

OH-PKAL

Ohio Project Kaleidoscope
Increasing STEM Success in Higher Education

Otterbein University, Westerville, OH

May 16, 2015

Ohio Project Kaleidoscope Inaugural Conference INCREASING STEM SUCCESS IN HIGHER EDUCATION

Otterbein University | Westerville, OH
May 16, 2015

Welcome to the Inaugural OH-PKAL Annual Conference!

I am excited to share the debut of the OH-PKAL Annual Conference with so many dedicated STEM faculty and supporters! Victoria “Vicki” McGillin is the major driving force behind OH-PKAL and the realization of this day. We are grateful for her vision and creative commitment in her roles as Consultant on Institutional Collaboration with the Association of Independent Colleges and Universities of Ohio (AICUO) and Professor of Psychology, Otterbein University. National Project Kaleidoscope (PKAL) has a long history of supporting transformation in STEM education. Now, partnered with the Association of American Colleges and Universities (AACU), PKAL is under the leadership of Kelly Mack, Vice President for Undergraduate STEM Education, and Executive Director, Project Kaleidoscope.

On January 29 of last year, the initial OH-PKAL Advisory Board held our first meeting on a frigid, windy day. Some met in Columbus while others joined the meeting through video conference. Working groups created mission and vision statements, developed a governance structure, and began planning this inaugural conference. Soon after, a governing board formed and established a conference committee. Here we are 16 months later attending an energizing conference as the result of an impressive team of dedicated Conference Committee and Governing Board Members.

Locally, we are deeply grateful to the leadership and tireless efforts of Paul Wendel, Conference Committee Chair, and Terry Lahm, Conference Committee Co-Chair. Otterbein University made available essential facilities and funding through their WIDER grant. Nationally, we thank Christina Shute, Program Coordinator, PKAL for all of her administrative help and Kelly Mack for believing in OH-PKAL. Thank you all!

The Conference Committee has compiled a vibrant program promoting evidence-based practices across four important threads:

- ❖ Meeting the Needs of Underprepared STEM Students
- ❖ Promoting Effective Learning in Large Lecture Classrooms
- ❖ Improving First-Year Experiences
- ❖ Improving Upper-level STEM Experiences

We are particularly excited to have Scott Freeman as our Keynote Speaker, who is the lead author of *Active Learning Increases Student Success in Science, Engineering, and Mathematics* (Freeman, Eddy, McDonough, Smith, Jordt, & Wenderoth, 2014:PNAS).

We thank all of the organizers, the many presenters, and of course, all of the attendees. We anticipate that this inaugural conference is just the first step towards growing a collaborative community of practice with the goal of improving STEM education for all undergraduates in Ohio.

Judith “Judy” C. Amburgey-Peters
OH-PKAL Chair 2014-2015
Associate Professor of Chemistry, The College of Wooster

PKAL Regional Network: Ohio (OH-PKAL)

Vision

Ohio-PKAL's vision is to create a regional community of practice to promote and enhance learner-centered STEM (science, technology, engineering and mathematics) education through evidenced-based best practices, faculty development, and community engagement & education.

Mission

Ohio-PKAL's mission is to become a central conduit for providing information, communication, and resources focused on the enhancement of STEM education. Ohio-PKAL desires to be the foremost leader in connecting people within institutions of higher education, organizations, and the business community around the shared goals of producing highly qualified STEM professionals and improving scientific literacy among all students and graduates of Ohio schools.

You can get involved with OH-PKAL

- Serve on the annual conference committee
- Contribute to professional development of STEM faculty
- Collaborate in identifying and securing funding, and sharing resources for projects to improve STEM education;
- Engage community partnerships between local agencies and businesses interested in improving undergraduate STEM education
- Promote undergraduate STEM research opportunities
- Develop, maintain, and disseminate avenues for sharing of information, resources, and best practices for promoting and improving STEM education in Ohio
- Engage in strategic planning for policy decisions concerning STEM education in Ohio
- Partner with local, regional and national organizations to promote STEM outreach in Ohio

Contact any member of the Governing Board with your ideas!

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Columbus State Community College

**Schedule: Ohio Project Kaleidoscope Inaugural Conference
May 16, 2015**

8:30 – 8:45	<i>Riley Auditorium</i>	Opening
8:45 – 9:45	<i>Riley Auditorium</i>	Plenary Speaker Scott Freeman: Evidence-Based Teaching and the Achievement Gap
10:00 – 11:10		Concurrent Sessions I
	<i>Science 104</i>	Theme I: Meeting the Needs of Underprepared STEM Students The Benefits of Challenge Based Learning on STEM Students, p. 6 Strategies for Providing Holistic Support to Increase Retention and Graduation Rates of Underserved STEM Students, p. 6 A Multifaceted Approach to Enhance STEM Student Success, p. 7
	<i>Towers 112</i>	Theme II: Promoting Effective Learning in Large Lecture Classrooms Using Interactive Video Vignettes to Impact Student Learning in a Flipped Classroom Setting, p. 7 Implementing Peer Instruction in a Large (N > 300), Flipped, General Chemistry Classroom, p. 8 Using Learning Catalytics in a Flipped Classroom for Algebra-Based Physics, p. 8
	<i>Roush 114</i>	Theme III: Improving First-Year Experiences Evaluating the Use of Adaptive Courseware to Improve the First Year Experience in STEM Courses, p. 8 STEM-LLC: Lessons from a First-Year Learning Community, p. 9
	<i>Riley Auditorium</i>	Theme IV: Improving Upper-Level STEM Experiences and Theme I: Meeting the Needs of Underprepared STEM Students Guided Group Work in the Junior to Graduate Level in the OSU Physics MS-PhD Bridge Program (Theme IV), p. 9 A Guided Inquiry-Open Inquiry Approach in the Physical Chemistry Laboratory (Theme IV), p. 9 An Intrusive Advising Model to Enhance Retention of STEM Majors (Theme D), p. 10
11:20 – 12:10	<i>Science Atrium</i>	Posters 1: Whole-to-Part (WTP) Approach to Improve Special Visualization Skills Using Computer Aided Design Model Simulations and Hand-Held 3-D Objects, p. 10 2: Mathematics for Chemistry, p. 11 3: A Learning Community between Introductory Biology and First Year Seminar for At-Risk Students, p. 11 4: The Transformative Games Initiative: Blending Undergraduate Research with Games-Based Learning, p. 11 5: Operation STEM for PreCalculus, p. 12 6: Learner Self-Assessment with Math Machines, p. 12 7: Active Learning Impact on Student Attitudes Toward Chemistry in General Chemistry, p. 12

- 8: Implementation of Evidence-Based Instructional Practices in Multiple Levels of a Biological Sciences Curriculum, p. 13
- 9: Enhancing Faculty Engagement and Student Learning in Foundational STEM Courses at a Large Public University, p. 13
- 10: Lessons Learned Teaching General Chemistry via Video Teleconference, p. 13
- 11: Lessons Learned from Distance Learning Laboratories in Physics, p. 13
- 12: A Case Study on Effective Technology Integration to Math Classroom Using MyMathLab Learning Environment, p. 14
- 13: Aligning the Learning of Science with the Nature of Science in Large Lecture Classrooms, p. 14
- 14: Student-Led Supplemental Instruction (SI) as an Adjunct Learning Tool in First-Year Biology Courses, p. 14
- 15: Fearless Investigators: Teaching a General-Education Science Course Through Experimental Design, p. 14
- 16: Peer Supported Programs to Enhance Learning in Introductory Chemistry Courses, p. 15
- 17: Teaching Matters: Undergraduate Grant Writing, p. 15
- 18: Brown Bag Sessions: Improving STEM Student Success in Collaborative Research, p. 15

12:25 – 1:25 *Clements
Recreation Center*

Lunch and Roundtables

- Table 1: STEM Experiences through an NSF Project: Hands-on and Games, p. 16
- Table 2: Bridge in STEM Disciplines: From the Community College to Four Year Colleges, Universities, and Beyond, p. 16
- Table 3: Does Homework Still Play an Integral Role in Developing Mastery of STEM Disciplines?, p. 16
- Table 4: Preparing Underprepared STEM Students for Success, p. 17
- Table 5: Methods to Improve Performance of Students with Weaker Math Skills in an Algebra-based Physics Course, p. 17
- Table 6: Factors Contributing to Gender Gaps in Undergraduate Information Technology Programs, p. 17
- Table 7: Employing Academic Tools and Technology as an Intervention Model for Improving Enrollment and Success of Underprepared Freshmen Students in STEM, p. 17
- Table 8: Using real cadaver specimens at a STEM event: Is it appropriate for everyone?, p. 18
- Table 9: My Smartphone Makes Me Smarter, p. 18
- Table 10: A High Score on Online Homework does not mean a High Examination Average, p. 18
- Table 11: Facilitate Student Learning using a “Flipped Classroom” Method, p. 19
- Table 12: Using the POGIL Strategy, p. 19

