



# Ohio Project Kaleidoscope

Evidence-Based Practices in Undergraduate STEM Education

Capital University, Bexley, Ohio

May 21, 2016



*Association  
of American  
Colleges and  
Universities*

## 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

***To learn more about contributing to OH-PKAL, contact Nominations & Elections Chair Joyce Fernandes, [joyce.fernandes@miamioh.edu](mailto:joyce.fernandes@miamioh.edu) or any of the Governing Board members.***

**Ohio Project Kaleidoscope 2nd Annual Conference  
Evidence-Based Practices in Undergraduate STEM Education  
Capital University / Bexley, Ohio**

**May 21, 2016**

Welcome to the 2nd Annual OH-PKAL Annual Conference!

Following a very successful conference last year at Otterbein University, we are very much looking forward to this conference at Capital University and to another productive year. OH-PKAL is a regional affiliate of National Project Kaleidoscope (PKAL), which has a long history of supporting transformation in STEM education. PKAL is now partnered with the American Association of Colleges and Universities (AAC&U) and is under the leadership of Kelly Mack, Vice President for Undergraduate STEM Education, and Executive Director, Project Kaleidoscope.

The Governing Board is exploring a number of ideas that can enhance collaboration among STEM university instructors, including a STEM educator forum and a STEM mentorship program for instructors. At the poster session we will have some board members hosting a conversation, "What Can Ohio PKAL Do for You?" that will give details about some of these ideas. More importantly, we would like to get your feedback about what would be useful to you. We will also provide an opportunity to give input in the conference post-survey. And of course, you can also contact me or any other board member directly with your thoughts. We will look forward to any feedback you may have about these ideas.

OH-PKAL is committed to ensuring a broad diversity of participation among all higher education STEM instructors from all regions. To help facilitate this, we are interested in having the annual conference hosted in different locations across the state. To this point, we are happy to announce that the University of Findlay will host the 2017 OH-PKAL conference on May 20, 2017 (mark your calendars!). Further, The University of Mount Union will be hosting the 2018 OH-PKAL conference. If you are interested in hosting the 2019 conference, we will announce a call for applications this coming fall 2016.

Note that, while we are named "OH-PKAL", this year we have extended invitations to neighboring regions in adjacent states that are relatively close to the conference site. So we send a welcome to those coming from these neighboring regions, and we look forward to extending the community!

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 Across Teaching Environments (e.g., lecture, lab, field, community, online)
- Cultivating the Value of Diversity in Science to Attract and Retain Students
- Student Learning Outcomes and Assessment

We are excited to have Dr. Jennifer Lewis as our Keynote Speaker this year. She is a professor and associate chair of the Department of Chemistry at the University of South Florida and active researcher in the assessment of student learning and attitudes in STEM related fields. We look forward to hearing and learning about her experiences with POGIL (Process Oriented Guided Inquiry Learning) active learning techniques, innovative STEM curriculum, and other evidence-based practices in undergraduate STEM education.

We thank this year's host Capital University and especially the excellent leadership and efforts of the conference committee; Christine Anderson, Jeffrey Frye (Conference Co-Chair), Andrea Karkowski, Kathleen Koenig, Terry Lahm (Conference Chair), Tracey Murray, Mandy Smith, Cheryl Vaughn, and Paul Wendel. We also thank the presenters and of course all of the attendees that make this a special event.

This is an exciting time for STEM education. Transformative materials and methods are emerging from education research every year in each STEM discipline, and there is a substantial amount of interest, expertise and exploration in STEM instruction happening among our colleagues in this region. This 2<sup>nd</sup> annual conference will provide an excellent venue to meet with such colleagues, make contacts, share ideas, and participate in a collaborative community of practice in STEM higher education.



