

Thursday, August 5 morning

Symposia sessions

Start	End	Room	Title
9:10	10:30	U-409	Calibrated Peer Review: New Developments and Uses
7:30	10:10	WH-113	Curricular Revisions to Improve Student Learning
8:10	9:50	U-413	Food and Cooking in the Chemistry Curriculum
7:50	10:30	U-415	Micropublishing
7:30	10:30	WH-118	Monitoring, Assessing, and Improving Students' Oral Presentation and Scientific Writing Skills within Chemistry Courses and throughout Science Programs
7:30	10:30	U-411	Research in Chemistry Education
7:30	10:30	WH-119	Research in Effectiveness of Active Learning Pedagogies
7:30	10:30	U-418	Survivor Skills for 1st to 5th year Chemistry Teachers
7:50	10:30	U-417	Using History in Teaching Chemistry
7:50	10:30	WH-121	Web Based Applications for Chemical Education

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Symposia sessions

7:30 AM - 10:30 AM U-409

S60: Calibrated Peer Review: New Developments and Uses

Arlene Russell (UCLA, USA)

The symposium addresses research on teaching and learning using CPR and strategies for institutionalizing the program on a campus.

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|-------|-----------------|---|
| 9:10 | Marie Parkes | P726: Introducing Calibrated Peer Review in a large general chemistry laboratory course |
| 9:30 | T. Keith Hollis | P727: Resuscitating learning through writing: Hooking faculty, administrators and students on CPR |
| 9:50 | Tim Champion | P728: An evaluation of a world-wide-web-based writing tool (Calibrated Peer Review™) for improving student writing of long laboratory reports: Suggestions for improved use |
| 10:10 | Arlene Russell | P729: Calibrated Peer Review (version 5) - adding visuals to technical writing |

P726: Introducing Calibrated Peer Review in a large general chemistry laboratory course

Marie Parkes (University of New Mexico, USA), **K. Joseph Ho** (University of New Mexico, USA)

Calibrated Peer Review (CPR) was recently introduced in a large (more than 500 students) general chemistry laboratory course at a public state university. Two different types of CPR assignments were completed: essays focusing on critical experimental concepts and post-lab reports written after completing a laboratory experiment. In the first semester, the class was randomly divided into two groups for each assignment: one group performed a traditional task (taking a quiz about critical experimental concepts or writing a post-lab report and submitting it to a teaching assistant to be graded) while the other group completed an analogous assignment through the CPR program. The first group served as a control group against which learning outcomes were evaluated. In subsequent semesters, CPR assignments will be integrated into the course as the standard method by which post-lab reports are completed and evaluated. We will present results from the first semester control-group-standardized experiments as well as logistical considerations and hurdles overcome in the implementation of Calibrated Peer Review assignments in a large general chemistry laboratory course.

P727: Resuscitating learning through writing: Hooking faculty, administrators & students on CPR

T. Keith Hollis (The University of Mississippi, USA)

One of the major stumbling blocks for the adoption of innovative technologies to improve instruction is faculty/administrator/student resistance (lack of buy-in). Practices and means of fostering campus-wide adoption of technologies with a focus on Calibrated Peer Review will be

discussed. The presentation will focus on the author's experiences when introducing CPR® to a university campus that had never heard of Calibrated Peer Review®. With five years experience using CPR® in Organic Chemistry courses, the author joined the faculty of The University of Mississippi, Department of Chemistry and Biochemistry in the summer of 2006. Many disciplines on campus are now becoming users of CPR, and the Center for Writing and Rhetoric has adopted CPR® for training composition instructors, as well as, student instruction. Key attitudes to broadcast, identifying campus co-conspirators, managing administrator's and student's expectations, communicating key features of CPR®, and identifying funding sources will be discussed.

P728: An evaluation of a world-wide-web-based writing tool (Calibrated Peer Review™) for improving student writing of long laboratory reports: Suggestions for improved use
Tim Champion (Johnson C. Smith University, USA)

This three-year study examines the results of using Calibrated Peer Review™ (CPR) instead of instructor-graded drafts for college general chemistry laboratory long reports. The CPR treatment was only used for the second of four long reports for each year, and the principal dependent variable is actual improvement from the first report to the third report. Results indicate the effect of CPR is comparable to instructor review and that participation in the assignment can be increased if more CPR assignments are included. Instructors are also encouraged to use the CPR system as an exercise leading up to a final draft of an assignment that is then graded by instructor review. Support of MBRS RISE (NIH) R25 GM 58042, The Bush-Hewlett Technology Mini-Grant Program at JCSU, and the Mellon Scholarship of Teaching and Learning Mini-Grant Program at JCSU are gratefully acknowledged.

P729: Calibrated Peer Review (version 5) - adding visuals to technical writing
Arlene Russell (UCLA, USA)

Calibrated Peer Review (TM) (CPR) is an internet-based instructional tool which enables instructors to promote student (1) understanding through writing, (writing-to-learn), (2) critical thinking skills through the process of evaluation and reviewing, as well as (3) higher-order writing skills (learning-to-write). The CPR program provides a template and a process to manage the submission and evaluation of writing assignments in any size class. The overwhelming adoption by faculty across the country since the program's first use at UCLA in 1997 underscores the recognition of the power of writing as an instructional tool in higher education. Currently, the CPR-user base includes 1300 institutions involving faculty in all of the STEM disciplines. Collectively they have prepared over 2500 CPR writing assignments for their students. Chemistry, the discipline where CPR started, continues to dominate, even though student's have not been able to include traditional visual materials such as graphs, molecular structures, equations, or spectra in their written CPR work. The new Version 5 removes that handicap. This talk will discuss a pilot study with CPR5 that investigated the impact on (1) the focus, organization and argumentation of student written texts when visual material is included and (2) the effect on inter-rater reliability of peer review ratings when visuals are included with a text.

7:30 AM - 10:30 AM WH-113

S61: Curricular Revisions to Improve Student Learning

Matthew Miller (South Dakota State University, USA), *Tyson Miller* (University of

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Connecticut, USA)

This symposium will focus on curricular-level revisions in chemistry that improve student learning and professional success.

7:30	introduction
Susan	
7:35 Deratzou, Ph.D.	P730: Chemistry II: From proposal to reality
7:55 Bryan May	P731: Students as individuals: How community colleges excel in student learning
8:15 Paul Martino	P732: NSF catalyzes curricular change at our community college: NMR award drives innovation and implementation of guided inquiry labs
8:35 Paul Szalay	P733: Vertical integration of scientific instrumentation in an undergraduate chemistry curriculum
8:55	break
9:10 Jeffrey Pribyl	P734: Beginnings of the redesign of pre-service chemistry teaching program to address issues related to preparedness
9:30 Ryan Sweeder	P735: BRAIDing the science curriculum
9:50 Matthew Miller	P736: Redesigning the general/organic sequence to create a path toward undergraduate research

P730: Chemistry II: From proposal to reality

Susan Deratzou, Ph.D. (Radnor High School, USA)

High School students have an opportunity to take a first year chemistry course and to take Advanced Placement Chemistry, but what about the student who may have an interest in chemistry, but does not know if science is a career goal and/or does not want the intensity of an Advanced Placement course? I developed a Chemistry II course that fills the need for this student. This year two sections of advanced chemistry students at my high school have an opportunity to take this class. This paper will discuss the course from the conception and proposal, to the planning of the course (where textbooks were not part of the budget), to the actual teaching of the course, and to the present where you will hear what has worked, what has changed, and what will be used the following school year. Students had an opportunity to learn various chemistry topics in more depth and breadth, to do more advanced laboratory work, to participate in a monthly colloquium, and to prepare and present chemical demonstrations to elementary students, among many other activities.

P731: Students as individuals: How community colleges excel in student learning

Bryan May (Central Carolina Technical College, USA)

Community Colleges succeed in facilitating student learning by tailoring instruction to best reach each and every student. Instructors are able to consistently gauge student learning and in particular identify and address any deficiencies in student learning. This consistent personalized attention is the primary key to student success. Community college courses can tailor assignments to the interests and programs of study of each student. The laboratory provides more opportunities for community college courses to provide meaningful learning experiences. Small

sections allow laboratory sections to utilize equipment and solve problems not typically available in general chemistry courses. Interdisciplinary projects can play a large role building a strong program of study. Community colleges can and should excel by building courses that consistently focus on student learning.