1:40 – 2:40		Contributed Themes
	<i>Science 104</i>	Creating Environments that Enhance Retention in STEM, p. 19
	<i>Towers 110</i>	Introductory STEM Teaching, Learning, & Culture: Data for Self-Evaluation, p. 20
	<i>Towers 112</i>	S-STEM: Increasing STEM Student Recruitment, Retention, and Success at Ohio Universities, p. 20
	<i>Roush 114</i>	Assessing Quantitative Skills Preparedness and Learning, p. 21
	<i>Riley Auditorium</i>	The Impact of Learning Style Preferences on STEM Course Performance, p. 21
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	<i>Science 104</i>	Theme III: Improving First-Year Experiences and Theme II: Promoting Effective Learning in Large Lecture Classrooms Educational Methods for Inverted-lecture Computer Science Classrooms to Overcome Common Barriers to STEM Student Success (Theme III), p. 21 Developing and Assessing Scientific Reasoning in First-Year Physics Lab (Theme III), p. 22 Concept Maps as a Student-Centered Approach for Teaching Photosynthesis to Undergraduate Students (Theme II), p. 22
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	<i>Towers 112</i>	Theme II: Promoting Effective Learning in Large Lecture Classrooms Towards Mastery of Material: Developing Students' Problem-solving Abilities in General Chemistry Using Cooperative Learning and Metacognition Enhancement, p. 23 Large-scale Use of Interactive Simulations in General Chemistry, p. 24 Implementation, Effectiveness and Transferability of SENCER Teaching Strategies in Chemistry, p. 24
	<i>Roush 114</i>	Theme III: Improving First-Year Experiences Interteaching: An Active Learning Approach for the STEM Classroom, p. 24 A Collaborative, Interdisciplinary Approach to Engage Undergraduate Students in a First Year Program, p. 25 Enriching Introductory Physics Courses with Programming Exercises Using Classic Video Games, p. 25
4:10 – 4:30	<i>Riley Auditorium</i>	Closing with Scott Freeman

Session Evaluations

Individual session evaluations are available at each venue in paper or online at <https://www.surveymonkey.com/s/OH-PKAL2015>

Post-conference Evaluations

The post-conference evaluation will be available immediately following the conference at <https://www.surveymonkey.com/s/OH-PKAL2015-Overall>

Ohio Project Kaleidoscope Inaugural Conference
May 16, 2015

8:30 **Opening**

8:45 – 9:45 **Plenary**
Scott Freeman, Speaker

Evidence-based Teaching and the Achievement Gap

Our research group has documented dramatic declines in failure rates, increased overall student performance, and an almost-50% reduction in the achievement gap experienced by students from disadvantaged backgrounds in introductory biology at the UW, as a course was transformed from a lecture-intensive to a lecture-free design. In addition, we recently published a meta-analysis of 225 papers that compared student performance under active learning versus lecturing in undergraduate courses across the STEM disciplines. The results indicate that on average, students are 1.5 times more likely to fail when being lectured to compared to taking the same course with an active learning component, and that active learning increases exam scores by almost half a standard deviation. This work is starting discussions among faculty internationally; the abstract has been downloaded over 72,000 times. Taken together, the results raise serious concerns about the ethics of traditional instruction—especially in light of active learning’s disproportionate benefit for under-represented minority students and women in male-dominated STEM fields.

Scott Freeman, Principal Lecturer, Biology—University of Washington

10:00 – 11:10 **Concurrent Sessions I**

Theme I: Meeting the Needs of Underprepared STEM Students
Science 104

10:00 – 10:20

The Benefits of Challenge Based Learning on STEM Students

Research has found that engineering programs have a higher attrition rate than any other program, with attrition rates exceeding 60%. High dropout rates in the colleges of engineering have been attributed to the cultural atmosphere of the institution. Students have reported a low sense of belonging and relatability to course material. To reduce negative experiences and increase motivation in K-12 classrooms, Apple Inc. developed the pedagogical technique, Challenge Based Learning (CBL). It is a structured model for course content with a foundation in earlier strategies, such as collaborative problem-based learning. CBL is different from project-based learning in that instead of presenting students with a problem to solve; it offers general concepts from which the students derive the challenges they will address. CBL activities offer many of the benefits of project-based learning, as they engage students in real-world problems and make them responsible for developing solutions. Using CBL, students have the satisfaction that comes from solving both the issue to be tackled and the solution they develop.

Whitney Gaskins, Visiting Associate Professor—University of Cincinnati

10:25 – 10:45

Strategies for Providing Holistic Support to Increase Retention and Graduation Rates of Underserved STEM Students

Demand for STEM talent continues to rise and many higher education institutions are experiencing increased STEM enrollment. Yet students are often woefully underprepared for

the rigors of STEM disciplines, especially those from underserved populations (i.e., first-generation, lower-income, racial and gender minorities, and non-traditional students).

Baldwin Wallace's Choose Ohio First STEM Scholars program is a proven approach to recruiting and graduating underserved students in STEM disciplines. This model is grounded in student development theory and provides holistic financial, academic, and social support framed in clear and consistent: (1) Expectations, (2) Support, (3) Assessment & Feedback and (4) Involvement.

STEM Scholars are intentionally connected with a community of learners, success coaches, experiential learning opportunities, existing on-campus resources, and are also immersed in a culture of problem-solving.

While three-in-four STEM Scholars are from underserved populations, program participants' four-year graduation rates are nearly double that of their non-participating peers. Learn how to adopt program elements at your institution.

Jacqueline Morris, Associate Professor of Biology; Director of Neuroscience Program; Stephanie Forstner, Director of STEM Student Initiatives, —both of Baldwin Wallace University

10:50 – 11:10

A Multifaceted Approach to Enhance STEM Student Success

The Columbus State Community College STEM Program takes a multifaceted approach to addressing the challenges faced by our STEM students. We provide structural support and engaging opportunities from the moment students are accepted into our program through their transition to a 4-year institution. We offer a two-week Bridge Program before the first semester, where we assess students' strengths and address deficiencies in writing, math, and core science disciplines. Students enroll in cohort classes for math, science, and science-related English composition and we track their academic progress with an Early Alert system. We also provide frequent individualized advising and mentoring. Our STEM Club introduces students to community resources, internships, careers in the sciences, and social engagement opportunities. Our students have the opportunity to share their growing STEM-related knowledge with middle and high school students who visit our science labs during one of our community outreach programs.

Adam Keller, Assistant Professor Department of Biological and Physical Sciences; Merideth Sellars, Assistant Professor Department of Biological and Physical Science; Laura Shady, Program Coordinator—all of Columbus State Community College

Theme II: Promoting Effective Learning in Large Lecture Classrooms Towers 112

10:00 – 10:20

Using Interactive Video Vignettes to Impact Student Learning in a Flipped Classroom Setting

One of the challenges in the flipped classroom setting is engaging students with course content outside of class. A possible solution is the use of interactive video vignettes (IVVs), a set of which are now available for selected topics in physics and biology (compadre.org/ivv). Vignettes are short video expositions that support textbook readings or serve as pre-lecture activities. They target a single topic for which students are known to struggle, and are therefore designed around principles of student learning, including elements of elicit,

confront, and resolve. Throughout each IVV, students make predictions, complete observations and/or analyses, and then compare findings to initial prediction(s) as a means of reflection. A sample vignette for Newton's Third Law will be discussed, along with evidence demonstrating its impact on student understanding as measured by the Force Concept Inventory. A freely available software tool for creating your own IVVs will also be presented.
Kathleen Koenig, Associate Professor STEM Education & Physics—University of Cincinnati

10:25 – 10:45

Implementing Peer Instruction in a Large (N > 300), Flipped, General Chemistry Classroom

Sal Khan's TED Talk titled "Let's use Video to Reinvent Education" encouraged many instructors to flip their classrooms. In its simplest form, the students in a flipped classroom watch traditional lectures for homework and do traditional homework in class in the presence of a content expert. Much attention has been given to the lecture videos due to the title of Khan's talk. However, instructors executing a flipped classroom should shift their focus from lecture videos to ensuring students are actively engaged.

One such method of active engagement is peer instruction. Peer instruction has the largest benefit for a student when the student first answers questions individually, and when that student feels ownership of his or her answer, the answer is discussed with groups of classmates (PHYS. REV. ST PHYS. EDUC. RES 10, 020113 (2014)). This presentation highlights the best practices of peer instruction in the flipped classroom which can be applied to all courses and disciplines.

