcogen ligands and square planar geometry) have not been researched to a great extent. A series of new selenium and tellurium compounds...
coordinated with Ph₂P[Et(CNNHNC)][Et]Ph₂ (with E=O, S and Se) ligands has been synthesized. These versatile ligands have different coordination modes and exhibit planarity and electron delocalization. The compounds were characterized by IR, Raman and 1H, 13C, 77Se and 125Te NMR spectroscopies. Thermogravimetric analyses were conducted to assess if these compounds were good single source precursors for thin layer vapor physical deposition. The compounds have shown an adequate thermal stability.

CHED 189

Metal carbide nanowires as fuel cell catalysts for a healthier tomorrow

Gregory R Waetzig(1), gwaetzig@uwyo.edu, 1000 E. University Avenue, Laramie WY 82072, United States; Brian M Leonard(1); (1) Department of Chemistry, University of Wyoming, 1000 E. University Avenue, Apt 5, Laramie WY 82072, United States

Fuels cells are a promising clean power source for the future. The problem with current fuel cell technology is the expensive platinum catalyst used in the oxidation and reduction reactions of fuel cells. To combat this, we are investigating non-precious metal carbide catalyst materials. We are interested in carbide materials because they have electronic properties similar to platinum making them a perfect low cost replacement. Carbides have a very high melting point which makes them difficult to synthesize as high surface area nanomaterials. To fix this we use salt flux reactions to transport the metal from the bulk material to the carbon where it can react. To better control the morphology of our catalyst, we react multi-walled carbon nanotubes with two metals creating a multi-metallic nanowire. The addition of the second metal will allow manipulation of electronic and geometric properties to be used in the fuel cell reactions stated above.

CHED 190

Synthesis and characterization of asymmetric bimetallic ruthenium complexes that interact with DNA

Jessica G Posio(1), posioj@kean.edu, 1000 Morris Ave, Union NJ 07071, United States; Marina Hanna(1); Matthew T Mongelli(1). (1) Chemistry and Physics, Kean University, Union NJ 07083, United States

Ruthenium complexes of the form [(TL)₂Ru(BL)RuCl(TL)₂]²⁺, where TL is the bidentate ligand 1,10-phenanthroline (phen) or 2,2’-bipyridine (bpy), TL is the tridentate terminal ligand 2,2’-6’,2’’-terpyridine (tpy) or tris(1-pyrazolyl)methane (tpm) and BL is a bridging ligand 2,3-bis(2-pyridyl)pyrazine (dpp) have been synthesized and characterized. The complexes show strong absorbances in the visible region as well as well separated oxidation states of the two metals. These complexes have been assayed for their ability to bind and photocleave DNA with visible light and visualized using agarose gel electrophoresis. The synthesis and characterization data will be presented as well as the metal complexes-DNA interactions.

CHED 191

Cation optimization of the sensitivity of nitrogen phosphorus detectors

Alia M. Saad(1), asaad033@unm.edu, 1001 University Boulevard, SE, Albuquerque New Mexico, United States; Timothy J. Boyle(2); Leigh Anna M. Ottley(2); Ryan F. Hess(2). (1) University of New Mexico, Albuquerque New Mexico, United States (2) Sandia National Laboratories, Albuquerque New Mexico, United States

Nitrogen phosphorous detectors (NPD) are employed for the analysis of many small organic molecules in pharmaceuticals and environmental toxins. The active component of the NPD is based on flame ionization detectors that employ a rubidium or cesium bead contained inside a heated coil to specifically identify the N-P molecules. After numerous runs, the alkali salt, usually embedded in a silicate matrix, deteriorates, compromising both reliability and sensitivity. To improve the lifetime of these detectors, it is important to probe the mechanism for how these NPDs operate. We have generated a series of thin films based on the dimethylphenoxido (DMP) derivatives of the Group I congener series and compared these results with a series of Row 6 (Cs, Ba, La, Hf, Ta, and W) derivatives. The synthesis and characterization of these “M(DMP)x" precursors, the subsequent films, their N-P detection ability, and the testing processes involved with the NPDs, will be discussed.

CHED 192

Synthesis and characterization of novel metal tris(trimethylsilyl)silanol precursors for production of siloxide-based nanomaterials

Sarah M Hoppe(1)(2), shoppe@sandia.gov, 1001 University Blvd SE, Albuquerque New Mexico 87106, United States; Timothy J. Boyle(1); Leigh Anna M Ottley(1). (1) Sandia National Laboratories, United States (2) Department of Chemistry and Chemical Biology, University of New Mexico, United States

Silica (SiO₂) containing complex ceramic nanomaterials are of interest for use in a number of diverse applications, such as bioimaging and scintillators. When typical metal siloxide [M(OSiR₃)ₓ : M = transition metal] precursors were used in solvothermal (SOLVO) or solution precipitation (SPPT) routes, they formed oxides (MOₓ) rather than the desired siloxides (MSiOₓ). Since a Si-Si bond is weaker than a C-Si bond, we exploited the tris(trimethylsilyl)silanol (H-ST) ligand to form MSiOₓ. With few MSST compounds in the literature, a novel family of compounds was synthesized and decomposed to form nanomaterials. The synthesis and characterization of the M-ST compounds and their nanomaterials will be presented.
The ferrocene compounds have applications in catalysis, material sciences and bioorganometallic chemistry. The ferrocene carboxaldehyde was reacted with different ketones in basic conditions to obtain the corresponding unsaturated compounds. The methods of characterization was FT-IR, NMR and UV-Vis. The purpose of the synthesis is to study the biological activity of the new derivatives.

**CHED 196**

Synthesis of ruthenium(II) complexes and the evaluation of their effect on halting plasmid replication

Jeremy M Carr\(^{(1)}\), jcarr@huntingdon.edu, 1500 East Fairview Ave, Montgomery AL 36106, United States; Ramí Herrera\(^{(1)}\); Kellie Hilton\(^{(1)}\); Mary Elizabeth Terrell\(^{(1)}\); Ginger Tyson\(^{(1)}\); Winston Wooten\(^{(1)}\). (1) Department of Chemistry and Biochemistry, Huntingdon College, Montgomery Alabama 36106, United States

The compound cis-diamminedichloroplatinum(II) (cisplatin) and its corresponding analogs, have shown remarkable effects in treating cancerous cells. Unfortunately, cisplatin demonstrates harsh side effects including nausea, vomiting, nephrotoxicity, and neurotoxicity. Since cisplatin's discovery, several other transition metal complexes have been investigated as potential therapies with which to treat cancer. Of these, ruthenium(II) arene complexes have shown promising results, demonstrating IC\(_{50}\) values against human ovarian cancer cells that are equivalent to or better than cisplatin derivatives, without the toxic side effects. Our group is currently synthesizing a variety of these complexes to study how they affect DNA replication in plasmids.

**CHED 197**

In silico analyses of the use of bombesin to target metal-based drugs to tumors

Rachel M Saylor\(^{(1)}\), saylorrm@mail.lipscomb.edu, 1 University Park Dr., Nashville TN 37204, United States; J Dominic Smith\(^{(1)}\). (1) Department of Chemistry, Lipscomb University, Nashville TN 37204, United States

DFT (density functional theory) methods are used to calculate \(\Delta G\) values. Cancer drugs are targeted to tumors by coupling the metal-based drugs to peptides with receptors displayed on cancer tumors. Computational analyses are run on these complexes to determine the free energy change involved in binding the drug to the peptide. The binding of peptides with drugs based on metals, including titanium, platinum and others, show promising \(\Delta G\) values in terms of the formation and dissociation of the drug-peptide complex.

**CHED 198**

Novel nitroxy (HNO) donors
Cinnamaldehyde and vanillin are compounds that are present in common food flavorings, cinnamon and vanilla, respectively. It has been reported that cinnamaldehyde and vanillin, and the nucleosides, 2'-deoxyguanosine and 2'-deoxyadenosine are poorly understood. Previous research has shown that α,β-unsaturated aldehydes can form exocyclic adducts with 2'-deoxyguanosine. The focus of this research was to synthesize possible exocyclic products of cinnamaldehyde and vanillin with 2'-deoxyguanosine and 2'-deoxyadenosine. HPLC was used to compare results of these synthetic reactions with the results obtained when calf-thymus DNA was independently treated with cinnamaldehyde and vanillin and subjected to enzymatic digestion. NMR spectral analysis confirms cinnamaldehyde does react with 2'-deoxyguanosine.

CHED 199

Investigation of the interactions between cinnamaldehyde and vanillin, and the nucleosides, 2'-deoxyguanosine and 2'-deoxyadenosine

Katelyn D. Taylor(1), katelyn.taylor@mnmsu.edu, 407 East Elm Street, Brandon SD 57005, United States; Danaé R. Quirk Dorr(2), (1) Department of Chemistry, Minnesota State University, Mankato, Mankato MN 56001, United States

Cinnamaldehyde and vanillin are compounds that are present in common food flavorings, cinnamon and vanilla, respectively. It has been reported that cinnamaldehyde and vanillin have the potential to induce the cell’s ability to repair mutated DNA specifically at the sites where 2'-deoxyguanosine has been mutated. However, the precise reactions that cinnamaldehyde and vanillin undergo with 2'-deoxyguanosine are poorly understood. Previous research has shown that α,β-unsaturated aldehydes can form exocyclic adducts with 2'-deoxyguanosine. The focus of this research was to synthesize possible exocyclic products of cinnamaldehyde and vanillin with 2'-deoxyguanosine and 2'-deoxyadenosine. HPLC was used to compare results of these synthetic reactions with the results obtained when calf-thymus DNA was independently treated with cinnamaldehyde and vanillin and subjected to enzymatic digestion. NMR spectral analysis confirms cinnamaldehyde does react with 2'-deoxyguanosine.

CHED 200

Procedural developments in molecular docking methods via novel substituted aurones

Brian A McKinnon(1), brian.mckinnon@bobcats.gcsu.edu, 529 West Bypass Rd, Milledgeville Georgia 31061, United States; Chavonda A Mills(1), (1) Department of Chemistry and Physics, Georgia College & State University, Milledgeville Georgia 31061, United States

Cyclooxygenase-2 selective agents have been intensively evaluated for their ability to treat cancer. Unfortunately, the most promising class of COX-2 specific inhibitors evaluated as anticancer agents also exhibited adverse and sometimes fatal side effects. Therefore, it is critical to develop a new class of agents with superior COX-2 specific inhibition and fewer side effects. Flavonoids are naturally-occurring compounds that have anti-cancer properties. Reports indicate that inhibition of tumor development by flavonoids is mediated through inhibition of the COX-2 enzyme. Using rational drug design methods, docking studies were performed to model novel structurally-modified flavonoids, particularly aurone derivatives, at the COX-2 active site. Presented herein are docking studies of key interactions between derivatives and the enzyme binding pocket. Furthermore, binding free energy and inhibitory concentration (IC50) values were calculated and compared against known inhibitors. Results of these docking studies provided promising results thereby leading to the synthesis of the most promising derivatives.

CHED 201

Schottky diodes and sensors fabricated from electrospun PEDOT-PSSA nanofibers and their characterization in toxic gaseous environments

Yarely Davila(1), nicholas.pinto@upr.edu, 100 Road#908, CUH Station, Humacao PR 00791, Puerto Rico; Danairé Rivera(1), nicholas.pinto@upr.edu, 100 Road#908, CUH Station, Humacao PR 00791, Puerto Rico; Nicholas J Pinto(1), nicholas.pinto@upr.edu, 100 Road#908, CUH Station, Humacao PR 00791, Puerto Rico; Brian A McKinnon(1), brian.mckinnon@bobcats.gcsu.edu, 529 West Bypass Rd, Milledgeville Georgia 31061, United States; Nicholas J Pinto(1), nicholas.pinto@upr.edu, 100 Road#908, CUH Station, Humacao PR 00791, Puerto Rico

Schottky diodes and sensors fabricated from electrospun PEDOT-PSSA nanofibers and their characterization in toxic gaseous environments

Sub-50 nm diameter nanofibers of the commercially available p-doped conducting poly(3,4-ethylenedioxythiophene) polymer doped with (poly styrene sulfonic acid)-PEDOT-PSSA have been electrospun in air and used in the fabrication of Schottky diodes and sensors. The diodes were tested in the presence of several toxic gases like NO2 and aliphatic alcohols. The rectification ratio of the diodes was tunable and the response reversible in the presence of these gases with no damage to the device. Some of the fibers were also used in the fabrication of NO using a specific NO detector. Some of the fibers were used in the fabrication of NO using a specific NO detector. Some of the fibers were used in the fabrication of NO using a specific NO detector.
of sensors. Large surface to volume ratio and small quantity of active material make these sensors similar or faster in response time compared to alcohol sensors based on PEDOT. Increasing the size of the alcohol molecule increases response times due to slower diffusion of the larger molecule into the polymer. The same sensors were annealed in air at 70°C and used to sense NH₃, HCl and NO₂ gases.

**CHED 202**

Reaction of silane coupling agents with the surface of magnetite oxide nanoparticles

A. Kirstin Sockwell(1), drnikles@mint.ua.edu, Box 870336, Tuscaloosa Alabama 35487-0336, United States ; M. Adam Begi(1); Jeremy S. Pritchett(1); Jacqueline A. Nikles(2); David E. Nikles(1). (1) Department of Chemistry, The University of Alabama, Tuscaloosa Alabama 35487-0336, United States (2) Department of Chemistry, University of Alabama at Birmingham, Birmingham Alabama 35294-1240, United States

Our interest in the biomedical application of magnetic nanoparticles has led to this study of the reaction of silane coupling agents with the particle surface. [3-(2-aminoethylamino)propyl]trimethoxysilane (AEAPT) was reacted with either magnetite, cobalt ferrite, manganese ferrite or nickel ferrite to covalently attach the AEAPT ligand to the particle surface through the siloxane groups. [3-Aminopropyl]trimethoxysilane (APS) was reacted with either cobalt ferrite or magnetite and the bound amine groups were reacted with caprolactone to give magnetic nanoparticles with a polycaprolactone surface coating. Biotin was reacted with APS to give an amide, which was reacted with magnetite to bind biotin to the particle surface.

**CHED 203**

Measuring the integrity of lipid bilayer coatings on silica nanoparticles

Aundrea R Piper(1), apiper10@gmail.com, Campus Box 194, PO Box 173364, Denver Colorado 80217-3364, United States ; Scott Reed(1). (1) Department of Chemistry, University of Colorado Denver, Denver Colorado 80217-3364, United States

C-reactive protein (CRP) is a serum protein whose level rises in response to inflammation. Binding of CRP to oxidized lipid membranes causes isofrom conversion from native pentameric CRP to a modified (mCRP) form. mCRP expresses neoeptopes and is believed to be pro-atherogenic and pro-inflammatory, hence, it is of great importance to understanding cardiovascular disease. Here, lipid coated silica nanoparticles (PC-SiNP)s are synthesized as cell mimics to allow elucidation of the role of membrane curvature in pCRP binding. Specifically, the research focused on methods to determine the packing density, uniformity, and lamellarity of lipids. Loading and encapsulation of SiNP with calcein dye was achieved using a liposome containing phosphatidylcholine and cholesterol. After encapsulation, PC-SiNP stability was determined by calcein leakage studies, followed by induced membrane leakage. Thermogravimetric analysis was used to determine the number of lipids present in the sample and allow calculation of degree of coverage of the nanoparticles.

**CHED 204**

Surface adhesion variation of *Staphylococcus epidermidis* on alkyl thiol SAM surfaces

Indrajith C. Seneviratne(1), isenevir@lhp.edu, 401 N. Fairview St., Lock Haven PA 17745, United States ; Alicia M. Amroski(2); Karisa M. Bowersox(2); Joseph P Calabrese(2); Reshani N Seneviratne(3). (1) Geology and Physics, Lock Haven University, Lock Haven PA 17745, United States (2) Biology, Lock Haven University, Lock Haven PA 17745, United States (3) Food Science, Pennsylvania State University, University Park PA 16802, United States

Controlled surface adhesion of non-pathogenic gram positive strain, *Staphylococcus epidermidis* is interesting as a model system due to possible development of respective biosensors for prevention and detection of the pathogenic strain methicillin resistant *Staphylococcus aureus* (MRSA) and further as a study for bio-machine interfacing. Clean/flat Au(111) surface was used for self assembly for Self Assembled Monolayers (SAM) with varying mixtures of 1-hexanethiol, 1-octanethiol and 1-decanethiol at total 1.5 mM solution. The SAM layered Au(111) surfaces were dipped in 5Log/ml – 6Log/ml S. epidermidis solution. Subsequent surface adhesion due to variations resulting in surfaces due to thiol mixtures will be discussed, correlated with quantitative and qualitative adhesion properties of bacteria on the different SAM surfaces. The bacteria adhered SAM surfaces were investigated using intermittent contact, lateral force and contact modes of Atomic Force Microscopy (AFM).

**CHED 205**

Study of surface adhesion and confinement: *Escherichia coli* DH5 alpha on thiol SAM surfaces

Karisa M. Bowersox(1), kbowerso@lhp.edu, 401 N. Fairview St., Lock Haven PA 17745, United States ; Indrajith C. Seneviratne(2); Alicia R. Amroski(1); Joseph P. Calabrese(1); Reshani N. Seneviratne(3). (1) Biology, Lock Haven University, Lock Haven PA 17745, United States (2) Geology and Physics, Lock Haven University, Lock Haven PA 17745, United States (3) Food Science, Pennsylvania State University, University Park PA 16802, United States

Engineering surfaces for adhesion and confinement of bacteria is interesting due to sensory applications focused on detection and prevention, biotechnology and possible hybrid systems. Non-pathogenic gram – negative strain, *Escherichia coli* DH5 alpha is investigated as a model system for pathogenic *E. coli.*
Clean/flat Au(111) surface was used for self assembly for Self Assembled Monolayers (SAMs) of thiols with 1-undecanethiol, 11-mercapto-1-undecanol and 11-mercaptoundecanoic acid, at 1.5 mM solution. Each of the SAM layered Au(111) surfaces were dipped in 5Log/ml – 6Log/ml DH5 alpha solution. Subsequent surface adhesion due to variations resulting in surfaces due to functional sites will be discussed, correlated with quantitative and qualitative adhesion properties of DH5 alpha on the individual SAM surfaces. Atomic Force Microscopy (AFM) was used to investigate the bacteria adhered SAM surfaces in intermittent contact, lateral force and contact modes.

**CHED 206**

Synthesis and characterization of nanoalloys for solder application

Thu Q Doan(1), tdoan@sandia.gov, 1001 University Blvd. SE, Albuquerque NM 87106, United States ; Timothy J Boyle(1); Leigh Anna M Ottley(1); Sarah M Hoppe(1); Jerome Regent(2); Paul T Vianco(2); Aaron C Hall(3). (1) Advanced Materials Laboratory, Sandia National Laboratories, Albuquerque NM 87106, United States (2) Sandia National Laboratories, Sandia National Laboratories, Albuquerque NM 87123, United States

Recent efforts in the field of solders has been focused on using nanoparticles as solders. Nanoparticles have the unique property of having a lower melting temperature than their respective bulk materials. Thus, using nanoparticles as solders would lower melting temperatures, energy, and costs required for soldering. Our research focuses on developing routes for synthesizing nanoparticle alloys as solders. The alloys of interest include tin/lead, as well as several lead-free alloys including tin/silver, tin/gold, and gold/germanium. These alloys are synthesized through either solvothermal or solution precipitation route, using metal amides or metal alkoxides as nanoparticle precursors. Characterization of the nanoalloys include transmission electron microscopy (TEM), Fourier Transform Infrared Spectroscopy (FTIR), and Thermogravimetric Analysis (TGA)/Differential Thermal Analysis (DTA). The details of the synthesis and characterization of the nanoalloys and their application as nanosolders will be discussed later.

**CHED 207**

Antibacterial activity of copper nanoparticles in sock fabric

Yantenew Gete(1), yantew@yahoo.com, Campus Box 52 PO Box 173362, Denver CO 80217-3362, United States ; Richard H Lohaus(1); Rosemarie Walker(1). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217-3362, United States

Advances in padding fabrics with nanoparticles to inhibit bacterial growth have led to recent development and marketing of silver, carbon, and copper antibacterial clothing for consumers. We examined the inhibitory effects of swatches of copper impregnated socks on cultures of gram-negative *Escherichia coli* and gram-positive *Staphylococcus aureus* in liquid broth and on agar plates. Previous experiments in this lab have shown that carbon swatches produced no inhibition, while silver swatches demonstrated marked inhibition, depending on fabric mass. *E. coli* exhibited more inhibition than *S. aureus* with silver, the reverse inhibition was exhibited by copper. Estimates of fabric durability and antibacterial efficacy over time were developed through repeated rinses using a shaker bath. Concentration of copper ion resulting from aqueous interaction with nanoparticles was quantified using ICP-MS, and bacterial counts were assessed through plate-counting and spectrophotometry. Further investigations will explore anti-fungalicidal efficacy of both copper and silver nanoparticle impregnated fabric.

**CHED 208**

Size effects on scintillator properties of novel high Z tungsten based nanomaterials

Cory Zarick(1), cjzaric@sandia.gov, 1001 University Blvd., Albuquerque NM 87106, United States ; Bernadette Hernandez-Sanchez(1); Janelle V. Branson(1); Timothy J. Boyle(1); Sarah Hoppe(1). (1) Advanced Materials Laboratory, Sandia National Laboratories, Albuquerque New Mexico 87106, United States

Current radiation detection materials suffer from performance and reliability issues, such as low luminosity, volume restrictions, and chemical instability. Critical to overcoming these restraints is the development of scintillators with well-understood interactions with radiation. When excited by ionizing radiation, scintillators absorb energy and emit light. We elected to probe the fundamental changes in scintillation behavior based on particle size (bulk to nano), activator concentration, and surface chemistries of the W-based materials. The materials studied included bulk and nanomaterials of the standard CaS:Ln(E,S,Se,Te) materials. The solution and solvothermal syntheses and characterization of these W-based nanomaterials will be presented. In addition, their scintillator behavior was determined using X-ray diffraction, electron microscopy, photoluminescence, cathodoluminescence, and ion beam-induced luminescence.

**CHED 209**

Synthesis of anticorrosion and antifouling nanoparticles for marine hydrokinetic technology

Laura Montoya(1), cjzaric@sandia.gov, 1001 University Blvd., Albuquerque New Mexico 87106, United States ; Bernadette Hernandez-Sanchez(1); Cory Zarick(1); Susan Altman(1); David Sanchez(1)
Marine Hydrokinetic energy is the production of renewable electricity converted from the kinetic energy of ocean waves, current, tides, or by thermal gradients. Currently an emerging global industry is focused on developing novel technology to harness this sustainable power. These alternative energy devices require advances in anticorrosion and antifouling coatings to enhance lifetime and performance. In order to understand the microbial-nanomaterial interaction as well as nanomaterial corrosion process, we have elected to examine a variety of metallic, oxide and phosphate based nanomaterials. The synthesis of these materials using solution precipitation and solvothermal routes along with their full characterization will be presented.

CHED 212

Energy transfer in ternary macrocycle complexes

Teresa Mako(1), tmako17@my.uri.edu, 51 Lower College Road, Kingston RI 02881, United States ; Mindy Levine(1). (1) Department of Chemistry, University of Rhode Island, Kingston RI 02881, United States

Certain commercially available macrocycles, such as gamma-cyclodextrin and [8]-cucurbituril, are able to form three-component complexes with two small-molecule guests. These ternary complexes have been exploited for catalytic applications. Energy transfer between the two small-molecule guests has rarely been investigated, although efficient energy transfer could be used in a variety of sensing applications. Reported herein is the generation of ternary complexes with gamma-cyclodextrin, anthracene, and a series of near-infrared emitting squaraine dyes. These ternary complexes demonstrate efficient fluorescence-based energy transfer. Exciting the anthracene at 350 nm results in efficient energy transfer to and emission from the squaraine molecules at approximately 650 nm. Without the gamma-cyclodextrin, no energy transfer is observed. These results have substantial potential applications, for example, in the detection of explosives via ternary-complex formation and energy transfer.

CHED 213

Synthesis of dissymmetric organic macrocycle for sensing and catalysis

Kayla Flynn(1). kayla_flynn@my.uri.edu, 31 Pendar Road, Apartment 1A, North Kingstown Rhode Island 02852, United States ; Mindy Levine(1). (1) Department of Chemistry, University of Rhode Island, Kingston Rhode Island 02881, United States

The objective of our research is the design, synthesis and characterization of a dissymmetric, flexible organic macrocycle that can generate ternary complexes with two small-molecule guests. Organic macrocycles are important molecules that can be used for a variety of applications in various settings. While there is much research on the encapsulation of single molecules by organic macrocycles, there has been little research on the encapsulation of two molecules, which leads to the formation of ternary complexes. This is partially due to difficulty in synthesis, as well as the entropic penalties of triacylglycerols were prepared by the NaOCH3 catalyzed interesterification of model reactions performed with different molar ratios of Triacetin, Tripropionin, and Tributyrin. The reaction products were characterized by Gas Chromatography (GC), GC/MS and Proton NMR. We found that the difference in fatty acid size and the reduced steric demands of the SCFA did not give rise to positional specificity and we found no observable deviations from the random interesterification chemistry model.
generating these complexes. Our synthesis addresses these difficulties by using a masked boronate, which allows for sequential ring-closing reactions, and favors the formation of the macrocycle over the competing polymerization reaction. The macrocycle is able to create ternary complexes due to the presence of an electron-rich and an electron-deficient segment, enabling the molecule to bind two electronically distinct molecules.

**CHED 214**

**Synthesizing a polymer-sugar bioconjugate for exploration of placental malaria**

*Kelly M Ferrill*\(^{(1)}\), *j.kawa@mail.usi.edu*, 8600 University Boulevard, Evansville Indiana 47712, United States; *Edmir O Wade*\(^{(1)}\), *jjkawa@mail.usi.edu*, 8600 University Boulevard, Evansville Indiana 47712, United States

Malaria infection in pregnant women is a persistent and devastating problem in many parts of the globe. The malaria parasite infects red blood cells, which can hide in the placenta. As the placenta becomes covered with infected erythrocytes, the nutrient and gas transfer from the mother to fetus is greatly reduced and the health of both mother and child are adversely affected. The goal of this research is to understand more about the multiple attachments of the infected erythrocytes to the carbohydrate chondroitin sulfate A (CSA) located along the placenta tissue. A multivalent, polymer-based molecule is being synthesized to this effect. Using sugar monomers as starting materials, synthesis is being explored to create a CSA mimic. This mimic is attached via a tether to a polymerizable imide. When the polymer is made, the molecule should bind to a multitude of infected erythrocytes, potentially blocking placental infection from occurring.

**CHED 215**

**Synthesis of novel ditheipin-based hosts to sequester TNT and C\(_{60}\)**

*Joseph J Kawa*\(^{(1)}\), *jjkawa@mail.usi.edu*, 8600 University Boulevard, Evansville Indiana 47712, United States; *V. Hogges*\(^{(1)}\), *jamesa.v.hogges@live.mercer.edu*, 1400 Coleman Avenue, Macon GA 31207, United States; *Bridget G Trogden*\(^{(1)}\), (1) Department of Chemistry, Mercer University, Macon GA 31207, United States

The objective of the research project is to synthesize two ditetheipin-based molecules. Both hosts are highly conjugated ditheipin-based molecules. The highly conjugated systems make these structures very UV active, which provides a method of detection for host/guest complex formation. Host 1 would be a reasonable host for targeting TNT. Host 2 is a potential Buckminsterfullerene (C\(_{60}\)) host. Currently, all components necessary to assemble the two novel hosts have been synthesized. The overall synthetic schemes of both hosts are similar; therefore a model synthetic scheme has been optimized and employed to combine the various components required for assembly of the individual host molecules. We report the progress toward the synthesis of each ditheipin-based host molecule. The fine-tuning of the synthetic model as it applies to the overall synthetic scheme of each Host, will lead to the successful synthesis of each host molecule.