Andrew Heckler  
OH-PKAL Chair 2015-2016  
Associate Professor of Physics, Ohio State University

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## Schedule-at-a-Glance

### Ohio Project Kaleidoscope 2<sup>nd</sup> Annual Conference

### May 21, 2016

<b>8:00 – 8:30 AM</b>	<b>Mees Auditorium</b>	<b>Conference Registration</b>
<b>8:30 – 8:45 AM</b>	<b>Mees Auditorium</b>	<b>Opening Welcome</b>
<b>8:45 – 9:45 AM</b>	<b>Mees Auditorium</b>	<b>Plenary Speaker – Dr. Jennifer Lewis</b>
<b>10:00 – 11:00 AM</b>	<b>Concurrent Sessions I</b>	
<b>Battelle Hall 254</b>	<b>Meeting the Needs of Underprepared STEM Students</b>	
10:00 AM	Perusall: Every Student Prepared for Every Class <i>Matthew Stoltzfus</i>	
10:20 AM	Portfolio Based STEM Classes: Goal Focused Learning and Assessment <i>Matt Kretchmar</i>	
10:40 AM	University of Cincinnati UC Scholars Academy: Preparing students for STEM Undergraduate Careers <i>Whitney Gaskins</i>	
<b>Learning Center 202</b>	<b>Promoting Effective Learning across Teaching Environments</b>	
10:00 AM	A Fully Integrated Theme-Based Inquiry of Introductory Chemistry <i>Joseph Reczek, Frank Hassebrock</i>	
10:20 AM	Using iPads to Promote Critical Thinking in Organic Chemistry <i>Justin Houseknecht</i>	
10:40 AM	Creating an Effective Flipped Classroom Setting in an Anatomy and Physiology Course <i>Paul Nodzak</i>	
<b>Learning Center 260</b>	<b>Promoting Effective Learning across Teaching Environments</b>	
10:00 AM	A Hybrid, Adoptable Model for Success and Retention of Underprepared Math Students <i>Monica Hennessy</i>	
10:20 AM	Hands-on Laboratory Training with 3D-printable Smartphone Spectrophotometer <i>Adam Smith</i>	
10:40 AM	Opportunities to Improve STEM Instruction with Programming Content: Experiences from Introductory Physics <i>Chris Orban, Gregory Ngirmang</i>	

**11:15 AM – 12:15 PM Capital Center - Field House Poster Session**

1. Assessment of Undergraduate and High School STEM Research Experiences  
*Christine Anderson*
2. From Cookbook to Research: Redesigning an Advanced Biochemistry Laboratory  
*Debra Boyd-Kimball*
3. Inquiry Teaching and Undergraduate Research: Encouraging Students to Learn Science as Scientists Do  
*Kerry Cheesman, Alan Stam, Nancy Swails, Kimberly Heym*
4. Impact of a Scientific Reasoning Tool on Lab Reports in an Instrumental Analysis Laboratory Course  
*Anna Donnell*
5. Student Identification of Reliable Source Materials is Affected by Processing Fluency  
*Robert Duncan*
6. Assessing the Value of Peer-Facilitated Supplemental Instruction (SI) in First-Year Biology Courses  
*Bruce Epps, Kimberly Heym, Kerry Cheesman*
7. Using Faculty Learning Communities to Develop and Sustain STEM Educational Practices across an Institution  
*Joyce Fernandes, Michael Crowder*
8. A Supplemental Study Skills Course Improves Student Performance and Study Habits in Introductory Biology  
*Josiah Gantz, James Wiebler, Kel Arlinghaus, Tyler Hoskins, Blake Chaffee Michael Hughes, Jayanthi Sanjeevi, Joyce Fernandes*
9. What Can Ohio PKAL Do for You?  
*Brad Mallory, Kathy Koenig*
10. Making Connections: Impact of Primary Literature Assignments on Lecture and Laboratory Learning  
*Keith Miller*
11. Documenting and Assessing Process Skills in a POGIL Classroom  
*Tracey Murray*
12. Improving Introductory STEM courses via Smartphone-based Virtual Reality  
*Chris Orban, Jonathan Brown, Chris Porter*
13. Using the 12 Principles of Green Chemistry to Promote Sustainability  
*Carolyn Reid*
14. A Tiered Approach to the Preparation of First Year Chemistry Laboratory Reports  
*Paul Szalay, Lois Zook-Gerdau, Eric Schurter, Deepa Perera*
15. Comparative Study of Different Teaching Techniques in Introductory Calculus  
*Mahendra Thapa, Kathleen Koenig*
16. Recruiting and Retaining Minority Students in Healthcare Education: What is Working at UC  
*Kendra Varner, Leann Mey*