Matthew W. Stoltzfus, Senior Lecturer, Chemistry & Biochemistry—The Ohio State University

10:50 – 11:10

Using Learning Catalytics in a Flipped Classroom for Algebra-Based Physics

In this talk, I will describe how Learning Catalytics is used in a flipped classroom for Algebra-Based Physics. The class of 135 students meets in a tiered classroom twice per week for two hours. Over the preceding weekend students spend approximately 2 hours reading the text, taking short multiple choice conceptual quizzes, and viewing videos covering the material. In class, students use Learning Catalytics to work through homework problems in groups, guided by the instructor and one learning assistant. Learning Catalytics is a modern Personal Response System which allows graphical, numerical, short answer and algebraic inputs in addition to classical multiple choice questions. We find substantial improvements in student success on both conceptual and formal questions on tests by comparing students in the flipped classroom to twice as many students in standard classes taking the same tests. We acknowledge the support of NSF DUE 1022563.

Leigh Morris Smith, Professor of Physics—University of Cincinnati

Theme III: Improving First-Year Experiences

Roush 114

10:00 – 10:20

Evaluating the Use of Adaptive Courseware to Improve the First Year Experience in STEM Courses

Research demonstrates that blended learning increases active participation and student engagement. Adaptive Learning technology was implemented in a first-year Anatomy and Physiology course. Components of the program include weekly reading, quiz assignments with unlimited attempts at completion, linked text flash cards with student self-evaluation of understanding (I know it: I think I know it: I am unsure: No idea), video lectures,

demonstrations, and virtual labs. Our study evaluates the use of this data-driven approach to learning by evaluating student engagement, content acquisition, and subject matter mastery in Anatomy and Physiology.

Methods: Study participants include n=102 undergraduate nursing students taking freshman-level Anatomy and Physiology. SPSS Statistics (version 22) was used to analyze data collected through McGraw Hill's 'Connect' adaptive learning, cloud-based software.

Kimberly Loscko, Associate Professor; **Darrell Spurlock**, Associate Professor; **Heather C. Houchard**, Instructor and Math/Research Learning Coach—all of Mount Carmel College of Nursing

10:25 – 11:45

STEM-LLC: Lessons from a First-Year Learning Community

The STEM-Leadership Learning Community was designed for students who wished to pursue the natural sciences or medicine, but whose background indicated they were likely to benefit from additional resources and alternative approaches to maximize success. During their first semester at Denison, students in this learning community enrolled concurrently in specially designated sections of Essentials of Calculus, taught in a flipped-classroom format, and introductory chemistry, Atoms and Molecules, which incorporated a guided-inquiry component. Students also participated in additional work that provided extra support and enrichment through a Building Community course. Having completed two iterations of this experience, we will share some preliminary outcomes, student responses and lessons learned.

Kimberly M. Specht, Associate Professor of Chemistry & Biochemistry; **Lewis D. Ludwig**, Associate Professor of Mathematics and Computer Science—both of Denison University

Theme IV: Improving Upper-Level STEM Experiences and Theme I: Meeting the Needs of Underprepared STEM Students Riley Auditorium

10:00 – 10:20

Guided Group Work in the Junior to Graduate Level in the OSU Physics MS-PhD Bridge Program (Theme IV)

As part of the OSU Physics MS-PhD Bridge Program, we have developed guided group work material to accompany junior/senior undergraduate physics courses (electricity and magnetism, quantum mechanics, classical mechanics), as well as graduate quantum mechanics. Group work is well established in senior undergraduate courses, but much less common at the graduate level, and the challenges of incorporating it there are discussed. We also discuss tactics to increase participation particularly on the part of at-risk students, as well as the overall population. These tactics often led to attendance of this purely optional session that was on the order of 50% of the class. This program is in its second year, but this is the first year it has been extended to the graduate level. Data are still being collected. We present examples of material used, sample student feedback, and preliminary data on the gains students demonstrated from one week to the next.

Christopher Douglas Porter, Postdoctoral Researcher—The Ohio State University

10:25 – 10:45

A Guided Inquiry-Open Inquiry Approach in the Physical Chemistry Laboratory (Theme IV)

The physical chemistry laboratory course at Baldwin Wallace University is a one-semester course requirement for all chemistry majors. The two laboratory investigations in this course are a combination of guided inquiry and team-based research project, both in the area

of chemical kinetics. The advanced open-inquiry investigation builds upon the skills and knowledge garnered from the guided inquiry.

One investigation employs the kinetic modeling program, Kintecus, in studying complex reaction mechanisms. Student teams first complete a guided inquiry focused on a simple two-step reaction mechanism for the atmospheric degradation of ozone. Using only the inputs of the elementary processes, associated rate constants and initial concentrations of chemical species, students are able to generate reaction profiles at a specified temperature.

Student teams then propose, design and thoroughly investigate a reaction and mechanism of interest. The design characteristics of the investigation are left to individual teams. At a minimum, the proposed investigation must have a significant environmental theme and demonstrate depth. Student ratings of the laboratory experience indicate mixed results for the guided inquiry-open inquiry approach.

James McCargar, Professor of Chemistry—Baldwin Wallace University; Robert F. Hansen, Research Fellow, Department of Chemistry—University of Leeds

10:50 – 11:10

An Intrusive Advising Model to Enhance Retention of STEM Majors (Theme I)

In 2007, Miami University received an award from the National Science Foundation to enhance retention in the biological sciences among students from underrepresented groups. The programming included targeted recruitment by partnering with the Office of Admissions, development of curricular offerings to provide academic support, and placement in research labs. Central to the success of the goal of retention was a pro-active/intrusive advising approach, which was embedded in all the programming as well as through a dedicated assistant director of the program. Close monitoring of student grades, frequent one-on-one meetings, monthly meetings in workshop formats, and monthly reporting, allowed close contact with the students, and provided opportunities for professional and career development. Several elements of the programming are being adopted across the institution. During the 7 year duration of the award, 39 students were engaged in the program, and 79% of them were retained in the four biological science majors represented.

Bonita Porter, Project Director of LSAMP; Joyce Fernandes, Professor of Biology; Phyllis Callahan, Dean, College of Arts and Science, and Professor of Biology—all of Miami University

**11:20 – 12:10 Posters
 Science Atrium**

Theme I: Meeting the Needs of Underprepared STEM Students

Poster 1: Whole-to-Part (WTP) Approach to Improve Special Visualization Skills Using Computer Aided Design Model Simulations and Hand-Held 3-D Objects

Engineering Drawing and Computer Aided Drafting (CAD) are common subjects across engineering disciplines. One of the major goals of Engineering Drawing or CAD is to develop or improve special visualization skills, which is critical as this ability has been connected with success in engineering problem solving. Community Colleges are creating pathways for engineering students by preparing them for skillful-workforce and university education. These students are mixed-skilled students including underprepared students, and therefore are required to develop instructional methods to bridge the skill gap and improve the special visualization skills in Engineering Graphics courses. Further, recent engineering curricular revisions reduced the total number of credits to graduation and traditional graphical instructions are squeezed and emphasis has been given to the 3-D CAD. Creative efforts to design suitable learning tasks have been implemented through the Whole-to-Part approach

by using CAD packages with animations and 3-D hand-held objects to improve the special visualization skills.

Punya A. Basnayaka, *Assistant Professor, Department of Mechanical Engineering—Cuyahoga Community College*

Poster 2: Mathematics for Chemistry

Students were not mathematically prepared for the Chemistry I course despite an Algebra prerequisite for the Chemistry course. Chemistry instructors spent time teaching the necessary mathematical skills and, as a result, the chemistry content of the course suffered. The Chemistry and Mathematics departments worked together to determine the required math skills for Chemistry. The result was some rearrangement of the Chemistry topics and creation of a one credit hour MTH 095 “Mathematics for Chemistry” course to review prerequisite math skills. Students, who do not pass a short math test, take MTH 095 during the first half of the semester in which they are enrolled for Chemistry I. The topics in the two courses are arranged so that math topics are reviewed before they are needed in the Chemistry course.

Mary A. Bergs, *Assistant Professor of Mathematics*; **Barbara A. Stoos**, *Dean of Science and Mathematics*; **Lakshmi Dalwala**, *Assistant Professor of Mathematics—both of Mercy College of Ohio*

Poster 3: A Learning Community between Introductory Biology and First Year Seminar for At-Risk Students

A learning community between an introductory majors-level biology course and first year seminar (FYS) was designed for students with an ACT score of 18 to 23 and/or high school GPAs below 3.0. The goal was to integrate STEM study skills into the FYS course, as well as to provide additional contact with the biology faculty member to improve performance in the biology course and retention at the University. In the FYS course, students reviewed exams to identify areas of strength and weakness, performed content-specific exercises on reading the textbook and note taking, and worked on scientific writing skills. Of the 17 students enrolled in the learning community, 15 (88%) completed the biology course, all of whom passed. Of those 17 students, 15 (88%) returned for the 2013-2014 academic year, a 20% improvement over the overall 68.3% retention rate for first to second years for the institution.