**CHED 216**

**Mechanistic overview of homo-Nazarov cyclization**

*Carson Swanson*\(^{(1)}\), *carsonswanson@gmail.com*, 729 Brittain Drive, Atlanta Georgia 30313, United States; *Stefan France*\(^{(1)}\); *Lien Phun*\(^{(1)}\); *Marchello Cavitt*\(^{(1)}\), (1) Department of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta Georgia 30313, United States

Herein, we will present a detailed mechanistic study of the homo-Nazarov cyclization of donor-acceptor-acceptor (D-A-A) cyclopropanes. A series of kinetic experiments will be discussed that provides insight into the reaction. This information was used in the design of a one-pot cyclopropanation/homo-Nazarov cyclization procedure.

**CHED 217**

**Kinetic study of the asymmetric intramolecular Stetter reaction**

*Anthony P. Silvestri*\(^{(1)}\), *asilvest@rams.colostate.edu*, Oval Dr., Fort Collins Colorado 80523, United States; *Jennifer L. Moore*\(^{(1)}\); *Javier Read de Alaniz*\(^{(1)}\); *Daniel A. DiRocco*\(^{(1)}\); *Tomislav Rovis*\(^{(1)}\), (1) Department of Chemistry, Colorado State University, Fort Collins CO 80525, United States

A kinetic study of the asymmetric intramolecular Stetter reaction has been undertaken. Rate law determination, "H kinetic isotope effect data, and results from competition experiments provide significant evidence to conclude that proton transfer is the first irreversible step. Additionally, the mechanism of proton transfer has been probed and a transition state model proposed.

**CHED 218**

**Supramolecular controlled photodimerization in molecular crystals**
Factors influencing the Kulinkovich cyclopropanation reaction

Tanner Neuman\textsuperscript{(1)}, trneuman@ymail.com, 1201 Wesleyan Street, Fort Worth Tx 76105, United States; Phillip Pelphey\textsuperscript{(1)}. (1) Department of Chemistry, Texas Wesleyan University, Fort Worth Tx 76105, United States

The study of substituted aryl cyclopropanes has led to advances in the fight against breast cancer and CNS diseases including schizophrenia, alcoholism, and drug abuse. Cyclopropanes are useful synthetic precursors that exhibit increased reactivity due to high levels of ring strain. The compounds of interest were synthesized using a modified Kulinkovich protocol involving the reaction of an ester, olefin, and Grignard reagent in the presence of a titanium catalyst. Factors influencing the efficiency of this reaction were studied in order to provide better mechanistic understanding.

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\text{Ar} + \text{R} + \text{O} \xrightarrow{\text{CIT(OiPr)}_3, \text{THF}} \text{MgCl}_2, 0 ^\circ \text{C} \xrightarrow{\text{Ar}} \text{OH} \]

**CHED 221**

Kinetic study of the reaction of trichloroisocyanuric acid with phenylpropiolic acid

Crystal R. Benner\textsuperscript{(1)}, cbenner@uccs.edu, 1420 austin Bluffs Pkwy, Colorado Springs Colorado 80918, United States; Allen M. Schoffstall\textsuperscript{(1)}. (1) Department of Chemistry and Biochemistry, University of Colorado Colorado Springs, Colorado Springs Colorado 80918, United States

Halogenation of alkynes is an important step in the synthesis of certain pharmaceutical drug design scaffolds. Understanding the process by which this reaction occurs will streamline the synthetic process. One such reaction occurs between trichloroisocyanuric acid and phenylpropiolic acid to yield chlorophenylacetylene. The mechanism of this reaction was explored using kinetic methods of analysis and reaction progress was monitored via gas chromatography-mass spectrometry.

**CHED 222**

Encapsulation properties of 'reverse benzyl ether' dendrimers

Rebecca M Triano\textsuperscript{(1)}, balija@fordham.edu, 441 E Fordham Road, Bronx NY 10458, United States; Michele L Paccagnini\textsuperscript{(1)}; Amy M Balija\textsuperscript{(1)}. (1) Department of Chemistry, Fordham University, Bronx NY 10458, United States

Constitutional isomers of the classic 'Fréchet-type' benzyl ether dendrimers were synthesized. These 'reverse benzyl ether' systems were designed to determine the effect of subtle structural changes on the encapsulation properties of dendritic macromolecules. Specifically, these dendrimers are proposed to entrap polycyclic aromatic hydrocarbons (PAHs) and other small molecule organic pollutants from aqueous environments. Fluorescence spectroscopy studies demonstrated that encapsulation was dependent on the dendrimer size and the molecular volume of the PAH. As a control, analogous classic benzyl ether dendrimers were prepared and evaluated.
CHED 223
Cyclohexane based dendrimers: Synthesis and encapsulation studies
Michele L Paccagnini(1), balija@fordham.edu, 441 E Fordham Road, Bronx NY 10458, United States ; Matt P Tracey(1); John R Coombs(1); Rebecca M Triano(1); Amy M Balija(1). (1) Department of Chemistry, Fordham University, Bronx NY 10458, United States
Dendrimers have been employed as nanosponges to remove polycyclic aromatic hydrocarbon (PAH) pollutants from aqueous media in proof-of-concept studies. A family of novel cyclohexane based dendrimers was prepared to probe how hydrophobic groups impact the ability of dendrimers to encapsulate PAH substrates. The key step in this synthesis required the alkylation of a bis-phenol monomer with bromomethyl cyclohexane. Initial low yields were overcome by optimizing reaction conditions so that the alkylation product was obtained in over 85% yield. Fluorescence spectroscopy was used to examine the efficiency of zero and first generation cyclohexane based dendrimers to encapsulate PAH pollutants from water.

CHED 224
Does rigidity play a role in a hydridic-to-protonic hydrogen bonded system?
Ryan J Scamp(1), rscamp@umd.umich.edu, 420 Buckingham Rd., Canton Michigan 48188, United States ; Simona Marincean(1). (1) Department of Natural Sciences, University of Michigan-Dearborn, Dearborn Michigan, United States
Reduction of carbonyl compounds, a widely used reaction, is typically performed using borohydride, BH₄⁻. At the same time BH₄⁻ has been reported to participate in hydridic-to-protonic hydrogen (HHH) bonding with traditional proton donors. As expected, substrates that contain hydroxyl groups in close proximity to the carbonyl are activated for reduction by the HHH bonding interaction between BH₄⁻ and OH. Since directing effect of such an interaction may be affected by free rotation around single bonds, we investigated the reaction in rigid systems, 2-hydroxyacenaphthenone as well asacenaphthenequinone. The kinetic results, in terms of activation, are similar to those observed in more flexible substrates such as cyclopentanone. Stereoselectivity of the reaction has been evaluated with respect to the HHH bonding and thermodynamic stability of product isomers.

CHED 225
Synthesis and characterization of 4 and 4′-substituted chalcones and their corresponding diaryl-isoxazoles
Quan Tran(2), nichole.powell@emory.edu, 100 Hamill Street, Oxford GA, United States ; Gabriela Alvarez(1); Phan Nguyen(3); Rishi Patel(2); Nichole L Powell(1). (1) Division of Natural Sciences and Mathematics, Oxford College of Emory University, Oxford GA 30054, United States (2) Emory College, Emory University, Atlanta GA 30322, United States
Chalcones are natural products that are abundant in edible plants and are precursor compounds for flavonoid synthesis. Flavonoids are naturally occurring polyphenols that have been shown to possess various biological activities including antitumor/anticancer properties, and analogs of these compounds have become a relevant topic of modern research. This project focused on the synthesis of amino, chloro, and methoxy substituted chalcones, and exploration of efficient methods for their conversion to the corresponding isoxazoles.

CHED 226
Cyclooctene-supported cobalt(salen) catalysts in the aminolytic kinetic resolution (AKR) of terminal epoxides: A route to enantiopure 1,2-amino alcohols
Nina Schuchman(1), nina.shayne@nyu.edu, 100 Washington Square East, New York NY 10003, United States ; Marcus Weck(1). (1) Department of Chemistry, New York University, New York NY 10003, United States
Cyclooctene-supported Co(salen) cyclic oligomers are among the most reactive catalytic species for the hydrolytic kinetic resolution (HKR) of terminal epoxides. Exploitation of this catalytic system with the use of nitrogen as the nucleophile in asymmetric aminolytic kinetic resolution (AKR) of terminal epoxides can afford enantiopure 1,2-amino alcohols, which have biological importance. Because of the existence of multiple catalytic sites within a single molecular framework, a decrease in catalyst loading is possible compared to the monomeric catalyst. Carbamates have been shown to work effectively as nitrogen sources for the AKR of terminal epoxides with monomeric Co(salen) units. The cyclooctene based Co(salen) macrocycle catalyst shows high activity and enantioselectivity with 0.5 equivalents of tert-butyl carbamate as the nucleophile at 0.5 mol% catalyst loading with hexene oxide as the epoxide (enantiomeric excess of residual epoxide > 99% within 24 hours), providing promise for the further development of reactions catalyzed by this system.

CHED 227
Microwave efficiency effect on the optical rotation of single enantiomer of racemic chiral drugs: Ibuprofen as a model compound
Jeremy Burgess(1), jburgess@jsu.edu, 700 Pelham Road N, Jacksonville AL, United States ; Nagarajan Vasumathi(1). (1) Department of Physical and Earth Sciences, Jacksonville State University, Jacksonville AL 36265, United States
Racemic mixtures of chiral enantiomers exhibit change in optical properties with respect to change in temperature, solvent and concentration. The optical properties of isoborneol and its enantiomer had previously been studied by our group under different conditions. Our current research focuses on...
MW energy effect on the isomerization of (±)-ibuprofen using commercial kitchen microwave oven (860GHz/360 W). Solutions of ibuprofen in aqueous and/or organic solvents of different concentrations are prepared and are heated in Pyrex beakers covered with watch glass. The optical rotation and specific rotation are measured using Rudolph Autopol IV Automatic Polarimeter at every ten minutes for up to 30 minutes. The reaction time, temperature and any visible change in the solution are noted. The experiment is repeated by cooling the solution to lower temperature conditions to study the change in optical properties of the solution. The experiment is monitored and analyzed by IR and NMR spectroscopic methods.

CHED 228

Sweet-'Clicked'-Curcumin: A water-soluble, bioactive, turmeric based green drug candidate

Dinali Obeyesekera(1), dinali.obeyesekera@gmail.com, 2800 Victory blvd., Staten Island New York 10314, United States; Sukanta Dolai(1); Christopher Corbo(2); Saadyah Averick(1); Alejandra Alonso(1); Probal Banerjee(1); Krishnaswami Raja(1). (1) Department of Chemistry, College of Staten Island, Staten Island NY 10314, United States

We have developed a general strategy towards mono-functional derivatives of curcumin, the active ingredient in turmeric (the dried rhizomes of Curcuma longa). The synthesis of a water/plasma soluble, non-toxic, bio-compatible derivative of curcumin with amplified bio-efficiency in modulating amyloid-β aggregation is presented. Curcumin mono-alkyne was 'Clicked' with commercially available acetal-protected galactose azide. The deprotected curcumin Clicked galactose (sweet curcumin) is freely soluble in water. Sweet-curcumin inhibits Aβ aggregation at significantly lower concentrations compared to curcumin. Where curcumin barely inhibits Aβ aggregation at a concentration of 8 mM, sweet-curcumin inhibits aggregation at concentrations as low as 8 nM. It was found to be a more powerful antioxidant than curcumin. A MTT assay on cultured hippocampal slices of mouse brain indicated that the sweet-curcumin is potentially neuroprotective and non-cytotoxic. Thus, sweet-curcumin is a promising green drug candidate against Alzheimer's disease.

CHED 229

Convergent synthesis of ABT-737 derivatives in search of specific binders of viral Bcl-2 protein mimics

Samantha J. Paluck(1), goode_dr@mercer.edu, 1400 Coleman Ave, Macon GA 31207, United States; David R. Goode(1), (1) Department of Chemistry, Mercer University, Macon GA 31207, United States

Central to a successful mammalian host cell invasion by a virus is the ability to gain control of apoptosis, or programmed cell death. Viral mimics of anti-apoptotic Bcl-2 proteins are one strategy pox viruses use to delay apoptosis, giving the virus time to overtake cellular machinery, resulting in viral replication. These viral mimics could be selectively targeted by small, organic molecules. Disruption of the viral proteins should allow apoptosis to proceed, killing the initially infected cell, but also halting viral replication. Compounds, such as ABT-737, have been previously shown to bind the native anti-apoptotic Bcl-2 proteins and induce apoptosis. Derivatives of ABT-737 may be able to selectively bind viral mimics of Bcl-2 over the native proteins. In the course of devising a parallel synthesis of ABT-737 derivatives, multiple paths have been evaluated for formation of the N-acyl sulfonamide bond and will be the focus of this poster.

CHED 230

A comparative study on the fluorescence property of aniline and para substituted anilines

Sani M. Brah(1), jsu6430n@jsu.edu, 700 Pelham Road N, Jacksonville AL, United States; Nagarajan Vasumathi(1), (1) Department of Physical and Earth Sciences, Jacksonville State University, Jacksonville AL 36265, United States

The effects of fluorescence were examined by comparing the spectrum of aniline and its derivatives as solutions in ethanol and methylene chloride. The spectra were run using the Hitachi F-2500 spectrophotometer. Both excitation and emission spectra were collected for each solution at speeds of 60 and 1500 nm/min. The fluorescence of these solutions was first examined using a 0.001M concentration, and then using 0.00001M and 0.0000001M solutions, respectively. Differences and similarities in the fluorescence intensity of each solution are compared and discussed. The relative fluorescence intensities were measured for each peak by calculating the peak area. The fluorescence intensities were also affected by both concentration and the rate of excitation and emission.

CHED 231

Prolin-based organocatalysts: Reactivity observation via electrospray mass spectrometry

Rebecca H Foos(1), foosr@jbu.edu, 2000 W University, Siloam Springs AR 72761, United States; Martin Schmidt(2), (1) Department of Chemistry, John Brown University, Siloam Springs AR 72761, United States; Nagarajan Vasumathi(1), (2) Department of Chemistry, University of Bonn, Bonn, Germany

An investigation of the reaction mechanisms of organocatalytic reactions via electrospray mass spectrometry (ESI–MS). Synthesis of prolin-based organocatalysts marked with a fixed charge, localized on a substituent molecule isolates the charge from the catalytic prolin, allows detection of the organocatalyst and its intermediate by ESI-MS. The detection of these intermediate cations has been limited in past enantioselective organocatalysis due to the immediacy of certain catalytic
rations, i.e. fast catalysis. In situ observation of the reaction by ESI-MS has proved a valid method towards mechanism observations, especially as relevant with enantioselective processes.

**CHED 232**

Rapid synthesis of N-[1-(4-methoxyphenyl)ethyl]formamide

Braden A Burckhard

Mikhail M Bobylev, mikhail.bobylev@minotstateu.edu, 500 University Avenue West, Minot North Dakota, United States; Mikhail M Bobylev

(1) Division of Science, Minot State University, Minot North Dakota 58707, United States

Substituted 1-phenylethlamines are important intermediates in the synthesis of numerous biologically active compounds, including agrochemicals and pharmaceuticals. They can be obtained from the respective substituted acetophenones via the intermediate substituted 1-phenylethylformamides.

Recently, we developed an accelerated procedure for the synthesis of formamides. It was important to investigate if the procedure can be successfully applied for the synthesis of 1-phenylethylformamides with electron-donating substituents, for example N-[1-(4-methoxyphenyl)ethyl]formamide. The reaction was conducted on 10 mmol scale at 188-192°C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products. The reaction was fully completed in 10 minutes and produced N-[1-(4-methoxyphenyl)ethyl]formamide in good yield. The new reaction opens the way for the fast synthesis of N-[1-(4-methoxyphenyl)ethyl]amine and its derivatives in the laboratory practice and industry.

**CHED 233**

Rapid synthesis of N-[1-naphthylmethyl]formamide

Yannick N Nkuni

Mikhail M Bobylev, mikhail.bobylev@minotstateu.edu, 500 University Avenue West, Minot North Dakota, United States; Mikhail M Bobylev

(1) Division of Science, Minot State University, Minot North Dakota 58707, United States

N-[1-naphthylmethyl]amine is an important intermediate in the synthesis of biologically active compounds, including allylamine fungicides, such as nufine, terbinafine, and butafenine. N-[1-naphthylmethyl]amine can be prepared from 1-naphthaldehyde via an intermediate N-[1-naphthylmethyl]formamide. Recently, we developed an accelerated procedure for the synthesis of formamides. In this work, the accelerated procedure was applied to the synthesis of N-[1-naphthylmethyl]formamide. The reaction was conducted on 10 mmol scale at 190-192°C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products. The reaction was fully completed in 1 minute and produced N-[1-naphthylmethyl]formamide in good yield. Three byproducts were isolated and their structures were determined. The new reaction opens the way for the fast synthesis of N-[1-naphthylmethyl]amine and its derivatives in the laboratory practice and industry.

**CHED 234**

Rapid synthesis of N-(4-t-butylnbenzyl)formamide

Luke W Uran

Mikhail M Bobylev, mikhail.bobylev@minotstateu.edu, 500 University Avenue West, Minot North Dakota, United States; Doug M. Fredrich

Mikhail M Bobylev

(1) Division of Science, Minot State University, Minot North Dakota 58707, United States

Substituted benzylamines are important intermediates in the synthesis of numerous biologically active compounds. They can be obtained from the respective substituted benzaldehydes via the intermediate substituted benzylformamides. Recently, we developed an accelerated procedure for the synthesis of formamides. It was important to investigate if the procedure can be successfully applied to benzaldehydes with electron-donating substituents, for example 4-t-butylnbenzaldehyde. The reaction was conducted on 10 mmol scale at 190°C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products. The reaction was fully completed in 1 minute and produced N-(4-t-butylnbenzyl)-formamide in good yield. Three byproducts were isolated and their structures were determined. The new reaction opens the way for the fast synthesis of N-(4-t-butylnbenzyl)amine and its derivatives in the laboratory practice and industry.

**CHED 235**

Synthesis, characterization and quaternization of vinylbenzyl thymine-containing copolymers: Applications as antimicrobial thin films

Amanda L McLaughlin

Amanda12mclaughlin@gmail.com, 52 Kent St, Apt 3, Boston MA 02445, United States; Katrina M Thistle

Katrina.thistle@simmons.edu, 300 The Fenway, c/o Department of Chemistry and Physics, Boston MA 02115, United States; Maureen Corrielus

Maureen.corrielus@simmons.edu, Simmons College, Boston MA 02115, United States; Nowakowski Veronica

Nowakowski Veronica@simmons.edu, Simmons College, Boston MA 02115, United States; Changqing Chen

Changqing Chen@simmons.edu, Simmons College, Boston MA 02115, United States; Richard W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; Melissa Werner

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurney

Richard W Gurney@simmons.edu, Simmons College, Boston MA 02115, United States; W Gurne...
been possible, however, due to the highly positive charge of the copolymer. Copolymerization of VBT with vinylbenzyl chloride (VBC) will lead to a system that can be fully characterized by MALDI-TOF MS and subsequently quaternized to yield a polymer with similar utility, but with higher tunability to that of the (VBT)n(VBA)m system. The synthesis and characterization of the (VBT)n(VBC)m copolymers, as well as the quaternization experiments will be described.

CHED 236

Derivatives of fullerenes (C₆₀): Synthesis and activity study of photodynamic inactivation of microorganisms and viruses

Angel M. Suarez-Marquez(1), angel.suarez@upr.edu, Ave.Campo Bello Bo. Arenas, BOX 5640, Cidra Puerto Rico 00739, Puerto Rico ; Magda Perez(1); Luz E. Torres(1), (1) Chemistry, University of Puerto Rico at Cayey, Cayey Puerto Rico 00736, Puerto Rico

Fullerenes are soccer ball shaped molecules, consisting of carbon atoms (C₆₀) with sp² hybridization. Photodynamic inactivation (PDI) is a developing antimicrobial technology that combines a photosensitizer (PS) or non-toxic light-activated dye in combination with harmless visible light of the correct wavelength to excite the dye to its triple-reactive in the presence of oxygen which generates reactive oxygen species that are highly toxic to cells. A major inconvenience for this application is the low solubility of fullerenes in polar solvents and the subsequent formation of aggregates in aqueous solutions. When the C₆₀ fullerene is derivatized with various functional groups, it forms molecules that are more soluble in water and can mediate efficiently in PDI with light and also cationic fullerenes can bind selectively to microbial cells.

CHED 237

Modulation of contact angle of droplet interface bilayers : Effect of ionic nature and strength

Darius Fartash(1), DFartash1@iona.edu, 715 North Avenue, New Rochelle NY 10801, United States ; Nousin Haque(1), NHaque1@iona.edu, 715 North Avenue, New Rochelle NY 10801, United States ; Zuzanna Michalak(1), ZMichalak1@iona.edu, 715 North Avenue, New Rochelle NY 10801, United States ; Sunghee Lee(1), (1) Department of Chemistry, Iona College, New Rochelle NY 10801, United States

We have studied individual pairs of surfactant-monolayer coated aqueous droplets which adhere at an interface to form a droplet interface bilayer (DIB). Droplets are generated and manipulated by micropipet. The use of 1-glyceryl monooleate (GMO) as surfactant dissolved in squalene medium provides droplet pairs which have a large contact zone, the size and area of which is amenable to an optical microscopy study. We report investigations of the variability of the contact angle of the DIB as a function of the nature and concentration of ions present in the aqueous microdroplet. Both specific anion and cation effects have been observed. Possible explanations for the observed effects, including binding of certain cations to the GMO headgroup, as well as enhancement of solvent exclusion from the bilayer area, will be explored.

CHED 238

Behavior of human insulin Langmuir monolayers on ZnCl₂ subphase

Wei Liu(1), w.liu3@umiami.edu, 1301 Memorial Drive, Coral Gables FL 33146, United States ; Sheba Johnson(1); Roger M Leblanc(1). (1) Department of Chemistry, University of Miami, Coral Gables FL 33146, United States

Human insulin is a peptide hormone that controls blood glucose level in the body. Since the discovery of insulin, diabetes has become treatable. Interactions of human insulin with human cellular membrane are studied by using the Langmuir monolayer technique as an in vitro model of biomembranes. This allows us to study intermolecular interactions between molecules spread at the interface and forming the monolayer. Here, human insulin dissolved in acidic solution is spread onto a water surface to form the Langmuir, or floating, monolayer. The process is usually monitored with the π–A isotherm. Surface pressures, ranging from 30 to 35 mN/m, commonly found in the natural biomembrane can be simulated on the monolayer to mimic human cell membrane. Compression-decompression studies of the human insulin monolayer provide insight into the structure and stability of the human insulin with changing surface pressure. Absorbance and fluorescence are also tested at the interface.

CHED 239

Catalytic properties of poly (oxyalkylene) diamine-intercalated smectite in a triphase system

Rachel Starner(1), rsa@siue.edu, Box 1652, Edwardsville Illinois 62026-1652, United States ; Nahid Shabestary(1); Daniel C. Rivera(1). (1) Chemistry, Southern Illinois University Edwardsville, Edwardsville Illinois 62026-1652, United States

Smectic natural montmorillonite clay has been modified through intercalation reaction with poly(oxypropylene)-polyamine quaternary salts with various molecular weight range. The X-ray basal spacing of these silicates had been expanded from 14 to 63 Å for montmorillonite clay. It is known that these wide spatially enlarged silicates can encapsulate over 60% (w/w) of organic composition and display an unusual amphiphilic characteristic in toluene/water mixture. We have utilized this property to demonstrate the application of these novel composite materials as solid phase in triphase catalytic reactions. Triphase catalysis is a unique type of phase transfer catalysis in which the catalyst and each of a pair of reactants
are located in different phases. Using various Poly(oxyalkylene)diamine-Intercalated montmorillonite as solid phase, we have observed an active catalysts for the conversion of alkyl bromide to the corresponding thiocyanate [K_{obs} = (29.9 ± 0.6) hr^{-1}] using 2000 MW poly(oxypropylene)diamine-montmorillonite intercalate.

CHED 240
Small molecule dynamics in polyelectrolyte thin films and solutions
Kathleen J. Ryan(1), kathleen.j.ryan@gmail.com, 501 College Ave., Wheaton IL 60187, United States ; Meredith G. Triplet(1), Meredith.triplet@my.wheaton.edu, 501 College Ave., Wheaton IL 60187, United States ; Peter Walthout(1). (1) Department of Chemistry, Wheaton College, Wheaton IL 60187, United States

While the structure and dynamics of polyelectrolyte solutions have been studied for decades, the dynamical effects of a polyelectrolyte environment on small molecule dynamics has been less explored. We present studies of prototypical electron transfer reactions in both polyelectrolyte solutions and in polyelectrolyte multilayer thin films made via the method of electrostatic layer-by-layer deposition from aqueous solutions. While the highly charged nature of a polyelectrolyte medium invites comparisons to similar studies in ionic liquids, the additional presence of the polymers and water make these solutions and films unique environments in which to study electron transfer. The electron donor is ruthenium(II) tris(bipyridine) and either ferricyanide or methyl viologen is the electron acceptor. The films are 50 nm thick and made from sodium poly(styrene sulfonate) and poly(diallyldimethylammonium chloride). The photo-induced electron transfer kinetics have been studied by both steady-state and time-dependent fluorescence methods.

CHED 241
Temperature and pH dependence of diffusion through a sol-gel matrix: A study utilizing ethyl-violet dye reversibility
Jisu Ryu(1), rjs712@gmail.com, 1 College Circle, Geneseo New York 14454, United States ; Kazushige Yokoyama(1); Dan J Mark(1); Jocelin M Kalish(1). (1) Chemistry, SUNY Geneseo, Geneseo New York 14454, United States

The ethyl-violet dye encapsulated sol-gel was studied for biochemical sensing and membrane simulation. Under basic conditions (pH 10) ethyl-violet is violet in color, while under acidic conditions (pH 2), it is light blue in color. Initially, the sol-gel sample was exposed to an acidic buffer solution (pH 2) for a period of one hour, during which the absorption was analyzed by Ultraviolet-Visible spectroscopy in five minute intervals. Afterward, the same process was repeated with a basic buffer solution (pH 10). From the acquired data, the diffusion rates of acid and base through the matrix were determined. The diffusion of base was found to be higher at temperatures above 25°C. Diffusion of acid was observed to be independent of temperature (constant), whereas diffusion of base was dependent. The activation energy for acid penetration was determined to be 0 kJ/mol, while the activation energy for the base penetration was 34.2 kJ/mol.

CHED 242
Electron microscopy study of the amyloid beta protein on the surface of gold and silver colloidal nanoparticles
Jeffrey Ma(1), yokoyama@geneseo.edu, 501 College Ave., Geneseo New York 14454, United States ; Kazushige Yokoyama(1); Makaia M Papasergi(1); Winnie W Eng(1). (1) Chemistry, SUNY Geneseo, Geneseo New York 14454, United States

Our research involves the investigation of the nanoscale aggregation of the Amyloid Beta Protein (Aβ_{1-40}) under interfacial conditions. Aβ_{1-40} is involved in the process of fibrillogenesis which is a trademark of Alzheimer’s disease. Through research of the reversibility of Aβ_{1-40} aggregation, it may be possible to find a process to reverse Alzheimer’s disease. We have succeeded in characterizing microscale properties of 20 nm – 60 nm gold and silver colloids by using Transmission Electron Spectroscopy (TEM) for various pH conditions. This study enabled us to determine the behavior of Aβ_{1-40} as seen through its interaction with gold and silver colloid nanoparticles, respectively.