P732: NSF catalyzes curricular change at our community college: NMR award drives innovation and implementation of guided inquiry labs

Paul Martino (Flathead Valley Community College, USA)

An NSF award enabled the purchase of an upgrade for an existing 60-MHz continuous wave NMR to a state-of-the-art FT-instrument with multi-nuclear capabilities for use throughout the 2-year chemistry curriculum at Flathead Valley Community College. The improvement in NMR capabilities allowed the incorporation of more inquiry-based laboratories with the acquisition of NMR data and the elucidation of chemical structures. The NMR instrument is used in both the science major's course sequence track and in the non-science major's track. The main goals of the project are: 1. Improve student learning and experiences. 2. Reform department laboratory curriculum to include guided inquiry experiments. 3. Increase department faculty professional development. Successes and challenges regarding these goals will be discussed. The project is beginning its third and final year. Assessment tools include attitude surveys, the ACS First Term Organic Chemistry with Spectroscopy Exam, and use of an external project evaluator. Significant findings include favorable attitude survey results regarding an innovative cooperative learning exercise involving local high school students. Second-term college organic students served as peer-leaders to facilitate NMR and IR-based cooperative learning exercises with small-sized groups of high school organic chemistry students. As part of these exercises, groups ran samples, processed data, and discussed interpretation of data. Peers survey results indicated that students felt the understanding of NMR significantly improved by having to “teach” the material to high school students. Peers survey results indicated that many students, as a result of the exercise, now will seriously consider careers in science education.

P733: Vertical integration of scientific instrumentation in an undergraduate chemistry curriculum

Paul Szalay (Muskingum College, USA), *Deepa Perera* (Muskingum College, USA), *Eric Schurter* (Muskingum University, USA), *Lois Zook-Gerdau* (Muskingum College, USA)

Repeated exposure to instrumental methods within the context of a variety of courses allows students to progress from experiments where instruments are used primarily to reinforce core concepts of the first year chemistry lecture or to introduce students to the basic operation, theory and application of the equipment to more advanced guided-inquiry projects that require higher level skills. For this reason our department has made a concerted effort to integrate Gas Chromatography Mass Spectrometry (GC-MS) via a multilevel approach within the four-year curriculum. The achievement of these goals are being pursued by: 1) increasing opportunities for experimentation involving guided-inquiry at all levels of the curriculum, including in the first year 2) enhancing interdisciplinary training in a broad spectrum of sub-disciplines, including environmental science and forensic science 3) providing students with opportunities for method development in experimentation involving GC-MS, and 4) furthering the integration of research into the chemistry education curriculum. The progress towards meeting these goals will be described along with the assessment methods being used to evaluate our efforts thus far

P734: Beginnings of the redesign of pre-service chemistry teaching program to address issues related to preparedness

Jeffrey Pribyl (Minnesota State University – Mankato, USA), Ginger Zierdt (Minnesota State University – Mankato, USA)

To address issues related to how well chemistry teaching majors are prepared for their first teaching jobs, we are undertaking a total redesign of our pre-service teaching program. This work in progress moves from a model of some clinical experiences during the sophomore, junior and senior years ending with a 16 week student teaching experience to an intensive, coordinated model of progressive clinical experiences, year long “student teaching” experiences incorporating co-teaching methodology as well as chemistry content taught on-site/on-line during the last year. This new model relies on collaboration between faculty members in the College of Education and those in the Department of Chemistry and Geology to overcome barriers of time and resources to allow pre-service teachers the time to spend an entire year in the high school classroom while still completing upper-level courses. This new program will also incorporate mentoring and induction experiences for the new teachers to help them during the first years of teaching.

P735: BRAIDing the science curriculum

Ryan Sweeder (Michigan State University, USA)

Lyman Briggs College at Michigan State has been working on developing connections between the introductory science courses over the past 4 years. The successes, failures and lessons learned from three different models within this residential college will be discussed. We will present our approach to making connections between lecture classes, laboratory classes and our current model for creating interdisciplinary connection: a one-hour seminar involving faculty from multiple disciplines. We will provide reasons why multiple faculty are necessary to help the students break out of a mono-disciplinary mindset.

P736: Redesigning the general/organic sequence to create a path toward undergraduate research

Matthew Miller (South Dakota State University, USA), David Cartrette (South Dakota State University, USA)

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. 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. Our approach differs from previous blended approaches; it is designed for students interested in chemistry as a vocational path, not to eliminate a semester of general chemistry, and to enhance an esprit de corps in the initial years on campus. We have devised a curriculum beginning with a qualitative foundation and progressing toward a rigorous quantitative capstone which will serve to facilitate student understanding of advanced coursework. We have also created a laboratory component to support the new sequence. The laboratory component places emphasis on hands-on training with standard research instrumentation, moving from verification/skills toward a guided inquiry approach over four semesters of instruction. The main purpose is to create a community of scientists-in-training that will afford its members a broad sense of the nature of science and the research enterprise. It is our vision that the progressively more inquiry-based pedagogical approach will serve as a springboard for students to become

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involved in undergraduate research earlier in their academic training. This new sequence is in the first year of implementation and data regarding the impact of this sequence is being collected to examine student perceptions and conceptual understanding as a result of the sequence.

7:30 AM - 10:30 AM U-413

S55: Food and Cooking in the Chemistry Curriculum – Part 2 of 2

Sunil Malapati (Clarke College, USA), *Raymond Shively* (Baldwin-Wallace College, USA)

The symposium is designed to share ideas, topics, innovations and approaches to the teaching of the chemistry of food and cooking. The topic is growing in popularity in courses for non-chemistry majors. Presentations are welcomed in areas that serve non-majors, majors, and undergraduate research.

8:10	introduction
8:15	Doctor DeMento (Dr. Jerry DeMenna)
8:35	Angelia Gibson
8:55	break
9:10	Terry Bunde
9:30	Keith Symcox

P737: Nutritional labeling lies

Doctor DeMento (Dr. Jerry DeMenna) (CCNY, USA)

QUESTION: You are a manufacturer of a cream-filled chocolate wafer cookie... commonly known as Oreos (Nabisco), Hydrox (Keebler), Zer-Ohs! (Voortman), Double-Os! (Meijer) and a host of other names. By law, you must perform a nutritional analysis of the “complete” cookie product and verify its content on the nutritional label, but practically speaking, how do you sample part of a production batch of over 5 million non-homogeneous items (i.e.: cookies) and expect to get anything that is statistically significant? ANSWER: You can’t... and the plethora of government guidelines and regulations allows you to legally “lie” about the values put on a food’s nutritional label. We’ll actually evaluate the tremendous variability of labeled nutritional content for a variety of food products using FT-IR, UV-Vis & fluorescence spectroscopy, liquid and gas chromatography, and elemental analysis then demonstrate analytically unacceptable precision that these government guidelines allow. “Free” on the label does not always mean the food is “free” of that component, and “light” and “low” are relative terms. Learn from the “lies” and eat better, maybe live healthier, too!

P738: The fruit salad lab: A model for experimental design in a biochemistry course

Angelia Gibson (Maryville College, USA)

Because it is abundant and rather easily extracted from many plants and fungi, tyrosinase has long been used as model for teaching Michaelis-Menten kinetics in the undergraduate biochemistry laboratory. Students can appreciate the clinical and commercial relevance of the

enzyme, because of its roles in pigment production and the browning of fruits and vegetables. In a 3-week laboratory project at Maryville College, students extract tyrosinase for kinetic analysis from plants or fungi. This project builds upon the traditional labs for extracting and assaying tyrosinase, by giving students time and inspiration for experimental design. During the “Fruit Salad Lab” in week 1, the students are presented with sliced fruit exposed to variables that affect tyrosinase-mediated browning such as pH, oxygen, water, temperature and time. With no prior introduction to tyrosinase, students are asked to compare their fruit samples within their groups, record their observations about the fruit, generate hypotheses to explain their observations, and propose experiments to test their hypotheses. When the students share their ideas with the class, and as a more comprehensive set of observations and interpretations emerges, the students refine their hypotheses. Following a lecture with some background material on tyrosinase enzymes, each group is charged with designing and executing an experiment based on observations made in the “Fruit Salad Lab”. During the following 2 weeks, the lab groups extract and assay tyrosinase from a biological source of their choice in the presence and absence of an exogenous “effector”. Examples of student-generated hypotheses and data will be presented. Guidelines for assignment and assessment will be discussed along with ideas for improving the lab.