Shelley E. Amstutz-Szalay, *Assistant Professor of Biology—Muskingum University*

Poster 4: The Transformative Games Initiative: Blending Undergraduate Research with Games-Based Learning

The National Council for Undergraduate Research encourages faculty to mentor students or infuse classrooms with research-like experiences. However, faculty members are typically overwhelmed with requests for mentorship, and student-faculty interests do not always align. The Transformative Games Initiative provides students with opportunities to design games for education, behavioral intervention, or social impact. The design of each game is rooted in the Learning Sciences. Games are excellent learning management systems that are capable of teaching and assessment. Many games were designed to benefit matriculating freshmen who are underrepresented in STEM and who might be the first in their family to attend college. An iterative design-based research program was developed to answer the following foundational questions: (1) What can be learned about the process of learning by blending game-based learning with undergraduate research; (2) What skills can be taught; and (3) What data need to be collected to assess learning outcomes?

Robert O. Duncan, *Assistant Professor of Behavioral Science—York College of The City University of New York*

Poster 5: Operation STEM for PreCalculus

At Cleveland State University, we have an NSF-STEP grant to help increase the number of graduates in STEM. This presentation discusses our activities targeting students entering CSU who place into our Precalculus I class. Our interventions include a Summer Bridge Program, Mandatory Supplemental Instruction for all students, Project-Based Learning, Calculus for Free and a Research Preparation Course. We will discuss the successes and challenges of each of these approaches.

John P. Holcomb, Chair, Department of Mathematics—Cleveland State University

Poster 6: Learner Self-Assessment with Math Machines

“Math Machines” began in 1995 as an active-learning math-science-technology collaboration within a major grant to Sinclair Community College from NSF’s Advanced Technological Education program. Although initially targeting Sinclair’s two-year engineering technology programs, the methodology has expanded into other programs at Sinclair. The methodology, curriculum, software and equipment have also “spun-off” to produce an independent, non-profit organization, Learning with Math Machines, which has provided dozens of workshops for secondary school and community college faculty. A key distinguishing feature of Math Machines is the role of low-cost equipment in providing learners with immediate, dynamic, physical feedback about their work WITHOUT explicitly telling them if their answers are “right” or “wrong” and without giving them the “right” answer. In addition to answering the familiar question, “When am I ever going to use this?” the approach is effective in encouraging groups of learners to persist longer in their search for solutions.

Frederick J. Thomas, President—Learning with Math Machines, Inc.; Robert A. Chaney, Professor of Mathematics—Sinclair Community College

Theme II: Promoting Effective Learning in Large Lecture Classrooms

Poster 7: Active Learning Impact on Student Attitudes Toward Chemistry in General Chemistry

The spring semester Chemistry 111 course at Case Western Reserve University contains a mix of students who are retaking the course after an unsuccessful attempt and those students whose schedules have prevented them from taking the course on sequence. Because of the percentage of students retaking the course, it is generally assumed that the majority of students in the class will begin the semester with a negative attitude toward the subject of chemistry. We have studied the impact of active learning on the attitudes of these students throughout the semester using the attitudes toward the subject of chemistry inventory (ASCI). Active learning in the course consisted of a mixture of in class activities focused on presentation of new material and activities centered on development of problem solving skills. Results are compared to students who performed active learning in a large lecture course for pre-med students and a “flipped” summer organic chemistry lab course where students derived their own procedures.

Drew A. Meyer, John Teagle Professorial Fellow in Chemistry and Instructor; Rekha Srinivasan, Instructor—both of Case Western Reserve University

Poster 8: Implementation of Evidence-Based Instructional Practices in Multiple Levels of a Biological Sciences Curriculum

We discuss data collected from the implementation of evidence-based practices across a variety of biology courses at Northern Kentucky University, a regional metropolitan campus. Problem-based team learning strategies were employed in an entry-level 100+ student Introduction to Biology course, a sophomore-level 50+ student Genetics course, and upper-level 20-30 student courses in Evolution, Advanced Cell Biology, and Cancer Genetics. Increases in attendance, student motivation, and pass rates have been observed. Additional data on successes, student impacts and impressions are considered within each course and as cross comparisons. Future goals include incorporation of additional components to increase success for under-prepared and minority students.

Bethany Bowling, Associate Professor of Biological Sciences; Erin Strome, Assistant Professor of Biological Sciences—both of Northern Kentucky University

Poster 9: Enhancing Faculty Engagement and Student Learning in Foundational STEM Courses at a Large Public University

We present preliminary efforts of an NSF-supported multi-disciplinary program to enhance learning in foundational STEM courses. A central theme, supported by evidenced-based research across the STEM disciplines, is that active learning engages students in ways that enhance student learning. A secondary theme is that sustained use of active learning techniques by faculty needs a supportive local culture. We describe our initial efforts with the use of Teaching and Learning Liaisons, faculty members trained in research-based instructional strategies in order to lower the barriers for faculty to try new active learning strategies, and to ensure that these faculty carry out the strategies with fidelity. A collection of faculty across the STEM disciplines of Biology, Chemistry, and Physics are participating; we will compare initial activities by these departments. A supportive culture for these faculty was provided by meeting sponsored by department heads. We acknowledge support from the National Science Foundation (DUE 1022563).

Howard E. Jackson, Professor of Physics; Kathleen Koenig, Associate Professor of Physics—both of the University of Cincinnati

Poster 10: Lessons Learned Teaching General Chemistry via Video Teleconference

Teaching General Chemistry via a video teleconference format offers both challenges and opportunities that are unique to both the class format and the topic content. A video teleconference offering of a General Chemistry course can be a highly positive learning experience; the instructor need only approach the course with careful consideration of all of the potential advantages and potential pitfalls. Through our experience we have learned how to leverage the videoconference format, exploiting associated technologies, to actually advance student learning. We would like to offer insights and associated evidence from our experiences teaching General Chemistry via video teleconference.

Regan L. Silvestri, Assistant Professor of Chemistry—Lorain County Community College

Poster 11: Lessons Learned from Distance Learning Laboratories in Physics

A need for distance-learning (DL) laboratories led us three years ago to design and implement the first DL lab experience in Physics at Kent State University, providing a great opportunity to design a new course with a new perspective. This summer, the course was revamped based on students' evaluations and experiences. The course involved several modes of activity for students, including our first remote-access labs, where students work from home to control computers in the Physics building and use them to conduct actual experiments, not simulations.

Jon Secaur, Assistant Professor of Physics—Kent State University

Poster 12: A Case Study on Effective Technology Integration to Math Classroom Using MyMathLab Learning Environment

Most of the research studies on technology-infused math education emphasize only the technical aspect of learning mathematics, which involves mathematical activities and procedures that lead to numerical computations, solving equations, using diagrams, and collecting and sorting data (Borwein, 2005). This research evaluates the success of MyMathLab instrumental implementation to the learning process while solving math problems. Results of this research study will shed light on the efficacy of such technology in computer-assisted instruction compared to traditional (face-to-face) instruction of mathematics in developmental classes.

Adam Chekour, Assistant Professor of Mathematics—University of Cincinnati - Blue Ash College

Poster 13: Aligning the Learning of Science with the Nature of Science in Large Lecture Classrooms

This presentation is based on a collaborative project between the worlds of science and science education. It looked to improve student achievement and experience in two separate large lecture courses by aligning the learning of science with the nature of science. By adding more inquiry-based methods, students were provided with opportunities to engage in scientific thinking instead of the more traditional consumption of scientific facts. The focus of the organic chemistry course was on learning the content with the ability to apply it to novel situations. The focus of the physical science course was developing understanding of the content in a manner consistent with how they are expected to teach. By forcing students to engage, struggle, question, explore and build their own understanding of the content, they also develop a broader and deeper understanding of the nature of science.

Scott A. Sander, Science Education Clinical Faculty, Department of Teacher Education; Dominik Konkolewicz, Assistant Professor, Department of Chemistry and Biochemistry—both of Miami University

Theme III: Improving First-Year Experiences

Poster 14: Student-Led Supplemental Instruction (SI) as an Adjunct Learning Tool in First-Year Biology Courses

Supplemental Instruction (SI) is a peer-led collaborative learning program for increasing student success and retention in historically challenging entry-level courses. The SI program targets courses in which 30% or more of students receive a final course grade of D, F or W. Participation in SI sessions is voluntary and open to all enrolled in the course. SI sessions were implemented for a two-semester sequence, introductory biology course at Capital University. Attendance at each SI sessions was recorded, tracked by the office of academic success, and compared each semester with final course grades. Student t-tests show significantly higher course grades for SI attendees (2.59 for semester I and 2.94 for semester II) compared to students who never attended SI (2.02 for semester I and 2.35 for semester II). Although SI attendance reduced the D/F/W rate for semester I, it did not reduce the D/F/W rate for the second semester.