CHED 243
Ab Initio Calculations of the impact on alkali cation binding on organophosphate micro-hydration
Amy R Garner(1), agamer@sandia.gov, Sandia National Laboratories, Albuquerque NM 87185, United States ; Todd M Alam(1); Janelle E Jenkins(1). (1) Department of Electronic Materials and Nanostructures, Sandia National Laboratories, Albuquerque NM 87185, United States

The interaction of organophosphate (OP) chemical warfare agents (CWA) with surfaces is being investigated to develop novel CWA-resistant materials, more efficient descriptions of CWA fate, specifically OP, has been shown to impact the surface adsorption energies. It has also been demonstrated that decomposition rates of OP in sea water vary greatly, depending on the ion identity and concentration. In this study, ab initio calculations were used to evaluate the binding potential energy surface of alkali atoms and cations (Li, Li^+, Na, Na^+) to Sarin and the simulant dimethyl methylphosphonate (DMMP). The impact of these alkali and alkali-water interactions on the micro-hydration was investigated, with the role on surface hydration discussed.
Calculations were completed on polynitrated isomers of the BON-BON and NOB-NOB molecules, having between 1-8 and 1-4 nitro groups, respectively. We report on their structures, thermochemical properties and contrast them with established HEDMs to ascertain their potential as new HEDMs.

**CHED 244**

Ultrahigh vacuum studies of electron-induced reactions of condensed methanol

**Chan Myae Myae Soe**(1), csoe@wellesley.edu, 21 Wellesley College Road, Unit 5408, Wellesley Massachusetts 02481, United States ; **Lisa M Jacob**(1), ljacob@wellesley.edu, 21 Wellesley College Road, Unit 1828, Wellesley Massachusetts 02481, United States ; **Christopher R Arumainayagam**(1); **Michael C Boyer**(1); **Kristal K Chamberlain**(1); **Monica Choi**(1); **Linda Ding**(1); **Mavis D Boamah**(1); **Farrah C Yhee**(1); **Kellie P Wo**(1); **Sunny Paik**(1). (1) Department of Chemistry, Wellesley College, Wellesley Massachusetts 02481, United States

We are studying the dynamics of low-energy (2–20 eV) electron-induced reactions in multilayer, nanoscale thin films of methanol under ultrahigh vacuum (2×10⁻¹⁰ torr) conditions. Our objectives are to identify all radiolysis products, and to investigate the dependence of product yield on electron energy and electron fluence to determine possible mechanisms for the formation of these radiolysis products. Methanol, an important precursor of several prebiotic species, is found in relatively high abundance in interstellar media such as comets and protostars. The interaction of high-energy radiation such as cosmic rays and stellar wind particles with these environments produces copious quantities of low-energy secondary electrons, forming distinct energetic species that are thought to promote a variety of radiation-induced chemical reactions. Our ultimate goal is to verify the hypothesis that dissociative electron attachment, typically occurring at electron energies below 15 eV, is the primary mechanism leading to radiation-induced damage in condensed matter.

**CHED 245**

Characterization of the novel 6-membered heterocycle, BON-BON, a family of compounds based on BON-BON and related isomers based on NOB-NOB compounds

**Aloysius K Lawong**(1), lawongaloy@gmail.com, 2557 St. Olga Ave, Cleveland Ohio 44113, United States ; **David W Ball**(1). (1) Department of chemistry, Cleveland State University, Cleveland Ohio 44115-2214, United States

High energy density materials (HEDMs), compounds with high-energy applications, are used in aeronautics, weapons and other high-tech industry. Our research group made use of standard computational chemistry programs such as Gaussian 09 (Ohio Supercomputer Center), Gaussian 03W and Gaussianview 4.1.2 to investigate a novel 6-membered high energy density (HED) compound based on boron, oxygen, nitrogen and hydrogen with a proposed name BON-BON, and an isomer with proposed name NOB-NOB. The calculational method used was the density functional (DFT) plus the correlation functional of Lee, Yang, and Parr (B3LYP) along with the standard Gaussian basis set labeled 6-31G(d,p). DFT calculations were completed on polynitrated isomers of the

**CHED 246**

Rotational dependence of ion-molecule reactions

**Niger Washington**(1), niger.washington@pomona.edu, 645 N. College Avenue, Claremont California 91711, United States ; **Bill Hase**(2). (1) Department of Chemistry, Pomona College, Claremont California 91711, United States (2) Department of Chemistry, Texas Tech University, Lubbock Texas, United States

Understanding the influence of the internal energy on ion-molecule reactions requires techniques that can create ions in variable vibrational or rotational states. Additional insight can be gained from the study of state-selected molecular ions. Resonance enhanced multiphoton ionization (REMPI) can be used to produce molecular ions in well defined internal states. The cross section of the proton transfer from selected HBr⁺ ions to CO₂, for example, decreases with rotational excitation. Although the total angular momentum is supposed to be conserved during the reaction, one interesting question arising from these results is whether these effects of rotational excitation can be traced back to energetic or rotational angular momentum effects. To answer this question we will perform a comparison between the reactions of state-selected ions with CO₂. With REMPI it is possible to prepare both ions with the same narrow rotational state distribution over two or three dominant rotational quantum states.

**CHED 247**

Interfacial photoinduced electron transfer dynamics in semiconductor nanocrystal-organic ligand complexes

**Vladislav Vasilenko**(1), vladislav.vasilenko@gmail.com, Im Neuenheimer Feld 234, Heidelberg Germany, Germany ; **Adam Morris-Cohen**(2); **Ken Aruda**(2); **Emily A. Weiss**(1). (1) Department of Chemistry, Ruprecht-Karls-Universität, Heidelberg, Germany (2) Department of Chemistry, Northwestern University, Evanston IL 60208-3113, United States

Due to their size and shape dependent properties, colloidal semiconductor nanocrystals hold great promise as materials for future generations of electro-optical devices. Developing a mechanistic understanding of the processes that control the movement of charge into and out of nanocrystals remains a major challenge to realizing the potential of these materials. We will present results comparing the photoinduced electron transfer rates for a series of molecules as a function of the ligand-nanocrystal coordination motif.
Tuning the electronic properties of conducting polymers for OPV applications

Matthew D. Lovander(1), lovan005@morris.umn.edu, 600 E 4th St., Morris MN 56267, United States ; Ted M. Pappenfus(1), (1) Division of Science and Mathematics, University of Minnesota, Morris, Morris MN 56267, United States

Among the technologies available for solar power conversion, organic photovoltaics (OPV) are particularly attractive due to their potential low-cost production via low-temperature processing. Bulk heterojunction (BHJ) solar cells based on a conjugated conducting polymer donor and fullerene acceptor have been the most successful organic solid-state devices to date. Tailoring the electronic properties of these materials are crucial for optimal device performance. Our work has focused on tuning the electronic properties of conducting polymers for solar power conversion. Specifically, we are looking at taking advantage of the hypervalent nature of sulfur in monomers as well as adding tetracyanoethylene to alkynyl-based conjugated polymers. The synthesis, electronic, and redox properties of these materials will be presented.

Synthesis and characterization of new PEGylated poly(ester sulfide) dendrimers

Jacob Robison(1), jacob7476@live.missouristate.edu, 901 S. National, Springfield Mo 65897, United States ; Jonathan Fury(1); Reza Sedaghat-Herati(1), (1) Department of Chemistry, Missouri State University, Springfield Mo 65806, United States

Dendrimers are highly branched, monodisperse synthetic polymers of nanometer dimensions. Dendritic macromolecules are applied in light harvesting, catalysis, as MRI contrast agents, in gene therapy, and drug delivery. Here, we report on the synthesis and characterization of a series of dendrimers consisting of a block of poly(ethylene glycol) (PEG) and poly(ester sulfide) dendrons. The dendrimers have been prepared using readily available materials and contain either alkene or hydroxyl groups on the periphery. The dendrimers were characterized by elemental analysis, NMR spectroscopy, GPC, and MALI-TOF. An acid sensitive acetal has been prepared employing generation three of mPEG-Poly(ester sulfide) dendrimer. Micelle formation has been demonstrated by encapsulation of the fluorescent probe pyrene into the generation three of mPEG-Poly(ester sulfide) dendrimer capped with cyclic acetal on the periphery. In contrast, generation three of mPEG-Poly(ester sulfide) dendrimer with hydroxyl groups in the periphery did not exhibit micelle formation.

Synthesis of curcumin based water-soluble copolymers for imaging and therapeutic applications

Matthew D. Lovander(1), lovan005@morris.umn.edu, 600 E 4th St., Morris MN 56267, United States ; Ted M. Pappenfus(1), (1) Division of Science and Mathematics, University of Minnesota, Morris, Morris MN 56267, United States

Azide terminated poly(tert-butyl acrylate) was synthesized via atom transfer radical polymerization [ATRP]. Subsequent deprotection was performed to yield poly(acrylic acid) (PAA) possessing a reactive chain-end. Curcumin was reacted with propargyl bromide to produce curcumin mono-alkyne, which was further reacted with amino-PEG-azide under 'click' conditions to yield curcumin mono-amine. A one pot sequential amidation of the PAA with the amine derivatives of curcumin and glucose produced curcumin incorporated water soluble copolymers. A series of copolymers containing different loadings of curcumin were synthesized. The copolymers were characterized via NMR, FT-IR and GPC techniques. Biological activity assay of these copolymers were performed.

Coumarin and dihydrocoumarin: A multistep synthesis for the second year organic laboratory

Sophia Hirakis(1), james.mccullagh@manhattan.edu, Manhattan College Parkway, Riverdale NY 10471-4098, United States ; James V McCullagh(1), (1) Chemistry and Biochemistry, Manhattan College, Riverdale NY 10471-4098, United States

This work describes the multi-step synthesis of coumarin and dihydrocoumarin used in our second semester organic lab curriculum. The target compounds are formed from salicylaldehyde using a Knoevenagle condensation followed by lactonization, saponification, decarboxylation and transfer hydrogenation. The individual steps proceed in high yield and with excellent purity. The synthesis relies on reactions covered in a typical 2nd year organic chemistry lecture course. During the course of the synthesis, thin-layer chromatography is used to monitor reactions extraction, recrystallization. Column chromatography is used to purify the products. IR-Spectroscopy, Gas-Chromatography and TLC comparison to commercial samples are used to analyze product purity. Together, all of these factors make the project an excellent review of the techniques covered over the two-semester Organic Chemistry laboratory course. The experiment has received considerable positive feedback from our students who have enjoyed the beautiful sweet vanilla-like smell of the products.
In 2012, The Pennsylvania State University will be hosting the 22nd Biennial Conference on Chemical Education. The theme of our conference is “Education for Everyone,” reflecting Penn State’s sesquicentennial celebration of the College Land Grant Act. This legislation was signed in 1862 by President Lincoln and was enacted to “promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.” In addition to traditional key note speakers, symposia, and workshops that focus on varying aspects of chemical education, we will also be holding a special historical symposium on the history of our Land Grant University. In keeping with our theme, we will be hosting a Demonstration Extravaganza; a student-focused chemistry demonstration competition across different age groups from middle school, high school, and college to bring chemistry education to a wider range of people. The call for workshops and symposia will be coming soon.

CHED 253

The benefits of supplemental instruction to peer leaders

Matthew Lake(1), mjlake1@hotmail.com, Campus Box 52 PO Box 173362, Denver CO, United States; Ralph McBride(1); Patrick Bevins(1); Ryan Fitt(1); Dustin Politica(1); Michael D Radulovich(1); Connie Gabel(1); Rosemarie D Walker(1). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217-3362, United States

The benefits of Supplemental Instruction (SI) on students in targeted courses have been explored in other research. In this poster we report on the effects on the Peer Leaders in the STEPS (Strides Toward Encouraging Professions in Science) SI program on the Auraria Campus in Denver, Colorado. The Peer Leaders have acquired better leadership, presentation, time management and communication skills through their involvement in the SI program. They have learned group dynamics and various teaching techniques such as the use of models, real world examples and analogies to help students understand difficult concepts. SI Peer Leaders have become fascinated with how people learn and have found that SI fuels their passion for teaching and exciting people about learning chemistry. Even SI Peer Leaders who had not originally intended careers in education are now interested in incorporating teaching in their future career plans.

CHED 254

Chemical demonstrations at James Madison University

Casey Rogers(1), rogersce@dukes.jmu.edu, 901 Carrier Dr., Harrisonburg VA 22801, United States; Kevin L. Caran(1). (1) Department of Chemistry and Biochemistry, James Madison University, Harrisonburg Virginia 22807, United States

All novel and established chemistry demonstrations within the James Madison University Chemistry and Biochemistry Department were organized into handouts, giving instructions on how to present each demonstration. Lesson plans and problem sets were developed to accompany selected demonstrations for targeted use in the classroom. These were formatted into a demonstration website, which includes the Virginia Standards of Learning covered for each demonstration. Internally, “Demo Kits” were assembled to provide instructors with the ability to easily perform demonstrations in class without the hassle of preparing and gathering the materials. A demonstration workshop was held for twelve high school teachers from throughout Virginia. An annual “Demo Day” is held for freshman chemistry majors at JMU to teach them how to do several demonstrations and to serve as a gateway to encourage our students to become involved in departmental outreach activities.

CHED 255

Classification of black cohosh population by anti-oxidant capacity

Marcus Carter(1), mjcarter0@frostburg.edu, 626 Cambridge Hall, Frostburg MD 21532, United States; Peggy S Biser(1). (1) Department of Chemistry, Frostburg State University, FROSTBURG MD 21532, United States

Previous studies have shown that it is possible to use the oxygen radical absorbance capacity (ORAC) assay to classify the radical scavenging power of natural products which includes black cohosh. Currently, no efficient methods of fingerprinting cohosh populations have been devised. Fingerprinting cohosh populations is imperative because it provides potential methods of tracking the origins of cohosh extracts within various supplements. The correlation of location with a specific value of anti-oxidant capacity will allow for the protection of medicinal herbs' natural habitats and authenticate the claims of manufacturers who produce supplements supposedly containing extracts of black cohosh. The anti-oxidant characterization method could potentially correlate quantifiable levels of the chemical constitution of the plant populations with their specific anti-oxidant capacity, which could further the understanding of what populations can be more efficiently targeted for alleviating specific symptoms and provide strategies to test mechanisms of black cohosh interactions in the body to influence diseases.

CHED 256

University of Colorado Denver Chemistry Club: A society of learning and doing

Aundrea R Piper(1), apiper10@gmail.com, Campus Box 194, PO Box 173364, Denver Colorado 80217-3364, United States; Andrew J Feldkamp(1), afeldkamp@gmail.com, Campus Box 194, PO Box 173364, Denver Colorado, United States; Chi
Huynh(1), chilthihuynh@gmail.com, Campus Box 194, PO Box 173364, Denver Colorado 80217-3364, United States; Jamie Bui(1), jbtqnbui@gmail.com, Campus Box 194, PO Box 173364, Denver Colorado, United States. (1) Department of Chemistry, University of Colorado Denver, Denver Colorado 80217-3364, United States.

The University of Colorado-Denver Chemistry Club is a proud Student Affiliate Chapter of the American Chemical Society. The main goal of our club is to increase awareness and excitement for the sciences in general and Chemistry in particular. We also strive to help our community and environment whenever possible. To help our community, we participate in numerous community service and volunteering activities throughout any given semester. To protect our environment, we ensure that any demos we perform are green in nature. To improve our natural surroundings, we as a club have participated in humanitarian and ecological activities in the Denver area that have allowed us to combine our passion for our community and environment. The drive to improve our natural world led us to becoming the only SAACS chapter in Colorado to earn a Green Chemistry Award for the last several years. Although we are proud of our past accomplishments and actions, we as a club are constantly striving to improve ourselves, our club, and our community in all that we do.

CHED 257

University of Connecticut SAACS Chapter Activities 2010-2011

Kyle Cole(1), uconnchem@gmail.com, 55 North Eagleville Road, Unit 3060, Storrs CT 06269-3060, United States; Tyson A. Miller(1), tyson.miller@uconn.edu, 55 North Eagleville Road, Unit 3060, Storrs CT 06269-3060, United States; Jessica Johnson(1); Stacey O'apos;Brien(1); Elizabeth Pedrick(1); Dayton Horvath(1). (1) Department of Chemistry, University of Connecticut, Storrs CT 06269-3060, United States.

The University of Connecticut SAACS Chapter continues to strive for excellence and enthusiasm for chemistry with members of our community and students. The club organizes and plans community outreach events in the field of chemistry for the community. We also plan fundraising events for educational and other activities such as visits to chemical enterprises and science museums. During the fall semester, the chapter hosted its annual barbeque for chemistry undergraduates, graduate students, and professors. National Chemistry Week activities included demonstrations, ice cream making with liquid nitrogen, and giveaways to raise awareness of NCW. In November, club members took a field trip to Pfizer’s Global Research and Development site in Groton, CT. There, we got a firsthand look at the facilities and the process behind developing a drug. Also, we will be heading to Boston in April for our annual Boston Beer Brewing trip, where we visit two breweries in Boston to learn how chemistry is involved in aspects other than research. This year, we revived our club newsletter, The Chemical Connection, which strives to connect the club to the department and faculty by featuring club activities and faculty research. The chapter has also continued to fundraise through the sales of Krispy Kreme Donuts and ACS Review books for Organic Chemistry Exams. We also formed a Relay for Life team to fundraise for cancer research and raise awareness on our campus. To further undergraduate research, we are pushing for club members to get involved in research and present a poster at the ACS-Connecticut Valley Section undergraduate symposium in April 2011.

CHED 258

¶ in your face! Duquesne University ACS student members grows by a factor of ¶

Jeffrey D Evanseck(1), evanseck@duq.edu, 600 Forbes Avenue, Pittsburgh PA 15282, United States; Roman Becicka(1); Kimberly Daley(1); Emily Renk(1); Mihaela R Mihaiescu(1); Paul Johnson(1); Jared Romeo(1). (1) Chemistry and Biochemistry, Duquesne University, Pittsburgh PA 15282, United States.

Duquesne’s student membership has more than tripled over the last two years, and has provided new and exciting activities that have impacted the students at Duquesne and the surrounding regional schools. Important milestones for the Student Members over the last year include: (1) tripling its membership, (2) enhancing Duquesne’s curriculum by designing new computational laboratories for freshmen chemistry, (3) expanding its role in the regional Pennsylvania Junior Academy of Sciences (PJAS), (4) hosting and developing a more extensive ACS symposium for regional students and faculty, (5) promoting faculty-student relations with “¶ your professor” on March 14th (¶-day), (6) encouraging students to learn about the science of recycling for Earth Day, and (7) successfully raising funds from Bayer Incorporated. Our poster will highlight each of the major initiatives undertaken this year, along with the successes for each effort.

CHED 259

James Madison University Student Affiliates Chapter of the ACS

Brooke N Stevens(1), stevenbn@dukes.jmu.edu, 901 Carrier Drive, MSC 4501, James Madison University, Harrisonburg VA VA 22807, United States; Victoria Mariani(1). (1) Department of Chemistry and Biochemistry, James Madison University, Harrisonburg VA 22807, United States.

In the 2010 - 2011 school year, the James Madison University Student Affiliates of the American Chemical Society (JMU SAACS) has celebrated chemistry by holding various events for National Chemistry Week and the International Year of
Chemistry, sponsoring department seminars, and giving back to the community. Events such as the “Periodic Table Flip Tab”, which is a giant periodic table where a person can pay to pick an element to learn about that element and win a prize, was run for several days to spread chemistry awareness and fun. To honor the International Year of Chemistry the JMU SAACS sponsored a year long event called Project Periodic Table. Project Periodic Table is where students, faculty, and members of the community bid on elements to then receive a 4x4 ceramic tile to decorate. Tile painting events where spread throughout the school year. Upon completion, the tiles will be pieced together as complete periodic table and displayed in the building lobby. JMU SAACS also supported an alumni round-table focused on previous JMU graduates' achievements and JMU faculty seminars geared towards underclassmen who could be looking for research opportunities. Our group has given back to the community by performing chemistry demonstrations to many groups ranging from 2nd to 8th grade, running a year long competition for collection of pop tabs to donate to the Ronald McDonald House, and donating a portion of our fundraising to the charity Relay for Life.

CHED 260

Wittenberg University Chemistry Club

Jill R. Underwood(1), s12.junderwood@wittenberg.edu, PO BOX 720, Springfield OH 45501, United States ; Raymond Dudek(1); Christa Snyder(1); Kacia Nolan(1); Brianna Watson(1); Kevin To(1); Ashley Zkiab(1), (1) Department of Chemistry, Wittenberg University, Springfield OH 45501, United States

The Wittenberg Chemistry Club has recently established an active chapter involved in numerous activities including: fundraising, campus and community outreach, and the promotion of chemical curiosity. Wittenberg University is a small liberal arts college located in Springfield Ohio, with an enrollment of 1800 students. The club is involved in a variety of outreach programs. One such event is Girl Scouts Science Night, helping to promote and expose science to area Girl Scouts. The club has also been involved in helping to interest high-school students about chemistry, and making fake snow (poly-acrylate) for siblings of current students. Students in the club have attended area conferences to present their research posters. For fundraising, the chemistry club has sold beaker mugs, chemistry department sweatshirts, and ACS organic chemistry study guides. These funds went towards visiting graduate schools, chemistry awareness events (Mole Day), an ice cream social, and refreshments during finals week.

CHED 261

Old Dominion University ACS Student Affiliates

Shannon Furbish(1), sfurb001@odu.edu, 5115 Hampton Blvd, Norfolk VA 23529, United States ; Stephanie McElhenie(1), smcel005@odu.edu, 5115 Hampton Blvd, Norfolk VA 23529, United States ; Sean Whitty(1), swhit102@odu.edu, 5115 Hampton Blvd, Norfolk VA 23529, United States ; Joseph Orians(1), joria002@odu.edu, 5115 Hampton Blvd, Norfolk VA 23529, United States ; Jeffrey Goodwin(1), jgood036@odu.edu, 5115 Hampton Blvd, Norfolk VA 23529, United States ; Thomas Sprinkle(1), tspri005@odu.edu, 5115 Hampton Blvd, Norfolk VA 23529, United States . (1) Department of Chemistry, Old Dominion University, Norfolk Virginia 23529, United States

Old Dominion University's ACS student affiliates will present a poster with the activities they do on campus. Some of the activities include: Attraction Day, Scout's Day, Gathering of Local Chemistry Departments and Undergraduate Poster Session, Pie-A-Professor, Relay for Life, and the Mad Scientist Show.

CHED 262

Brigham Young University-Idaho student affiliate chapter activities for 2010-2011

Kathleen A Munns(1), kamunns91@gmail.com, 4118 Suncrest Dr., Fort Collins CO 80525, United States ; Michael S Pack(1); Marie Pipparinen(1); John Z Hancock(1); Joseph W Hubbard(1); Leslie A Scrivener(1); Lauren A Holden(1); Trevor J Smith(1); Stephen Ott(1); Hector A Becerril-Garcia(1); David C Collins(1), (1) Department of Chemistry, Brigham Young University Idaho, Rexburg ID 83440, United States

The objectives of the Brigham Young University - Idaho Student Affiliate Chapter of the American Chemical Society include participation in community outreach, development of chemical awareness through education, student career preparation, support of chemistry department and university activities, and social development among students and faculty. These objectives were realized during the academic year 2010/2011 through regular meetings and activities. Community outreach included helping local scouts earn their chemistry merit badge, mentoring K-12 students on science projects, and judging the local science fair. Chemical awareness was developed by presenting chemistry demonstrations at local elementary and high schools during National Chemistry Week. Internship and career nights were held regularly each semester to help prepare students for future careers. The chemistry department and university were supported by cleaning the chemistry department's laboratory hoods, overseeing a breakout session for the 2011 Regional Math Competition, and managing the booth for the university's Majors Fair. Volleyball, bowling, barbecues, and the building of an Erlenmeyer flask snow sculpture all helped develop social bonds among students and faculty.
CHED 263

Student Affiliate Chapter of the American Chemical Society: Minot State University

Braden A Burckhard, mikhail.bobylev@minotstateu.edu, 500 University Avenue West, Minot North Dakota 58707, United States ; Jennifer N Kondos; Amanda K Kraft; Elias R Metzigen; Halee D Namanny; Yannick N Nkuni; Luke W Uran; Mikhail M Bobylev. (1) Division of Science, Minot State University, Minot North Dakota 58707, United States

The Student Affiliate Chapter of the ACS at Minot State University is a fairly new organization and its initial goal has been to strengthen ties between the students themselves and between the students and the community at large. The students work closely in a number of aspects with the campuses Science Club, which provides them perspectives of all areas of science. Students interact with each other in social activities such as game/movie nights. They interact with the community, to educate and show the excitement of chemistry, through events such as the MSU at the Mall event, demonstrations to local schools and the annual Science Open House. These events allow the students to share their excitement for chemistry. All members of the Chapter have been very active in conducting research in chemistry and in presenting the research results at various science meetings including the National Meetings of the American Chemical Society.

CHED 264

Chemical Interactions: Student Affiliate Chapter

Aniela Cordoba, cordobaa@unlv.nevada.edu, 4505 S. Maryland Pkwy, Las Vegas NV 89154, United States ; Stefany Cordoba; Krista Patel; Allie Moriarty. (1) Department of Chemistry, University of Nevada, Las Vegas, Las Vegas NV 89154, United States

As a Student Affiliate chapter of the American Chemical Society and a university organization, we strive to promote exposure in the sciences through educational outreach. We work with our local section and other organizations, as well as independently, to promote science and chemistry in local elementary schools and youth clubs. Our group also enhances the quality of life throughout our community and environment becoming actively involved in service and volunteer work. We look forward to expanding our horizons with an emphasis in green chemistry, collaborating further with the ACS, and increasing the local support for our group.

CHED 265

Designing mechano-responsive microcapsules that undergo self-propelled motion

Anna C Balazs, balazs@pitt.edu, 1249 Benedum Hall, Pittsburgh PA 15261, United States ; German V Kolmakov; Alexander Schaefer; Igor Aronson. (1) Department of Chemical Engineering, University of Pittsburgh, Pittsburgh PA 15261, United States (2) Department of Chemistry and Center for Simulation and Modeling, University of Pittsburgh, Pittsburgh PA 15260, United States (3) Department of Electrical and Computer Engineering, University of Pittsburgh, Pittsburgh PA 15261, United States (4) Division of Materials Science, Argonne National Laboratory, Argonne IL 60439, United States

We use computational modeling to design a simple synthetic “cell” that exhibits a hallmark of living systems: self-sustained motion. Our cellular object is formed from a nanoparticle-filled microcapsule that is located on an adhesive substrate in solution. In response to a locally applied force, the deformed capsule releases nanoparticles that bind to the surface and dynamically create adhesion gradients. Under the action of the self-generated gradients, the capsule moves autonomously from regions of less adhesion to greater adhesion. During the capsule’s motion, new nanoparticles are released that both sustain and propagate the adhesion gradients and thus, the capsule sustains autonomous movement along its path. We isolate critical parameters that control the dynamic behavior of this mechano-responsive capsule. Notably, this simple system exhibits fundamental aspects of cellular activity: the ability to change the local environment, sense the change and respond to this change by self-sustained motion.