P739: Hexane extraction of volatile organics from beer foam: Component analysis by gas chromatography and gas chromatography-mass spectrometry

Terry Bunde (Maryville College, USA)

As part of a senior thesis research project in biochemistry on the analysis of volatile organics in the headspace above a food sample, we investigated an alternate method for extracting the foam in beer samples with hexane. Approximately 40 ml of a beer sample is shaken in a 125 ml separatory funnel and the residual liquid quickly drained from the foam. Hexane (20 mL) is added to collapse the foam into a small amount of residual liquid which is drained. The hexane is removed, centrifuged at low speed in a table top centrifuge to remove remaining liquid and the hexane dried over sodium sulfate (anhydrous) to remove water. The hexane is rotary evaporated to dryness and the sample is resuspended in 500 microliters of hexane for GC and GC-MS (HP 5890 II+ and HP 5972 with ChemStation software). The same beer sample (20 mL) is placed in a 40 mL screw-capped septum vial and shaken and left to come to room temperature. A headspace sample of 200-300 uL is removed and injected into the GC or GC-MS to compare the volatile profile. The resulting peaks appear in smaller amounts but the volatiles profile is almost identical to the hexane extract of the foam; very few of the volatile compounds are lost by extracting the foam. The results for many different beers compare favorably with results reported previously in the literature. This approach can be adapted for many liquid beverage samples and avoids the expense of using SPME, commercial helium purge headspace or purge and trap systems.

P740: The chemistry of cooking: Using food to tie together the undergraduate chemistry curriculum

Keith Symcox (University of Tulsa, USA)

Traditional undergraduate chemistry curricula tend to foster the mindset that the subdisciplines of chemistry are somehow distinct from one another. We have designed a capstone course for the senior undergraduates called the Chemistry of Cooking that shows the students how to apply their undergraduate knowledge of organic, physical and biochemistry to a real system in a way that is both tasty and interesting. The students learn the chemical basis for many kitchen techniques developed empirically over the centuries, and how to apply their knowledge of the

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scientific process to the art and science of the culinary arts.

7:30 AM - 10:30 AM U-415

S62: Micropublishing

Roy Jensen (Grant MacEwan University, Canada)

A new paradigm in publishing. Faculty members and departments are abandoning traditional publishers and moving to developing their own instructional material, from laboratory manuals to course packs to textbooks. This symposium explores the mechanics of getting started and getting published and also showcases the products of these micropublishing initiatives.

Presenters are encouraged to share their experiences, strategies, wisdom, and successes.

7:30		introduction
7:35	Antony Williams	P741: ChemSpider SyntheticPages as a micropublishing environment for organic chemists
7:55	Chad Wallace	P742: Self-publishing a supplemental organic chemistry workbook and other chemistry lab manuals at a small university
8:15	Stephanie Myers	P743: An open access web publishing
8:35	Daniel Tofan	P744: General chemistry workbook: A self-published resource for introductory chemistry
8:55		break
9:10	Jackie Stewart	P742: Development, implementation, and evaluation of a Chemistry Integrated Resource Package (ChIRP) for first year chemistry at UBC
9:30	Mark Bishop	P746: Self-publishing: Even a caveman could do it
9:50	Roy Jensen	P747: Exploring chemistry: A micropublishing success
10:10		discussion

P741: ChemSpider SyntheticPages as a micropublishing environment for organic chemists **Antony Williams** (ChemZoo, USA)

ChemSpider SyntheticPages is an online database of chemical synthesis procedures provided to the community with the intention of providing access to high quality chemical reactions that can be repeated, updated, and annotated by the community. The SyntheticPages platform is a public deposition system where the community can publish their chemical syntheses and, specifically, is a way by which students can easily publish their data and build up a public record of peer-reviewed micropublications in a public forum. At a time when the internet is becoming one of the primary communication vehicles for science, whether via blogs, wikis or hosted services for presentations and videos, there has been little effort to provide simple to use deposition and peer-review systems for micropublications. ChemSpider SyntheticPages addresses this need for the synthetic chemistry community.

P742: Self-publishing a supplemental organic chemistry workbook and other chemistry lab manuals at a small university

Chad Wallace (Anderson University, USA)

At Anderson University, we have started self-publishing a supplemental organic chemistry

workbook. It has been helpful in teaching organic chemistry students the most important concepts needed to be successful in the class. Reinforcing the most critical and crucial concepts has improved our success rate. Additionally, the self-publishing of lab manuals in most of our chemistry and physics courses has given us more control over the labs. The very pleasant added benefit of generating a small profit has aided the funding of undergraduate research. The process of receiving permission for this endeavor, the trials and successes of printing the materials, and the views and opinions from our students and faculty will be presented.

P743: Anecdotes in open-access web publishing

Stephanie Myers (Augusta State University, USA)

Chemistry professors at Augusta State University publish a wide variety class materials on their open-access web pages. The department website hosts experiments for the general chemistry and non-majors chemistry courses and a variety of information available at the usual department information. This talk will discuss the different types of material published by ASU faculty and relate some of interactions that have occurred because of their universal availability.

P744: General chemistry workbook: A self-published resource for introductory chemistry

Daniel Tofan (Eastern Kentucky University, USA)

I created a workbook for Introductory and General Chemistry, which provides first year students at a comprehensive university with a set of worked examples and practice worksheets. The workbook covers essentially the typical material covered in an introductory course. Lulu.com was chosen for self publishing this book. Setting up the book and its options is straightforward using Lulu's design tools. Distribution has been local so far, but I am considering more widespread dissemination after receiving very positive feedback from students.

P745: Development, implementation, and evaluation of a Chemistry Integrated Resource Package (ChIRP) for first year chemistry at UBC

Jackie Stewart (University of British Columbia, Canada), *Derek Gates* (University of British Columbia, Canada), *Michael Wolf* (University of British Columbia, Canada)

The Chemistry 121: Integrated Resource Package, affectionately known as the ChIRP, is a custom workbook designed to cover the essential general chemistry content in the University of British Columbia's introductory chemistry curriculum. Chemistry 121 is a one term course taken by approximately 2000 first year science and non-science students each year. This workbook, introduced in 2009, presents a streamlined approach to teaching and learning chemistry. This approach allows students to focus their attention on the key concepts they are required to master in an introductory chemistry course. All students were required to purchase a ChIRP and no other textbooks were used in the course. Students brought the ChIRP to class with them, since it is lightweight and portable. There is ample space in the workbook for students to take notes and to complete exercises with the instructor during the lectures. The instructor version contains notes to help instructors integrate use of the ChIRP into lectures. I will describe the development of the ChIRP from securing funding to publication and share our experiences using it in nine sections taught by eight instructors. I will describe the outcomes of our evaluation, which were very encouraging. We believe that students demonstrated better mastery of the material and student feedback was generally positive. In addition, I will discuss our plans for the second edition.

P746: Self-publishing: Even a caveman could do it

Mark Bishop (Monterey Peninsula College, USA)

Many chemistry textbooks, lab manuals, and workbooks are started, but for a variety of reasons, only a fraction of them are actually published. Only a fraction of those that are published sell well enough to be actively promoted by the publishers. Therefore, I assume that there are many authors who might be interested in self-publishing their work. Not only does self-publishing provide a way for authors to distribute their work, but because it can provide low-cost books, it also provides a service to students. In my presentation, I will describe my self-published introductory chemistry text and its tools, and I will explain why they provide a high-quality textbook and tools at a student cost of \$0 to \$79.95. I will also describe the tools necessary for creating a similar project of your own. You can get more information about my project at http://preparatorychemistry.com/Bishop_info.htm.

P747: Exploring chemistry: A micropublishing success

Roy Jensen (Grant MacEwan University, Canada)

Exploring Chemistry is a general chemistry textbook that has evolved from the desire to correct misconceptions, acknowledge limitations by level, link all of chemistry together, and keep the door open to future learning. This presentation explores the evolution of Exploring Chemistry: the successes, the hurdles, the resources, the costs, and a licensing model that is sure to infuriate traditional publishers.