Kimberly Heym, Senior Lecturer, Biological Sciences; Kerry L. Cheesman, Robert M Geist Professor, Biological Sciences; Bruce Epps, Director of Academic Success—all of Capital University

Poster 15: Fearless Investigators: Teaching a General-Education Science Course Through Experimental Design

In Otterbein University's new general education course entitled "Fearless Investigators: How to Ask Questions About Energy," students design experiments to investigate energy-related phenomena. Whole-class discussions follow each experiment, in which students present

experimental designs and results to one another and critique one another's experimental approaches. When serious experimental design flaws are identified or a clear consensus does not emerge, students design and conduct fresh experiments. In a culminating project, students investigate a "sustainable" power system for human use. The course explicitly targets experimental design as well as energy content-related outcomes. Students are offered multiple and varied opportunities to demonstrate understanding of each outcome. Conceptual understanding gains are measured via research-validated pretest/post-test questions, and scientific reasoning gains are measured via pretest/post-test gains on the Lawson Test of Scientific Reasoning. We describe the course, present pretest/post-test gains, and discuss ongoing progress in course development.

Robin E. Grote, Assistant Professor of Chemistry; Paul J. Wendel, Assistant Professor of Education—both of Otterbein University

Poster 16: Peer Supported Programs to Enhance Learning in Introductory Chemistry Courses

For the past 10 years, Muskingum University has used undergraduate peer leaders in a variety of ways to attempt to improve learning outcomes of students in general chemistry I and II and in the nursing chemistry course, organic and biochemistry. The initiation of peer programs began with the NSF-supported Workshop Project Associates (WPA) grant we received for the 2004-2005 academic year to incorporate Peer-Led Team Learning (PLTL) workshops into the two semesters of general chemistry. We followed the PLTL model for 6 years, but this was not a financially sustainable model for our institution, and since 2010, we have moved to "leaner" versions of peer-supported programs. Information presented will include the nature of these peer programs as well as the extent of success of these supplementary learning opportunities for our students.

Paul S. Szalay, Professor of Chemistry; Lois A. Zook-Gerdau, Associate Professor of Chemistry; Deepa Perera, Associate Professor of Chemistry; Eric Schurter, Associate Professor of Chemistry—all from Muskingum University

Theme IV: Improving Upper-Level STEM Experiences

Poster 17: Teaching Matters: Undergraduate Grant Writing

Little literature on grant writing courses/assignments in undergraduate education exists. To gather data and best practices, a semester long undergraduate grant writing assignment was developed as an introduction to the grant writing process. This assignment was tested in both a seven-week advanced biochemistry laboratory setting and semester long advanced biochemistry lecture course. The goal of the assignment was to progress student learning from passive to active engagement as the students developed their own solutions to self-identified problems in biochemistry using primary literature. To achieve this goal, scaffolding of assignments, graded rubrics for all drafts, peer reviews and one-on-one meetings were utilized. Assessment of the assignment was completed using student evaluations, unsolicited emails, student writing samples, student peer reviews/reflections, and research faculty assessment of their students. Conclusions drawn from these various areas demonstrated that students were better prepared for research, had improved scientific communication skills, and had developed real world skills.

Keith R. Miller, Assistant Professor of Biochemistry—University of Mount Union

Poster 18: Brown Bag Sessions: Improving STEM Student Success in Collaborative Research

Nursing students at a mid-western state university have the opportunity through a competitive selection process to be awarded as a Choose Ohio First Nursing (COFN) Scholar. The COFN scholars are an elite group of nursing students that are entering into and successfully completing STEM courses. Students in the STEM field need to have a

ubiquitous learning environment that would allow them to grow in the research field with evidence-based practice. An Evidence-Based Practice Seminar (EBPS) was held that revealed a need for a faculty-guided practice and more structured opportunities for collaboration. In response to this need a series of brown bag lunch sessions were developed to guide student's progress throughout the process of developing an evidenced-based research poster for professional presentations.

Sherleena Buchman, BSN Coordinator, Assistant Professor of Nursing; Chad Kopenski, Academic Advisor—both of Ohio University

12:25 – 1:25 Lunch and Roundtables Clements Recreation Center

Theme I: Meeting the Needs of Underprepared STEM Students

Table 1: STEM Experiences through an NSF Project: Hands-on and Games

The Boat of Knowledge in Science Classroom (BookS), a NSF-funded STEM project, took high school students for on-boat water sampling trips in the Ohio River and two tributaries (the Muskingum River and the Kanawha River). Graduate students and high school teachers collaboratively developed lesson plans for these trips. High school students were excited to conduct real-world research in their backyards, and through sampling discovered many water quality problems. In addition, graduate students developed a “virtual boat,” a computer game, to simulate on-boat sampling for STEM classroom teaching when the physical boat is not in use. Hands-on and computer gaming experiences for STEM education will be discussed.

Tiao J. Chang, Professor of Civil Engineering—Ohio University

Table 2: Bridge in STEM Disciplines: From the Community College to Four Year Colleges, Universities, and Beyond

Over the past seventeen years, faculty at Cuyahoga Community College (Tri-C, Cleveland OH) have successfully facilitated the transfer of students majoring in STEM disciplines to four-year academic institutions in Ohio. This has been accomplished with continuous funding provided by the National Institute of General Medicine, a branch of the National Institutes of Health (NIH). Over this period, Tri-C has partnered with research faculty at several Northeast Ohio institutions to provide research experiences and mentoring for underrepresented students in the STEM disciplines. In addition, these students are mentored by six Tri-C faculty, with whom regular meetings and programs are scheduled throughout the academic year and the summer. This roundtable will provide discussion of how six faculty at Tri-C have successfully accomplished this for seventeen years. We will highlight some of the students who have gone on to achieve advanced degrees in STEM disciplines. We will also discuss the internal and external collaborations necessary for a successful program. We will discuss our most recent funding from NIH for the period of 2015-2020.

Ormond D. Brathwaite, Professor of Chemistry; Geza Varhegyi, Assistant Professor of Biology; Alexandria Custer, Assistant Professor of Biology—All of Cuyahoga Community College

Table 3: Does Homework Still Play an Integral Role in Developing Mastery of STEM Disciplines?

In this roundtable discussion we would like to explore thoughts and innovative approaches to integrating homework into a comprehensive plan for teaching STEM courses.

Questions for which we will seek answers include:

- Is homework important or even necessary?

- Should it be done on paper or on-line?
- How should homework be evaluated?
- What attitudes do you find among your students concerning homework?
- Is your approach similar to that of your colleagues?
- Did homework play an important role in your STEM education?
- What motivated you to put in the time and effort to complete homework assignments?

Ralph Kemphaus, Mathematics Instructor—University of Cincinnati, Blue Ash

Table 4: Preparing Underprepared STEM Students for Success

The objective of this roundtable is to share strategies that will better prepare underprepared students in the STEM disciplines for success. Several recommendations will be outlined which will increase the level of engagement with underprepared students in the STEM disciplines and subsequently prepare them for success.

These include:

- increase relevance
- use group work
- assign real-life-based projects
- use some flipped classroom techniques

Jordan Jimmy Crabbe, Assistant Professor of Mathematics—University of Cincinnati, Blue Ash College

Table 5: Methods to Improve Performance of Students with Weaker Math Skills in an Algebra-based Physics Course

In order to enhance student success in an algebra-based physics course, we use ALEKS, an adaptive online mathematics tutorial engine, before the term begins. Approximately three to four weeks before the beginning of the term, an email is sent to all of the students in the course informing them of the possibility of improving their math proficiency by using ALEKS. Using only a minimal reward on homework, we have achieved a 70% response rate with students spending an average of 8 hours working on their math skills before classes start. For students who came to the University of Cincinnati unable to get into calculus, the use of ALEKS reduced the DWF rate in the algebra-based physics course from 52% to 12%. We acknowledge the support of NSF DUE 1022563.

Leigh Morris Smith, Professor of Physics—University of Cincinnati

Table 6: Factors Contributing to Gender Gaps in Undergraduate Information Technology Programs

Despite the continued growth of female participation in higher education, their success in science, technology, engineering, and mathematics (STEM) programs is significantly lower than for males. Women have surpassed men in graduation rates in many academic programs, yet they lag in some STEM programs. In particular, they are significantly underrepresented in Information Technology programs. In this increasingly technologically advanced world, women's underrepresentation in Information Technology is widely considered as one of the bottleneck issues in women's advancement. This roundtable will present several important factors that contribute to the gender gap in Information Technology undergraduate program and will suggest strategies to address the issue.

Bilquis Ferdousi, Associate Professor of Information Technology—University of Cincinnati Clermont

Table 7: Employing Academic Tools and Technology as an Intervention Model for Improving Enrollment and Success of Underprepared Freshmen Students in STEM

Wilberforce University traditionally educates underserved populations. Students entering the University generally display deficits in STEM areas. Selection criteria of most

institutions would deny such students admission for failure to satisfy minimum credit hour or required math and science courses. Therefore, an intervention is needed to address this unmet need and also contribute to improved enrollment, retention and persistence of students in STEM. To this end, math and science records for entering students were analyzed. Results revealed most students did not satisfy course work in STEM areas. And, when placement test (Accuplacer) results were compared to college admission tests, they were well correlated. Accuplacer results were utilized to provide course placement: This method was found to be a successful intervention tool to predict student matriculation. In addition, when tracked into a gateway STEM course – e.g., physical science, results from Student's t-test showed statistically significant improvement in students' performance.