CHED 266

Unusual molecular conformations in fluorinated, contorted hexabenzocoronenes

Yueh-Lin Loo, lloo@princeton.edu, A323 Engineering Quadrangle, Princeton NJ 08544, United States ; Anna M. Hiszpanski. (1) Department of Chemical & Biological Engineering, Princeton University, Princeton NJ 08544, United States

We have successfully synthesized a series of contorted hexabenzocoronenes (HBCs) having varying extents of fluorination on the peripheral aromatic rings. Consistent with predictions by density functional theory calculations, increasing the extent of fluorination systematically reduces the energy levels of the highest occupied- and lowest unoccupied molecular orbitals of the compounds with respect to the vacuum level while preserving the electronic band gap. The most fluorinated compound, 20F-HBC, exhibits an electron affinity of -3.9 eV. This value closely matches the electron affinity of [6,6]-phenyl-C61-butyric acid methyl ester (PCBM), and suggests 20F-HBC to be a promising electron acceptor for organic photovoltaics. Increasing the extent of fluorination also has strong repercussions on the molecular conformation of the compounds. In particular, close-contact fluorine-fluorine intramolecular interactions in 16F- and 20F-HBC result in a metastable, saddle-like conformation not previously observed.
Heating above 100°C irreversibly converts them to the stable and more commonly observed doubly concave conformation.

**CHED 267**

Bio-inspired nanocomposites

*Stuart J Rowan*(1), stuart.rowan@case.edu, 2100 Adelbert Road, Cleveland Ohio 44106-7202, United States . (1) Department of Macromolecular Science and Engineering, Case Western Reserve University, Cleveland Ohio 44106-7202, United States

Sea cucumbers have the fascinating ability to rapidly and reversibly alter the stiffness of their inner dermis. Several recent studies have related this dynamic mechanical behavior to the distinctive nanocomposite architecture of the collagenous tissue, in which interactions between collagen fibrils are regulated by neurosecretory proteins. Here we report on a new family of artificial polymer nanocomposites that mimic this architecture and the mechanic adaptability of the sea cucumber dermis. The new materials are based on a low-modulus polymer matrix that is reinforced with a percolating cellulose nanofibers (or whisker) network. In these materials addition of water to the system disrupts the whisker-whisker interactions resulting in a dramatic drop in the modulus of the film. This talk will focus on our current work to develop a better understanding of these materials and how one can control of mechanical contrast between the stiff and soft states of the nanocomposite.

**CHED 268**

Clickable polypeptides: New routes to self assembly and biological mimics

*Paula T. Hammond*(1), hammond@mit.edu, 77 Massachusetts Avenue, 66-352, Cambridge MA 02139, United States . (1) Department of Chemical Engineering and Koch Institute for Integrative Cancer Research, Massachusetts Institute of Technology, Cambridge Massachusetts 02459, United States

To broaden the range of capabilities possible with the NCA chemistry platform, our research group recently introduced the first NCA polymerized synthetic polypeptides with "clickable" side groups through the introduction of a new N-carboxy anhydride polymer, poly(γ-propargyl L-glutamate) (PPLG), which contains a pendant alkyne group that can be reacted with an azide. We were able to demonstrate key advantages to the use of a clickable backbone system with a nearly quantitative post-polymerization functionalization step. To demonstrate the versatility of the new polymer, we have used the "click" reaction to attach various pH responsive groups for endosomal buffering and solubility transitions and different lengths of azide-terminated polyethylene glycol (PEG) to demonstrate polymer grafting using a "grafting onto" approach. We have also demonstrated the ability to mimic the activity of antimicrobial peptides via the attachment of long chain n-alkyl amines while achieving or exceeding the efficiency of the naturally occurring systems. A series of pH responsive synthetic polypeptides and hybrid block polymer-polypeptides have been developed that are substituted with various amine moieties that range in pKa and hydrophobicity, providing the basis for a library of new synthetic structures that can be tuned for specific interactions and responsive behaviors. These amine-functionalized polypeptides have the ability to change solubility, or reversibly self assemble into micelles with changes in the degree of ionization; they also adopt an α-helical structure at biologically relevant pHs that can be disrupted with pH. We examine the reversible micellization with block copolymers of the polypeptides and nucleic acid encapsulation that demonstrate the potential use of these materials for systemic drug and gene delivery.

**CHED 269**

Organic near-infrared squaraine dyes in an undergraduate teaching laboratory.

*Mindy Levine*(1), mindy.levine@gmail.com, 51 Lower College Road, Pastore Hall, Kingston RI 02881, United States ; Patrick Marks*(1), (1) Department of Chemistry, University of Rhode Island, Kingston RI 02881, United States

Small-molecule squaraine dyes have been studied extensively for their use in fluorescent detection and in biological sensing schemes. We present herein the straightforward synthesis of a highly fluorescent small-molecule squaraine dye, with synthetic modifications that make it feasible to synthesize in an advanced undergraduate laboratory. The pedagogical applications of the synthesized squaraine product include measuring the absorption and fluorescence spectra of the synthesized product, and studying its role in energy transfer schemes. The incorporation of squaraine in thin films will also be discussed.

**CHED 270**

Unknown white powders: An introduction to organic chemistry at the general chemistry level

*Sheryl A Rummel*(1), sad270@psu.edu, 211B Whitmore Lab, University Park PA 16802, United States ; Joseph T Keiser*(1); Jing Dong*(1); Guy Anderson*(1), (1) Department of Chemistry, The Pennsylvania State University, University Park PA 16802, United States

Traditional general chemistry labs often do not have the capacity to introduce advanced analytical techniques to identify organic compounds due to class size and limited access to instrumentation. This experiment was designed to acquaint 40 chemistry majors in our general chemistry lab with our facilities and advanced organic chemistry techniques. It is part of an overall scheme to introduce our majors to our organic, analytical, and physical laboratories during their first semester. Each student was given an unknown white powder to identify...
using melting point, TLC, IR, and NMR. This enabled students to identify their white powders as one of eight over-the-counter medications. Overall student response to this lab was positive and the success rate of proper identification was over 95%. Students not only developed problem-solving skills but also became familiar with techniques that are important in organic chemistry.

CHED 271
Pedagogic approach for the identification of possible number of isomers
Varaprasad R Koganti(1), dvrkoganti@gmail.com, Ameerpet, Hyderabad Andhra Pradesh 500073, India. (1) Department of Chemistry, New Science College, Hyderabad Andhra Pradesh 500073, India

I recently conducted a test called 'Diagnostic Test in Organic Chemistry' to identify common mistakes/difficulties. In this test 600 undergraduate students, who were preparing for competitive exams, wrote the test. Based on this test, I recognized one of the common areas of difficulty i.e., identifying the possible number of isomers for a given molecular formula. For example the students were asked to write all possible isomers for C₄H₆. A great majority (90%) of the students wrote down three isomers (the correct figure is 6). To provide solutions to such problems, I developed a pedagogy for identifying all possible isomers. The first step in this process is to calculate Index of Hydrogen Deficiency (IHD). Then the next step is to write down all possible isomers in algorithmic order. Twelve worked out representative examples will be discussed.

CHED 272
Development of scientific writing skills through integration of virtual laboratory exercises into an organic chemistry lab curriculum
Allison A Schmitt(1), allison.schmitt@duke.edu, Box 90348, Durham NC 27708, United States; James A Parise(1). (1) Department of Chemistry, Duke University, Durham NC 27708, United States

We have implemented a two-semester organic laboratory program that integrates virtual lab exercises, or 'dry labs', with traditional wet experiments. In the second semester, dry lab exercises were focused on progressive development of scientific writing skills, as well as a continuing reinforcement of important chemistry concepts presented in wet labs. Students were instructed incrementally on proper methods to write individual sections of a scientific paper using the wet laboratory exercises conducted the previous week as the basis for their reports. Finally, students wrote an entire scientific paper focused on the final experiment conducted in the semester. Students and teaching assistants reported significant gains in student scientific writing skills across the semester. As in the first semester program, we were able to cut required staffing and laboratory space in half using this program of study.

CHED 273
Development, use, and assessment of organic course content materials on mobile handheld devices
David P Pursell(1), dpursell@ggc.edu, 1000 University Center Lane, Lawrenceville GA 30043, United States; Sonal Dekhane(1); David Gabrel(1); Julia Paredes(1); Richard Pennington(1); Gautam Saha(1); Joseph C Sloop(1); Mai Yin Tso(1). (1) School of Science and Technology, Georgia Gwinnett College, Lawrenceville GA 30043, United States

To enhance student engagement in undergraduate organic chemistry, faculty investigated student use of handheld technology inside and outside the classroom. For the past 3 years, faculty developed a suite of course content materials (topical and problem solving podcasts, lab techniques videos, reaction flashcards) viewable on handheld devices. Using grant funds, faculty issued Apple iPod Touch mobile devices to students in 3 sections of Organic I and 2 sections of Organic II during the 2010-2011 academic year. Students used materials via streaming access or direct downloads from the University System of Georgia podcast server. Students in sections not issued the iPod Touch could access the materials via computer. This presentation will discuss project organization, development of mobile content materials, student use of these materials, student attitudes, and assessment of student performance on graded course events.

CHED 274
Use of neural scaffolding to improve comprehension in organic chemistry
Dustin Politica(1), dpolitic@mscd.edu, Campus Box 52 PO Box 173362, Denver CO 80217-3362, United States; Connie Gabel(1); Rosemarie DePoy Walker(1). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217-3362, United States

Organic chemistry is a traditionally challenging course for many college undergraduates. Many topics in organic chemistry involve large amounts of information and the development of new skills. Examples of these topics include nomenclature; spectroscopy; addition, substitution, and elimination reactions. Supplemental instruction (SI) to the professors' lectures provided an opportunity to reinforce organic concepts. Neural scaffolding was used in SI sessions to alleviate information overload for students struggling with organic concepts. Neural scaffolding also helped create a community of learners. Techniques that separated large topics into smaller pieces allowed students to manage the material more effectively. Examples included distributing nomenclature throughout the duration of the course, organizing details about organic reactions in a meaningful manner and grouping.
Developing chemistry graphic novels as a teaching aid for organic chemistry

Haim Weizman(1), hweizman@ucsd.edu, 9500 Gilman Dr, La Jolla CA 92037-0303, United States. (1) Chemistry and Biochemistry, UC San Diego, La Jolla California 92037-0303, United States

Analogies are often used in chemistry classrooms to relate unfamiliar concepts to subjects more familiar to students. This technique lowers the barrier of unfamiliarity and helps students construct their understanding on the foundation of existing knowledge. Building on this approach, we develop chemistry-based short fiction and graphic novels as a method for delivering chemical knowledge in an entertaining manner. Graphic novels are a form of storytelling that relies primarily on illustration with brief accompanying text. This format is popular among many students; therefore we chose it as a platform to express chemical concepts through personification. Human relationships and plot developments representing interactions and events at the molecular level. Each story ends with highlighting the parallels between the plot and fundamental chemical concepts.

An example of a graphic novel that uses personification to teach nucleophilic substitution mechanisms is presented. This approach has the potential to augment traditional teaching through engaging students through topics closer to their interests.

Multi-component discovery based experiments for an honors organic chemistry laboratory

Norma Dunlap(1), ndunlap@mtsu.edu, P.O. Box 68, Murfreesboro TN 37132, United States. (1) Department of Chemistry, Middle Tennessee State University, Murfreesboro TN 37132, United States

Recently, a number of laboratory experiments have been published that are discovery-oriented and move away from typical "cookbook" experiments. A further improvement on that model would be to incorporate a research-like series of connected experiments. Two such multi-week experiments have been developed for an Honors Organic Chemistry laboratory and are presented here. The first involves a three-week experiment that incorporates steam distillation, chromatography and spectroscopy. Students isolate volatile components from herbs and spices of their choice, which are then purified and identified. The second multi-week experiment is a two-step synthesis. A variety of choices of starting materials and a variety of reagents are available. From this, students design a two-step synthesis of their choice. Possibilities include oxidation, reduction, acetylation, hydroboration/oxidation, Wittig and Williamson ether synthesis. The product of each step is purified and identified by NMR spectroscopy. Both sequences develop critical thinking skills and foster independence in the laboratory.

Infusing green chemistry and sustainability into the curriculum during the International Year of Chemistry and beyond

Michael C Cann(1), cannm1@scranton.edu, 800 Linden St., Scranton PA 18510, United States. (1) Department of Chemistry, University of Scranton, Scranton PA 18510, United States

To quote the main website for the IYC (http://www.chemistry2011.org/): "The IYC 2011 will celebrate the achievements of chemistry and its contributions to mankind." One of the greatest contributions to humankind that we, as chemists, can make is to use our expertise and knowledge of chemistry to create a more sustainable world, and to educate the world on our achievements to this end. This talk will focus on our efforts to bring both green chemistry and the broader issues of sustainability into the curriculum and beyond.
Sustainability and IYC-2011: A York College Chemistry Society production

Patrick Lestrange(1), plestran@ycp.edu, 441 Country Club Road, York PA 17103, United States; Timothy Cumming(1), tcummin2@ycp.edu, 441 Country Club Road, York PA 17403, United States; Gregory Foyster(1). (1) Department of Chemistry, York College of Pennsylvania, York PA 17405, United States

This presentation is a follow-up to the presentation made in Anaheim last spring. It highlights the York College Chemistry Society's efforts in developing videos relating sustainability to the International Year of Chemistry (IYC-2011) through a community outreach program. The ACS has defined four themed quarters throughout IYC-2011: Water in the Environment, Alternative Energy, Materials, and Health. Several ACS governance committees endorsed in concept an SEE proposal for multimedia productions submitted by student groups and adhering to posted guidelines. The York College Chemistry Society has created sustainability focused productions, which are informative and related to compounds highlighted in the four themed quarters and their environmental impact. Each production portrays a message which is educational with respect to the compound, while also relating how it can positively help our environment.

IYC 2011: York College Chemistry Society's efforts

Anthony J Tomaine(1), atomaine@ycp.edu, 207 Marble Lane, Lafayette Hill Pennsylvania 19444, United States; Kiersten L DeBlaker(1); Kathleen M Halligan(1). (1) Department of Physical Sciences, York College of Pennsylvania, York Pennsylvania 17403, United States

Throughout the International Year of Chemistry (IYC 2011), the York College Chemistry Society has made efforts to incorporate chemistry into its student population and the surrounding community. The theme for IYC 2011 is sustainability and the four themed quarters Water in the Environment, Alternative Energy, Health, and Materials, as defined by ACS, all incorporate sustainable efforts. The York College Chemistry Society strives to bring sustainable ideas to York College and plans to continue its efforts beyond IYC. This presentation will highlight the past efforts of the chemistry society and suggest new efforts as IYC 2011 progresses.

IYC 2011 kick-off at COP16: Through the eyes of an undergraduate

Leah Block(1), lblock@ycp.edu, 441 Country Club Lane, York Pennsylvania 17405, United States. (1) Department of Physical Sciences, York College of Pennsylvania, York Pennsylvania 17405, United States

In December 2008, the United Nations General Assembly officially declared 2011 the International Year of Chemistry under a unifying theme “Chemistry – our life, our future.” No chemistry related issue is more closely linked to our life and our future than climate change. Under that premise, the ACS Committee on Environmental Improvement and C&E News endorsed and supported a student blog project to kick-off IYC-2011 from the December 2010 United Nations Framework Convention on Climate Change COP16 climate conference in Cancun, Mexico. The C&E News blog was created for the purpose of engaging college and university students in the international climate dialog. One of the main goals of this project was to obtain a deeper understanding of the issues and report on the current events through the eyes of an undergraduate scientist. Reporting efforts focused on behind-the-scenes stories. Specific tools such as social networking through facebook and the blog were used to captivate a larger audience of peers to inform on this topic.

Chemistry and sustainability: IYC 2011 teams with YCP-SES for celebratory year

Keith E Peterman(1), peterman@ycp.edu, Country Club Road, York PA 17403, United States. (1) Department of Physical Sciences, York College of Pennsylvania, York PA 17403, United States

This year marked the launch of both the International Year of Chemistry and the York College of Pennsylvania (YCP) Sustainability & Environmental Studies (SES) program. In celebration, the YCP-SES and chemistry programs have teamed to offer chemistry and sustainability outreach programs to multidisciplinary campus and community audiences. Our celebration follows the global quarterly IYC 2011 themes Water, Energy, Materials, and Health. Education and public outreach activities include an ACS sponsored IYC 2011 kick-off from a UN climate conference, documentaries, panel discussions, lectures, demonstrations, seminars, webinars, blogs, YouTube videos, and more.

The International Year of Chemistry on the Texas Gulf Coast

Eric J Klinker(1), ejklinker@dow.com, 212 Rosemary Ln, Lake Jackson TX 77566, United States. (1) IYC Committee, Brazosport ACS Section, Lake Jackson TX 77556, United States

The Brazosport local section of the ACS is celebrating the IYC with a series of diverse events aimed at educating both the general public and the chemistry-savvy veterans of the chemical industry on the Texas Gulf Coast. The kick-off event for the Brazosport section was a Science Café aligned with the first quarter IYC theme of “Water in our World”. The interactive
event presented material on the importance of water as a resource and also educated on water treatment in the local community. In alignment with the second quarter theme of Energy, a panel discussion on energy is planned and will be open to the surrounding communities. The event will feature panelists with expertise in the areas of nuclear, solar, and wind energies to discuss the fundamentals of each energy source and the market for these technologies in the future. Experiences from these events and plans for future events will be presented as well as the lessons learned through outreach to the greater community.

CHED 284

Development of an IAC relationship with an undergraduate chemistry program and our joint celebration of IYC 2011

Kathleen Halligan(1), khalliga@ycp.edu, 441 Country Club Road, York PA 17403-3651, United States . (1) Physical Sciences, York College of Pennsylvania, York PA 17403-3651, United States

York College of Pennsylvania has developed an Industry Advisory Council with area companies and is currently engaged in several joint IYC 2011 activities. We have established a mutually beneficial relationship that provides opportunities for students to gain valuable industry experience. Representatives from member companies interact with our students several times a year in a variety of forums such as seminars, poster symposia and formal dinners. This presentation will focus on the development of the York College Chemistry IAC and a look at our programming for the celebration of IYC 2011.

CHED 285

College and Industry unite in IYC 2011 and beyond

Gregory P Foy(1), gfoy@ycp.edu, 441 Country Club Rd, York PA 17403, United States . (1) Department of Physical Sciences, York College of Pennsylvania, York PA 17403, United States

One of the most significant issues in chemistry is sustainability, and this concept permeates many aspects of our chemical world. The ability to deliver fresh water is a significant part of the sustainability story. This presentation will focus on York College Chemistry students and faculty, York College Sustainability and Environmental Studies students and faculty, and an industry consortium called Wecology joining forces to launch a multiyear environmental study and remediation program of the Codorus Creek Watershed—a tributary to the Chesapeake Bay. The study investigates ways in which the buffer system surrounding a waterway can affect the amount of sediment run-off as well as levels of nitrate and phosphate reaching the water. These levels are directly linked to the sustainability of the Chesapeake Bay.

CHED 286

Long-term effects of a one-week, laboratory-based, multisensory science experience for high-school students who are blind or low-vision

April A Hill(1), ahill45@mscd.edu, Campus Box 52, PO Box 173362, Denver CO 80217, United States ; Cary A Supalo(2); H. David Wohlers(3); Thomas E Mallouk(4). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217, United States (2) Department of Chemistry, The Pennsylvania State University, State College PA 80217, United States (3) Department of Chemistry, Truman State University, Kirksville MO 63501, United States (4) Center for Nanoscale Science, The Pennsylvania State University, State College PA 16802, United States

Penn State University's Center for Nanoscale Science (CNS) has partnered with the Independent Laboratory Access for the Blind (ILAB) project to produce several hands-on science experiences for blind or low-vision (BLV) learners. These modules combine CNS's experience in informal science education with ILAB's adaptive tools to allow BLV students to conduct experiments without the aid of sighted assistants. In summer 2009, a one-week, research-based experience was presented to 15 high-school students attending the National Federation of the Blind's Youth Slam program. Participants used colorimeters equipped with text-to-speech software to determine "contaminant" concentrations in water samples pre- and post-treatment with multiple remediation technologies. Combining hands-on experimentation with multisensory learning aids (e.g., molecular models, Braille diagrams, etc.) allowed the students to independently complete a technologically-relevant research project with real-world implications. The tools and procedures used in this module as well as feedback and assessment data collected from the participants will be discussed.

CHED 287

Research-inspired modules in the general chemistry lab curriculum

Kurt Winkelmann(1), kwinkel@fit.edu, 150 West University Blvd, Melbourne FL 32901, United States ; Monica H. Baloga(1); George Anquandah(1); Peter Cohen(1); Monica Price(1); Alfred Menendez(2); Cory Hodes(3). (1) Department of Chemistry, Florida Institute of Technology, Melbourne FL 32901, United States (2) Department of Physics and Space Sciences, Florida Institute of Technology, Melbourne FL 32901, United States (3) Department of Marine and Environmental Systems, Florida Institute of Technology, Melbourne FL 32901, United States

The general chemistry laboratory can improve students' understanding of and appreciation for research when the experiments are based on based on interdisciplinary research topics. The authors have designed four multi-week modules...
was based on research currently being conducted at Florida Tech in the departments of physics, marine and environmental systems, mechanical and aerospace engineering, and chemistry. The respective module topics are: generation of NOx gases via electrical discharge, use of nanoparticles to remove water pollutants, effect of surface treatment on composite properties, and removal of aqueous pharmaceutical pollutants using high oxidation state iron (ferrate). Student perceptions of this new curriculum and brief summaries of the experiments will be reported.

CHED 288
Introducing undergraduate students to faculty research via formal instruction at the sophomore level
Matthew L Miller(1), Matt.Miller@sdsstate.edu, 351 Avera Health and Science Building, Brookings South Dakota 57007, United States ; David P Cartrette(1), (1) Department of Chemistry & Biochemistry, South Dakota State University, Brookings South Dakota 57007, United States
The Department of Chemistry and Biochemistry at South Dakota State University has implemented a laboratory component for the first two years of the chemistry major emphasizing hands-on training with standard research instrumentation, moving from verification/skills toward a guided inquiry with a fourth semester stand alone research course intended to replicate a research group. The main purpose is to create a community of scientists-in-training that will afford its members a broad sense of the research enterprise in the context of faculty driven research projects. It is our vision that the progressively more inquiry-based pedagogical approach will be a springboard for student involvement in undergraduate research and create an esprit de corps in subsequent years building connections to members of the department. The first cohort completes the sequence in the spring of 2011 and data is being collected to examine perceptions and conceptual understanding.

CHED 289
Phenomenological approach to understanding learning in the general chemistry laboratory
Santiago Sandi-Urena(i), ssandi@usf.edu, 4202 E. Fowler Ave CHE 205, Tampa Florida 33620, United States ; Todd A. Gatlin(ii); Susana S. Lopez(iii), (1) Department of Chemistry, University of South Florida, Tampa Florida 33620, United States

Often, research in laboratory experiences uses interventions and centers in the assessment of their effectiveness. Complementary to this approach, we propose one that is ecological and investigates the learning environment as enacted in diverse laboratory programs. This approach may allow identifying factors that promote learning and development of scientific skills for students and teaching assistants (GTAs) alike. Two significantly different general chemistry laboratory programs were studied. Students and GTAs were interviewed separately in each case and a phenomenological approach was used for the analysis and interpretation of data. Evidence for the relationship between the format of the laboratory and learning will be presented and discussed. Furthermore, findings show that GTA self-image plays a determinant role in graduate students’ instructional decisions when facilitating the proposed curriculum. We have identified the factors that influence formation of GTA self-image and proposed a model to inform their training and professional development.

CHED 290
Using POGIL to improve the academic laboratory experience
Frank J. Creegan(i), fcreegan2@washcoll.edu, 300 Washington Ave., Chestertown Maryland 21620, United States . (1) Department of Chemistry, Washington College, Chestertown Maryland 21620, United States

A POGIL laboratory is one in which students, in advance of any classroom work on underlying principles, work in self-managed teams to conduct experiments rather than exercises that verify previously taught principles. The instructor poses a Question of the Day, (When an alcohol reacts as a base what role do substituents play?), and students, working within their groups, propose a set of tentative answers. To test these hypotheses, teams of students run reactions and collect data, which are pooled, first within their groups, then within the laboratory section, and are analyzed with the aid of in-lab and post-experiment or post-laboratory guided-inquiry questions. This Learning Cycle Approach (Exploration phase, Concept Invention phase, and Application phase) not only guides students to construct their own understanding of important chemical concepts but also helps them to develop valuable learning process skills. The application of the POGIL approach to Organic Chemistry courses will be described.

CHED 291
Does laboratory course work make a difference in student learning? A study of the impact of laboratory course on student problem solving in general chemistry
Tanya Gupta(i), tgupta@iastate.edu, 3051 Gilman Hall, Ames IA 50011, United States ; Thomas J Greenbowe(i), (1) Chemistry, Iowa State University, Ames IA 50011, United States

Several researchers have questioned the relevance of laboratory work in freshmen level college chemistry. Does taking a chemistry laboratory course as a co-requisite have any impact on student understanding of chemistry content and laboratory skills? Does laboratory course work help students connect with the content being covered in the lecture? A study
being conducted at a state university involves comparison of two general chemistry courses and investigation of student performance in the lecture based on taking or not taking the laboratory. Students, graduate teaching assistants and course instructors were interviewed on similar problems. Preliminary findings indicate that students enrolled in the laboratory had a better understanding of the concepts and they approached the problems in specific content area similarly as the chemistry graduate teaching assistants did, while the students not enrolled in the laboratory approached chemistry problems like novices.

**CHED 292**

Making connections in organic chemistry lab: Combining single-topic technique-based labs into a discovery-based lab

David R. Goode(1), goode_dr@mercer.edu, 1400 Coleman Ave., Macon GA 31207, United States ; Kevin M. Bucholtz(1); Samantha J. Paluck(1); Clayton T. Williams(1). (1) Department of Chemistry, Mercer University, Macon GA 31207, United States

Disconnect between the lab and lecture has been a common complaint for first semester organic chemistry courses at Mercer University. Upon further conversation with students, we discovered that this disconnect stemmed more from a lack of engaging, discovery-based material in the laboratory exercises than a misalignment with lecture topics. In an effort to alleviate this disconnection, a four-week discovery-based laboratory was developed by combining single topic technique-based labs to provide students with the opportunity to synthesize information, and draw broader conclusions based upon their data. The structural, stoichiometric, and temperature effects on equilibria of esterification reactions between acetic acid and pentanol isomers are the overarching problem this multi-week lab addresses. Techniques incorporated into the laboratory experiment include reflux reaction conditions, fractional distillation, gas chromatography, data compilation, and data analysis. Students complete the laboratory by submitting a report in the style of the Journal of Organic Chemistry where they are required to draw general conclusions on the effect of alcohol structure and temperature in an esterification equilibrium reaction.

**CHED 293**

Nanoparticles in biology: Engineering the interface for sensing and delivery

Vincent M. Rotello(1), rotello@chem.umass.edu, 710 North Pleasant St., Amherst MA 01003, United States ; (1) Department of Chemistry, University of Massachusetts, Amherst MA 01003, United States

A key issue in the use of nanomaterials is controlling how they interact with themselves and with the outer world. Our research program focuses on the tailoring of nanoparticles of surfaces for a variety of applications, coupling the atomic-level control provided by organic synthesis with the fundamental principles of supramolecular chemistry. Using these tailored monolayers, we are developing particles for biological applications, in particular delivery and sensing. This talk will focus on the interfacing of nanoparticles with biosystems, and will discuss our use of nanoparticles for delivery applications as well as their application as therapeutics in their own right.