7:30 AM - 10:30 AM WH-118

S63: Monitoring, Assessing, and Improving Students' Oral Presentation and Scientific Writing Skills within Chemistry Courses and throughout Science Programs

Joe Shane (Shippensburg University, USA)

This symposium will focus on methods for improving students' oral presentation and/or scientific writing skills within specific chemistry courses and across multiple years such as a middle- or high-school science sequence and chemistry programs at two- and four-year colleges and universities. In addition to specific activities and assessment criteria, descriptions of how science and other faculty (e.g. from English departments) collaborate in order to improve students' communication skills should be included.

7:30		introduction
7:35	Elizabeth Innicki-Stone	P748: Teaching writing to chemistry graduate students: What they learned, what we learned
7:55	Sarah St. Angelo	P749: Writing in the intermediate and advanced chemistry laboratory
8:15	Jason Powell	P750: A customized rubric for assessing multiple outcomes in written and oral presentations in the chemistry program
8:35	Marin Robinson	P751: Read, analyze, and write: Improving the writing skills of upper-division chemistry majors
8:55		break
9:10	Melissa VanAlstine	P752: Critical thinking assignment: Equipping students to write and reflect

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9:30 Stephanie Myers P753: Varying lab reports: Using both oral and written formats
10:00 discussion

Withdrawn

P748: Teaching writing to chemistry graduate students: What they learned, what we learned

Elizabeth Ilnicki-Stone (Brock University, Canada)

Brock University's Ph.D. Chemistry candidates must successfully complete a scientific communication course which covers scientific writing, persuasive writing, and oral presentation skills as part of their studies. Participation is also encouraged for M.Sc. Chemistry and Biotechnology students. The goal is to ensure that Ph.D. Chemistry graduates have the necessary scientific communication skills required to be successful in their careers. This course was developed by the Student Development Centre's Learning Skills Services in close collaboration with a committee of Chemistry Faculty. Each workshop was designed to be extremely interactive to facilitate discussion and provide opportunities for students to write, critique, and edit work. This course has evolved greatly based on student evaluations, supervisor suggestions, and instructor experiences. This talk will discuss the topics covered, the differences between what topics graduate students most value and those that supervisors believe they need, and overall best practices.

P749: Writing in the intermediate and advanced chemistry laboratory

Sarah St. Angelo (Dickinson College, USA)

Strategies for teaching writing to students in intermediate and advanced laboratory settings will be presented. Students in a 200-level physical chemistry course are tasked with writing their first thorough lab reports with rigorous calculations. They are given strategies to approach their lab reports, discussion of calculations, and for including chemical literature into their reports. In an advanced level, a 300-level inorganic course, students are introduced to writing lab reports as if they are for submission to a mock ACS journal. Structured peer review is used to replicate a journal-style review process for student manuscripts. This reporting style at the advanced level provided students with an authentic professional writing experience.

P750: A customized rubric for assessing multiple outcomes in written and oral presentations in the chemistry program

Jason Powell (Ferrum College, USA)

Ferrum College has a strong program for assessing student learning across the curriculum: from general education "Liberal Arts Core" related courses through program-based capstone courses. One of the greatest strengths of this program is the complete integration of program-based learning and general education learning throughout the curriculum. This presentation will outline the process by which campus-wide student learning outcomes and program-based student learning outcomes were integrated together into a single rubric designed to assess multiple outcomes in a single writing or oral presentation assignment in a particular course. This

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embedded assessment model provides valuable information for the department and the college without causing the course instructor to bear any additional burden related to the assessment of student writing and oral presentation skills.

P751: Read, analyze, and write: Improving the writing skills of upper-division chemistry majors

Marin Robinson (Northern Arizona University, USA)

We have adapted the “read, analyze, and write” approach to writing, as described in the textbook *Write Like a Chemist*. In a junior-level writing course (CHM 300W), students are asked to read selected excerpts from peer-reviewed journals, analyze those excerpts for science and writing, and then write on their own, in a series of progressive writing assignments, using the excerpts as writing models. Materials used in this course and methods used to assess student writing will be shared.

P752: Critical Thinking Assignment: Equipping Students to Write and Reflect

Melissa VanAlstine (Adelphi University, USA), Michael Matto (Adelphi University, USA), David W. Parkin (Adelphi University, USA)

We created the Critical Thinking Assignment (CTA) to improve our chemistry majors’ skills in information literacy, scientific writing, reflection, and presentation. The CTA provides an opportunity for the students to demonstrate, in the form of a paper and presentation, their ability to relate organic or biochemistry concepts to a scientific paper of their choice. The CTA was created in conjunction with Dr. Michael Matto, Director of the Writing Center. The CTA consists of weekly writing assignments that encourage the students to explore critically and reflect on journal articles that lead to a final paper. The weekly written assignments are intended to both deepen student’s understanding and allow them to produce, in a low-stakes assignment, what amount to dry-runs in writing the various parts of the final assignments. Some key assignments along the way include a letter to the corresponding author, letter to a friend, critical analysis of a colleague’s paper and a presentation at the end. The students, with guidance from the instructor, create a rubric for marking the CTA and presentation. Both Biochemistry II and Advanced Organic have used the CTA. A confidential six question open-ended feedback survey was given to the students upon completion of the CTA. Approximately 80% of the biochemistry students felt their critical thinking ability greatly improved and another 10% felt their critical thinking ability slightly improved. A common response was “I no longer just accepted what is in the paper; I actually look to see if the author has proof for her/his conclusions”

P753: Variety in lab reports: Using both oral and written formats

Stephanie Myers (Augusta State University, USA)

Experiments in many classes are often conducted with partners. However, a single written lab report from the group tends to be written by only one of the partners, and usually the same person every time. If each person submits a written lab report, then the two generally end up

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remarkably similar. Therefore, in Instrumental Analysis at Augusta State University, one person submits a written report and the other does an oral report. Specifics of how this works, typical assignments, advantages, disadvantages and pitfalls of this method will be discussed.

7:30 AM - 10:30 AM U-411

S64: Research in Chemistry Education – Assessment (II)

Ann Cutler (University of Indianapolis, USA), *Bill Robinson* (Purdue University, usa)

This symposium provides a forum for chemical education research. A submitted presentation should briefly address 1) the motivation for the research and type of problem investigated and 2) the methodology chosen to both gather and interpret the data collected. The presentation should focus primarily on the findings and the interpretation of the data. This symposium is sponsored by the ACS DivCHED Committee on Chemistry Education Research.

7:30		introduction
7:35	Moises Camacho	P754: Authentic/ alternative assessment in chemistry/ science education V: Effect of the auto quiz on the achievement of science college students
7:55	Moises Camacho	P755: Classification of organic compounds, reactions/mechanisms by science majors
8:15	Sachel Villafane	P756: Development of an eight-factor diagnostic instrument for biochemistry courses
8:35	Lisa Kendhammer	P757: Differential item functioning on multiple choice general chemistry assessments
8:55		break
9:10	Lijiang Hu	P758: The practice and effect of accomplishing different teaching levels and cultivating innovative talents for applied chemistry specialty undergraduates
9:30	Keily Heredia	P759: Using a two concept diagnostic exam for predicting students' achievement
9:50	Sonali Raje	P760: What do students really need to know to be successful in introductory chemistry
10:10	Uma Jayaraman	P761: Effects of a content-enriched and inquiry-based sustained professional development program on in-service chemistry teachers' classroom practices

P754: Authentic/alternative assessment in chemistry/science education V: The effect of the Auto Quiz on the achievement of science college students

Moises Camacho (University of Puerto Rico at Mayaguez Campus, Puerto Rico)

The autoquiz is an assessment technique in which the students read, understand, analyze, synthesize and evaluate the assigned topics (e.g. chapter). Then they prepared 15 questions of the most relevant content of the chapter. After they have learned the answers (and reasons for the best or most correct of them) they presented the autoquiz orally to the class. The professor evaluated both the quality of the questions, answers, reasons and examples provided by each

student according to the written instructions. The sample had consisted of about 50 students per semester during several semesters. The students, who prepared, presented and approved one autoquiz per chapter also approved the regular quiz and three exams of the professor with 80% to 100%. In addition, the autoquiz students also approved the course with 90 to 100%. This constructivist technique was invented and applied by the author and has been very effective in demonstrating the extent of understanding of a topic. There was a significant statistical difference between the mean scores of regular and autoquiz students. This study is relevant for chemical, science education and science in general since this constructivist technique promote the development of higher cognitive skills, it' is relevant for science and science education.