**12:15 – 1:30 PM      Capital Center - Field House      Lunch and Roundtables**

Table 1: Increasing Student Enthusiasm and Interest Using Interesting and Complicated Projects  
*Aaron Blodgett*

Table 2: Using Video-Conference Learning in the K-16 Classroom: Extending Options to Expose Students to STEM Careers  
*Lucia Bortz, David Dombrowski*

Table 3: We are All Physics Experts  
*Mike Hoffner*

Table 4: Designing Faculty Development to Support the Transformation of STEM Education  
*Kathryn M. Plank, Joan Esson, Paul Wendel, Anna Young*

Table 5: Enhancing STEM Education with Vernier's Data Collection Device for Interactive Based Learning  
*Johnathan Tedesco, Deborah Schulman, Richard Sheptak Jr., Richard West, Allen Fazenbaker*

Table 6: An Analysis of Perspectives about Alternative Approaches to Teaching Math to Young Children  
*Victoria Wangia-Anderson*

Table 7: What's Not Working? Innovations That Fail  
*Paul Wendel, Anna Young*

Birds of a Feather Roundtables: Informal gatherings at tables of shared interests. Look for topic labels on each of the tables at lunch.

**1:45 – 2:45 PM      Concurrent Sessions II**

**Battelle Hall 103      Student Learning Outcomes and Assessment**

1:45 PM      Evaluating the Use of Adaptive Courseware to Improve the First Year Experience in STEM Courses

*Kimberly Loscko, Darrell Spurlock, Heather Houchard*

2:05 PM      Tracking Conceptual Change in General Chemistry

*Ted Clark*

2:25 PM      STEM Student Learning: A Multi-Departmental Examination of an Institution's Conceptual Gains

*Paul Wendel, Anna Young, Kathryn M. Plank, Joan Esson*

**Battelle Hall 254      Promoting Effective Learning across Teaching Environments**

1:45 PM      Whiteboards: A Tool to get Students Thinking and Talking in STEM Classes

*Krista Wood, Louis Kutcher*

2:05 PM      Can Challenge Based Learning be Implemented in an Online Course?

*Victoria Wangia-Anderson, Heekyoung jung, Lakshmi Tirumala, Whitney Gaskins*

2:25 PM      Redesigning Statistics Lessons for Student Success: A Case Study

*Natalya Koehler, Nimet Alpay, Tawana Washington, Carolyn LeVally*

<b>Learning Center 202</b>	<b>Meeting the Needs of Underprepared STEM Students</b>
1:45 PM	Research and Writing (RAW) Model: A Two-Part Model for Scientific Productivity <i>Ruth Washington, Llancyllius Williams</i>
2:25 PM	The Early Scientist Research Program <i>Harry Kestler, Kathryn Durham</i>
<b>Learning Center 260</b>	<b>Meeting the Needs of Underprepared STEM Students</b>
1:45 PM	Learning from Science Centers: Inclusion of Informal Science Practices in General Chemistry <i>Rebecca Ricciardo, Ted Clark, Tyler Weaver</i>
2:25 PM	Developing a Network of Mentorship and Support Activities for Underrepresented Students in STEM <i>Rich Bretz, Rick Page, Dominik Konkolewicz, Bonita Porter</i>
<b>2:45 – 3:00 PM</b>	<b>Break – Beverages and Snacks Outside Learning Center 260 and Lobby of Battelle Hall</b>
<b>3:00 – 4:00 PM</b>	<b>Concurrent Sessions III</b>
<b>Battelle Hall 103</b>	<b>Student Learning Outcomes and Assessment</b>
3:00 PM	Leveraging a Collaborative Process to Improve Student Outcomes through the Design of Space <i>Paul Orban, Giancarlo Del Vita</i>
3:20 PM	The Use of Supplemental Instruction in Statistics <i>Jim FitzSimmons, Angela Mitchell</i>
3:40 PM	Assessment of Critical Thinking in Computational Methods Curricula <i>Ahmed Elgafy</i>
<b>Battelle Hall 254</b>	<b>Promoting Effective Learning across Teaching Environments</b>
3:00 PM	Writing Intensive STEM Courses <i>Matt Kretchmar</i>
3:20 PM	Using Oral Histories of Persons with Schizophrenia to Enhance Student Learning of Mental Illness <i>Tracy McDonough</i>