**CHED 294**

Designing multi-scale nanomaterials for sensing and imaging

Teri W. Odom(1), todom@northwestern.edu, 2145 Sheridan Road, Evanston IL 60208, United States. (1) Department of Chemistry and Materials Science and Engineering, Northwestern University, Evanston IL 60208, United States

Biological structures such as seashells and Australian opals exhibit at least two different, functional length scales, where the structural factors largely dictate their physical properties, from mechanical to optical. Artificially structured materials offer new opportunities to control the size and placement of specific features in multi-scale structures. Such control can result in open architectures or anisotropic structures starting from a single template. This talk will describe multi-scale, metal nanomaterials that exhibit distinct structural features from one nm to several hundred nm simultaneously. Specifically, we will focus on a 3D template—nanofabricated pyramidal shells—and discuss how each length scale correlates to new near-field and far-field optical properties. Intrinsic to their multi-scale architecture, the pyramids contain specific features spanning three orders of magnitude: the tip is of order 1 nm, the shell thickness is tens of nm, and the overall size is of order 100 nm. We will describe prospects for these multi-scale nanomaterials in SERS and biological sensing and imaging.

**CHED 295**

Design in organometallic synthesis: Molecular wires and gyroscopes

John A Gladysz(1), gladysz@mail.chem.tamu.edu, P.O. Box 30012, College Station Texas 77842, United States. (1) Chemistry, Texas A&M University, College Station Texas 77843, United States

Applications of olefin metatheses to targeted syntheses of two classes of organometallic molecules – insulated molecular wires and molecular gyroscopes – will be described. The former entails the construction of M(C≡C)₆ moieties in which both metal termini are substituted with two trans phosphine ligands of the formula PR₃(CH₂)nCH=CH₂. Two fold intramolecular ring closing metatheses, followed by hydrogenations, lead to species of the type I. The latter entails the initial preparation of complexes with trans R₃P-ML₃-PR₃
linkages, with R groups that terminate with a CH=CH₂ moiety. Three-fold intramolecular ring closing metatheses, followed by hydrogenations, give gyroscope-like species of the type II. Yields are highest with rotators such as Fe(CO)₅, which feature a three-fold symmetry axis, analogous to the phosphine ligands. However, reasonable yields can also be obtained with ML₆ = PtCl₂, Rh(CO)Cl (square-planar geometry) and Re(CO)₅X (octahedral geometry).

**CHED 296**

**Combining heterogeneity with uniformity in metal-organic frameworks**

**Omar M Yaghi**(1), yaghi@chem.ucla.edu, 607 Charles E. Young Drive East, Los Angeles Ca 90095, United States . (1) Department of Chemistry and Biochemistry, University of California Los Angeles, Los Angeles Ca 90095, United States

Metal-organic frameworks (MOFs) represent an extensive class of porous crystals in which organic 'struts' are linked by metal oxide units to make open networks. The flexibility with which their building units can be varied and their ultra-high porosity (up to 10,000 m²/g) have led to many applications in gas storage and separations for clean energy production, to mention a few. This lecture will focus on how one can design porosity within MOFs to affect highly selective separations (carbon dioxide), storage (hydrogen and methane) and molecular recognition. The lecture will also outline a new concept involving the design of heterogeneity within crystalline MOFs to yield 'gene'-like sequences which code for specific separations and chemical transformations.

**CHED 297**

**Engaging the masses: Encouraging pre-meds to "buy into" the organic chemistry "program"**

**Neil E Schore**(1), neschore@ucdavis.edu, One Shields Avenue, Davis CA 95616, United States . (1) Chemistry, University of California, Davis, Davis CA 95616, United States

Teaching organic chemistry to large-enrollment classes of pre-medical and other pre-professional students is a challenge. This is not news. Engaging such students and keeping them engaged requires an awareness of what they care about. Since, for many of them, it's getting a grade that will get them into med school, it helps to be honest and realistic about that up front. It is also useful to reacquaint them with the goals of the course, which are more than just learning material. We'll talk about the "program" of an organic chemistry course, which encompasses the development of the ability to work with the material. We'll talk about motivating students to "buy into" a program where their focus becomes using what they learn to solve extrapolative problems, and how that focus becomes a more reliable route to both a good grade and a quality educational experience.

**CHED 298**

**Using short videos to supplement lectures on organic spectroscopy, reaction mechanisms and polymer chemistry**

**Arno Kraft**(1), A.Kraft@hw.ac.uk, Riccarton, Edinburgh Scotland EH14 4AS, United Kingdom ; Valeria Arrighi(1); Emma S. Rankin(1); Cindy S. G. Nadai(1); Guillaume Hedir(1). (1) Chemistry, School of Engineering & Physical Sciences, Heriot-Watt University, Edinburgh Scotland EH14 4AS, United Kingdom

We have developed a series of short (5 – 15 minutes) videos to introduce students to topics such as curly arrow reaction mechanisms, spectroscopic techniques, and the polymerization of styrene. The videos are designed to supplement lecture courses or lab classes, as well as serve as a revision tool. As such, they help students who are struggling with lectures, who enter the undergraduate programme late, or who have simply forgotten elementary skills. The videos introduce students to the topic at a fast pace, emphasise key features, use simple "visual effects" and aim to entertain, but avoid the normal "Powerpoint" lecture style. More recently, a series of videos on aspects of polymer synthesis and characterisation were prepared by BSc (Hons) project students in their final year. Advantages and disadvantages of this approach, and the impact on student understanding and comprehension will be discussed.

**CHED 299**

**Novel Petasis and Sonogashira reactions for the undergraduate organic laboratory**

**Andrew P. Dicks**(1), adicks@chem.utoronto.ca, 80 St. George Street, Toronto Ontario M5S 3H6, Canada ; Katherine J. Koroluk(1); Derek A. Jackson(1). (1) Department of Chemistry, University of Toronto, Toronto Ontario M5S 3H6, Canada

Two novel named reactions designed for the organic teaching laboratory will be presented in this paper. Both reactions have
significance in pharmaceutical synthesis, with the Sonogashira reaction related to the palladium-catalyzed 2010 Nobel Prize-winning reactions. The Petasis reaction features a multi-component boronic acid Mannich transformation forming a tertiary amine, which is an anti-fungal analog. Students isolate and analyze their Petasis product using IR and proton NMR spectroscopy. They also obtain an NMR spectrum of the protonated product in order to observe and interpret unusual chirality at the ammonium nitrogen atom. The Sonogashira reaction showcases aqueous organic reactivity where an activated aromatic iodide is coupled with a terminal alkyne in the presence of palladium (II) chloride to form an internal alkyne. Students additionally learn about flash chromatography as a purification technique. These reactions were both successfully performed in a third-year synthetic organic laboratory at the University of Toronto during Spring 2011.

CHED 300

Incorporation of virtual laboratory exercises as progress towards a new pedagogy for teaching organic chemistry laboratories

James A Parise(1), james.parise@duke.edu, Box 90346, Durham NC 27708, United States; Allison A Schmitt(1), (1) Department of Chemistry, Duke University, Durham NC 27708, United States

We have implemented a two-semester organic laboratory program that integrates virtual lab exercises, or ‘dry labs’, with traditional wet experiments. In the first semester, we developed a series of exercises designed to introduce key organic chemistry concepts that were lacking from the previous program. We focused on three key areas of emphasis for the dry labs: chromatography and solvents, stereochemistry, and spectroscopy. Solvents and chromatography were addressed early in the semester to supplement the wet laboratory exercises. A stereochemistry dry lab appeared mid semester. Spectroscopy lessons were gradually introduced throughout the term, and culminated in the final two labs. The dry labs familiarized students with the theory behind techniques. These labs, combined with the traditional wet labs that gave students experience with essential experimental techniques, provided students with comprehensive training in introductory organic chemistry. Additionally, required laboratory space and staffing were effectively cut in half using this new pedagogy.

CHED 301

What's wrong with carbonyl chemistry?

Scott T Handy(1), shandy@mtsu.edu, East Main Street, Murfreesboro TN 37132, United States; Matthew L Miller(1), Matt.Miller@sdstate.edu, 351 Avera Health and Science Center, Brookings South Dakota 57007, United States; David P Cartrette(1), (1) Department of Chemistry & Biochemistry, South Dakota State University, Brookings South Dakota 57007, United States

In general, students struggle with the carbonyl sections of Organic Chemistry. Although each and every new Organic text claims to have a new and different approach to teaching carbonyl chemistry, the results, in terms of student performance on exams and retention of material, appear to be largely the same regardless of the text. In struggling with how to improve student comprehension and retention of carbonyl chemistry, one possible source of the problem was identified as its location. In most cases, it is covered near the end of the second semester of a two semester long sequence of Organic Chemistry. As a result, it could be simple fatigue that is part of the problem. To study this hypothesis, Organic II has been taught with a revised order: carbonyl chemistry at the start of the second semester and aromatic chemistry at the end. The results of this experiment and further thoughts for future improvement will be presented.

CHED 302

Integrating historical examples into the organic chemistry lecture

Kevin M. Bucholtz(1), bucholtz_km@mercer.edu, 1400 Coleman Ave., Macon GA 31207, United States; Matthew L Miller(1), Matt.Miller@sdstate.edu, 351 Avera Health and Science Center, Brookings South Dakota 57007, United States

Organic chemistry can be a distant subject and unrelated to any courses that students have seen in their college careers. Many textbooks work to address this problem by incorporating sidebars and vignettes to supplement the textbook material. However, these additions are usually surface level descriptions and rarely go into substantial detail to describe the impact and significance that the examples have in the students' everyday lives. In an attempt to provide more substantial examples and to incorporate the foundations of a liberal arts education into the course, the book Napoleon's Buttons: 17 Molecules That Changed History by Penny Le Couteur and Jay Burreson was and continues to be incorporated into organic chemistry coursework at Mercer University to supplement the standard textbook. By examining 17 molecules or classes of molecules that have had significant impacts on history, society, and culture, this book provides students with substantial and tangible, “real-life” examples that supplement the corresponding chapter or topic in the organic chemistry textbook. Results from this approach along with specific examples will be discussed.

CHED 303

Redesigning the general/organic sequence for ACS majors and honors students

Matthew L Miller(1), Matt.Miller@sdstate.edu, 351 Avera Health and Science Center, Brookings South Dakota 57007, United States; David P Cartrette(1), (1) Department of Chemistry & Biochemistry, South Dakota State University, Brookings South Dakota 57007, United States
The Department of Chemistry and Biochemistry at South Dakota State University has implemented a blended curriculum for the first two years of instruction for chemistry and biochemistry majors. Our objectives for the curricular change are: 1) increase retention/recruitment of majors; 2) enhance conceptual understanding with the goal of improved performance by majors in upper division courses; and 3) improve math preparation prior to math intensive chemistry courses. We have devised a curriculum beginning with a qualitative foundation and progressing toward a rigorous quantitative capstone which is intended to facilitate student understanding of advanced coursework. The intent of the curricular revision is to provide a transparent approach to chemistry as a discipline building upon fundamental concepts present in a variety of sub-disciplines. Students in the first cohort to experience these changes will complete the sequence in the spring of 2011 and will be surveyed to identify reactions to the curricular changes.

CHED 304
Making organic chemistry palatable using clickers, e-homework, and research papers
Margaret R. Asirvatham(1), margaret.asirvatham@colorado.edu, Campus Box 215, Boulder CO 80309-0215, United States. (1) Department of Chemistry & Biochemistry, University of Colorado-Boulder, Boulder CO 80309-0215, United States
Interactive engagement in the classroom using “clickers” (personal response systems) helps students to self assess their learning and offers instructors a diagnostic and formative assessment tool. Drill and practice necessary to learn the language of organic chemistry have been “gently enforced” using a pedagogically effective online homework system. The chemistry/biology interface provides an exciting platform to investigate real life applications of organic molecules. Transformations in teaching and learning organic chemistry in large lecture classes will be presented.

CHED 306
Student-lead instructor facilitated guided inquiry learning (SLIFGIL) versus Science Writing Heuristic (SWH) approach
Tanya Gupta(1), tgupta@lastate.edu, 3051 Gilman Hall, Ames IA 50011, United States; Thomas J. Greenbowe(2); K. A. Burke(2). (1) Chemistry, Iowa State University, Ames IA 50011, United States; (2) Chemistry, Iowa State University, Ames IA 50111, United States
The Science Writing Heuristic (SWH) and Process Oriented Guided Inquiry Learning (POGIL) approaches have been proven to improve student academic performance when implemented appropriately by instructors. Science writing Heuristic has been implemented by students at a State University in which students are assigned roles consistent with the Science Writing Heuristic format of laboratory report. The modified SWH approach is called SLIFGIL (student-led instructor facilitated guided inquiry laboratories). When assigned specific roles students were found to perform better in their hour exams and laboratory practical final exams. In the next phase of this study we are looking at the arguments made by students in their laboratory reports and the correlation with responses on the problems presented in the hour exams and the laboratory practical exams. Preliminary findings on how the student hour exam problem performance correlates with the level of scientific argumentation they make in their reports will be discussed. Are the SLIFGIL students making better scientific arguments on specific concepts as compared to the SWH laboratory students? How does the performance of SLIFGIL students compare with the SWH students on specific exam problems?

CHED 305
Can writing-to-learn using Calibrated Peer Review be effective as optional assignments?
Wendy L Keeney-Kennicutt(1), k-keeney@tamu.edu, PO Box 30012, College Station TX 77842-3012, United States. (1) Department of Chemistry, Texas A&M University, College Station TX 77842-3012, United States
The web-based writing/assessing program, Calibrated Peer Review (CPR), is a sound pedagogical tool for writing-to-learn and critiquing-to-learn. I have used CPR in my large first-year Chemistry classrooms since 2002. In Fall 2006, curriculum changes forced me to reduce the required amount of outside work for students, so I made CPR optional. In 2007, 422 students (96% of those who took the final exam), 56% did at least one assignment, and 92% agreed that future classes should have the opportunity to do CPR. Further analysis of the in-class survey will be shared and compared to Spring 2011 data to show how some students benefit when writing and critiquing are included in the curriculum.

CHED 307
Using Calibrated Peer Review to assess concept mastery of graphing skills
Breeyawn N Lybert(1), ririe@chem.ucla.edu, 607 Charles E. Young Drive East, Box 951569, Los Angeles CA 90095, United States; Arlene A Russell(2). (1) Department of Chemistry, University of California, Los Angeles, Los Angeles CA 90034, United States
The Calibrated Peer Review (CPR) program, a web-based writing-to-learn tool, has recently added a feature that allows students to upload a file along with their text. This provides a vehicle now to be able to assess concept mastery of other forms of communication skills beyond writing. In a CPR assignment, students submit a document (including visuals) on
a specific subject relevant to their course. Within the program students then evaluate three pre-written documents as well as three of their peer's submissions. After reading and evaluating the peers' work students should gain a deeper understanding of the topic and recognize any errors made within their original document, which is evaluated last. We will discuss how students modified their graphing practices during a quarter based on the feedback they received during a CPR assignment in which they used their own laboratory data and graphs.

CHED 308

Designing a new framework for teaching scientific writing within analytical chemistry

Charles T Cox(1), ccox@stanford.edu, 333 Campus Drive, Stanford CA 94305, United States . (1) Department of Chemistry, Stanford University, Stanford CA 94305, United States

Analytical chemistry is the writing in the major course at Stanford University. This quarter the course has been redesigned to focus specifically upon writing development with smaller writing assignments that will allow students to develop writing skills with maximum feedback. In addition, calibrated peer review was incorporated to provide an additional paradigm for peer review and self assessment. This presentation will focus specifically on the types of writing introduced, the feedback provided to students, and student performance, attitude, and opinion regarding the materials will be discussed.

CHED 309

Employing POGIL in writing research proposals

Danae R. Quirk Dorr(1), danae.quirk-dorr@mnsu.edu, Ford Hall 241, Mankato MN 56001, United States . (1) Department of Chemistry and Geology, Minnesota State University, Mankato, Mankato MN 56001, United States

POGIL activities were designed and implemented with the core intention of guiding students through the process of writing research proposals. The first activity utilized a YouTube news story as the model. The focus of the activity was to help students recognize misconceptions about what research is, and then identify the characteristics of research. From that, students extrapolated general and specific research questions from research problems. Then, they used the characteristics of research to formulate research plans. Next, students were guided to reach an understanding of the format and key components of research papers. Subsequent activities helped students correlate the general goals of research to the discussion section of research papers. Students recognized how background information can be used to develop the justification for research and utilized the methodology section to enhance their proposed methods. Finally, using correlations between the sections of research papers, students established outlines of research proposals.

CHED 310

Embedding writing skills in content-driven Calibrated Peer Review™ assignments

Arlene A Russell(1), russell@chem.ucla.edu, 607 Charles E. Young Drive East, Los Angeles CA 90095-1569, United States ; Breeyawn Lybbert(1), (1) Department of Chemistry and Biochemistry, University of California, Los Angeles, Los Angeles CA 90095-1569, United States

The widespread adoption of Calibrated Peer Review™ in the STEM disciplines attests to the value that scientists hold for learning and demonstrating understanding through writing. Frequently, faculty have assumed that student writing skills would also automatically improve. The data, however, are mixed. Early anecdotal reports suggested this was the case, but more frequently, the results show no gain (or loss) in writing skills. To address this deficiency in instruction, we have purposefully begun to embed both lower-order (mechanics, grammar, spelling) and higher-order (logical flow, use of evidence in argumentation) writing skills in our assignment rubrics. Preliminary results showed that students recognize good writing and can accurately evaluate peer documents on these criteria. We will report on how reinforcement of the need to attend to higher-order writing skills on multiple CPR assignments in a term affects students’ attention to writing quality without compromising content accuracy.

CHED 311

Incorporating LC/MS into the Quantitative Analysis Laboratory

Karen L Steelman(1), ksteel@uca.edu, Laney Hall, Conway AR 72035, United States . (1) Department of Chemistry, University of Central Arkansas, Conway AR 72035, United States

With an NSF-MRI acquisition of a Waters Acquity UPLC with a TQMS Detector, the Chemistry Department at the University of Central Arkansas is increasing our use of sophisticated instrumentation in undergraduate laboratories. Traditional quantitative analysis laboratory experiments typically use limited instrumentation such as spectrophotometry and ion selective electrodes. However, students entering the workforce or attending graduate/professional school need to be prepared for the complex instrumentation they will encounter. The LC/MS has been incorporated into group projects, in which the students pick a problem, search the chemical literature, write an experimental procedure, perform the experiment, write a “journal” article, and present an oral talk to the department. Specific teaching challenges have included sample preparation, method development, and instrumentation software literacy.
CHED 312
Unit operations laboratory experiences in chemical engineering
Kenneth R Jolls, jolls@iastate.edu, 2114 Sweeney Hall, Ames Iowa, United States. (1) Chemical and Biological Engineering, Iowa State University, Ames Iowa 50011 - 2230, United States

The unit operations laboratory is a historical rite-of-passage in undergraduate chemical engineering curricula. Experiments involve chemistry, physics, engineering and laboratory safety and are often followed by exercises in mathematical modeling and the treatment of data. Students prepare industrial-style reports for each experiment, thus adding a component of technical writing. This talk will describe ChE unit ops experiments and procedures in place at Iowa State University and the progress being made to strengthen the laboratory and maintain its relevance to areas of current interest.

CHED 313
Application centered nanotechnology experiments for first-year students
Kurt Winkelmann, kwinkel@fit.edu, 150 West University Blvd, Melbourne FL 32901, United States; Monica Price, Cory Hodes; Christina Termini; Angela Camp; Catherine Thiele. (1) Department of Chemistry, Florida Institute of Technology, Melbourne FL 32901, United States (2) Department of Marine and Environmental Systems, Florida Institute of Technology, Melbourne FL 32901, United States (3) Department of Chemical Engineering, Florida Institute of Technology, Melbourne FL 32901, United States

Two new experiments involving applications of nanotechnology have been developed for first-year students. Students prepare polymethylmethacrylate (PMMA) composites containing aluminum oxide nanoparticles. These nanocomposites are stiffer than the pure PMMA solid material and their mechanical properties vary with the amount of nanomaterial added. A simple device allows students to measure the modulus of elasticity of their PMMA samples. This experiment demonstrates how engineering aspects of materials related to intermolecular forces and other chemical properties. In a second experiment, students synthesize iron nanoparticles and add them to a dye solution. During a five minute period, students measure the decrease in dye concentration as the iron nanoparticles chemically reduce the dye molecules. Students then use iron powders with different particle sizes to perform the same reaction. Reaction rates vary with particle size with larger particles reacting more slowly. Students discuss the advantages and disadvantages of using nanoparticles for waste water remediation.

CHED 314
Designing PCR primer multiplexes in the undergraduate forensic laboratory and testing using real time PCR and agarose gel electrophoresis
Kelly M. Elkins, kelkins1@mscd.edu, CB 52, PO Box 173362, Denver CO 80217, United States. (1) Chemistry Department, Metropolitan State College of Denver, Denver CO 80217, United States

The polymerase chain reaction (PCR) is a common experiment in junior and senior-level undergraduate biochemistry, molecular biology, and forensic laboratory courses as reagents and thermocyclers have become more affordable for institutions. Typically, instructors design PCR primers and students prepare their samples for PCR and analyze the results. However, primers can be designed successfully in undergraduate labs with students at this level. In my Criminalistics II course that focused on forensic DNA biology for forensic chemistry students, students designed STR PCR primer multiplexes and tested them in silico using freeware software prior to testing using human K562 DNA using real time PCR and agarose gel electrophoresis. This lab enables students to more fully understand how the primers and multiplex DNA typing kits routinely employed by the crime labs function and the engineering inherent in creating multiplexes to adequately prepare students for research and careers in the field.

CHED 315
Development of a low-cost capillary electrophoresis on-a-chip system for use in the undergraduate laboratory curriculum
Carrie M. Clippard, cmc5652@psu.edu, 330 Whitmore Lab, University Park PA 16802, United States; Paul Munson; Dan Sykes. (1) Department of Chemistry, Penn State University, University Park PA 16802, United States

Capillary electrophoresis on-a-chip (CE-chip) is known to be a useful separation technique because of its small sample sizes, little waste, and portability. CE on-a-chip also provides better resolution and signal to noise, and faster analysis times than conventional CE. However, use of CE-chip in undergraduate teaching labs is limited by its large price tag. In order to increase CE-chip availability to high schools and universities, we have designed a low-cost chip-based instrument equipped with contact conductivity and laser-induced fluorescence (LIF) detection. The instrument costs less than $500 to construct. Laboratory exercises, validation results demonstrating the accuracy and effectiveness of the instrument, and possible future implications will be presented.
Undergraduate secondary teacher licensure in science from the chemistry perspective: Trying to do it all in 138 credit hours

Doris R Kimbrough\(^{(1)}\), doris.kimbrough@ucdenver.edu, Box 173364, CB 194, Denver CO 80217-3364, United States; Mark Anderson\(^{(1)}\). (1) Department of Chemistry, University of Colorado Denver, Denver CO 80217-3364, United States

Previously the State of Colorado had a post-baccalaureate only process for secondary teacher licensure. Students earned their bachelor's degree in a specific major and then obtained their teacher's license in a fifth year of graduate training. The Colorado Department of Education recently revised their requirements to allow students to obtain undergraduate licensure; however the state limits undergraduate degree programs to 138 credit hours. How does one include all the science content required to be qualified to teach high school science courses in chemistry, biology, physics, and earth science AND fold in all the Education coursework and internships that the state requires for licensure into a 138 credit hour degree? Science departments at UC Denver wrestled with this problem for several years before successfully crafting a workable solution. The Chemistry Department's contribution to the solution will be described in this paper.

Encouraging undergraduates at a research university to consider teaching as a career

Neil E Schore\(^{(1)}\), schore@chem.ucdavis.edu, One Shields Avenue, Davis CA 95616, United States. (1) Department of Chemistry, University of California, Davis, Davis CA 95616, United States

We'll discuss several opportunities that the UC Davis environment affords undergraduate students to explore possible interests in teaching as a career. One is the UC Davis Mathematics and Science Teaching (MAST) Program. This program helps students design curricula within their majors that prepare them for credential programs and also provides three levels of teacher training experiences in area schools. Another is a Natural Sciences major track that targets students with an interest in teaching science. Finally, a program that is under development is one that proposes to provide students with a "waiver curriculum" for prospective high school teachers of chemistry. The required courses will be chosen to meet the standards expected of teachers such that satisfactory completion of the curriculum will waive the need to take the usual examinations.

New course development: Teaching and learning chemistry

Laurie S Langdon\(^{(1)}\), Laurie.Langdon@colorado.edu, UCB 215, Boulder CO 80309, United States; Julie Andrew\(^{(2)}\); Robert Parson\(^{(2)}\). (1) Department of Chemistry and Biochemistry, University of Colorado, Boulder CO 80309-0215, United States (2) School of Education, University of Colorado, Boulder CO 80309, United States

We are creating a new "teaching and learning chemistry" course that targets our growing community of future chemistry teachers, current teachers, and future faculty. The course complements existing "teaching and learning" courses already offered in the physics and biology departments at our institution. It is designed to strengthen participants' chemistry content knowledge and provides them with experience implementing curricular frameworks that use data and evidence to build student understanding of chemistry. We will highlight the main designs and student activities planned for the course.

Chemistry for pre-service teachers as a stand alone course.

Bryan E Breyfogle\(^{(1)}\). bryanbreyfogle@missouristate.edu, 901 S National Ave, Springfield MO 65897, United States. (1) Department of Chemistry, Missouri State University, Springfield MO 65897, United States

This talk will describe a course at Missouri State University involving chemistry content specific to pre-service chemistry teachers. The course is typically taken after students have completed a significant portion of their chemistry content and professional education courses. The course focuses on issues specific to managing and teaching a chemistry laboratory in secondary schools as these issues are often insufficiently covered in content and education courses. Students exit the course with competencies in preparing lab supplies, troubleshooting experiments, managing chemical inventories, utilizing technologies for automated data collection, and key safety issues.

Increasing the participation of chemistry and biochemistry faculty in support of chemistry students in pursuit of teacher education certification

Matthew L Miller\(^{(1)}\). Matt.Miller@sdstate.edu, 351 Avera Health Sciences Building, Brookings South Dakota 57007, United States; Kenneth Emo\(^{(2)}\). (1) Department of Chemistry & Biochemistry, South Dakota State University, Brookings South Dakota 57007, United States (2) Department of Teaching, Learning, and Leadership, South Dakota State University, Brookings South Dakota 57007, United States

The Department of Chemistry and Biochemistry at South Dakota State University has a long history of producing chemistry majors certified in secondary teaching. However, the
number of students graduating with teaching certification has been critically low since 2001. A concerted effort has been made on campus through an interdisciplinary collaboration to increase the number of STEM certified secondary teachers. Specifically in chemistry, which has averaged around 2-3 since 2005, targets of 4, 6, and 8 graduates with certification have been identified for the years 2011, 2013, and 2015, respectively. Within the department efforts to increase the number of chemistry secondary teachers have included active engagement with current teachers, changing the ACS curriculum for majors, increased sensitivity in advising students, early recognition and support of students, and scholarly activities. These efforts and their results will be discussed.

CHED 321

Comparison between Zambian male and female pre-service science teachers’ understanding of the particulate nature of matter

Frackson Mumba(1), frackson@siu.edu, 625 Wham Drive, MC 4610, Carbondale IL 62901, United States; Asiana Banda(1); Vivien M Chabalengula(1); Simeon Mbewe(1); William J.F. Hunter(1), (1) Curriculum & Instruction, Southern Illinois University Carbondale, Carbondale IL 62901, United States

We compared male and female pre-service science teachers' understanding of the particulate nature of matter. Data was collected through a 36 item instrument. Both males and females had good understanding of the effect of phase changes on speed, spaces and number of particles in a substance. Also, both gender groups displayed good understanding of the effect of compression on speed, number, size and spaces between particles in solids and liquids. However, most females had poor understanding of the effect of phase change on the size of the particles in solids, liquids and gases as they incorrectly believed heating increase size of particles and cooling decrease size of particles. Results have implications for chemistry teaching and learning.