Freddie L. Jordan, Assoc. Dean, Professional Studies Division and Chemistry Faculty; **Francis J. Mozu**, Biostatistics Faculty; **Natalie A. Hollinger**, First Year Experience Instructor /Lab Coordinator—all of Wilberforce University, Wilberforce OH.

Table 8: Using real cadaver specimens at a STEM event: Is it appropriate for everyone?

Using real cadaver specimens (wet or plastinated) at a public STEM event where the audience ages can range from 5yrs-65yrs. can be a bit unnerving to some, especially the smaller kids. Is there an ideal age where real specimens are appropriate to use over models?

Seth Gardner, Assistant Professor of Biology—Bowling Green State University Firelands Campus

Theme II: Promoting Effective Learning in Large Lecture Classrooms

Table 9: My Smartphone Makes Me Smarter

Students using mobile devices have access to an unbelievably vast and ever-growing body of knowledge. However, while personal technology affords access to a multitude of educational Internet resources, it also provides persistent connections to social media, games, entertainment, and other diversions. How can teachers keep these students engaged? In this presentation, we discuss recommendations to deal with the daunting challenge of engaging students distracted by personal technology. Instead of disallowing mobile devices in the classroom, we offer suggestions to leverage students' personal technology to enhance the classroom experience. We will address best practice approaches to texting during lectures, social media, academic dishonesty, and electronic communication etiquette. The roundtable will be conversational and interactive, encouraging participants to contribute their experiences and concerns.

Jerry Schnepf, Assistant Professor of Visual Communication Technology-- Bowling Green State University

Table 10: A High Score on Online Homework does not mean a High Examination Average

During the past decade, we have used online homework software as a pedagogical tool for undergraduate students in our general chemistry courses (students are mainly freshman), in our GOBs (students are mainly freshman), and in our organic chemistry courses (students are mainly sophomores), all large lecture classes (100 to 500 students). Being strong proponents of homework, we were surprised to find that about half of the students who accurately complete 90% or more of the online homework assignments received D or F grades on the examinations. In order to eliminate examination bias, a comparison also was made of the online homework scores with questions answered correctly on the ACS standardized examinations. A similar trend was observed. We will share graphs of student performance

and will suggest several possible reasons for the poor correlation between online homework and examination scores.

Allan Pinhas, Professor of Chemistry; Anne Vonderheide, Assistant Professor of Chemistry Educator—both of University of Cincinnati

Theme III: Improving First-Year Experiences

Table 11: Facilitate Student Learning using a “Flipped Classroom” Method

This presentation discusses how a “Flipped Classroom” inverts traditional teaching methods. Course materials and lectures are sent to students through Power Points ahead of class so that students go through the material before class and spend class time in answering students’ questions and dealing with their difficulties. As a result, students participate in problem solving and focus on mathematical concepts and processes to improve student engagement and mathematical understanding. This method aids in reducing math anxiety and helping students become independent learners, aka “Math Selfies.” The technique is named “Flipped Classroom” because what used to be homework is now done in class and delivery of content through Power Points is facilitated by students at home.

Premjit Singh, Associate Professor of Mathematics—Ohio University

Theme IV: Improving Upper-Level STEM Experiences

Table 12: Using the POGIL strategy

Process Oriented Guided Inquiry Learning (POGIL) is a student-centered, active learning strategy used in many STEM classrooms, both high school and university, all over the country and world. This roundtable discussion will include a brief description of the POGIL philosophy and available materials and a more thorough discussion of different methods of implementation of the strategy in different settings. The leader of the roundtable uses POGIL in multiple classes, has published data about its efficacy, and is a POGIL workshop facilitator. However, it is hoped that many members of the roundtable will have stories to share and questions to ask.

Tracey Arnold Murray, Associate Professor of Chemistry and Biochemistry—Capital University

1:40 – 2:40 Contributed Theme Sessions

Science 104

Creating Environments that Enhance Retention in STEM

Since 2007, Miami University has received three NSF awards aimed at serving underrepresented student groups. Two awards, S-STEM (scholarships in STEM; Chemistry) and URM (Undergraduate Research and Mentoring; Biology) overlapped in their award duration, providing opportunities for programming synergies, and identification of practices that are successful for student retention in an institutional context. Both programs provided scholarships and engaged students as a community. A strength of the S-STEM program was academic support through study sessions, while the URM program used mentored research experiences to encourage the development of technical skills. The URM program also developed mechanisms to recruit students from underrepresented groups by collaborating with the Admissions Office, allowing for interactions with teachers and counsellors from high schools, which raises awareness about preparation for College. A recently awarded LSAMP award (Louis Stoke Alliance for Minority Participation) includes Engineering majors, and builds on the successes of the prior awards.

Joyce Fernandes, Professor of Biology; Richard Bretz, Assistant Professor of Chemistry and Biochemistry; Bo Brinkman, Associate Professor of Computer Science and Software

Engineering; Christopher Makaroff, Associate Dean and Professor of Chemistry and Biochemistry; Phyllis Callahan, Dean, College of Arts and Science and Professor of Biology—all of Miami University

Towers 110

Introductory STEM Teaching, Learning, & Culture: Data for Self-Evaluation

Presenters will describe the design and preliminary results of a study of introductory STEM teaching, learning, and culture at a comprehensive university. The study aims to examine strengths and weaknesses of the introductory STEM experience to identify areas for strategic reform. The interdisciplinary team, including STEM faculty and the Director of the Center for Teaching and Learning, employs a rigorous, mixed-method design to understand the current state of practice, culture, and learning from the perspective of both faculty and students. Presenters will also describe nascent efforts to promote interdisciplinary faculty learning communities. In addition to reporting preliminary data, facilitators will describe challenges that have been encountered, such as difficulties in selection and application of validated instruments and efforts to coordinate faculty across disciplines. During the session, participants will be asked to reflect on reform efforts at their home institutions and discuss obstacles and solutions they may face in similar efforts.

Paul J. Wendel, Assistant Professor of Education; Anna M. Young, Assistant Professor of Biology & Zoo Science; Kathryn Plank, Director, Center for Teaching and Learning; Joan M. Esson, Associate Professor of Chemistry—all of Otterbein University

Towers 112

S-STEM: Increasing STEM Student Recruitment, Retention and Success at Ohio Universities

Presenters from multiple institutions throughout Ohio will share the design, implementation, and assessment of their Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) programs, funded by the National Science Foundation. These programs are designed not only to provide scholarship money for selected students, but also supportive experiences, such as STEM specific orientations or bridge programs, STEM living-learning communities, peer mentoring programs, alumni mentoring programs, research opportunities, and career-related activities, among others. The main goals of S-STEM programs are to improve educational opportunities and support programs for students and increase the retention of STEM students. Audience members will not only learn about these programs, including strategies for design and assessment, pitfalls and successes, but also be invited to reflect on how resources could be leveraged at their institutions to develop programs that support STEM majors.

Joan M. Esson, Associate Professor of Chemistry, Otterbein University; Teresa J. Cutright, Associate Professor of Civil Engineering—The University of Akron; Leah H. Gold, Associate Professor of Mathematics—Cleveland State University; Kevin P. Hallinan, Professor of Mechanical and Aerospace Engineering—University of Dayton; Laura Bistrek, Coordinator, Minority and Women-In-Engineering Program—University of Dayton; Anant R. Kukreti, Director for Engineering Outreach and Professor—University of Cincinnati; Temesgen Aure, STEM Program Coordinator, Department of Biomedical, Chemical and Environmental Engineering, College of Engineering and Applied Science—University of Cincinnati; Valerie L. Young, Associate Professor and Chair, Department of Chemical and Biomolecular Engineering—Ohio University; David Juedes, Professor and Chair, Department of Electrical Engineering and Computer Science—Ohio University; Holly J Raffle, Assistant Professor, Voinovich School of Leadership and Public Affairs—Ohio University.

Roush 114

Assessing Quantitative Skills Preparedness and Learning

Quantitative reasoning and graphical, statistical, mathematical skills are essential for participating in 21-century science and interpreting data important for many aspects of daily life, underscoring the need for reliable measures of proficiency for our students. This session aims to highlight national efforts in quantitative skills assessment as well as measures being taken at Oberlin College, and hopes to address process and adaptation at a variety of institutions. Oberlin's Howard Hughes Medical Institute (HHMI)-funded science education program has a focus on the development of quantitative skills, and toward that end we have developed an assessment strategy based on two key instruments: the Quantitative Literacy and Reasoning Assessment (QLRA, developed Eric Gaze, Bowdoin, and co-workers, NSF supported) and BioSQuaRE, a biology-specific instrument in development with six other HHMI-funded institutions. In this session we will report on our progress with these instruments and the broader context of quantitative skills assessment.