P755: Authentic/alternative assessment, V: Classification of Organic Compounds, Reactions/Mechanisms by Science Majors

Moises Camacho (University of Puerto Rico at Mayaguez Campus, Puerto Rico)

The purpose of this study was to investigate the ability to complete, identify and classify common organic reactions, the mechanisms by which they take place and the major organic reactants/products. A pilot study was made with majors/non-majors to observe their classification skills with a sample of 50 reactions which were taken from well known organic chemistry texts like Mc Murry Organic Chemistry. The instrument was administrated to about 60 chemistry majors and non-majors (Biology) who had approved from 16 to 40 chemistry semester hours. The results demonstrated that 98.0% of the subjects had forgotten almost 100% of the type of classes (e.g. compounds, reactions, mechanisms involved in the reactions). Only about 2% remembered very few concepts. The study was repeated for several semesters with the purpose of reproductibility. The results were very similar. There was no significant statistical difference between the mean scores of majors and non-majors. These findings have been observed in several classification studies (e.g. compounds, reactions, equations, problems) of the author and others. The implications for chemical education, science and mathematics in general are relevant since these findings reflected rote-memorization not genuine understanding, permanent learning, nor long term memory (LTM).

P756: Development of an eight-factor diagnostic instrument for biochemistry courses

Sachel Villafane (University of South Florida, USA), Jennifer Lewis (University of South Florida, USA), Jenny Loertscher (Seattle University, USA), Vicky Minderhout (Seattle University, USA)

Biochemistry is a challenging course, since students are expected to draw on prior knowledge of both chemistry and biology and apply it to new biological contexts. This talk will focus on the development of an instrument that includes five general chemistry concepts and three biology concepts. Since these basic concepts are considered pre-requisite knowledge for biochemistry learning, the use of the instrument at the beginning of a biochemistry course can provide information about relevant gaps in knowledge. Unlike most knowledge tests, this instrument was specifically designed to have a factor structure. The developed instrument has been tested in twelve biochemistry courses, and the results obtained from confirmatory factor analysis provide evidence to support the factorial validity of the scores. The instrument development process and the results from its most recent administration will be presented.

P757: Differential item functioning on multiple choice general chemistry assessments

Lisa Kendhammer (University of Wisconsin – Milwaukee, USA)

The use of testing to determine student grades imparts an imperative that tests be made as fair as possible. When subgroups of equal ability perform differently on an assessment item (where equivalent ability students should have equivalent probability of answering an item correctly) this is called differential item functioning (DIF). In order to identify possible DIF and more importantly, improve the assessment writing process, large studies of student performances have been conducted to both identify DIF and categorize collected DIF items. Recently, the ACS Examinations Institute has begun to conduct DIF studies on trial exams in general and organic chemistry. General chemistry items which were rejected for inclusion on a final exam based on possible DIF were studied in more depth to examine if DIF persists, to what extent it persists and if varying content and construct affect the persistence of DIF. These questions were also included in the student's work load in high stakes environments (i.e. examinations) and low stakes environments (i.e. practice problems) to examine the extent to which DIF persists. Additionally, the use of both internally and externally relevant measures of ability matching will be presented.

P758: The practice and effect of accomplishing different teaching levels and cultivating innovative talents for applied chemistry specialty undergraduates

Lijiang Hu (Harbin Institute of Technology, China)

The ability to cultivate innovative talents effectively in higher education entities has generated considerable interest in many colleges and/or universities. Focusing on statistics such as increased coverage for an applied chemistry specialty, a higher number of acceptance students per year and enhanced benefits to society, we instituted a method to teach different levels in our system and have received positive results. As a first step, we adopted a flexible teaching plan. Based on the nature of the courses, the curricula are cataloged into three types: 1) Emphasis on the introduction of basic knowledge; 2) organization of various classes with the same amount of class time but with different contents and different requirements; the students in each class are divided depending on their entrance scores and they are reassigned based on their course scores at the end of each semester; 3) institution of a course-selective policy whereby additional courses are added for those students who excel or are interested in further study. In the second and the third courses, at least two courses per semester are introduced to teach two languages in order to maintain English language training for students on a course-by-course basis during their four years. These practices have increased student activity, revealed their potential abilities and enhanced their innovative research interests. In addition, the number of students pursuing masters degrees has increased significantly, especially at leading universities.

P759: Using a two concept diagnostic exam for predicting students' achievement

Keily Heredia (University of South Florida, USA), Jennifer Lewis (University of South Florida, USA)

The Particulate Nature of Matter and Chemical Bonding Diagnostic Instrument (Othman, et. al., 2008), is used to investigate students' conception of the particulate nature of matter and their understanding of chemical bonding. The instrument, originally developed for secondary school students, is a two-tier diagnostic test. The first tier of each item is a multiple-choice question, which relates to a problem statement. The second tier of each item is composed of a multiple-choice set of explanations for the answers from the first tier. These explanations consist of one scientific concept as well as alternative conceptions. The instrument was given the second week of class to 1402 students enrolled in General Chemistry I during the fall of 2009 as a paper and

pencil test. Confirmatory factor analysis supported the 2-factor structure that was proposed by the scale developers. This presentation focuses on interesting findings regarding the use of the diagnostic instrument to predict students' achievement.

P760: What do students really need to know to be successful in introductory chemistry

Sonali Raje (Towson University, USA), Liina Ladon (Towson University, USA), Alan Pribula (Towson University, USA)

Prior research has shown a wide range of predictors of success in college introductory chemistry. Two of the factors that have been identified are prior Chemistry content knowledge and a strong mathematics background. As part of our effort to streamline the enrollment and graduation processes for undergraduates, we designed and administered a diagnostic test to help determine which factors correlate with the success that students experienced in an introductory chemistry course, as indicated by their final course grade. Test questions included conceptual questions, algebra and math word problems, metric unit conversions, interpretation of graphs, and chemistry content knowledge. We also collected demographic information from students to determine their prior chemistry and mathematics experience. We administered this diagnostic in the first week of the Spring 2010 semester to two sets of Introductory Chemistry students, those enrolled in a course designed for non-majors (N = 112) and another set of students enrolled in a slightly advanced introductory course primarily designed for science majors (N = 300). As part of our results, we will discuss separate and composite correlations between end-of-term test grades and (a) each of the math background categories and (b) prior chemistry content knowledge.

P761: Effects of a content-enriched and inquiry-based sustained professional development program on inservice chemistry teachers' classroom practices

Uma Jayaraman (Temple University, USA)

To effectively remedy the shortage of physical science teachers in urban schools, a university in the mid-Atlantic region offered a sustained Master's degree program to the grades 5-12 in-service teachers, with the goal of improving the academic chemistry content preparation of the teachers and their knowledge base of using instructional strategies consistent with a research-based inquiry approach to teaching and learning. This exploratory case study of 6 graduates of the program teaching chemistry in the high schools of the School District of Philadelphia (SDP) investigated how did graduation from the program affect the implementation of research-based classroom practices of the teachers in the domains of lesson design and implementation, content, and classroom culture and how did the implementation differ among the six teachers. The teachers' concerns expressed as factors that enabled and hindered the implementation were also investigated. The teachers completed a Stages of Concerns Questionnaire (SoCQ), were observed and rated with the Reformed Teaching Observation Protocol (RTOP), completed a self-reported survey of their classroom practices, and participated in a semi-structured interview. The results revealed that the teachers implemented the practices learned in the program to a low extent in their classrooms. While the enabling or potentially enabling factors reported by teachers were depth of knowledge and use of formal lab reports acquired in the program, the hindering factors toward implementation of recommended practices were the mandated curriculum and pacing schedule, standardized test preparation, administrative duties, large classes, unmotivated and unprepared students, and lack of administrative support.

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S65: Research in Effectiveness of Active Learning Pedagogies

Tina Mewhinney (Eastfield College and University of North Texas, USA)

Papers reflecting studies on the effectiveness of active pedagogies, such as POGIL or PTL, are welcomed.