CHED 322

Colorado Learning Assistant Program: Creating a community of future K-12 science and math teachers

Laurie S Langdon(1), laurie.langdon@colorado.edu, 215 UCB, Boulder CO 80309-0215, United States; Robert Parson(1); Susan M Hendrickson(1), (1) Department of Chemistry and Biochemistry, University of Colorado, Boulder CO 80309-0215, United States

The Learning Assistant (LA) model was developed at the University of Colorado to improve the quality of undergraduate math and science education and to recruit talented math and science students into K-12 teaching careers. The NSF Noyce Scholarship program provides professional development opportunities to students who decide to teach math and science in high-needs school districts. These programs have led to a substantial increase in the number of math and science majors pursuing K-12 teaching at the University of Colorado. In our department, eight faculty members have worked with 86 Learning Assistants to improve undergraduate chemistry courses. Of these LAs, three are now teaching high school chemistry, 12 are preparing to teach secondary science, and several more are exploring the possibility of teaching. The department's engagement with these programs has created a critical mass of students who are being encouraged and supported as they prepare for a teaching career.

CHED 323

Research experience for teachers (RET) to foster inquiry-focused teaching in science and mathematics

Doris R Kimbrough(1), doris.kimbrough@ucdenver.edu, Box 194, PO Box 173364, Denver CO 80218, United States; Carole Basile(2); Michael S Jacobson(3), (1) Department of Chemistry, University of Colorado Denver, Denver CO 80217-3364, United States (2) School of Education & Human Development, University of Colorado Denver, United States (3) Department of Mathematics, University of Colorado Denver, United States

As part of the NSF-funded Rocky Mountain-Middle School Math and Science Partnership (RM-MSMP), the University of Colorado at Denver instituted a capstone research experience for teachers (RET) who had participated in significant numbers of professional development coursework. Now in its second cycle, the RET results are discussed: its effectiveness, transformative aspects for teachers and for STEM faculty, and carryover into the classroom.

CHED 324

Recruiting and retaining the next generation of chemistry teachers: successes, challenges, and a call to action

GREGORY B RUSHTON(1), GRUSHTON@KENNESAW.EDU, DEPT CHEM AND BIOCHEM, 1000 CHASTAIN ROAD MD1203, KENNESAW GA 30144, United States; Deborah Bromfield Lee(1), dbromfl1@kennesaw.edu, 1000 CHASTAIN ROAD #1203, KENNESAW GA 30144, United States; Michelle Dean(1), (1) KENNESAW STATE UNIVERSITY, United States

In this presentation, we will detail the approaches, successes, and challenges encountered after a chemistry department at a midsize, southeastern regional comprehensive institution made it a strategic goal to increase the number and quality of secondary chemistry teachers in Georgia schools. In the five year period between 2006-11, a total of 44 students have completed the degree and certification requirements either at the bachelor's or master's level, over 80% of whom are currently in K12 teaching positions. Plans for increasing this
number to more than 100 graduates in the next five years will be discussed as well as the challenges that must be addressed in order to achieve this goal.

CHED 325

ACS efforts in preparing future high school chemistry teachers of tomorrow

Kenetta Thompson\(^1\), k_thompson@acs.org, 1155 Sixteenth Street, NW, Washington DC 20036, United States; Mary Kirchhoff\(^1\); Terri Taylor\(^1\). (1) Education, American Chemical Society, Washington DC 20036, United States

The American Chemical Society (ACS) recognizes the critical role of the chemistry community in preparing the high school chemistry teachers of tomorrow and has launched efforts to engage the community in addressing the considerable shortage of highly qualified high school chemistry teachers in our nation. Through its largest ever gift of $33 million from the Hach Scientific Foundation, ACS provides almost $1 million dollars annually in scholarships to chemistry majors pursuing certification to become high school chemistry teachers, as well as scholarships for second-career chemistry teachers and outreach grants to in-service teachers. In fall 2009, the ACS Society Committee on Education (SOCED) released a statement on pre-service education; to date, more than 100 chemistry departments nationwide have endorsed this statement. ACS is also currently engaging the chemistry community in exploring, framing, and formalizing additional Society initiatives in the pre-service education of K-12 STEM teachers. This session will present these efforts in preparing future high school chemistry teachers.

CHED 326

Molecular visualization in STEM education - An integrated assessment platform

Gordon Rule\(^1\), rule@andrew.cmu.edu, 4400 5th Ave, Pittsburgh PA 15213, United States; Diana Bajzek\(^2\); Anya Goodman\(^3\); Aaron Kessler\(^4\). (1) Department of Biological Sciences, Carnegie Mellon University, Pittsburgh PA 15213, United States (2) Office of Technology for Education, Carnegie Mellon University, Pittsburgh PA 15213, United States (3) Department of Chemistry and Biochemistry, California Polytechnic State University, San Luis Obispo CA 93407, United States (4) School of Education, University of Pittsburgh, Pittsburgh PA 15213, United States

Online instruction is playing a larger role in chemical education. The effectiveness of this material increases with the engagement of the student. In the past we have delivered animations and molecular simulations to students in biochemistry/technology courses using the Open Learning Initiative platform (OLI). The significant and unique feature of OLI is its rich assessment environment that provides feedback to the student as well as reporting student progress to the instructor. These courses can be viewed in their open-and-free versions† that contain all of the course materials, with the exception of scored activities. More recently, we have initiated the development of newer tools that will allow students to interact with three-dimensional molecular models. The impact of the delivery of animations, molecular simulations and molecular models on student engagement will be discussed.

CHED 327

Monitoring student growth and learning: Mode of error analysis of student responses to pre-requisite knowledge assessments

David B. Benson\(^1\), dbenson@kettering.edu, 1700 University Avenue, Flint MI 48504, United States. (1) Department of Mechanical Engineering, Kettering University, Flint MI 48504, United States

Within any discipline there are a number of concepts and skills that form threads which connect content areas and are the scaffold upon which advanced knowledge is constructed. An incomplete understanding of these concepts can lead to difficulties which resonate throughout a student's academic career. Tools for identifying, mapping and assessing student capability along a number of these threads (trajectories) have been developed: focusing on science thinking, mathematics skill and essential discipline-specific content. Preliminary results indicate that the types of errors encountered are shared by large numbers of students and that some errors persist throughout a trajectory. The goal of this research is to enable institutions to generate longitudinal profiles of student capability and permit focused attention on teaching practices and efforts aimed at developing long-term improvement of the student knowledge base. The authors gratefully acknowledge the financial support of the NSF (DUE 0942572) for support of this project.

CHED 328

ChemPRIME: An online wiki textbook with exemplars

John W. Moore\(^1\), jwmoore@chem.wisc.edu, 1101 University Avenue, Madison Wisconsin 53706-1396, United States; Ed Vitz\(^2\); Justin Shorb\(^1\). (1) Department of Chemistry, University of Wisconsin-Madison, Madison Wisconsin 53706, United States (2) Department of Chemistry, Kutztown University, Kutztown Pennsylvania 19530, United States

ChemPRIME is an online wiki textbook for general chemistry that develops concepts in logical progression. Wiki format allows many authors to contribute and edit content. Because students frequently prefer a case study approach (which typically has not allowed a logical progression of topics), we provide 'Exemplars' for each concept in 'Tracks' (Biology,
Geology, Physics & Engineering, Arts and Humanities, Food, Forensics, Medicine and Health, Environment and Sustainability, and Lecture Demonstrations). Ultimately, students will be able to study the entire general chemistry course through exemplars. We have created the wiki (http://wiki.chemprime.chemeddl.org); digitized, translated to wikitext, and added to the wiki a standard general chemistry textbook (the ‘CoreChem’ track); and entered more than 100 Exemplars. ChemPRIME is a “Top 11 for 2011” resource of the Chemical Education Digital Library. We invite new users and contributors. The authors gratefully acknowledge the financial support of the NSF (DUE 0837607) for support of this project.

CHED 329

Opening the teaching pipeline for UCLA STEM majors
Arline A. Russell[1], russell@chem.ucla.edu, 607 Charles E. Young Drive East, Los Angeles CA 90095-1569, United States; James Rudd[2], (1) Department of Chemistry and Biochemistry, University of California, Los Angeles, Los Angeles CA 90095-1569, United States (2) Department of Chemistry and Biochemistry, California State University, Los Angeles, Los Angeles CA 90032, United States

The University of California, which admits the majority of science majors in the state, has recently created a system-wide program to address the dire shortage of science teachers. Building on the strong UCLA student commitment to community the UCLA California Teach program has developed five service-learning courses consisting of an academic seminar supported by a science- or math-focused field internship. However, to truly effect a change in the number of UCLA students entering STEM teaching, we needed easier curricular paths to teaching and a cultural change among faculty towards students wanting to teach. With the leverage of support from NSF, we have now been able to create a science education minor. The talk will address the difficulties we encountered to get there and how the program eventually obtained buy-in from STEM faculty. The authors gratefully acknowledge the financial support of the NSF DUE 0942118 for support of this project.

CHED 330

Cyber Peer-Led Team Learning (cPLTL)
Pratibha Varma-Nelson[1], pvn@iupui.edu, Center for Teaching and Learning, Room UL 1125, 755 West Michigan Street, Indianapolis IN 46202, United States; James Hassenzahl[2]; Virginia Brown[2], (1) Department of Chemistry and Chemical Biology, Indiana University - Purdue University at Indianapolis, Indianapolis IN 46202, United States; (2) Department of Chemistry, University of Toledo, Toledo OH 43606, United States

We are studying the conditions and tools required for enhanced cyberlearning through Peer-Led Team Learning (PLTL). This project is not about technology per se, but how it can be used to enhance an educational strategy that has already proven beneficial in STEM courses. To accomplish this we: a) Have created cyber PLTL (cPLTL), an online, synchronous, collaborative environment for conducting PLTL Workshops; b) Are studying the effectiveness of a cPLTL environment in duplicating the proven benefits of the traditional (face-to-face) PLTL method; c) Are examining the effectiveness of the existing PLTL materials in cPLTL Workshops; d) Have modified the existing training course for the peer leaders to be effective facilitators in the cPLTL model; e) Have developed a brief technology training for students learning chemistry in cPLTL workshops; f) Are in the process of articulating the critical components vital to successful implementation of a cPLTL program. Our experience with this method of teaching and preliminary results will be presented. The author gratefully acknowledges NSF (DUE 0941978) for support of this project.

CHED 331

ChemEd Bridges: Motivating community college faculty to adopt innovations in chemical education
Harry Ungar[1], haungar@cruzio.com, Box 1677, Aptos CA 95001, United States; Andy Jorgensen[1], andy.jorgensen@utoledo.edu, 2801 W Bancroft Avenue, Toledo OH 43606, United States

ChemEd Bridges provides professional development opportunities to expand the horizons and enrich the careers of community college chemistry faculty, encouraging more of them to adopt new pedagogical ideas. We support their travel to and participation in selected meetings of the American Chemical Society and the Two-year College Chemistry Consortium. At these meetings we organize chemical education symposia that are directly relevant to 2YC chemistry needs, including teaching innovations and undergraduate research. Since 2005, we have supported 35 faculty members from 10 colleges, organized symposia and workshops at five different meetings, and published two papers on our efforts. As a result faculty have adopted new, tested educational methodologies which, in at least two cases, led to department-wide curriculum reform.

The authors gratefully acknowledge the financial support of the DUE/NSF 0737166 for support of this project.

CHED 332

Creating a learning community for solutions to climate change
Andy Jorgensen[1][2], andy.jorgensen@utoledo.edu, 2801 W Bancroft Avenue, Toledo OH 43606, United States; Virginia Brown[2], (1) Department of Chemistry, University of Toledo, Toledo Ohio 43606, United States (2) National Council for Science and the Environment, Toledo Ohio 43606, United States (3) Chatham University, Washington DC 20036, United States
The academic community has been challenged to meet the educational needs of our students as the discourse about climate change has shifted from whether such change is occurring, to the need for dealing with ongoing impacts. Faculty and students require a set of knowledge and skills to actually find solutions to the changes in climate. The interdisciplinary and evolving nature of climate change causes, consequences, and solutions represents a nontraditional situation for instructors. The National Council for Science and the Environment (NCSE), through its Council of Environmental Deans and Directors, has created an online learning community called CAMEL (Climate, Adaptation, and Mitigation e-Learning). The initiative engages educators in the development of accurate content with the best pedagogical methods for enabling students to tackle this complex problem. We are creating a cyberinfrastructure to support and promote the creation of materials and the effective life of the community using NCSE’s Encyclopedia of Earth (eoearth.org). The authors gratefully acknowledge the financial support of the NSF (DUE-0950396) for support of this project.

CHED 333
What’s in our water and soil? Research-based environmental labs for undergraduate chemistry courses

Janice Hall Tomasik(1), tomas1jh@cmich.edu, DOW Sciences Building, Mount Pleasant MI 48859, United States; Dale J. LeCaptain(1); Sharyl A. Majorski(1); Anja Mueller(1). (1) Department of Chemistry, Central Michigan University, Mount Pleasant MI 48859, United States

Research-based environmental experiments have been developed for general and analytical chemistry courses to increase interest and skills of students in chemistry and improve undergraduate research. Students analyze water and soil sources on-site at Beaver Island, MI and in the mid-MI area. Samples are analyzed using water testing kits and hand-held XRF analyzers. Data are used for long-term monitoring, and potential “hot spots” are identified to the MI Dept. of Environmental Quality. The study seeks to determine the efficacy of the labs, and impacts on student learning and interest in chemistry. The evaluation uses control vs. treatment, pre-and post-qualitative and quantitative assessments, including student focus-group interviews and surveys. This paper discusses the development and implementation of the labs, and the promising preliminary evaluation results obtained a year into the project. The authors gratefully acknowledge the financial support of the NSF DUE 0942131 for support of this project.

CHED 334
Why my students and I appreciate clickers (most of the time)

Wendy L Keeney-Kennicutt(1), k-keeney@tamu.edu, PO Box 30012, College Station TX 77842-3012, United States. (1) Department of Chemistry, Texas A&M University, College Station TX 77842-3012, United States

Teaching large general chemistry classes has always been challenging, but frequent low stakes, open-book, in-class group quizzes kept my students engaged. With budget cuts and loss of grading help, paper quizzes for 500 students was becoming untenable. “Clickers” gave me back the ability to stop instruction during class and allow students to practice what they just learned with quizzes very similar to my paper ones. I will be presenting my clicker methodology and student data illustrating why I persevere with clickers in spite of occasional equipment glitches. Even with technology issues, I found that 80% of my students thought that clicker quizzes helped them to pay attention and learn in class. What more can you ask?

CHED 335
Keeping the pace: Personal response systems to keep students moving forward

Joe L March(1), march@uab.edu, 1530 3rd Ave S, CHEM 201, Birmingham AL 35294, United States. (1) Department of Chemistry, University of Alabama at Birmingham, Birmingham AL 35294, United States

Personal response systems (or clickers) provides an opportunity to engage students in the large lecture environment. We have employed clickers in the general chemistry program at the University of Alabama at Birmingham to supplement in-class activities, assess progress, record attendance, and sometimes have just a little fun. This presentation will describe how clickers have been used to keep students on task during POGIL activities and keep students engaged in the classroom. It will include some discussion of common difficulties and a brief discussion about how students react to the system.

CHED 336
Do cooperative learning and clickers lead to improved learning in General Chemistry I?

David J. Weiss(1), dweiss@uccs.edu, 1420 Austin Bluffs Pkwy, Colorado Springs Colorado 80918, United States. (1) Department of Chemistry and Biochemistry, University of Colorado Colorado Springs, Colorado Springs Colorado 80918, United States

Clickers are sometimes used in General Chemistry to encourage student participation and attendance. We are endeavoring to use both cooperative learning in groups for problem-solving as well as clickers to evaluate student learning. We want to know if students using clickers and cooperative learning learn more in General Chemistry I than students in a traditional formal lecture. Lectures were taught by
the same faculty member in two different sections of General Chemistry I. One section was taught in the traditional lecture format as a control group. No clickers were used. The other section used cooperative learning in formal groups and used clickers to report individual results. A prequiz was given to both groups before learning a unit, followed by a quiz after the unit. Quizzes were identical in both sections. Scores are compared to give a quantitative measure of the impact of cooperative learning and clickers on student learning.

**CHED 337**

Pro and cons of peer collaboration using clickers in organic chemistry

_Margaret R. Asirvatham_ (1), margaret.asirvatham@colorado.edu, Campus Box 215, Boulder CO 80309-0215, United States. (1) Department of Chemistry & Biochemistry, University of Colorado-Boulder, Boulder CO 80309-0215, United States

Clickers were introduced into the large first-semester organic chemistry course in fall 2007 to actively engage students in the learning process. Peer collaboration was encouraged based on results observed in our large general chemistry courses with predominantly first-semester freshmen. In fall 2010, a switch from peer collaboration to individual performance was implemented to assess student accountability and to facilitate self-assessment by students who are predominantly sophomores. These results will be presented to examine prevalent views about peer collaboration when using clickers.

**CHED 338**

Using clickers to identify points of confusion

_Daniel B King_ (1), daniel.king@drexel.edu, 3141 Chestnut Street, Philadelphia PA 19104, United States. (1) Chemistry, Drexel University, Philadelphia PA 19104, United States

One of the biggest challenges for instruction in large-enrollment introductory courses is the identification of topics that students do not understand. The large number of students in these courses makes it difficult to implement some effective pedagogical techniques, such as “muddiest point cards,” where students are asked at the end of class to identify which topic from that day’s class is still unclear, usually on three-by-five cards. Over the past two years, personal response devices (or clickers) have been used to collect muddiest point information in general chemistry courses. Data will be presented on the topics that were most commonly chosen as the muddiest point. While approximately 75% of the instructor-chosen muddiest point topics were qualitative in nature, students were more likely to choose quantitative topics as the muddiest point. Student performance on in-class clicker questions and exam questions related to muddiest point topics will be presented.

**CHED 339**

What course size for optimal clicker usage?: Searching the middle ground

_James R MacArthur_ (1), james.macarthur@adams.edu, 208 Edgemont Blvd., Alamosa CO 81102, United States. (1) Department of Chemistry, Computer Science and Mathematics, Adams State College, Alamosa CO 81102, United States

Previous work has focused on studying how clickers were used in large-enrollment (200+) general chemistry courses. Clickers have appeared to be quite successful in these larger courses based on their ability to catalyze self-assembly of student learning groups. Drawing on the results of this work, clickers were used to teach a moderate-enrollment (60) introductory chemistry course, applying similar principles to the selection of instructional methods as were observed to be beneficial in the large-enrollment courses. Comparisons will be made between the apparent effectiveness of clickers versus other instructional methods used in the same course.

**CHED 340**

Clickers in a large lecture class: Student impressions and perceived learning

_Vickie M. Williamson_ (1), williamson@tamu.edu, Texas A & M University, College Station TX 77843-3255, United States. (1) Department of Chemistry, Texas A & M University, College Station TX 77843-3255, United States

This talk will highlight four semesters of survey data from approximately 2000 students concerning their impressions of the use of clickers. Clickers were used daily in a large lecture general chemistry class. Questions were both conceptual and algorithmic in nature, but responses were multiple choice. Students were allowed to work with a partner in a short time period before submitting a response. The perceived learning that students attribute to clicker use was also investigated. Overall, students were positive. They valued clicker use and attributed learning to clickers. In open-ended survey questions, students explained their responses. Some explanations were surprising.

**CHED 341**

Every student (well almost every student) already carries an audience response system. Let’s use them.

_Michael J. Kenney_ (1), mjk56@case.edu, 10900 Euclid Avenue, Cleveland OH 44106, United States. (1) Department of Chemistry, Case Western Reserve University, Cleveland OH 44106, United States

Clickers? Who the heck needs clickers when virtually every student already carries a cell phone. This presentation will share ways individuals can incorporate an audience response system into their classroom without investing in extra
technology. The presentation will be interactive so be sure to bring your cell phone!

CHED 342
Applications of a virtual learning environment to enhance teaching capabilities for undergraduate courses
Joaquin Tirano(1), jetiranov@unal.edu.co, Carrera 30 No 45-03, Bogota Bogota, Colombia ; Gabriel Camargo(2); Hugo Zea(2). (1) Chemical & Environmental Engineering, National University of Colombia, Bogota Bogota 99999, Colombia (2) Environmental Engineering, Universidad Libre de Colombia, Bogota Bogota 99999, Colombia

The rapid expansion of "Virtual Learning Environments" (VLE) as teaching tool requires studies that examine their efficacy. This study reports the results of a project denominated "VLE as a support of in-class courses". The project's goal was to enhance non-conventional teaching tools that propel students in the use of multimedia online-based technologies in the learning process and to promote the creation of innovative forms of communication at teacher-student and student-student level. The project includes two thermo-chemistry courses (VLE and non-VLE); the results indicate that the majority of students on the VLE course used the tool, 59% of the students report to feel more motivated in the VLE class along with a 15% increment in the student who report to have understood concepts better than in the non-VLE class. Frequency and type of use of the VLE did not correlate strongly with final grade.

CHED 343
Clickers and collaboration: Group work in the general chemistry classroom
James F. Kirby(1), james.kirby@quinnipiac.edu, 275 Mt. Carmel Ave., Hamden CT 06518, United States ; (1) Department of Chemistry & Physical Sciences, Quinnipiac University, Hamden CT 06518, United States

Clickers have generally been accepted as a method for large classes to receive immediate response to questions where each individual uses his/her own clicker. In the freshman level courses that have used clickers at Quinnipiac, group decision making has been applied and only group answers have been accepted. The general views of students to this process will be presented.

CHED 344
Undergraduate chemistry program and student assessment with the DUCK (Diagnostic Undergraduate Chemical Knowledge) exam
Miles D Koppang(1), mkoppang@usd.edu, 414 East Clark Street, Vermillion SD 57069, United States ; Susan Schelble(2). (1) Department of Chemistry, University of South Dakota, Vermillion South Dakota 57069, United States (2) Chemistry, Metropolitan State College of Denver, Denver Colorado 80204, United States

In response to user requests for a comprehensive undergraduate chemistry program exam, the ACS Exam Institute developed the Diagnostic Undergraduate Chemical Knowledge (DUCK) exam. The exam is designed to be administered to chemistry majors at the end of their undergraduate program. The sub-discipline integrated exam consists of analytical, organic, physical, inorganic and biochemistry questions. A scenario format is used in which a chemical situation is presented at the beginning of the exam question followed by questions that pertain to the scenario. The exam consists of 15 scenarios, each with 4 questions and many scenarios involve interpretation of presented data. The first version of the exam was released in 2008 and a new version is presently in development with an anticipated release of 2012. Results from use of the first exam will be presented as well as a more in-depth presentation of the scenario concept.

CHED 345
Assessing the laboratory: The ACS General Chemistry Laboratory Exam
Deborah Exton(1), dexton@uoregon.edu, 1253 University of Oregon , Eugene OR 97403, United States ; Jimmy Reeves(2), reeves@uncw.edu, 601 S. College Rd, Wilmington NC 28403, United States ; Tanya Reeves (2), reeves@uncw.edu, 601 S. College Rd, Wilmington NC 28403, United States

The General Chemistry Laboratory Assessment Committee was formed in 2008 in response to numerous requests for an exam that assesses laboratory skills and understanding. Designed for on-line delivery, the exam consists of six laboratory scenarios. It utilizes media and multiple question types to assess students' understanding of the procedures and equipment used in the general chemistry laboratory, experimental design and the ramifications of errors and mistakes. A separate series of laboratory practical exams has been developed to assess students' hands-on skills and ability to design experiments. This presentation will discuss the process of creating this exam, some examples of question types and videos, and the forms of the trial exam that are available for field testing.

CHED 346
Establishing equivalence of a laboratory practical assessment task
Thomas J. Greenbo(1), tgreenbo@iastate.edu, 1608 Gilman, Ames Iowa 50011-3111, United States ; Tanya Gupta(1); K. A. Burke(1); Megan L. Grunet(1); Thomas A. Holme(1). (1) Department of Chemistry, Iowa State University of
Science and Technology, Ames Iowa 50011-3111, United States

An ACS DIVCHED examination committee is developing a laboratory practical examination for general chemistry. There are web-based computer scenarios and "wet" laboratory tasks that are components of this examination. The committee wanted to know if student performance on the beta version of this new assessment instrument would be the same as student performance on a laboratory practical examination on the same topic. Establishing equivalence is important when developing a new examination to assess students' laboratory skills, experimental design, and chemistry content knowledge. Two institutions—one in the middle of the country and one in the far west of the country were beta test sites. Over 1,000 students participated. In one test, one week one half of the students were administered the computer scenarios, the other half fo the students were administered a Departmental wet laboratory practical task. In week two, the first group was administered the "wet" lab practical task, the second group was administered the computer scenarios. Results of this experiment will be presented and discussed.

CHED 347
Application of ACS exam residuals to the evaluation of instructional effectiveness

David Easter(1), de05@txstate.edu, 601 University Dr, San Marcos TX 78666, United States . (1) Department of Chemistry and Biochemistry, Texas State University, San Marcos TX 78666, United States

A pre-semester formative exam and survey were administered to students in 22 sections of Second Semester General Chemistry over a two year period, and an ACS Exam (GC06S) was administered as the common final exam. Formative exam results, survey responses, and university database information were modeled and were determined to account for more than 40% of variations between students' raw ACS exam scores. Modeling results were applied to develop an objective means for the assessment of effective teaching, based on final exam residuals (FERs). The FER represents the difference between a student's actual and projected (as calculated by the model) scores on the ACS exam. The use of FERs neutralizes (dis)advantages associated with disparities between the abilities of students enrolled in different sections of the course. One specific application of the study—relating section FER averages to student ratings of their instructors—will be explored.

CHED 348
Rasch analysis of the 2009 First-Term General Chemistry Exam: What does it tell us about our students and courses?

Jack Barbera(1), jack.barbera@unco.edu, Campus Box 98, Greeley CO 80639, United States . (1) Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States

The University of Northern Colorado administers ACS exams in all of its chemistry courses. This administration allows us to compare the performance of our students to other institutions. However, this normative data does not provide details about how well the exam works in evaluating our students' ability in chemistry. Rasch analysis of exam data provides details regarding student ability and item difficulty and also places them on the same measurement scale. This allows direct comparisons between students' ability and the difficulty of the items, which provides for an interpretation of student scores that goes beyond percent correct or national percentile. Results from the exam, given to several sections of first semester students (n~400), will be discussed. This pilot study will focus on student fit, item fit, instrument reliability, and the match between our students and the instrument itself. Subsequent studies will investigate properties such as differential item functioning.

CHED 349
Using an ACS Exam as part of a nomological network

Jennifer E. Lewis(1), jennifer@usf.edu, 12102 Wood Duck Pl, Tampa FL 33617, United States . (1) Department of Chemistry, University of South Florida, Tampa FL 33620, United States

While ACS examinations are often used for practice, for everything from serving as part of a student's final grade to providing information about the effectiveness of departmental curricula, they have a valuable role in chemistry education research as well. Although one traditional use of ACS exams by researchers has been as outcome variables for comparative studies, ACS exams are useful for researchers even in the absence of a quasi-experimental or experimental research design. Capitalizing on the value of ACS exams as a trusted measure of content knowledge can provide measurement insight in many research contexts. This talk will introduce the audience to the concept of a nomological network, present at least one example, and discuss the importance of building nomological networks for the advancement of chemistry education research.