Marcelo Vinces, Director, Center for Learning, Education and Research in the Sciences; Jason Belitsky, Associate Professor of Chemistry and Biochemistry; Nancy Darling, Professor of Psychology—all of Oberlin College

Riley Auditorium

The Impact of Learning Style Preferences on STEM Course Performance

This interactive session will showcase instrumentation, linking instructor and student learning preferences with the design and delivery of STEM coursework. This session utilizes and incorporates findings of a Franklin University research study on entry level statistics students. We will discuss the possible classroom impact of different types of mathematics learning disabilities.

Raymond L. Forbes, Chair, MS in Business Psychology; John S. Brent, Chair, Applied Psychology Program, Xiaopeng Ni, Faculty, International Institute for Innovation in Instruction—all of Franklin University

2:50 – 4:00 Concurrent Sessions II

Theme III: Improving First-Year Experiences Science 104

2:50 – 3:10

Educational Methods for Inverted-lecture Computer Science Classrooms to Overcome Common Barriers to STEM Student Success

Wright State University has implemented an adaptation of a successful students-with-disabilities model to be used with other underrepresented, as well as general, student populations. This project utilizes a Student Centered Active Learning Environment with Upsidedown Pedagogies (SCALE-UP) teaching model to address non-technical barriers that prevent underrepresented groups from progressing through a STEM discipline. Made free from the burden of simply lecturing in the traditional manner, classroom time is now used to overcome specific obstacles to student success through targeted group active/collaborative learning (ACL) activities. This project introduces specific in-classroom ACL activities designed to help overcome psychosocial, STEM identity, and other non-technical barriers to success among vulnerable student populations. The project is being evaluated on increased retention and success in STEM majors and improvement of measurable educational outcomes, including technical skills.

Kathleen M. Timmerman, Doctor of Philosophy Candidate, Computer Science and Engineering; Michael Raymer, Associate Dean for Research and Graduate Studies, College of Engineering and Computer Science; John Gallagher, Professor of Computer Science and

Engineering; Travis Doom, Robert J. Kegerreis Distinguished Professor of Teaching—all of Wright State University

3:15 – 3:35

Developing and Assessing Scientific Reasoning in First-Year Physics Lab

This presentation describes the implementation of a General Physics II Lab curriculum redesign at UC Blue Ash College and reports on preliminary findings on student development of scientific reasoning. We assessed scientific reasoning (SR) skills of twenty students in a redesigned physics lab. Using a new assessment tool, Inquiry for Scientific Thinking and Reasoning (iSTAR), we quantified gains in SR sub skills. Gains were demonstrated in the SR sub skills specifically targeted in the redesigned lab curriculum, including quantitative linear, correlation, control of variables (COV), integrated hypothesis, and hypothetical deductive reasoning. Little or no gain was demonstrated in SR sub skills not explicitly addressed in the lab curriculum. Assessed at a finer grain, basic COV sub skill gains were demonstrated. These findings provide information on two-year college, first-year physics student SR skills and will inform future revisions of lab curriculum so that SR sub skills can be more effectively targeted.

Krista E. Wood, Assistant Professor; Kathy Koenig, Associate Professor—both of University of Cincinnati

**Theme II: Promoting Effective Learning in Large Lecture Classrooms
Science 104**

3:40 – 4:00

Concept Maps as a Student-Centered Approach for Teaching Photosynthesis to Undergraduate Students

A comparative analysis was made between two groups of students enrolled in an introductory biology course: summer session students (n = 9) were assigned a concept map activity; a control group enrolled in the fall semester (n = 61) was not. Comprehension of the course material was measured using a set of multiple choice and true/false questions. Summer students outperformed fall students on all questions, suggesting a greater understanding was achieved compared to the control group. The results of this preliminary study highlight the value of reduction in breadth of course content in exchange for increased depth to provide students with the opportunity to engage in student-centered activities in the classroom, consistent with the recommendations in the Vision and Change in Undergraduate Biology Education report published by the American Association for the Advancement of Science (AAAS). The results also point to the prevalence of misconceptions about photosynthesis, as indicated by lowered scores in both groups on questions related to the relationship between respiration and photosynthesis.

Valerie Haywood, Instructor of Biology—Case Western Reserve University

**Theme II: Promoting Effective Learning in Large Lecture Classrooms
Towers 110**

2:50 – 3:10

Improving STEM Essential Skills through Brief, Spaced Practice

Through extensive student testing and interviews, we found that most students in an introductory materials engineering course and several physics courses and have numerous difficulties with many basic skills necessary for their coursework. To help students achieve and retain a core level of mastery and fluency, we developed and implemented a set of online

“essential skills” tasks. The task design is based on our findings of student difficulties as well as three well-established cognitive principles: 1) spaced practice, to promote retention, 2) interleaved practice, to promote the ability to recognize when the learned skill is needed, and 3) mastery practice to promote a base level of performance. The tasks covered several course-relevant topics including vector math, interpreting log plots, and dimensional analysis. Students spent a relatively small amount of time, 10-20 minutes in practice each week. Results indicate significant, and sometimes dramatic, gains on most topics, including for less-prepared students.

Andrew F. Heckler, Associate Professor of Physics; **Brendon Mikula**, Graduate Research Associate in Physics—both of The Ohio State University

3:15 – 3:35

Instituting SCALE-UP Physics at Miami University

It can be difficult to keep students active while they are in a large, tiered lecture hall. In the Department of Physics at Miami University, we have been fortunate enough to move into a new building, where we could design large, flat classrooms in which we can teach large active-learning courses. Our model is SCALE-UP, which stands for Student-Centered Activities for Large-Enrollment Undergraduate Programs. In a SCALE-UP classroom, we can seat 99 students at round tables, so that they can work in groups of three on problem-solving activities, computer simulations, and laboratory work. We have combined our lecture and laboratory courses, and the faculty and graduate student teaching assistants work together to help students learn together during class. This is new for our department, and being evaluated now. Participants will discuss the spaces in which we teach and how our students respond.

Jennifer Blue, Associate Professor of Physics—Miami University

3:40 – 4:00

Online Calculus: Building a Better Classroom

At OSU, we've been running a calculus MOOC that has now had more than 300k enrollments world-wide. At this point we are implementing a new version of this course whose goal is to replace the traditional textbook. In this presentation, we will discuss the tools that make this project a reality, including LaTeX (an open source language for writing mathematics), GitHub (an online repository that provides version control for collaborative work), and Ximera (a NSF-sponsored (DUE-1245433) project to turn LaTeX documents into online, interactive worksheets). Participants will learn the basics of these tools, which in turn will allow them to build online material in a similar fashion.

Bart Snapp, Auxiliary Assistant Professor of Mathematics; **Jim Fowler**, Assistant Professor of Mathematics; **Steve Gubkin**, Graduate Student, Department of Mathematics—all of The Ohio State University

Theme II: Promoting Effective Learning in Large Lecture Classrooms Towers 112

2:50 – 3:10

Towards Mastery of Material: Developing Students' Problem-solving Abilities in General Chemistry Using Cooperative Learning and Metacognition Enhancement

As the education environment changes to focus on outcomes, students are increasingly asked to demonstrate their mastery of material. In order for students to reach the mastery level, students need to develop problem-solving abilities. Professors commonly hear students proclaim that they understand the material when it was discussed in lecture, but they have difficulty applying the knowledge to problems. The challenge students have connecting

lecture material to situations can result from students being limited to algorithmic problem-solving and/or having poor metacognition. To improve students' problem-solving abilities in general chemistry, metacognition enhancement exercises are embedded in lecture and the Process-Oriented Guided Inquiry Learning model has been employed. These adaptations to the general chemistry curriculum have resulted in greater student performance and retention.

Pete Tandler, Professor of Chemistry—Walsh University

3:15 – 3:35

Large-scale Use of Interactive Simulations in General Chemistry

Interactive computer simulations, such as those provided by the PhET-program (<http://phet.colorado.edu>) are growing in popularity in high school and undergraduate settings, including in-class, in-lab, and outside of class implementation. Simulations typically allow the user to explore phenomena in a dynamic manner and receive instant feedback. Inclusion of symbolic, particle-level, and macroscopic representations makes many simulations well-suited for supporting conceptual understanding and model development in General Chemistry. Pedagogical approaches, along with logistical constraints and affordances accompanying the use of PhET simulations, will be discussed when the simulations are used in large-enrollment General Chemistry lectures. Gains in conceptual understanding, as measured by pre-, post-performance with questions from the Chemical Concept Inventory (CCI), will be discussed.