7:30		introduction
7:35	Diane Bunce	P762: Evaluation of effectiveness of POGIL on student achievement and process skills in general chemistry
7:55	Adessa Butler	P763: Effectiveness of guided inquiry on students' comprehension of chemistry concepts
8:15	Alexandra Brandriet	P764: Triangulating assessments: Multiple measures of student learning
8:35	Juliette Lantz	P765: ANA-POGIL materials in the classroom – Preliminary analysis
8:55		break
9:10		discussion
9:30	David Hanson	P766: Impact of POGIL: In context activities on proficiency in problem solving
9:50	Betsy Ratcliff	P767: We built it: Can we get them to come?
10:10	Sachel Villafane	P768: Advancing active learning in biochemistry: Student assessment data

P762: Evaluation of effectiveness of POGIL on student achievement and process skills in general chemistry

Diane Bunce (Catholic University of America, USA), Elizabeth Flens (Catholic University of America, USA), Kelly Neiles (Catholic University of America, USA), Jessica VandenPlas (Northern Arizona University, USA)

The NSF-funded learning approach, Process Orientated Guided Inquiry Learning (POGIL) has been adopted in high schools, 2 year and 4 year colleges and universities across the country. Although several research projects have reported on the effects of POGIL on student attitude, level of interaction and attrition rates, few have investigated the effect of POGIL on student achievement and process skill attainment. This two year study looked at student achievement on validated questions from a test bank of 24 multi-part chemistry problems on 12 general chemistry topics developed for this study. The process skills included in these questions were problem solving, critical thinking, metacognition, and information processing. Preliminary analysis showed that the test bank questions were not sensitive enough to differentiate among the 4 process skills but could differentiate between achievement and process skills in general. Achievement and process skills of 3,000 students in both POGIL and nonPOGIL general chemistry classrooms from approximately twenty 2 year and 4 year colleges and universities in the US were collected and analyzed. The results of this analysis will be presented.

P763: Effectiveness of guided inquiry on students' comprehension of chemistry concepts

Adessa Butler (The University of Akron, USA), William Donovan (The University of Akron, USA)

The inquiry teaching method has been shown to actively engage students in their learning. The purpose of this research was to determine the effectiveness of guided inquiry methods on students' comprehension of chemistry concepts in a non-science majors' one-semester college chemistry course that consisted of lecture and lab components. Three topics were chosen to study the effectiveness of guided inquiry teaching and inquiry labs in increasing the students' understanding of the chemistry topics. The students' understanding was evaluated based on scores on assessments on the three topics. A sample of students was also interviewed and asked questions related to the chemistry topics and their attitudes about the guided inquiry activities and labs. The data was analyzed using SPSS software for statistical differences between groups and topics. This presentation will discuss the inquiry lessons used, the data and results of the analysis, and implications for teaching and learning in non-majors chemistry courses.

P764: Triangulating assessments: Multiple measures of student learning

Alexandra Brandriet (Miami University, USA), Stacey Lowery Bretz (Miami University, USA)

For three years, we used POGIL recitations to teach general chemistry I students who were at risk for attrition due to their weak math knowledge. Attrition, retention into general chemistry II, and grades all improved. We conducted additional research regarding the cognitive and affective dimensions of student learning in the context of this reformed course. At-risk students completed four instruments, both pre- and post-semester: Grove & Bretz's CHEMX, Cooper & Sandi-Urena's MCA-I, Bauer's Semantic Differential, and the TOLT. Data from these assessments and the implications of these findings will be discussed.

P765: ANA-POGIL materials in the classroom: Preliminary analysis

Juliette Lantz (Drew University, USA), **Renee Cole** (University of Central Missouri, USA)

There is a need for instructional materials for teaching analytical chemistry which involves students developing key process skills such as critical thinking, information processing, problem solving, and teamwork. The Process Oriented Guided Inquiry Learning (POGIL) methodology has been shown to be an effective pedagogy in other disciplines, and materials have been developed for analytical chemistry by the ANAPOGIL project. Students involved in the study used POGIL activities for selected topics and completed student review documents on one or two of these activities. These documents were coded and analyzed. Hour exam questions and American Chemical Society (ACS) Exam questions were analyzed. CHEMX and SALG (student assessment of learning gains) data were analyzed to determine students' expectations about learning chemistry and perceptions of learning gains in the course. The preliminary data analysis will be presented along with an overview of the project.

P766: Impact of POGIL: In context activities on proficiency in problem solving

David Hanson (Stony Brook University – SUNY, USA)

One goal of college-level General Chemistry courses is to elevate performance of students from Knowledge Levels 1 and 2 (Information and Algorithmic Application) to Levels 3 and 4 (Conceptual Understanding and Problem Solving). Typical POGIL activities are designed to help students construct their understanding of concepts by following a learning-cycle paradigm. In the process they also acquire skills that help them become better problem solvers, but developing proficiency in problem solving is not explicitly supported. The goal of the POGIL-IC project was to improve student proficiency in problem solving through the use of specially designed activities. This presentation will describe the structure of these activities, research underlying the

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design, and results of a research project directed at answering the following questions. (1) Does the use of POGIL-IC activities increase proficiency in problem solving? (2) How do instructors go about introducing and supporting the POGIL-IC learning experience? (3) How does student achievement in problem solving compare with their achievement in chemistry knowledge over the course of a semester? Data were collected using pre, post, and mid-semester tests; monthly observations of classes by two observers; and by pre, post, and mid-semester student and instructor self-perception surveys.

P767: We built it: Can we get them to come?

Betsy Ratcliff (West Virginia University, USA), Jeffrey Carver (West Virginia University, USA), Razan Snari (West Virginia University, USA)

Peer Led Team Learning (PLTL) was implemented in the Chemistry Department at WVU as part of a multi-faceted effort to increase student retention, particularly of high risk students, in STEM disciplines. Grounded in the theory of social constructivism, PLTL involves students constructing conceptual understanding through shared social interactions. Early results indicate that despite having statistically similar ACT and SAT scores, PLTL participants outperformed their non-PLTL peers by one-half letter grade on average. Further, PLTL-participants have more positive attitudes towards their learning gains in chemistry, more confidence in their understanding of chemistry, and more positive attitudes towards the study of chemistry. PLTL participants express more confidence in non-subject specific academic skills such as developing a logical argument, interpreting information presented graphically, conceptualizing principles and summarizing principles in their own words. In terms of study habits PLTL participants report higher gains in the ability to study effectively. Sounds great, right?! Yet our PLTL program is under-utilized by its target audience, struggling general chemistry students. We report here on the efforts to increase student participation in PLTL and the decision making process of possibly mandating attendance in future semesters.

P768: Advancing active learning in biochemistry: Student assessment data

Sachel Villafane (University of South Florida, USA), Jennifer Lewis (University of South Florida, United States), Jenny Loertscher (Seattle University, USA), Vicky Minderhout (Seattle University, USA)

Advancing active learning in biochemistry is a NSF-funded project currently engaged in field-testing a coherent set of Process Oriented Guided Inquiry Learning (POGIL) activities for undergraduate biochemistry with the aim of broad dissemination. Documentation of student learning outcomes on a large scale requires an instrument that produces reliable and valid scores in a relevant content domain. This 24-item multiple-choice instrument is designed to capture student understanding of eight basic concepts that are considered pre-requisite knowledge for a biochemistry course. This instrument is at the final development and validation stages, and its administration will serve as the assessment needed to identify students' incorrect ideas that could hinder biochemistry learning when it is used as pretest and to determine if instruction helps students overcome those incorrect ideas when used as posttest. Results from previous administrations will be presented, including students' learning gains and their most common incorrect ideas.

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S66: Survivor Skills for 1st to 5th year Chemistry Teachers

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Laura Slocum (University High School of Indiana, USA)

National research data claims that one out of every five novice teachers leaves the teaching profession after only three years and 50% leave in the first five years. Often, these teachers are frustrated and feel overwhelmed because they are held to the same accountability standards as veteran teachers. One of the major reasons cited for leaving is the lack of support and guidance from the administration and colleagues. In this symposium, veteran teachers will offer themselves as role models for novice teachers or other educators seeking to improve and fine tune their classroom instruction and management skills. These veteran teachers will share a wide range of resources such as great lesson plans, teaching strategies, activities, projects or demonstrations that can help prevent novice teachers from having to reinvent the wheel. There will also be a packet and prize drawing for each one-five year teacher attending the symposium.