CHED 350
Using student performance on a standardized formative assessment to inspire creative chemistry project development

Karen Knaus(1), karen.knaus@ucdenver.edu, 1200 Larimer St., Campus box 194, Denver CO 80217-3364, United States . (1) Department of chemistry, University of Colorado Denver, Denver CO 80217-3364, United States
Many people view standardized exams in a negative light, especially chemistry exams. In this project, the results of a standardized formative assessment (given at the beginning of a General Chemistry II course) were used in a creative way to further inspire the teaching and learning of general chemistry. After being provided with their average scores in eight different content areas on a formative assessment, students were asked to create an original chemistry teaching product. Project development and project outcomes will be shared in this interactive talk.

CHED 351

Using practice organic examination as an integral part of ACS materials to contribute to department assessment

Susan M Schelble(1), sschelbl@mscd.edu, PO Box 173362, CB 52, Denver CO 80217, United States; Kristen Murphy(3); Karen Knaus(3); Kelly Elkins(1). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217, United States (2) Department of Chemistry and Biochemistry, University of Wisconsin-Milwaukee, Milwaukee WI 53201, United States (3) Department of Chemistry, University of Colorado-Denver, Denver CO 80217, United States

The use of ACS examinations for department assessment will be described. In particular the use of the practice examinations to inform students and faculty about pedagogical needs will be examined.

CHED 352

Undergraduate chemistry education programs supported by NSF

Susan Hixson(1), shixson@nsf.gov, 4201 Wilson Blvd, Arlington VA 22230, United States; Eun-Woo Chang(1); Bert E Holmes(1). (1) Division of Undergraduate Education, National Science Foundation, Arlington VA 22230, United States

The Division of Undergraduate Education (DUE) at the National Science Foundation has a comprehensive approach to strengthening and enhancing the undergraduate education in science, technology, engineering and mathematics (STEM). The progression of DUE’s programs illustrating this commitment to enhancing undergraduate chemistry education has culminated in the recent transformation of CCLI into TUES (Transforming Undergraduate Education in STEM). Following a brief historical overview of this progression, the TUES Program will be discussed. Finally, other DUE programs of interest to the chemistry community will be briefly reviewed. A question/answer session with NSF Program Officers concerning additional aspects of DUE programs will follow the presentation.

CHED 353

Assessment results for guided inquiry GC-MS laboratories in first year courses for majors and non-majors

Jack K. Steehler(1), jsteeehler@roanoke.edu, 221 College Lane, Salem VA 24153-3794, United States; Benjamin P. Huddle(1); Heather N. Anthony(1); Caroline A. Hunter(1). (1) Department of Chemistry, Roanoke College, Salem VA 24153, United States

Roanoke College has introduced guided inquiry GC-MS experiments in General Chemistry and two non-majors courses. Experiments range from traditional concepts such as intermolecular forces (a GC-MS inquiry experiment exploring many variables controlling extraction) to real life experiments based on crime scene or environmental scenarios. Examples include an arson investigation, a fuel spill study, and traditional reaction characterizations. Assessment has included surveys of student attitudes toward laboratory, student assessments of learning gains, assessment of content learning, and measurement of experimental design skills. Both unchanged traditional experiments and new guided inquiry experiments were studied. This report includes example experiments and two full years of assessment data, including a baseline comparison year. The effects of guided inquiry experiments on learning, attitudes and student perceptions will be reported. The authors gratefully acknowledge the financial support of the NSF (DUE-0737279) for support of this project.

CHED 354

Teaching gas chromatography-mass spectrometry in undergraduate laboratory courses using process oriented guided inquiry learning (POGIL)

Massimo D Bezoar(1), bezoarim@nsula.edu, Caspari Street, Morrison Hall, Room 143, Natchitoches LA 71497, United States; Margaret E Cochran(1); Jacqueline Mason(2); April French(3). (1) Department of LA Scholars’ College, Northwestern State University, Natchitoches LA 71497, United States (2) Department of Teaching and Learning, Northwestern State University, Natchitoches LA 71497, United States (3) Department of Mathematics and Physical Sciences, Northwestern State University, Natchitoches LA 71497, United States

This collaborative project is in its final stages. New and adapted experiments in gas chromatography-mass spectrometry (GCMS) have been implemented in General Chemistry I and II, Organic Chemistry I and II, Quantitative Analysis, Advanced Instrumental Analysis, and Ecology laboratory courses. These experiments have provided students with: a) an expanded basis of knowledge of modern analytical techniques; b) skills in using state-of-the-art instrumentation; c) opportunities in applying their knowledge to new situations; and d) abilities in evaluating experimental results. A five-day workshop has been conducted for 20 students from the two community colleges which are the collaborative institutions on the project. A second workshop is planned for May, 2011. Assessment results to date have been very positive. Cognitive
assessments using pre-lab and post-lab tests, as well as attitudinal assessments have established gains in all the laboratory courses and throughout the curriculum. Additional positive outcomes include student research activities (national ACS meeting, research presentations at local/regional NSU Research Day, and thesis research), faculty development (GCMS and POGIL training), and submission of a paper for publication.

The authors gratefully acknowledge the financial support of the NSF (DUE 0736653) for support of this project.

CHED 355

A project-based laboratory using LC-MS that introduces students to drug discovery
Timothy J. Peelen(1), peelen@lvc.edu, 101 N. College Ave., Annville PA 17003, United States; Justin M. Kontra(1); Brandon W. Parks(1). (1) Department of Chemistry, Lebanon Valley College, Annville PA 17003, United States

A multiple week project for the undergraduate organic laboratory has been developed that introduces students to the drug discovery process and the critical role played therein by liquid chromatography-mass spectrometry (LC-MS). The project combines parallel synthesis of a library of molecules with the power of LC-MS to quantitatively analyze samples from complex, biological matrices. In the project, students adapt the synthesis of lidocaine to prepare a library of analogs. Students use the LC-MS to develop detection methods tailored to the analysis of their lidocaine derivative and prepare a standard curve that allows them to quantify the concentration of their derivative relative to an internal standard. Finally, students determine metabolic rates by incubating their lidocaine derivative with rat liver microsomes and collecting and analyzing samples at various time points. The authors gratefully acknowledge the financial support of the NSF (DUE-0737390) for support of this project.

CHED 356

Developing the research experience in the freshman chemistry laboratories
Graeme R. A. Wyllie(1), wyllie@cord.edu, 901 8th St. S., Moorhead MN 56562, United States; Mark Jensen(1). (1) Department of Chemistry, Concordia College, Moorhead MN 56562, United States

For many students, the General Chemistry laboratory is their first college-level laboratory experience. Traditionally this experience involves a 'cookbook' approach where students simply follow line-by-line instructions to complete an experiment, with few opportunities for critical thinking, and gaining little in the way of conceptual understanding. To address this issue, we have significantly developed the second semester General Chemistry laboratory experience at Concordia College by introducing a multi-week research component in which students carry out each step in the scientific method. The course also introduces a range of analytical instrumentation that students may choose to use in these projects. This new laboratory pedagogy gives all students in the class a real research experience at the end of their first year of college-level chemistry, and student feedback has been extremely positive.

The authors gratefully acknowledge the financial support of the NSF (DUE-0837192) for support of this project.

CHED 357

Exploration of theme-focused approach for delivering the undergraduate analytical chemistry laboratory curriculum
Olujide T. Akinbo(1), oakinbo@butler.edu, 4600 Sunset Avenue, Indianapolis IN 46208, United States; Michael J Samide(1). (1) Department of Chemistry, Butler University, Indianapolis IN 46208, United States

Considerations about how analytical chemistry should be taught have been an ongoing topic of discussion for over a century. Previous discussions primarily focused on what topics to include and the prerequisite courses needed by students to be successful in the analytical program. More recently, national workshops were led by Theodore Kuwana on the topic. Several workers have used various learning approaches in the classroom. Our project is focused on the pedagogy of implementing the laboratory curriculum by using theme-focused courses. An evaluation of student’s perception of the preliminary implementation reveals that large gains occurred in higher cognitive taxonomies like application and analysis (44 and 32%). These gains indicate that the higher order goals designed for this class are being achieved. Affective gains are also seen, but these gains appear to be smaller. The authors gratefully acknowledge the financial support of the NSF (DUE-0736292) for support of this project.

CHED 358

Contexts for inquiry-based chemistry instruction: Adaptation of a constructivist curriculum to different classroom environments and student goals
Emily J Bordae(1), bordae@wwu.edu, 516 High St MS 9150, Bellingham WA 98225, United States. (1) Department of chemistry, Western Washington University, Bellingham, WA Washington 98225, United States

The development and implementation of an inquiry-based chemistry curriculum for undergraduate non-science majors will be described. This goals of this curriculum are: a) To help students build sophisticated mental models of the particulate nature of matter and chemical change; and b) To help students adopt informed views of the nature of science. The curriculum was adapted for use in two types of classroom contexts: 1) A small, fluid lab/discussion course geared toward preservice teachers, and 2) A more traditional large course in which labs
meet separately from “lecture.” Both forms of this curriculum have now undergone two major revisions and have been implemented over fifteen times at a medium-sized four-year university and two regional two-year colleges. Assessment and student perception data will be presented for selected courses that represent varied classroom environments and student interests. Implications for inquiry-based chemical education in different contexts will be discussed.

CHED 359
Introducing guided inquiry to the general chemistry laboratory sequence using green themed modules – implementation and first year assessment.

Will E. Lynch\(^{1}\), will.lynch@armstrong.edu, 11935 Abercorn Street, Savannah Georgia 31419, United States; Delana Nivens\(^{1}\), delana.nivens@armstrong.edu, 11935 Abercorn Street, Savannah Georgia 31419, United States; Todd Hizer\(^{1}\); Catherine MacGowan\(^{1}\); Joshua Smith\(^{1}\); Clifford Padgett\(^{1}\); Lea Padgett\(^{1}\); Yvonne Roach\(^{1}\), (1) Department of Chemistry and Physics, Armstrong Atlantic State University, Savannah Georgia 31419, United States

This presentation will focus on our first academic year implementation of guided inquiry and green chemistry experiments into the general chemistry laboratory. These experiments are 3-4 week guided inquiry modules centered around a green or environmental these. The goal of the project is to spur student interest in and student commitment to understanding chemistry while introducing students to the concepts and challenges of green chemistry, including the 12 Principles of Green Chemistry. The involved faculty and staff have developed a series of guided inquiry modules based on the process oriented guided inquiry (POGIL) pedagogy. The reason general chemistry is a critical curriculum implementation point for POGIL is that the general chemistry sequence impacts the greatest number of students. Further, these students come from across all the disciplines of science, ultimately creating a community of scientific learners. Traditionally, we have presented general chemistry laboratories in “cookbook” type activities that enable high throughput of students but limit the amount of discovery, student engagement and inquiry fundamental to the development of critical thinking skills. These multi-week guided inquiry modules are implemented in groups to promote collaboration among the students as well as foster a sense of scientific curiosity. The green topics explored in the modules include soil analysis, water pollution, green synthesis, biodiesel, acid rain, air pollution, and fuel cells. Our two-semester inquiry experience culminates in an environmentally related green chemistry research experience, thus fully modeling the development of scientific processes. The overarching goals of this transformative project include improving student experience and success in general chemistry, recruiting and retaining of majors into chemistry and into undergraduate research and equipping students with greater critical thinking skills. Inquiry labs, preliminary results, implementation challenges, student outcomes and assessment will be presented.

CHED 360
Meeting the challenges of large scale educational reform: SENCER and the problem of "Knowledge Inequality"

Wm. David Burns\(^{1}\), david.burns@sencer.net, 326 Market Street, Harrisburg PA 17101, United States . (1) Harrisburg University of Science and Technology, National Center for Science and Civic Engagement, Harrisburg PA 17101, United States

Much has been made of the growing gaps in income inequality and their implication for our democracy. These slopes, though steep, pale in comparison to “knowledge inequality.” The consequences to democracy are equally significant. NSF’s SENCER program focuses on helping students and teachers make connections between basic disciplinary learning and the biggest questions of our day. Having begun in courses for “non-STEM” majors, SENCER now embraces foundational disciplinary courses for majors and large scale curricular reforms. The presentation will focus on how the SENCER approach can be applied in broad scale curricular reform programs to reduce knowledge inequality through intensive study on topics of relevance and a focus on the development of epistemic practices of inquiry, discernment, representation and application.

CHED 361
Chemistry is my passion, outreach is my duty; My civic responsibility

Ruth A Woodall\(^{1}\), ruth.woodall@tnchamber.org, 611 Commerce ST. Suite 3030, Nashville TN 37203, United States . (1) Tennessee Scholars, Tennessee Chamber of Commerce & Industry, Nashville TN 37203, United States

American Chemical Society members are encouraged to become civic minded and carry the message of “Chemistry for Life” to the public. There are many ways to deliver this message. Using video, discussion, hands-on activities, and group interactions this session will explore ways to help you become more confident and dynamic in delivering the ACS message. This is a “must attend” session if you want to do public outreach to your community.

CHED 362
Applying the innovation diffusion model to SENCERizing the curriculum: Has SENCER crossed the chasm?

Amy Shachter\(^{1}\), ashachter@scu.edu, 500 El Camino Real, Santa Clara CA 95053, United States . (1) Department of
Chemistry and Biochemistry, Santa Clara University, Santa Clara CA 95053, United States

For over ten years, faculty, staff and students have worked to develop a SENCER courses across the country. In some cases, the SENCER approach has moved beyond individual courses and has been applied to the development of general education programs and to courses within science majors. The innovation diffusion model will be the framework used to explore how the undergraduate curriculum can be more broadly SENCERized. Building on the foundation of innovators and early adopters that brought a campus to “the chasm”, the presentation will discuss strategies for moving SENCER across the chasm into majority or mainstream curricula.

CHED 363

Incorporating an environmental research project across three STEM courses: a collaboration between ecology, organic chemistry, and instrumental analysis

Douglas E Latch(1), latchd@seattleu.edu, 901 12th Ave, Bannan 516, Seattle WA 98122, United States; Peter J Alaimo(1); W Lindsay Whitlow(1). (1) Seattle University, United States

Three faculty members at Seattle University collaborate on a research project studying pyrethroid pesticide concentrations, water quality, and invertebrate biology across a Superfund site, the Duwamish River in Seattle, WA. We designed and implemented aspects of this joint research project into three lab courses, wherein approximately 100 students contribute annually. Goals included (i) incorporating a contemporary socially-relevant problem into our curricula, (ii) achieving well-established course learning objectives, (iii) demonstrating how studying the complex chemical and ecological dynamics of emerging contaminants in aquatic ecosystems requires collaboration, and (iv) increasing our scholarly research output. We will present our design, course materials, process, output, and lessons learned.

CHED 364

Ten-year cumulative impact of incorporating civic engagement into a large-format, introductory chemistry course

Garon C. Smith(1), garon.smith@umontana.edu, 32 Campus Drive, Missoula Montana 59812-1006, United States. (1) Department of Chemistry and Biochemistry, University of Montana, Missoula Montana 59812-1006, United States

For nearly a decade, the SENCER ideals have been applied to the first semester of a year-long, introductory chemistry course for applied science majors at The University of Montana. This GOB (general, organic, biochemistry) offering annually serves 1000 students in forestry, wildlife biology, allied health care fields, health and human performance, and environmental studies. Local environmental and health issues are the source of most of the course’s sample problems. Related civic engagement and community service opportunities are offered to the students via an extra credit mechanism within the overall grading rubric. Cumulative statistics will be presented that summarize the results of 18 offerings of this course. These include tens of thousands of hours of community activities plus recruitment of students to science majors and civic leadership positions. One student was elected to the Montana state legislature, five have been student body president or vice-president, and many others were student senators.

CHED 365

Representing large scale SENCER projects to support educational reforms

Eliza Jane Reilly(1), eliza.reilly@fandm.edu, The Phillips Museum of Art, Lancaster PA, United States. (1) Center for Liberal Arts and Society, Franklin and Marshall College, Lancaster PA, United States

NSF’s SENCER program focuses on helping students and teachers make connections between basic disciplinary learning and the biggest questions of our day. Having begun in courses for “non-STEM” majors, SENCER now embraces foundational disciplinary courses for majors, linked courses, learning communities, capstone efforts, and larger-scale curricular reforms. One challenge we face is how to expand the opportunities we provide for faculty and student collaborators to share (and represent) their work in ways that make retrieval simple and facilitate adaptation for local conditions. A corollary challenge is how to represent larger scale reforms, be they departmental, college-wide, or multi-institutional in nature. This session will enable participants to review and critique strategies for larger scale representation, including case studies, publications, designated collections or “thematically” organized publications, and cyber-based programs.

CHED 366

Communicating your science in common language: Creating effective dual posters

Cynthia Maguire(1), cmaguire@twu.edu, PO Box 425859, Denton TX 76205, United States; LeAnne Shepard(1). (1) Chemistry and Physics, Texas Woman’s University, Denton TX 76205, United States

Many scientists do important work that could have a profound impact, but then have trouble communicating their ideas to the general public. Part of the challenge is that each discipline has jargon that is often not understood. By reducing jargon and describing highly complex scientific studies in a manner most people can understand, multiple disciplines will be better able to address problems together and better equipped to share the significance of their work with others. For this study a workbook was created with a step-by-step process for translating an existing scientific poster into a dual poster...
version. Students with an existing scientific poster were then recruited and then created a dual version of their technical poster. Finished posters were then shown to non-science majors in two SENCER science courses. Their understanding of and response to each version was measured; results for each pair of posters were compared.

**CHED 367**

**UNC Asheville's Integrative Liberal Studies Program: Using SENCER to influence major curriculum change**

**Keith E Krumpe**<sup>(1)</sup>, kkrumpe@unca.edu, 218 Phillips Hall, CPO# 1411, One University Heights, Asheville NC 28804, United States; **Edward J Katz**<sup>(1)</sup>, ekatz@unca.edu, 153 Phillips Hall, CPO# 1410, One University Heights, Asheville NC 28804, United States. (1) Office of Academic Affairs, UNC Asheville, Asheville NC 28804, United States

This presentation examines the curricular review and reform process at UNC Asheville and how the SENCER project and its ideals influenced the creation of UNC Asheville’s Integrative Liberal Studies (ILS) curriculum. While SENCER can be seen within the introductory and capstone colloquia, the ILS Topical Clusters are the component of the program that is most closely connected with SENCER. These collections of courses integrate natural science, social science, humanities and the arts, within the liberal arts curriculum. Stepping away from traditional approaches to general education, cluster faculty construct course-level curricula around complex, unresolved public issues, addressing them from disciplinary perspectives while strengthening cross-disciplinary connections. Faculty engage in collaborative curriculum development, often enriching the classroom experience with a variety of co-curricular opportunities. Clusters leverage the strengths of learning community pedagogies, while providing a cost-effective means for curricular development and delivery.

**CHED 368**

**Pedagogy of assessment: Assessment of pedagogy (Taking the sting out of assessment)**

**Stephen Carroll**<sup>(1)</sup>, scarroll@scu.edu, 500 El Camino Real, Santa Clara CA 95053, United States. (1) English Department, Santa Clara University, Santa Clara CA 95053, United States

This talk will focus on how to build assessment of student learning into course-design and pedagogy, so that it becomes an integral part of the course rather than an added burden. We’ll begin by transforming course goals into measurable objectives. Then we’ll use those objectives to generate a pedagogy—specific activities and strategies for accomplishing those objectives. Finally, we’ll use the pedagogy to generate evidence that we are meeting our objectives—and course goals. When the assessment teams come, you will have the evidence they’ll ask for. No fuss, no extra work, and you’ll be the envy of your colleagues.

**CHED 369**

**Council of Forensic Science Educators: Strengthening forensic science through education**

**Kelly M. Elkins**<sup>(1)</sup>, kelkins1@mscd.edu, CB 52, PO Box 173362, Denver CO 80217, United States. (1) Chemistry Department, Metropolitan State College of Denver, Denver CO 80217, United States

The Council of Forensic Science Educators (COFSE), formed over two decades ago, is an association of faculty teaching forensic science courses in undergraduate and graduate programs. COFSE is working to strengthen forensic science education by developing and improving research methods, methodologies, research programs, and continuing professional development for professionals in response to the 2009 National Academy of Sciences (NAS) National Research Council (NRC) report entitled, “Strengthening Forensic Sciences in the United States: A Path Forward”. While COFSE has worked primarily with the American Academy of Forensic Sciences (AAFS), Forensic Education Programs Accreditation Committee (FEPAC) and faculty of FEPAC-accredited forensic science programs in the past, COFSE is addressing regional and national forensic science and chemistry organizations with the intent of developing and implementing synergistic educational programs at the high school, undergraduate and graduate levels with relevant education and research projects.

**CHED 370**

**Visual representations and mental models: How should we assess student understanding**

**Jerry P Suits**<sup>(1)</sup>, jerry.suits@unco.edu, 501 20th St, UNC Campus Box 98, Greeley CO 80639, United States. (1) Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States

Animations and simulations have long been used in chemistry education (~1980 to Present). Obviously, a multiple-choice test is not the right way to assess what students have learned from these visualizations. At UNC we have tried to get students to express their mental models, which includes both visual and verbal representations. Mental models are constructed from a coherent set of mental representations and the operations conducted upon them. Some students can draw a scientifically correct sketch but cannot explain the sketch. Conversely, if they truly understand the sketch, they should be able to give a molecular explanation. Examples will be shown that illustrate naive conceptions, misconceptions, and so-called expert conceptions.
The use of animations as a tool to elicit mental models of undergraduate students enrolled in a GOB course.

Jacqueline L. Hilsenbeck-Fajardo(1), jacqueline.fajardo@unco.edu, Ross Hall 3570, 501 20th Street, Box 98, Greeley CO 80639, United States ; Richard M. Hyslop(1); Jerry P. Suits(1). (1) Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States

Mental models (MMs) are small-scale psychological representations that are influential in students' explanations of visual perception. Though they may reflect the depth of knowledge held by the learner, they are internalizations that are often highly abstract and not readily accessible to the researcher. The purpose of this study was to use an online animation to elicit MMs from 120 undergraduates enrolled in a one-semester general, organic, and biochemistry course. Participants viewed an animation depicting heat-induced protein denaturation, and then described their understanding of the process at three levels of transfer: near, intermediate, and deep. Results revealed that misconceptions tended to increase as the transfer model shifted from the context presented in the animation to the underlying particulate level. A fundamentally novel and unique measure of knowledge transfer was developed as a main result of this study. This new measure of learning, deep transfer, is widely applicable to science education research.

Aligning visually-based technologies to pedagogy

Roberto Gregorius(1), gregorir@canisius.edu, 2001 Main Street, Buffalo NY 14208, United States . (1) Department of Adolescence Education, Canisius College, Buffalo NY 14208, United States

An argument is made that the effort to enhance student learning by supplying visually-based technologies (VBT’s), primarily animations and simulations, will be more successful if some thought is first given to the learning objectives for a particular lesson or unit and then aligning the choice of VBT to that goal. Further, the alignment of VBT’s to learning objective will be more effective if those goals are stated in the context of a particular learning theory. For this discussion, learning theory is split into three important conceptions: behaviorist, cognitivist, and situated learning. Examples of animations and simulations that are aligned to a particular learning theory will be provided, and typical classroom use of VBT’s and how these activities may be scaffolded to align with learning theories will be discussed.

Fostering representation competence with molecular-level simulations and animations

Mike Stieff(1), mstieff@uic.edu, 845 W. Taylor Street (M/C 111), Chicago IL, United States . (1) Department of Chemistry, University of Illinois-Chicago, Chicago IL 60607, United States

Simulations and animations provide many opportunities to support student learning in the chemistry classroom. The present work will examine pedagogical models and curriculum designs that support the development of representational competence in chemistry. Specifically, I will demonstrate how simulations and animations, embedded in a guided-inquiry curriculum framework (i.e., The Connected Chemistry Curriculum) yield significant improvements in students’ ability to construct molecular-level diagrams of chemical phenomena as well as coordinate multiple representations on project-developed assessments and the ACS General Chemistry Conceptual Exam. The present analysis includes data from a quasi-experimental design that compares the responses of students who completed a simulation-based curriculum with students who completed a lecture-based curriculum. Interview and observational data will also be presented that demonstrates that representational competence can be improved most effectively with pedagogical models that emphasize collaborative learning activities that foster argumentation about chemical representations.
scores was found between the simulation group and animation group.

CHED 375
Using 2-D and 3-D animations to teach simple oxidation-reduction reactions: Which is better?
Michael J. Sanger(1), misanger@mtsu.edu, MTSU Box 68, Murfreesboro TN 37132, United States; Deborah R. Rosenthal(2), (1) Department of Chemistry, Middle Tennessee State University, Murfreesboro TN 37132, United States

In this interview study, students were asked to describe the chemical processes occurring when aqueous silver nitrate reacts with solid copper metal after viewing the chemical demonstration. Then, half of the students were shown a 2-D animation of this reaction while the other half were shown a 3-D animation of the same reaction, and both groups were asked to revise their descriptions of this process. This presentation will focus on students’ explanations of a few key concepts and how they changed as a result of viewing the 2-D or 3-D animation after the demonstration. This comparison will allow us to determine the effect of the two animations on students’ conceptions.

CHED 376
Insights from using PhET’s design principles for chemistry simulations
Kelly Lancaster(1), kelly.lancaster@colorado.edu, 390 UCB, Boulder CO, United States; Emily Moore(1); Robert Parson(1); Kathy Perkins(1), (1) University of Colorado Boulder, United States

The PhET project (phet.colorado.edu) uses a research-based approach to develop interactive simulations and to study how they affect student learning. PhET simulations are designed to engage students in scientific exploration. In addition to the visual features of animations, interactive simulations enable students to determine cause-and-effect relationships and link multiple representations. Each PhET simulation is tested in student interviews to ensure that it supports student engagement and understanding of the scientific concept. This research has resulted in a set of design principles for creating effective simulations. In this talk, we describe challenges in using these principles for the design of PhET’s chemistry simulations and what those challenges imply about the nature of chemistry itself.

CHED 377
An experiment on the coulometric analysis in the undergraduate laboratory
Rajeev B Dabke(1), dabke_rajeev@colstate.edu, 4225 University Avenue, Columbus GA 31907, United States; Zewdu Gebeyehul(1); Ryan Thor(1), (1) Department of Chemistry, Columbus State University, Columbus GA 31907, United States

An undergraduate experiment on the coulometric analysis of four commercial household products is presented. A special type of coulometry cell made of polydimethylsiloxane (PDMS) polymer is presented. The PDMS cell consisted of an internal salt bridge network and multiple analyte compartments. Experimental procedure for the analysis of the acid in a toilet bowl cleaner, base in household clear ammonia, Fe2+ in iron supplement tablets, and iodine in Povidone iodine is presented in this paper. The household samples were titrated against coulometrically generated reagents and the end point was detected by visual color change of an indicator. The experimental results obtained by coulometric titration were in good agreement with the results obtained by the volumetric titration, and with the data on the manufacturer’s label. The experiments highlight the real world significance of Faraday’s laws of electrolysis and the mole ratios.

CHED 378
Adapting a miniature inexpensive UV-visible diode array spectrophotometer for monitoring chromatography separations in teaching laboratories
Roger K. Gilpin(1), roger.gilpin@wright.edu, 3640 Colonel Glenn Hwy, Dayton Ohio 45435-0001, United States; Christina S. Gilpin(2), (1) Department of Chemistry, Wright State University, Dayton Ohio 45435, United States (2) Department of Educational Services, Select-O-Sep, LLC, Freeport Ohio 43973, United States

Diode array detectors are used often in carrying out modern high performance liquid chromatography experiments, especially when “on-the-fly” UV and/or UV-visible spectra are needed. Unfortunately most of these detectors are dedicated to a particular/single instrument, not highly portable, and expensive (i.e., $25K to $40K). Thus, they are not suited for general use in the lower level teaching laboratory (e.g., the organic laboratory for monitoring flash chromatography separations). Likewise, since their optics are optimized (i.e., sub-10µl cell volumes) for low volumetric high resolution separations, they are not compatible with preparative scale separations (e.g., flash chromatography). In the current talk an “off-the-self” inexpensive (i.e., <$4K) miniature UV-visible diode array spectrophotometer with 1 nm resolution and scan/spectral acquisition times down to 1 millisecond has been modified via “plug-and-go” optical cell to be used as an on-line preparative scale monitor for the teaching laboratory.