**Learning Center 202      Meeting the Needs of Underprepared STEM Students**

- 3:00 PM      Self-Reflection Videos to Overcome Learning Hurdles  
*Dominik Konkolewicz*
- 3:20 PM      Arts Nexus for STEM: Developing Creative Problem-Solving in an Inclusive and Divergent Framework  
*Kevin Hallinan, Brian LaDuca, Adrienne Ausdenmoore*
- 3:40 PM      Finding Place and Success in College: Using Holistic Support to Increase Underserved STEM Students' Success  
*Jim McCargar, Stephanie Forstner*

**Learning Center 260      Meeting the Needs of Underprepared STEM Students**

- 3:00 PM      Zendo: A Game to Teach Broad Mathematical Concepts  
*Jonathan Clark*
- 3:20 PM      Assessing the Impact of the Flipped Classroom in Introductory Calculus  
*Kathleen Koenig, Mahendra Thapa*

**4:15 – 4:30 PM      Mees Auditorium      Closing with Keynote Speaker – Dr. Jennifer Lewis**

## Opening Plenary

### **Applied Research for STEM Education**

***Dr. Jennifer Lewis, University of South Florida***

**8:45 – 9:45 AM/Mees Auditorium**

Applied research for STEM education at the college level aims to supply evidence that faculty can use to make curricular choices. As Director of the USF Center for the Improvement of Teaching and Research on Undergraduate STEM Education (CITRUS), which is focused on promoting student success in STEM fields, Lewis has conducted research into student achievement and attitudes over the past several years in college chemistry courses. The talk will present highlights of her research as well as implications for STEM teaching.

Dr. Jennifer Lewis is Professor and Associate Chair of Chemistry at the University of South Florida. She received her B.S. in Chemistry in 1992 from North Dakota State University and her Ph.D. (physical chemistry) in 1998 from the Pennsylvania State University. Her interest in STEM education began in graduate school, when she and several other students were allowed to play key roles in the development of a cooperative-learning-based intervention for at-risk students in general chemistry. After graduate school, she followed this interest in curriculum reform to a post-doctoral position at Beloit College, then the headquarters of the NSF-sponsored ChemLinks Systemic Change Initiative. In 2001, she was hired by USF and initiated the chemical education research track within the chemistry graduate program. In 2015, she was named a Fellow of the American Chemical Society for her service to that society and her contributions to the field of research in chemical education. In terms of teaching, she remains active in national reform movements, including Peer-Led Team Learning and Process-Oriented Guided Inquiry Learning, and has implemented a reform for general chemistry combining these two approaches. Her current research centers on the evaluation of curricular change and on the application of classical measurement theory to discipline-based educational research.

## Abstracts Listed Alphabetically by Primary Author's Last Name

### **Assessment of Undergraduate and High School STEM Research Experiences**

*Christine Schandorsky Anderson, Capital University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Student Learning Outcomes and Assessment

In 2013, Capital University began a collaborative partnership with nearby Reynoldsburg City School's Environmental Science, Technology, Engineering and Mathematics (eSTEM) Academy to engage junior and senior eSTEM high school capstone students in student-driven scholarship with undergraduate mentors. All students conduct rigorous place-based original research projects at nearby parks and/or in the laboratory under the guidance of faculty to promote effective learning across teaching environments. I designed learning outcomes and assessment tools for both populations of students, and also surveyed students not involved in the research experience. Participants indicated gains on potential benefits related to the research experience and lifelong learning, the value of working in peer groups or serving as a research mentor, and the effectiveness of the student-mentor-faculty model of interaction using quantitative methods. They also reported on career plans and answered open-ended questions on the pros and cons of the program and its value compared to coursework.

### **Increasing Student Enthusiasm and Interest Using Interesting and Complicated Projects**

*Aaron J. Blodgett, The University of Findlay*

**12:15 PM - 1:30 PM/Capital Center Field House**

Format: Round Table

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Students often will do as little work as possible on assignments and projects to meet the minimum requirements. I've found that by making projects more complex, interesting, and complicated, students will not only put in more work, but will become more engaged in and enthusiastic about solving the problem at hand. Some of these projects will be presented. Technology used in conjunction with these projects include Geogebra, Maple, and Excel, and courses range from pre-calculus on up. Examples of student work will be given, as well.