7:30	introduction
7:35	Kathy Kitzmann P769: Organizing labs and demos ... you can do it!
7:55	Jennifer Strahl P770: Student laboratory technician programs for high school
8:15	Jill Barker P771: Demo and lab helps
8:35	Paula Butler P772: High school chemistry teaching: My favorite tricks of the trade
8:55	break
9:10	Linda Weber P773: Sheet protectors, card stock and chocolate jimmies
9:30	Laura Slocum P774: JCE: A high school teacher's best friend - Part 1
9:50	Laura Slocum P775: JCE: A high school teacher's best friend - Part 2
10:10	discussion

P769: Organizing labs and demos ... you can do it!

Kathy Kitzmann (Mercy High School, USA)

Over the years (36 of them), this presenter has learned some things about organizing labs and demos to make them less stressful! She will present some of these tips and some of her favorite (easy) lab and demo ideas.

P770: Student laboratory technician programs for high school

Jennifer Strahl (Montverde Academy, USA)

Montverde Academy, an independent school in central Florida, has developed a program for student chemistry laboratory technicians. The curriculum, modeled after a program presented at BCCE 2005, fulfills needs for enrichment for advanced science students and practical help for science instructors. Student laboratory technicians are recruited from current and previous AP Chemistry classes, and students must have earned high grades in chemistry, as well as instructor approval, to elect this semester service-learning course (science elective, repeatable for credit). Student grades depend upon satisfactory completion of laboratory-preparation tasks and training assessments. Preparation tasks include experiment and demonstration set-up and tear-down, solution preparation, basic equipment maintenance, and inventory assistance. Training assessment topics include laboratory and stockroom safety, chemical storage and disposal, and solution preparation and standardization. Faculty and student perspectives on the program will be presented. Assessments and syllabi will be shared.

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P771: Demo and lab helps

Jill Barker (Millbrook High School, USA)

This presentation will focus on sharing ways to incorporate labs and demonstrations into classroom instruction. Multiple formats for lab reports and examples of demonstrations that will facilitate instruction will be provided. The demonstrations will be previously videotaped.

P772: High school chemistry teaching: My favorite tricks of the trade

Paula Butler (Cincinnati Country Day School, USA)

How do we really know that students are learning the chemistry we think we are teaching? A 26-year veteran shares favorite ideas on how to keep students engaged, moving them beyond rote memorization of facts and equations. Interesting activities and classroom strategies that promote inquiry, transfer of knowledge, and retention of chemical concepts will be presented. Handouts will be provided.

P773: Sheet protectors, card stock and chocolate jimmies

Linda Weber (Natick High School, USA)

The stress of professional obligations during the early years of teaching often eliminates the use of student-centered strategies in the classroom. This presentation will focus on easy-to-do activities designed to alleviate that stress while keeping students who learn in different ways actively involved in their own learning and understanding.

P774: JCE: A high school teacher's best friend - Part 1

Laura Slocum (University High School of Indiana, United States), Erica K. Jacobsen (University of Wisconsin – Madison, USA)

As each of us navigated our way through whatever path we took to arrive in the classroom, we learned about various tools that became "tried and true" resources for us. Presenters will share various ideas that we have taken from JCE and incorporated into our classrooms including research projects, demonstrations, labs, and JCE Classroom Activities. This presentation will also give participants an opportunity to try at least one hands-on Classroom Activity and we will show you how to navigate around JCE Online to easily find the materials you need for your classrooms.

P775: JCE: A high school teacher's best friend - Part 2

Laura Slocum (University High School of Indiana, United States), Erica K. Jacobsen (University of Wisconsin – Madison, USA)

As each of us navigated our way through whatever path we took to arrive in the classroom, we learned about various tools that became "tried and true" resources for us. Presenters will share various ideas that we have taken from JCE and incorporated into our classrooms including research projects, demonstrations, labs, and JCE Classroom Activities. This presentation will also give participants an opportunity to try at least one hands-on Classroom Activity and we will show you how to navigate around JCE Online to easily find the materials you need for your classrooms.

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S58: Using History in Teaching – Part 2 of 2

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Steven Wood (Brigham Young University, USA), *Amina El-Ashmawy* (Collin College, USA)
Textbooks are written by chemists who are formalized individuals that deal with the abstractions of our modern chemical science on a daily basis. Although, in most cases, their books present topics in well organized and fairly comprehensive discussions, they do not allow for a graduated learning of the material. A historical approach allows students to see the simplified concepts and the evolution of ideas that lead to our modern theories and principles.

7:50		introduction
7:55	Steven Wood	P776: Historically based media materials for general chemistry
8:15	David Heroux	P777: Chemistry that changed history: An honors course for non-science majors
8:35	David Doherty	P778: An interactive timeline of atomic theory: The people and their ideas come to life
8:55		break
9:10	David Thompson	P779: Designing and labeling a mercury thermometer: A historical introduction to the art of creative thinking and calibration in analytical chemistry
9:30	Abbey Rosen	P780: Investigating the development of biochemical concepts
9:50		discussion

P776: Historically based media materials for general chemistry

Steven Wood (Brigham Young University, USA)

I have been using a historical approach since I began teaching general chemistry almost 15 years ago. We currently use an atoms first approach, and I have found that the historical approach through quantum chemistry is especially effective in helping students better understand the significance of the key ideas and how they develop. Over the past several years we have also been producing media based materials for general chemistry and we have incorporated this approach in their development. As we have prepared the script and the visual media, we have gone to some of the original source material and used it as the basis for preparing our materials. A selection of the finished historical presentations will be shown along with a discussion of the power of telling the story historically.

P777: Chemistry that changed history: An honors course for non-science majors

David Heroux (University of Maine at Farmington, USA)

Since the end of the Stone Age and the beginning of the Bronze Age, much of history can be defined by the technology available. Through the industrial revolution to today's technological age, fundamental chemical discoveries have impacted change in human society. Through readings of popular science and history, this course examines the discoveries that have affected some of the major turning points of history as well as the chemistry hidden behind many of the social, economic, and political changes. The course is designed to increase the student's awareness of scientific progress, the role of technology in their lives, and the role they must play in decisions about technology. The presentation will give an overview of the course with focus on the everyday items that the students study. Resources available for developing a similar course will be covered along with discussion of student designed laboratory experiments about everyday items such as soap, ink, and photographs.

P778: An interactive timeline of atomic theory: The people and their ideas come to life

David Doherty (Bitwixt Software Systems LLC, USA)

The ~2700 year history of the development of Atomic Theory is a fascinating tale of profound ideas, persecution (including burnings at the stake), competition, and politics. From the natural philosophers to the alchemists to the natural scientists, there's something in the tale for everyone. It's also a story representing a triumph of human thought -- the development of the scientific method. As such, each individual's contribution in that history represents either scientific progress or a dead end. We present a visual and interactive timeline depicting the development of the ideas and discoveries of atomic theory. By dragging and clicking to move through time, students gain an appreciation for the vast period of time elapsing between the ideas of the Greek philosophers through to the explosion of scientific activity that began in the 17th century. They can click on any given philosopher/scientist to learn about his or her ideas and how those ideas relate to earlier and later conjectures and theories. Students can also click in those stories to launch interactive, 3D atomistic models that represent (for example) Thomson's Plum Pudding Model, Rutherford's and Bohr's planetary models and how they interact with the light spectrum, and a lab in which they implement Schrödinger's quantum model by building an electron configuration and populating an interactive 3D atomic orbital (cloud) model. This technology-enhanced approach merges chemistry with history and brings it to life.

P779: Designing and labeling a mercury thermometer: A historical introduction to the art of creative thinking and calibration in analytical chemistry

David Thompson (Sam Houston State University, USA)

Calibration and linear least squares regression are key concepts in quantitative chemical analysis. Abstract statistical presentations of this material are challenging for many students. Presenting a concrete example first and then connecting the numbers to the abstract representations is an effective method for helping students to learn the steps of a calibration and to assist in their gradual acculturation to abstract symbols. The specific example of the ideas that led people to imagine the absolute temperature scale and the thinking that went into designing the mercury thermometer are used to present a clear, compelling, and intellectually stimulating illustration of both creativity in scientific thinking and of the major concepts required to calibrate an instrument with a linear response.