Ted M. Clark, Auxiliary Assistant Professor—The Ohio State University

3:40 – 4:00

Implementation, Effectiveness and Transferability of SENCER Teaching Strategies in Chemistry

Following my attendance at the 2007 SENCER Summer Institute I began distributing comment cards on which I asked students to describe aspects of my lectures which were (a) surprising, (b) interesting or useful, and (c) confusing. I used these comments as a springboard for discussion in subsequent lectures, resulting in an immediate positive impact on student engagement and the clarity of my lectures, as detailed in ACS Symposium Book Series 1037, 63-84 (2010). I will present statistical data demonstrating that this strategy positively impacted student performance on exams and student evaluations of my teaching in the non-majors course, as well as circumstantial evidence indicating that the cards have subsequently had similar positive effects in my first year general chemistry and junior/senior physical chemistry lectures. I will detail efficient and practical strategies for implementing the use of cards in both large and small, introductory and advanced level classrooms.

Mark B. Masthay, Associate Professor of Chemistry—University of Dayton

Theme III: Improving First-Year Experiences

Roush 114

2:50 – 3:10

Interteaching: An Active Learning Approach for the STEM Classroom

Recent studies have shown that active learning can increase student learning in STEM disciplines as compared to the traditional lecture style. The interteaching method is an active learning approach that places a heavy emphasis on peer-based instruction with the idea that one really learns the material when “one teaches it”. It also emphasizes reinforcement of the material through frequent probes of the materials (or exams). Up until now, the interteaching method has mostly been used in behavioral science classrooms. We have adopted this approach in the chemistry classroom at both the lower (introductory chemistry) and upper levels (physical chemistry). In our presentation, we will provide an overview of the interteaching approach in the chemistry classroom, which could be adapted to other STEM

disciplines, and the observed outcomes. Briefly, the outcomes include increased preparedness for class, better class engagement, and higher test scores.

Melissa M. Schultz, *Associate Professor of Chemistry—The College of Wooster (In Memoriam)*. **Karl J. Feierabend**, *Assistant Professor of Chemistry*; **Bryan T. Karazsia**, *Associate Professor of Psychology—both of The College of Wooster*

3:15 – 3:35

A Collaborative, Interdisciplinary Approach to Engage Undergraduate Students in a First Year Program

At a four year private institution in Ohio, there are successful initiatives in place which engage students majoring in health science education and nursing in a collaborative interdisciplinary approach through curricular and co-curricular experiences in a first year program. Undergraduate health science and nursing majors can voluntarily participate in a first year program of a living learning community under the leadership of an Advisory Team from different disciplines. The members of this interdisciplinary first year program meet monthly and participate in curricular and co-curricular experiences together. The first year program of the living learning community yields a retention rate of 94% from freshmen to sophomore year. Various methods are used to recruit and retain students in the program, multimedia methods to communicate, and empower these students to advance their learning and excel as professionals. These students also take general education academic courses together as a group.

Laura Kruger, *Professional Instructor of Health Sciences, Coordinator of Lifetime Wellness*; **Karen Estridge**, *Assistant Professor of Nursing—both of Ashland University*; **Melissa Snyder**, *Associate Professor of Athletic Training—Western Carolina University*

3:40 – 4:00

Enriching Introductory Physics Courses with Programming Exercises Using Classic Video Games

As websites like code.org reach wider and younger audiences, the possibilities expand for using programming labs to enrich introductory physics courses and reinforce student learning. In the past, programming languages like vpython (c.f. Matter & Interactions by Chabay & Sherwood) and java have been used in these kinds of physics-centered programming exercises. We discuss and summarize student outcomes from programming labs designed to teach 2D kinematics using a relatively new framework called processing.js. The processing.js framework has a number of desirable features: (1) It can be used to create very concise but still very interesting programs, (2) any web browser can be used to compile and run student-written code without needing additional plugins, (3) the framework can be used to create interactive games, and (4) processing.js uses a familiar C/C++ syntax. Experiences and student feedback from introductory physics classes at OSU's Marion campus will be discussed.

Chris Orban, *Assistant Professor of Physics*; **Gregory Ngirmang**, *Graduate Student*; **Mark A. Schillaci**, *Graduate Student—all of The Ohio State University*

4:10 – 4:30 Closing Remarks Riley Auditorium

Scott Freeman will reflect on the day's events.

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May 16, 2015

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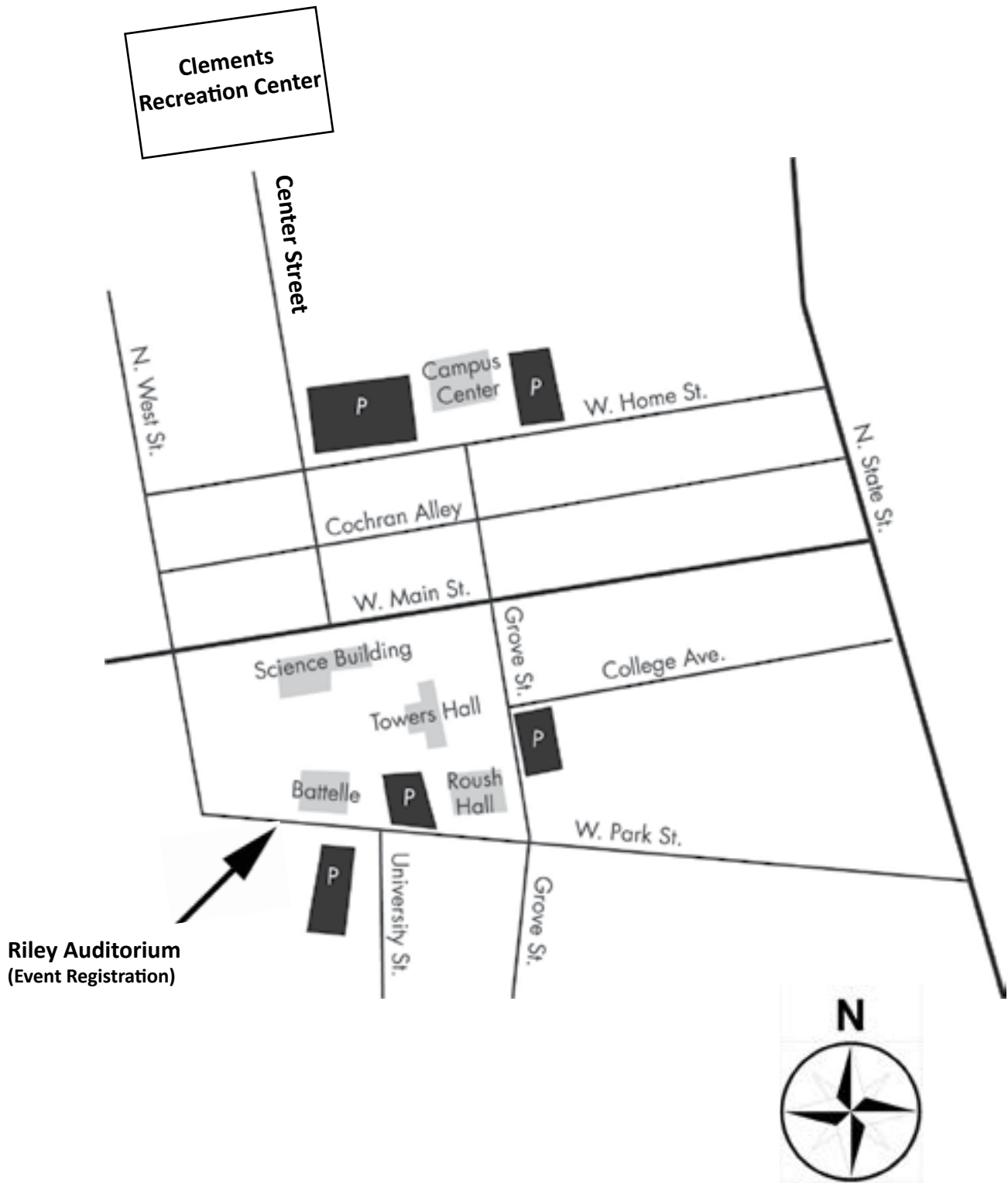
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Directions to Otterbein University

From the NORTH, take I-71 south to Gemini Place. After the exit, turn left on Gemini Place, follow the road as it turns to the right. Turn left on Polaris Parkway toward Cleveland Avenue (2 miles). Turn right on Africa Road, which becomes West St. Travel approximately 1.5 miles on Africa Rd. Continue onto West St., turn left onto West Park Street and immediately look for parking lot spaces on both sides of the street.

From the SOUTH on I-71, Route 315, or Route 23, take I-270 East (Wheeling) on the North side of Columbus. Follow I-270 to OH-3 north (exit 29) toward Westerville. Travel 2 miles and turn left on West Park Street. Continue past the intersection with Grove Street (about 0.2 miles from OH-3). Look for parking lot spaces on both sides of the street.

From the EAST or WEST on I-70, take I-270 North toward Cleveland. Travel 8 miles on I-270 and exit on OH-3 north (exit 29) toward Westerville. Travel 2 miles and turn left on West Park Street. Continue past the intersection with Grove Street (about 0.2 miles from OH-3). Look for parking lot spaces on both sides of the street.

Parking

Parking is available along West Park Street across the street from Batelle Fine Arts Center and on both sides of Batelle Fine Arts Center.