## **Using Video-Conference Learning in the K-16 Classroom: Extending Options to Expose Students to STEM Careers**

*Lucia Bortz, Franciscan University of Steubenville; David Dombrowski, Franciscan University of Steubenville*

**12:15 PM - 1:30 PM/Capital Center Field House**

Format: Round Table

Theme: Meeting the Needs of Underprepared STEM Students

The proposal effectively combines three of the conference themes including meeting the needs of under-prepared students, promoting effective learning across teaching environments and cultivating diversity in promoting fields of STEM study. Providing students with learning opportunities through Video Conferencing provides direct connections for students in under-served communities for live interaction with successful individuals in STEM careers. Bypassing economically prohibitive challenges or necessary social connections through this audio-visual medium that includes an interactive component, creates exposure that allows students to become aware of opportunities to study for diverse careers in STEM pathways.

## **From Cookbook to Research: Redesigning an Advanced Biochemistry Laboratory**

*Debra Boyd-Kimball, University of Mount Union*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Laboratory courses are often designed using step-by-step protocols which encourage students to conduct experiments without thinking about what they are doing or why they are doing it. Such course design limits the growth of our students as scientists and can make it more difficult for a student to transition to the expectations of a research laboratory experience. To facilitate student growth in the process skills necessary to transition from the teaching laboratory to the research laboratory, an advanced biochemistry laboratory was redesigned, largely based on a Process Oriented Guided Inquiry Learning (POGIL) philosophy, to be team-taught and project-based culminating in a 7 week group research project in which the students worked collaboratively to propose, design, and troubleshoot their own experiments.

### **Developing a Network of Mentorship and Support Activities for Underrepresented Students in STEM**

*Rich Bretz, Miami University; Rick Page, Miami University; Dominik Konkolewicz, Miami University; Bonita Porter, Miami University*

**2:25 PM/Ruff Learning Center 260**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

The model of best practices in retaining underprepared and diverse students in higher education STEM programs was set out in *Priming the Pump* (Gandara, 1999). Institutions with historically low enrollment of underrepresented minorities are still scrambling to develop programs that incorporate these best practices for their at-risk students. Miami University, in a collaborative effort with the Ohio LSAMP Alliance, is striving to develop programs and resources that provide underrepresented minority students with mentoring, financial, academic, and psychosocial resources to enable increased retention and persistence rates in STEM fields. Herein we examine the activities performed at Miami and discuss the impact of these steps on retention and persistence rates.

### **Inquiry Teaching and Undergraduate Research: Encouraging Students to Learn Science as Scientists Do**

*Kerry L. Cheesman, Capital University; Alan Stam, Capital University; Nancy Swails, Capital University; Kimberly Heym, Capital University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Research is extremely important in the biological sciences, and it is imperative that undergraduate biology majors understand both how to conduct research and how to interpret research by others, as well as being able to communicate research findings effectively. Many national reports, including the AAAS “Vision and Change” document in 2010 have challenged faculty to include more inquiry and research at all levels of the undergraduate curriculum, in an effort to promote effective learning among both majors and non-majors. As a department we have revamped the freshman and sophomore labs to include much more inquiry, and require all students to take a Research Methods course where hands-on research is conducted. As a result, students have been conducting research and presenting their work at regional and national conferences at a significantly higher rate than before these changes were implemented.

### **Zendo: A Game to Teach Broad Mathematical Concepts**

*Jonathan Clark, University of Cincinnati Clermont College*

**3:00 PM/Ruff Learning Center 260**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

Zendo is a game of inductive logic that manages to introduce mathematical principles without being overtly concerned with specific math topics. In the classroom, it has the potential to engage students in a non-threatening arena with what the field of mathematics at an abstract level. Students are encouraged to think about the field of mathematics beyond a set of algorithms and “rules” with the hope that this mindset will frame future discussions that meet learning objectives. Beyond critical thinking and inductive/deductive logic, students organically discuss the importance of specificity of language, pattern recognition, the construction of counter-examples, and more.