CHED 379
REU site as a research incubator
Karen L Buchmueller(1), karen.buchmueller@furman.edu, 3300 Poinsett Hwy, Greenville SC 29613, United States;
The Chemistry Department at Furman University, has developed an NSF-REU program that promotes the development of both students and faculty. The program accepts student-faculty teams from PUIs that are in the process of developing research programs. Visiting teams can work on their own projects or develop collaborations with Furman faculty. Inclusion of a faculty member from the same institution encourages the visiting student to continue research during the academic year. Faculty may participate over multiple summers and individual students are welcome to return if additional funds are obtained. Thus, it is not uncommon for visiting teams to include 2-3 students, promoting the development of an independent research program. Through a variety of activities the visiting teams become an integral part of Furman's summer program that comprises an average of 50 undergraduates every summer. The various components of this REU program will be discussed.

CHED 380

Chemist's guide to Pompeii and Herculaneum

Eleonora Del Federico(1), edelfede@pratt.edu, 200 Willoughby Ave, Brooklyn New York 11205, United States ; Cindie Kehlet(1); Barbara Charton(1). (1) Department of Mathematics and Science, Pratt Institute, Brooklyn NY 11205, United States

The Ancient roman cities of Pompeii and Herculaneum were frozen in time by the eruption of Mount Vesuvius on August 24, 79 AD. Preserved underground for nearly two thousand years, they provide today a wealth of information about ancient technology and how this technology affected the life of the ancient Roman people. Touring Pompeii and Herculaneum, one comes across ancient pigment and glass factories as well as dyeing houses, oil and perfume shops and reconstructed dye gardens. Unfinished wall paintings and pigment containers found in houses whose walls were being painted at the time of the volcanic eruption provide further raw material from which we learn about the artist's materials and artists' technology in antiquity. Furthermore, the exposure of wall paintings to extreme heat, volcanic ash and gases provide a unique opportunity to stimulate students' imagination. Thus, with chemical knowledge they might see how these paintings may have looked in ancient times. Here we touch on the present state of acute decay of the cities and the role of chemistry can play in the conservation efforts currently in place. The aim is to preserve buildings and artifacts for future generations. We will show how the cities can serve as a theme for a Chemistry course that can be taught at an introductory level exposing students to the connections of chemistry to history, archeology and historic preservation. The material can be presented at higher level or as a follow up course. The latter would focus on the chemistry of degradation processes and conservation treatments on archeological sites. This includes the non-destructive analytical techniques (XRF, FTIR, UV/Vis, XRD, NMR) that are used today “on site” to better understand these degradation processes and to develop more efficient conservation treatments.

These materials can also serve as a Chemical tourist's guide for those visiting the cities.

CHED 381

Development and analysis of concept inventory items: Challenges and insights

David Wren(1), dawren@gmail.com, 3480 Ross Hall, Campus Box 98, Greeley CO 80639, United States ; Jack Barbera(1). (1) Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley CO 80639, United States

Alternate conception research and concept inventory development have become ubiquitous in science education research. The identification and use of student alternate conceptions as distractors for multiple choice concept inventory items can provide invaluable instructional and evaluative information to instructors and researchers. The use of alternate conceptions can also provide unique challenges to both item development and item validation. Development of items from the outcome space (alternate conception-based distractors) to the question stem can be inherently counterintuitive. One caveat is the universality of both published and identified alternate conceptions. The use of student interviews (to evaluate item and distractor clarity, meaning, and quality) will be discussed, along with the iterative process of item development. A focus on what criteria was used for item analysis and how this information was used to reach final item forms will be presented.

CHED 382

Teaching strategies/techniques for peer leaders in a supplemental instruction program designed to enhance community college student comprehension & understanding of chemical concepts

Connie Gabel(1), cgabel@mscd.edu, Campus Box 52 PO Box 173362, Denver CO, United States ; Rosemarie D Walker(1). (1) Department of Chemistry, Metropolitan State College of Denver, Denver CO 80217-3362, United States

Peer Leaders from Metropolitan State College of Denver working in the STEPS (Strides Toward Encouraging Professions in Science) Supplemental Instruction (SI) Program on the Auraria Campus were taught to use various teaching techniques and strategies to assist the Community College of Denver students in their SI sessions. They were taught the techniques of neural scaffolding, group dynamics, and Bloom's Taxonomy. Neural scaffolding was used to prevent information...
overload and bridge gaps in student learning, group dynamics helped improve collaborative learning, and understanding Bloom’s Taxonomy helped the Peer Leaders to find appropriate challenge levels for the community college students. They were also instructed in the techniques of wait time, checking for understanding and redirecting questions. Peer Leaders were trained in teaching strategies such as student problem solving at the board, oral quizzing, and practice written tests. These strategies help improve comprehension and understanding of chemical concepts.

CHED 383
Development and implementation of a nanotechnology minor with an emphasis on chemical synthesis and analysis skills

Kurt Winkelmann(1), kwinkel@fit.edu, 150 West University Blvd, Melbourne FL 32901, United States; James Brenner(2); Joel Olson(1). (1) Department of Chemistry, Florida Institute of Technology, Melbourne FL 32901, United States (2) Department of Chemical Engineering, Florida Institute of Technology, Melbourne FL 32901, United States

A nanotechnology minor program with a strong emphasis on laboratory skills is described. Students complete ten of the 17 credit hours in the laboratory. Courses begin in the freshman year with a unique introductory nanotechnology lab, which prepares students for more advanced courses, such as a self-paced instrumentation course and a capstone research experience related to chemical nanotechnology. Although there is a strong emphasis on chemical lab skills, this program reflects the interdisciplinary nature of nanotechnology. Faculty from chemistry, chemical engineering, physics and biology departments have contributed to teaching and/or developing portions of the curriculum. Data related to student perceptions of the course and their demographics will be discussed, as well as notable aspects of the classes and specific experiments.

CHED 384
Hands-On Laboratory Without Chemicals or Glassware

Christina S Gilpin(1), crgilpin@selectosep.com, P O Box 158, 111 West Main Street, Freeport OH 43973, United States; Roger K Gilpin(2). (1) Select-O-Sep, LLC, Freeport OH 43973, United States; (2) Wright State University, Dayton OH 45354, United States

Most science educators agree the traditional “hands-on” laboratory, is an important part of science education. Unfortunately, budgetary and safety concerns are making it more difficult to provide this type of training at the high school level. Today’s presentation will discuss the development and initial testing of interactive computer-based software, the Electronic Chemistry Laboratory Workbook (ECLW) that can be used with or without tactile controls to emulate hands-on laboratory work to meet the educational challenges of replacing/supplementing it and still satisfy pedagogical needs. Initial testing of the ECLW was carried out in a large university Freshman chemistry class and at several high schools in Ohio. In all studies, the Test Group Students scored at least a half to a full letter grade higher than the Control Group Students. Subsequently, copies of the ECLW have been given to over 100 teachers for additional feedback.

CHED 385
Distance learning chemistry with an at home lab component: What works. What doesn’t.

Kathleen Carrigan(1), kcarriga@pcc.edu, 705 N Killingsworth Ave, PO Box 19000, Portland Oregon 97280-0990, United States; Kenneth Friedrich(2). (1) Math and Science, Portland Community College, Portland Oregon 97217, United States

Teaching chemistry fully online, including a “hands-on” laboratory component, is a reality and the results are impressive. Kathy Carrigan, Portland Community College (Portland, OR) Chemistry Instructor, and Kenneth Friedrich, PhD., Chemistry Department Chair present perspective, best practices, communication methods, student interaction and feedback, as well as learning results from teaching chemistry online with an at home “wet lab” experience from LabPaqs. We have been successfully offering completely distance learning chemistry courses since 2007. Carrigan and Friedrich present specific innovative and science-specific online methodologies, interactive multimedia formats, and student lab experiences. Why reinvent the wheel? Learn what did not work for our students and take what has worked well and help us to make it even better.

CHED 386
Inverted instruction: Redistributing homework and lecture time as a model for student-centered teaching in large lecture courses

Gabriela C. Weaver(1), gweaver@purdue.edu, 560 Oval Dr., West Lafayette IN 47907-2084, United States; Michael Hands(2). (1) Department of Chemistry, Purdue University, West Lafayette IN 47907-2084, United States

This paper describes an alternative format for chemistry lecture courses. The credit hour “effort” is redistributed such that this format would be able to be used in large lecture courses. In the inverted format, students view lectures and demonstrations online three times per week and take online quizzes for each online lecture via the Blackboard course management system. The professor meets in person with students once every other week during which students collaborate to solve selected problems and engage in group discussion facilitated by the professor. Each group of students has access to educational technology including a laptop and SmartBoard that allow them to share their work with the rest of the class. When not in class, students can access online
course tools including Mixable and Course Signals to engage in discussions about the course and receive feedback about their progress in the course.

CHED 387

Reinforcing organic chemistry learning through facilitated problem-solving discussions

Sarah B Wilson(1), sw67@iupui.edu, 402 N Blackford St. LD326, Indianapolis IN 46202, United States; Robert E Minto(3); Ryan Denton(3); Pratibha Varma-Nelson(1). (1) Department of Chemistry & Chemical Biology, Indiana University Purdue University Indianapolis, Indianapolis IN 46202, United States

The Department of Chemistry and Chemical Biology at Indiana University Purdue University Indianapolis (IUPUI), an emerging life sciences campus with an enrollment of over 30,000 students, serves approximately 500 students per calendar year in the first semester organic chemistry lecture. Mandatory peer-facilitated problem-solving discussion sections were added to the course to enhance student engagement, encourage the development of small-group learning communities, improve exam performance, and decrease the nearly 25% three-year average DFW rate. The problem-solving discussions’ formats were based on the principles of the Peer-Led Team Learning (PLTL) model, which has been demonstrated to be effective in STEM fields at several institutions throughout higher education. The effects of these discussion sections on standardized ACS and semester exams will be reported. Also, student perceptions from survey data and focus groups will be discussed. Finally, practical lessons learned and student leader comments from the first full year of implementation will be shared.

CHED 388

Improving student engagement and learning: Changing what is done in the chemistry lecture hall

David M. Majerich(1), david.majerich@temple.edu, College of Education, Philadelphia PA, United States; Judith C. Stull(1); Andria C. Smythe(1); Joseph S. Schmuckler(1); Susan Jansen Varnum(1). (1) Institute for Schools and Society, Temple University, Philadelphia PA 19122, United States

This research investigated the impact that increased engagement with the course material had on student learning. Taught by the same professor using a lecture-demonstration method, three different groups experienced the same 102 demonstrations. Each group was offered a demonstration worksheet strategy under one of three conditions: 1) out-of-class completion; 2) in-class, partial completion; and 3) in-class, full completion. Outcome measures were pre/post Chemistry Concept Inventory (CCI) and course attrition rates. Positive gain scores were shown for all groups on the CCI, with the highest gain score observed for students who completed the worksheet fully in-class. All groups suffered the loss of students. The greatest loss of students occurred for the “out-of-class” group. The attrition rate for this group was significantly different than for the other groups. The attrition rates for “in-class, partially” and “in-class, fully” groups were similar, with more learning that occurred compared to the “out-of-class completion” group.

CHED 389

Community engagement in a large enrollment laboratory course

Daphne Norton(1), dnorton@emory.edu, 1515 Dickey Drive, Atlanta GA 30322, United States. (1) Department of Chemistry, Emory University, Atlanta GA 30322, United States

Studies suggest real-world activities invigorate student interest in the sciences. Complex world problems such as climate change and energy consumption require a multi-disciplinary approach and effective communication to the public. Science students are often uncomfortable articulating problems through oral presentations and written proposals. A case study in general chemistry allows students to research alternative fuels and consider the impact they may have on the campus transportation system. Students must research alternative fuel sources and present group projects discussing natural gas, hydrogen and ethanol based fuels. Each team becomes the resident experts on a certain fuel source. Subsequently, students perform an experiment to synthesize biodiesel. The biodiesel product is purified and utilized in service vehicles on the Emory campus. In culmination, students are required to write a grant proposal making recommendations for a revised transportation system. This presentation will discuss the challenges and benefits of introducing group projects in a large enrollment introductory laboratory. This presentation will also present a service learning project related to sustainable chemistry.

CHED 390

Using analogies in introductory chemistry labs

Mitchell R. M. Bruce(1)(2), mbruce@maine.edu, 277 Aubert Hall, Orono ME 04469, United States; François G. Amar(1)(2); Carly M. Matthews(1); Tommy M. Wemys(2); Alice E. Bruce(1); Michael C. Wittmann(2). (1) Chemistry, University of Maine, Orono ME 04469, United States (2) RISE Center, University of Maine, Orono ME 04469, United States

Analogical reasoning is a fundamental mode by which new concepts can be constructed in the mind of the learner in terms of familiar, well-understood prior ideas. It is of particular importance in chemistry as the fundamental objects of chemical investigation are inaccessible to direct observation. Examples of analogies in textbooks, as classroom activities, and lab experiments have been reported including cautions and recommended guidelines for use. We seek now to
evaluate if a systematic strategy for the analogy in lab has a role in inquiry-based lab practices. Recent cognitive research offers specific recommendations as to how analogies may be effective in promoting learning and conceptual change. We present results of an investigation of the learning impacts on students who are exposed to a sequence of three labs with integrated analogical activities, using the Teaching-with-Analogies framework. The activities are presented within an Explore-Invent-Apply learning cycle and focus on conceptual learning rather than numerical answers.

**CHED 391**

**PhET interactive simulations for teaching and learning chemistry**

Emily B. Moore(1), emily.moore@colorado.edu, UCB 390, Physics Dept, Boulder CO 80309-0215, United States ; Kelly Lancaster(1); Trish Loeblein(1); Robert P. Parson(2); Katherine Perkins(1). (1) Department of Physics, University of Colorado, Boulder CO 80309-0215, United States (2) Department of Chemistry and Biochemistry, University of Colorado, Boulder CO 80309-0215, United States

The PhET project has developed over 100 interactive simulations for teaching and learning science with over 25 simulations covering chemistry topics. All simulations are available for free from our website (http://phet.colorado.edu). PhET’s efforts in chemistry include simulations on atomic structure, atomic energy levels, stoichiometry, gas properties, limiting reagents, solubility, reaction coordinates and acid-base solutions. These simulations provide interactive environments in which students learn through scientist-like exploration and experimentation. They emphasize the connections between real life phenomena and the underlying science, make the invisible visible (e.g. atoms, molecules, electrons, photons), and include the visual models that experts use to aid their thinking. Here, we introduce several PhET simulations and highlight how they may be used in large class environments to effectively enhance student learning and engagement.

**CHED 392**

**Embracing an iterative approach in the design of electronic learning tools**

Resa M Kelly(1), resa.kelly@sjsu.edu, One Washington Square, San Jose CA 95192, United States . (1) Chemistry, San Jose State University, San Jose CA 95192, United States

Developing electronic learning tools (ELTs) is often challenging. This talk will demonstrate how one research team developed ELTs using information from faculty and students. In addition, the nuances of how students used tools in a research setting versus how they authentically used the tools as a prelab exercise will be presented. Specifically, insights into how ELTs were developed iteratively will be shared.

**CHED 393**

**Assessment of teaching tools used in organic chemistry**

Steven A. Fleming(1), steve.fleming@temple.edu, 1901 N 13th Street, Philadelphia PA 19122, United States . (1) Chemistry, Temple University, Philadelphia PA 19122, United States

Pedagogy is the study of the art, science, or process of teaching. The term generally refers to strategies of instruction, or style of instruction. Teaching has always been impacted by technology. For example, the technology for 3D visualization has reached the point of being available for use in the standard classroom. This informational technology allows for a change in pedagogy. It does not necessarily require a change in pedagogy. Other technology that may impact pedagogy includes: email, video chat, voice email, Glogster, blogging, and wikis. One could argue that the information age is impacting the way students learn more than it impacts the way material is taught in the classroom. That is, many teachers are unable or unwilling to include the new technology in their teaching. The resistance to change may be justified. If all students are engaged and learning, then using new technology may not be necessary. If some students struggle with the material, then in order to reach all students, the teacher ought to alter his/her process of teaching. There are innumerable ways to change your pedagogy. One alternative is to use the 3D visualization technology that is available. One type of visualization technology is molecular animations. These teaching tools provide a mental image that textbooks and chalkboards are unable to produce. Students benefit from the enriched view that is provided by accurate molecular animations. Their perception of 3D issues improves. They can move beyondunderstanding what happens and grasp how it happens. We will discuss the desired learning outcomes and application of two visualization tools in and out of the classroom.

**CHED 394**

**Attracting the Ne(x)t generation: Pedagogical innovations with computer simulations**

Samia Khan(1), Samia.Khan@ubc.ca, 2125 Main Mall, Vancouver BC V6T 1Z4, Canada . (1) Department of Curriculum and Pedagogy, University of British Columbia, Vancouver BC V6T 1Z4, Canada

This presentation will report on the findings of 3-year study on a method of teaching chemistry with computer simulations. The method was developed by an expert chemistry teacher. It involves repeated cycles of GEM, or generate-evaluate-modify teaching maneuvers, across an undergraduate chemistry curriculum. Classroom observation, student tests, teacher interviews, and student problem-solving sessions reveal that this pedagogy was sustained with 32 teaching strategies and the full integration of computer simulations. Other findings include student gains in abilities to generate hypotheses and
evaluate them, and also conceptual gains in student understanding. The pedagogic roles of the teacher and the computer simulations will be discussed before concluding with new research on the future of computer simulation design for chemistry.

CHED 395
Interactive animations and simulations used in a tutorial for VSEPR
Prem D. Sattsangi(1), psds6@psu.edu, Fayette, The Ebely Campus, 1 University Drive, Uniontown PA 15401, United States . (1) Department of Chemistry, Pennsylvania State University, Fayette, The Ebely Campus, Uniontown PA 15401, United States

Animations and simulations have added new dimension to demonstrating concepts in a class room. They are especially useful in the delivery of online and web-based hybrid courses where face to face interaction with the instructor is limited or non-existent. Successful incorporation of molecular models, available in Chemical Education Digital Library, has made these tutorials much more informative. Use of these tutorials involving the understanding of a variety of molecular structures in relation to two to six electron domains around the central atom will be discussed. This learning module has been in use for several semesters with great success and has led students to a better understanding of this topic.

CHED 396
Teaching VSEPR theory in Second Life
Wendy L Keeney-Kennicutt(1), k-keeney@tamu.edu, PO Box 30012, College Station TX 77842-3012, United States ; Zahira H Merchant(2). (1) Department of Chemistry, Texas A&M University, College Station TX 77842, United States (2) Department of Educational Psychology, Texas A&M University, College Station TX 77842, United States

The virtual 3-D world of Second Life (SL) is a promising place to teach students about VSEPR theory, but no effectiveness studies exist. We will present preliminary results from our Spring 2011 quasi-experimental pre-posttest control group research design study in which spatial ability was hypothesized to mediate the relationship between SL and chemistry concept learning. Every semester I teach 2 large sections of general chemistry. The experimental class received VSEPR instruction in SL through 3 activities (The Molecule Game, Chemist as Artist and a VSEPR homework set) on TAMU’s 12th Man Island (http://snurl.com/qgh3c); the control class did the same assignments using 2-D screen shots from SL. The pre-post tests included a 36-question multiple-choice test applying VSEPR theory, the Purdue Visualization of Rotations Test, and the Card Rotations Test. Other post tests include a presence questionnaire, a VSEPR laboratory, and exam data. Assignment and result details will be shared.

CHED 397
Development and demonstration of chemical laboratory experiments in Second Life
Kurt Winkelmann(1), kwinkel@fit.edu, 150 West University Blvd, Melbourne FL 32901, United States ; Deborah Wong(2); Christopher Thomas(2); Marc Lafon(2). (1) Department of Chemistry, Florida Institute of Technology, Melbourne FL 32901, United States (2) Department of Computer Science, Florida Institute of Technology, Melbourne FL 32901, United States

A set of chemistry laboratory experiments are designed within the virtual world of Second Life. Experiments are appropriate for students enrolled in high school and general chemistry classes. Students use a mouse and keyboard to control the actions of their virtual representation (i.e. avatar). Students must select the appropriate actions for their avatars – choose the correct chemicals, select reaction conditions, follow the correct procedure and record their results. Outcomes of the experiments, including inaccurate results due to procedural mistakes, are determined by the student's actions. Some experiments are virtual replicas of traditional, real world experiments, such as qualitative analysis of ions. Other experiments are possible only in the virtual environment, such as designing the correct mixture of reactants which will properly inflate the airbags of a Mars Rover as it lands. In that case, students can watch as the Rover bounces safely or crashes onto the Martian surface. The presenter will demonstrate these experiments and discuss the challenges and advantages students using Second Life as a platform for learning chemical laboratory skills.

CHED 398
Involvement in K-12 programs and its impact in my undergraduate chemistry courses
Chetna Patel(1), cpatel@aurora.edu, 347 S. Gladstone ave., Aurora IL 60506, United States . (1) Department of Natural Science, Aurora University, Aurora IL 60506, United States

As a result of leading two summer workshops and teaching a graduate level course for K-12 teachers, I have implemented several changes to my chemistry courses at the undergraduate level. I have incorporated active learning, guided inquiry based labs, new technology to assess student learning as well as for classroom teaching. These changes have affected and can serve as a model to other science faculty. My involvement in K-12 programs has positively impacted my professional development and university service.

CHED 399
Obstacles that hinder the development and use of online courses at the K-12 levels
Christina S Gilpin(1), crgilpin@selectosep.com, P O Box 158, 111 West Main Street, Freeport OH 43973, United States ;
Using materials available at hardware stores. A CSI “wet” chemistry laboratory explored the principles of each station combined instruction with hands-on activity. Each station investigated the principles behind separation science and applied the lessons to a “crime scene” involving different brands of bottled water. A household and food chemistry activity discussed the role of MSDSSs, information contained on product labels, and the chemical changes associated with cooking onions. Finally, a role-playing activity examined a variety of chemistry-related career paths in the context of a hypothetical court case that might arise from an oil spill, including the presentation of scientific data in a courtroom by an expert witness. The use of field-compatible analytical instrumentation to augment the discussions will be presented.

CHED 401
Students with blindness and their understanding of secondary chemistry concepts
Amy L. Micklos Lewis(1), amicklos@purdue.edu, 520 Chestnut Drive, Oswego Illinois 60543, United States; George M. Bodner(1). (1) Department of Chemistry, Purdue University, West Lafayette Indiana 47907, United States

A critical theory framework was used to explore the secondary chemistry experiences of three students with blindness. The study focused on the students’ understanding of the structure of matter, chemical representations, problem-solving, and accessibility issues. The findings suggest that the students with blindness develop similar misconceptions as other students and encounter similar difficulties. Chemical representations were a larger hurdle than expected, especially when students tried to balance equations. Finally, this study offers classroom implications for any science educator with students who are blind or low vision. Science educators can become informed regarding the technology students already have available and provide simple modifications to laboratory work and direct instruction to allow greater inclusion of students with vision impairments. Modifying tables, directly indicating what material needs to be included in notes, and providing materials in electronic format before instruction affords students greater access.

CHED 402
Sense-able molecules: A discovery based activity to introduce organic structures in high school biology
Andro C Rios(1), acrios@ucsd.edu, 9500 Gilman Drive, La Jolla CA 92037, United States; Gerald French(2). (1) Department of Chemistry & Biochemistry, University of California San Diego, La Jolla CA 92037, United States; (2) Biological Sciences, Montgomery High School, San Diego CA 92154, United States

Biography is usually the first college-prep science course most students take in high school. Current biology standards emphasize concepts at the cellular and molecular level and consequently students are introduced to organic molecules. However, in our experience students view molecular structures...
as intimidating representations and even irrelevant to their learning of biology. To emphasize the relevance of molecular structures in biology, we have successfully developed and implemented a simple and engaging classroom activity to teach bond-line representations. Using fragrant molecules associated with common foods students become enticed to interrogate the structures of odors, discover functional group patterns, and learn the rules for unwritten carbon and hydrogen atoms. Highlighting the role organic molecules play in activating the sense of smell provides a chemistry-biology connection that stimulates students’ interests in organic chemistry while teaching them the structural language used by scientists.

CHED 403
Enhancing active learning: An inquiry-based laboratory in biomolecular chemistry at Michigan Technological University

Marty Thompson(1), thompson@mtu.edu, 1400 Townsend Drive, Houghton MI 49931, United States; Pushpa Murthy(1); Kedmon Hungwe(2). (1) Department of Chemistry, Michigan Technological University, Houghton MI 49931, United States (2) Department of Learning and Cognitive Sciences, Michigan Technological University, Houghton MI 49931, United States

We have developed a new senior-level, semester-long, inquiry-based course in biomolecular chemistry that focuses on developing higher order learning skills. During the design and development of the course, we focused on the following aspects: articulate clear learning outcomes; involve students in design, analysis, evaluation and defense; emphasize higher-order thinking skills; and emphasize deeper conceptual understanding and critical thinking. The laboratory emphasizes designing experiments, interpreting data, drawing and defending conclusions, critical analysis, and oral and written communication. A unique aspect of the laboratory experience is the 2-hour post-lab data presentation and discussion session where the students present and discuss their results and defend conclusions. Formative assessment results from last year were used to direct changes in the course this year. Course details as well as evaluation results for both years will be presented.

CHED 404
Posing questions about posing questions: Students’ perceptions of their POGIL experiences

Stephen G. Prilliman(1), sgprilliman@okcu.edu, 2501 N. Blackwelder, Oklahoma City OK 73106, United States . (1) Department of Chemistry, Oklahoma City University, Oklahoma City OK 73106, United States

Process Oriented Guided Inquiry Learning (POGIL) is a student-centered, constructivist and inquiry driven pedagogy in which students work in small groups on specially designed assignments with minimal assistance and coaching from an instructor. The POGIL pedagogy is based on prior research on how students learn, and has demonstrated superior student outcomes (e.g., course grades, standardized exam scores) compared to traditional teacher-centered learning. This work seeks to understand this positive impact of POGIL by looking at the experiences of individual learners. Interviews and surveys were conducted with students in a POGIL-taught General Chemistry course to understand what they experience during a POGIL activity, the ways in which that activity leads to learning, and the ways in which students realize that they have learned a new concept. Students’ responses and their implications for writing and facilitating POGIL activities will be discussed.

CHED 405
Video analysis of student discussion and relationships with key aspects of post-lab written work within an inquiry-based general chemistry laboratory course

Seth Anthony(1), seth.anthony@colostate.edu, 1872 Campus Delivery, Fort Collins CO 80523-1872, United States; Dawn Rickey(1). (1) Department of Chemistry, Colorado State University, Fort Collins CO 80523-1872, United States

Several aspects of students' written work produced within a general chemistry laboratory course employing the Model-Observe-Reflect-Explain (MORE) Thinking Frame have been linked with students' ability to successfully transfer their understanding of the underlying chemistry content into new contexts; these include constructing molecular-level models consistent with experimental evidence and accurately reflecting on changes to those molecular-level models. Students’ discussions and interactions during the laboratory period – such as consideration of molecular-level behavior or reflection on confirmation or refutation of prior ideas – may contribute to or influence these important facets of their post-lab models. In this study, we will present analysis of video from laboratory sessions, describing relationships and parallels between these in-lab discussions and interactions and the content of students' post-lab written work, and characterizing factors which instigate such episodes.