P780: Investigating the development of biochemical concepts

Abbey Rosen (Marian University, USA)

Biochemistry textbooks present our current understanding of the subject without too much discussion of the debates and development of the concepts. This does not allow students to see the “dirtier” aspects of science, to see how the “current understandings” change over time as new data is gathered. In an effort to expose students to more scientific literature and to give them more a historical background, this is the second year that my one-semester majors’ biochemistry course now incorporates several primary literature articles that supplement the course material. We begin with Crick’s hypotheses regarding the central dogma and protein synthesis and then proceed to read both more historical pieces and current literature to give the students a broader view of biochemistry. This paper will present these initial attempts to further engage my biology and chemistry majors in discussion of how biochemistry has developed and continues to develop.

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S26: Web Based Applications for Chemical Education - Online Learning Systems

Robert Belford (University of Arkansas – Little Rock, USA)

This symposia seeks to bring developers of web-based applications together with chemical educators to share experiences and innovations. We are looking for presentations from the perspectives of development and implementation of web based applications, along with how the open access nature of the web and social networking technologies have changed the way scientists and educators communicate information, and how that is impacting chemical education. Papers are invited relating to specific web-based applications, creative solutions to web-based issues in the context of chemical education, reports of the impact of web-based applications on pedagogy and learning, or visions of the future.

7:50		introduction
7:55	Myung-Hoon Kim	P781: Online laboratory assignments for general chemistry
8:15	Harmon Abrahamson	P782: Impact of web-based delivery on distance-education chemistry courses
8:35	Danielle Barker	P783: Lab versus lecture: Does location matter when introducing a web-based math tutorial into a general chemistry course?
8:55		break
9:10	John H. Penn	P784: WE_LEARN organic chemistry: Does practice make perfect?
9:30	Conrad Trumbore	P785: Strategies and design for a non-majors electronic chemistry textbook
9:50	Sheila Woodgate	P786: BestChoice: Discovering that students can help us to teach them
10:10	William Vining	P787: The OWLBook: An integrated online assignable text for general chemistry

P781: Online laboratory assignments for general chemistry

Myung-Hoon Kim (Georgia Perimeter College, USA)

In recent years, online homework assignments (mostly problem solving) for lecture courses in math, physics, chemistry and other subjects became increasingly popular with the advent of Chem Skill Builder, ARIS, WebAssign, MasteringChemistry, OWL and other programs. On the other hand, online homework assignments for laboratory courses – such as for delivering pre-lab quizzes, report of data analysis and results (namely, grading of reports) have been slow to develop compared to online lecture courses. This is because the assessment of data, analysis and results, which differs from student to student, is much more difficult and challenging than the lecture homework. In this investigation, however, the groundwork for the development of such program modules (Online Lab Assignments, OLA) is being laid out despite some limitations in the function and capacity of available software. Online delivery of pre-lab quizzes and grading of lab reports are preferable for laboratory courses because of their accuracy, pedagogical value (of imbedded guides and prompt feedback), uniformity (impartiality in grading, in particular), speed

of grading, reduction of paper waste, and time saved by both students and instructors. Some grading strategy and schemes will be presented with several examples, such as density measurements and/or acid-base titration experiments.

P782: Impact of web-based delivery on distance-education chemistry courses

Harmon Abrahamson (University of North Dakota, USA)

The University of North Dakota Distance Engineering Degree Program (DEDP) includes chemistry courses in its offerings. A change has been made from the old, physically-mailed, video-taped lecture delivery previously used in DEDP courses to a web-based streaming video system. In addition, extensive use is made of the Blackboard content-management system for daily work and exams. The use of these web-based systems has led to positive impacts for both professors and students. Details of the system will be presented in the context of the general chemistry courses taught by the author.

P783: Lab versus lecture: Does location matter when introducing a web-based math tutorial into a general chemistry course?

Danielle Barker (University of Kansas, USA), Joseph Heppert (University of Kansas, USA)

In an attempt to improve attendance in a large single lecture-style general chemistry course ($n=900+$), the math-related content from the first three chapters of the text (conversion factors, percent composition, molarity, limiting reactants, etc.) was removed from the lecture portion of the course. Students were introduced to this math-related content through ReMATCH (Reviewing Math—A Tutorial for Chemistry with Homework). ReMATCH is a web-based tutorial designed to introduce/review math content in everyday and chemical contexts until mastery of each topic is demonstrated. In fall 2006, the tutorial was integrated into select lab sections. Students ($n\approx 240$) were required to complete the ReMATCH homework for a grade. In fall 2007, the tutorial was integrated into the lecture portion of the course, and all students ($n=900+$) were required to complete the associated homework for a grade. Results presented will include a comparison of the impact that each implementation of ReMATCH had on student performance and examine the student response to each.

P784: WE_LEARN organic chemistry: Does practice make perfect?

John H. Penn (West Virginia University, USA)

Our group has developed the WE_LEARN system for organic chemistry to be a “Practice Makes Perfect” system. A basic assumption of this system, and of many teachers/professors, is that more time on task translates to better mastery of the subject matter. In this presentation, this assumption is challenged by analyzing over 1,000,000 student attempts on assignments which have been collected over several years of usage in order to evaluate the question of whether a correlation between the amount of time on the subject matter and the course mastery (e.g., final grade, final exam mark) does, indeed, exist.

P785: Strategies and design for a non-majors electronic chemistry textbook

Conrad Trumbore (University of Delaware, USA)

What unique opportunities does an e-text offer that are not available in a hard-copy text?

Foremost is interactivity, attracting tech-savvy students quickly with increased participation in the learning process. Highly interactive animations can clarify complex concepts and aid visual learners. Electronic testing at the time of interacting with animations can help draw out overlooked, subtle features of the animations. Assessment results can be electronically recorded in course management systems. Non-linear learning paths are both possible and encouraged. However, the navigational format should keep participants aware of the larger picture at all times and be able to refocus students quickly when they are finished being profitably sidetracked. The introductory non-major chemistry course faces a double challenge: a very wide range of student chemistry preparation and different instructor expectations for these students. Multilevel content sophistication is possible with a click of a button and offers both students and instructors new opportunities for exploring subjects in greater depths as well as dwelling on clearly defined fundamentals. Non-majors courses often involve rapidly-changing contemporary subjects such as climate change, energy issues, and biochemical topics. E-texts are updated easily and quickly for both students and instructors. Finally, instant feedback to both instructor and authors is possible through embedded email links. These design principles are being integrated into an e-text intended for liberal arts and non-chemistry majors. We will offer several examples of different e-text designs in chapters on basic chemical fundamentals and biochemical topics. A navigational scheme involving multilevel interactive concept maps will be demonstrated.

P786: BestChoice: Discovering that students can help us to teach them

Sheila Woodgate (The University of Auckland, New Zealand)

BestChoice is an open-access interactive web site (bestchoice.net.nz) that was developed initially to support learning in large first-year Chemistry classes at The University of Auckland in New Zealand. BestChoice is innovative in its emphasis on teaching both concepts and problem-solving strategies by guiding students to interact with the system in ways that promote their understanding. A large number of BestChoice modules covering a wide range of content have been used as on-line formative assessment activities for thousands of students in different countries and educational settings since 2003. The emphasis in this paper is how data entered by the students themselves and data collected from the system has informed development and use of these on-line activities. This will include a discussion of how, through student feedback, our approach to yield calculations has evolved.

P787: The OWLBook: An integrated online assignable text for general chemistry

William Vining (SUNY College at Oneonta, USA), *Beatrice Botch* (University of Massachusetts, USA), *Roberta Day* (University of Massachusetts, USA)

This presentation will review the creation and testing of an assignable, fully integrated online textbook and homework system for general chemistry. This project is an extension of the OWL

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electronic learning system and involves the blending of text, problem-based homework, and interactive modules. While the organization of the material is traditional in order and scope, the presentation describes noninteractive material such as static explanations, video examples, and whiteboard problem solutions with interactive and assignable figure-based exercises, concept simulations, tutorials and problem-based homework. The principal goal of the project is to create a system in which the students experience “text,” conceptual exercises, and assignable homework as an integrated whole. Results from preliminary tests with two classes will be presented, highlighting how students navigate the system, which parts they do and do not use, and how assignability influences their decisions as to how to use the system.