### **Tracking Conceptual Change in General Chemistry**

*Ted M. Clark, The Ohio State University*

**2:05 PM/Battelle Hall 103**

Format: Oral

Theme: Student Learning Outcomes and Assessment

An objective of science instruction in many diverse environments is conceptual understanding. In chemistry, the Conceptual Change Inventory (CCI) has been used to assess student understanding of some fundamental topics, like phase changes and stoichiometry. Historically, reported gains on the CCI, when administered before and after General Chemistry, have been small, suggesting that improved conceptual understanding is difficult to achieve. The aim here it is to analyze paired pre-, post-data for students in a classroom that emphasized both conceptual and algorithmic learning (with students in the course demonstrating gains on the CCI) compared with traditional courses without gains. For both groups, specific question responses will be analyzed to investigate whether lack of improvement is attributed to lack of change (i.e. persistence) with the same misconception, a shift to other misconceptions, or movement away from conceptions that are correct on the pre-test to alternate conceptions on the post.

### **Impact of a Scientific Reasoning Tool on Lab Reports in an Instrumental Analysis Laboratory Course**

*Anna M. Donnell, University of Cincinnati*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Student Learning Outcomes and Assessment

This presentation describes the use of a new tool that promotes scientific reasoning skills to assist undergraduates in constructing lab reports. Attendees will learn about the content of the new tool, the process through which it was implemented, and the preliminary evidence of its effectiveness in improving student lab report grades. Many undergraduate students struggle to understand the purpose of conducting lab experiments and do not often think about these experiments beyond the context of the course. This can limit a student's ability to conceptualize and articulate the purpose of a lab experiment when writing the lab report. In addition, students also have difficulty using experimental data to support a claim. This new tool seeks to address these issues to improve the quality of the Instrumental Analysis Laboratory course at The University of Cincinnati.

### **Student Identification of Reliable Source Materials is Affected by Processing Fluency**

*Robert O. Duncan, The City University of New York*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Meeting the Needs of Underprepared STEM Students

Fluent information is automatically processed, and disfluent information requires deliberation. Processing fluency was manipulated to determine why undergraduate students, who have been taught the value of peer-reviewed sources, gravitate toward less reliable Internet-based sources. Students (N=864) from a Minority Serving Institution participated in a critical thinking assessment. Choices were accompanied by icons representing four sources of information. In the fluent-source condition, an icon for peer-reviewed sources was reliably paired with the correct answer 50% of the time. In the disfluent-source condition, icons were randomly paired with answers. The fluency of the content was also manipulated. Subjects in the fluent-content condition were presented with high contrast text, and subjects in the disfluent-content condition were presented with low contrast text. Subjects did not use the information source to guide decisions, especially when the content was disfluent. Processing fluency should be considered when designing course curricula, particularly for colleges with English-language learners.

### **Assessment of Critical Thinking in Computational Methods Curricula**

*Ahmed Elgafy, University of Cincinnati*

**3:40 PM/Battelle Hall 103**

Format: Oral

Theme: Student Learning Outcomes and Assessment

Critical Thinking is crucial to success in STEM education, especially in engineering education. On the other hand, most of engineering programs introduce computational methods curricula. The learning outcomes from these curricula include; the ability to identify, analyze, and solve broadly-defined engineering problems. These particular learning outcomes are simply characterizing critical thinking criterion. Accordingly; assessing critical thinking is vital for computational methods curricula. In this presentation; different methodologies will be introduced for assessing critical thinking criterion in one of computational methods curriculum.

### **Assessing the Value of Peer-Facilitated Supplemental Instruction (SI) in First-Year Biology Courses**

*Bruce Epps, Capital University; Kimberly Heym, Capital University; Kerry Cheesman, Capital University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Supplemental Instruction (SI) is a peer-facilitated, collaborative learning program for increasing student success and retention that targets historically challenging entry-level university courses (those with a 30% or higher rate of D, F, or W final course grades). Participation in sessions is voluntary and open to all enrolled in the course. SI sessions were implemented for a two-semester introductory biology sequence at Capital University. Participation in the SI sessions was recorded, tracked by the office of Academic Success, and correlated each semester with final course grades. Student t-tests show significantly higher course grades for SI participants (2.53) compared to non-participants (2.08) during the fall semester course, but not during the spring semester course (2.56 compared to 2.24), since students who failed in the fall were not permitted to take the spring course. SI participation reduced the D/F/W rate in the fall semester from 29% to 15%.

## **Using Faculty Learning Communities to Develop and Sustain STEM Educational Practices across an Institution**

*Joyce Fernandes, Miami University; Michael Crowder, Miami University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

The overall goal of this year long- STEM Faculty Learning Community (FLC) at Miami University is to create a culture of collaborations across STEM departments to enhance research, education and outreach. The 12-member group is drawn from three Colleges at the institution and is representative of STEM disciplines. FLC members are engaged in activities that intend to develop awareness of national efforts in STEM education and research; collaborate in developing instructional pedagogies that improve retention in STEM and especially the success of underrepresented student groups; Enable pathways for faculty to develop educational outreach activities that stem from their research, extend the impact of to the K-12 level, and serve the recruitment of undergraduates to Miami University. The FLC hopes to help shape a vision for a Center for Excellence in STEM that currently does not exist at Miami, but one that we are well poised to develop.

## **The Use of Supplemental Instruction in Statistics**

*Jim FitzSimmons, Wilmington College; Angela Mitchell, Wilmington College*

**3:20 PM/Battelle Hall 103**

Format: Oral

Theme: Student Learning Outcomes and Assessment

Statistics classes can be challenging for undergraduate students. Supplemental Instruction (SI) sessions provide a means to facilitate learning in these courses. The optional, hour-long SI sessions are offered weekly and are led by a student who has previously excelled in the course. We have explored the correlations between SI participation and learning assessments to determine the efficacy of these SI sessions in statistics.

## **A Supplemental Study Skills Course Improves Student Performance and Study Habits in Introductory Biology**

*Josiah D. Gantz, Miami University; James Wiebler, Miami University; Kel Arlinghaus, Miami University; B. Caffee, Miami University;; M. Hughes, Miami University; J. Sanjeevi, Miami University; Joyce J. Fernandes, Miami University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Meeting the Needs of Underprepared STEM Students

Success in introductory courses is a well-recognized challenge for STEM majors. While many approaches have been developed to promote student success during the first-year bottleneck, most carry large financial and faculty labor burdens. We developed a one credit-hour sprint course to teach effective study habits, taught by a single graduate TA. Six semesters of data demonstrate that the supplemental course improves student performance on introductory biology lecture exams. Survey data suggests that the course encouraged students to study more, with greater frequency, and further in advance of exams. Students also improved on outlining and concept mapping, which were emphasized as effective study tools. Multivariate modeling revealed that improvement on skills emphasized in the sprint course had limited efficacy in predicting performance on lecture exams. We suggest that our course is an efficient method for improving student performance in introductory biology courses while providing valuable pedagogical training for future educators.

## **University of Cincinnati UC Scholars Academy: Preparing students for STEM Undergraduate Careers**

*Whitney Brooke Gaskins, University of Cincinnati*

**10:40 AM/Battelle Hall 254**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

The University of Cincinnati along with Hughes STEM High School, an urban public STEM high school have developed the UC Scholars Academy to 1) Increase number of students who graduate college and career ready; 2) Increase number of students entering the University of Cincinnati and other local colleges; 3) Increase number of students enrolling and completing STEAM degrees; and, 4) Develop an effective, sustainable and replicable college & career readiness program model. The UC Scholars Academy is a best-practice model for facilitating college and career readiness for greater Cincinnati students, with a special focus on supporting the tri-state's most underserved students to bring to reality a more diverse local student body and workforce that increases the vitality of the region. The Academy

is a deep and systemic partnership among UC, Hughes STEM High School, and other community partners to demonstrate the validity of our college and career readiness approaches.

### **Arts Nexus for STEM: Developing Creative Problem-Solving in an Inclusive and Divergent Framework**

*Kevin P. Hallinan, University of Dayton; Brian LaDuca, University of Dayton; Adrienne Ausdenmoore, University of Dayton*

#### **3:20 PM/Ruff Learning Center 202**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

The University of Dayton's (UD) Institute for Arts Nexus (IAN) engages students in an art-linked creative thinking and problem-solving process applied to social and technical innovation themes. IAN curriculum has been established for all students, Striking is the participation of minority students in IAN curriculum (more than 20%); with 100% of diverse students being retained. As well, an IAN pilot involving 13 students from engineering, business, science, and the arts who worked on developing a new product emerging from sensors and a 2050 visioning for the City of Dayton. Measurements showed strong growth in student creative confidence and ability to work in divergent teams.

### **A Hybrid, Adoptable Model for Success and Retention of Underprepared Math Students**

*Monica Hennessy, University of Cincinnati Blue Ash College*

#### **10:00 AM/Ruff Learning Center 260**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Developmental mathematics students are frequently challenged by length of program and breadth of deficiency. Our hybrid developmental mathematics courses address both of these issues and encourage student success and retention. This presentation will address a way to structure a series of hybrid developmental math courses incorporating in-class activities and individualized, self-paced online learning in order to promote critical thinking, the acquisition of mathematical knowledge, and the retention of students. Specific ways to structure class sessions, individualized student learning objectives, course content, methods of assessment of progress and knowledge, tips and tricks to keep students motivated and on-track, will be discussed. The presentation will also include a replicable methodology of assessment of the program's efficacy in terms of student knowledge and retention.

## **We are All Physics Experts**

*Mike Joseph Hoffner, Lakeland Community College*

**12:15 PM - 1:30 PM/Capital Center Field House**

Format: Round Table

Theme: Meeting the Needs of Underprepared STEM Students

First off, I believe that if we can remove walls to the scary subject of physics. I tell my students on the first day that they are experts, that they intuitively know how to walk, stand and can function within our environment/world. The only job we have in the classroom is to explore the math that might fit the natural systems around us. To that end the first lab we perform is we make and play with paper airplanes. I then tell them that the finest lab equipment supplier is "Toys-r-Us", this then takes us to the next step. Engineering at it's basic concepts, the breaking down complex systems into step-by-step parts that are manageable components of the whole. Imagine the toy "Mouse Trap", it is a very complex system and students can visually break the system into changes of that system and then apply their solutions. If you are the engineer or the scientist you will be excited by the approach if not the student will have enjoyed the learning process.

## **Using iPads to Promote Critical Thinking in Organic Chemistry**

*Justin B. Houseknecht, Wittenberg University*

**10:20 AM/Ruff Learning Center 202**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Electronic whiteboards (iPads) were used to amplify learning in an active-learning organic chemistry classroom. Students, working in teams of 3-4, recorded audio-visual solutions to problems designed to explore common misconceptions. Several of these solutions were then reviewed in class to highlight strengths and weakness before new problems were assigned. All solutions were saved to a database and commented upon by the instructor to aid students' review and consolidation of material. This technology was implemented as part of a larger pedagogy that saw Organic 1 exam scores increase by 1-3% and DFW rates decrease by 16% over two years. Variations of this approach should be amenable for classes up to about 100 students in which the processes of description and/or problem solving are important.

### **The Early Scientist Research Program**

*Harry W. Kestler, Lorain County Community College; Kathryn A. Durham, Lorain County Community College*

#### **2:25 PM/Ruff Learning Center 202**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

The Early Scientist Program is a university-level research immersion experience for first generation high school students (Early College) at LCCC in Elyria, Ohio. Students with no previous research experience are invited to participate in intensive high-level independent research projects. The students enter the Early Scientist Program without previous research experience and they are also entering the independent research program concurrently with their first registration in a college level science course -without the benefit of high school coursework experience. This is in stark contrast to the traditional model where undergraduate research opportunities are reserved for upper-level juniors and seniors. In 6 years, 25 high school students have participated in the Early Scientist Program at LCCC. One student was named to the USA today all-star academic team and most have presented their research at national scientific meetings. We believe this program is a successful model and can be expanded to other institutions.

### **Redesigning Statistics Lessons for Student Success: A Case Study**

*Natalya A. Koehler, Franklin University; Nimet Alpay, Franklin University; Tawana Washington, Franklin University; Carolyn LeVally, Franklin University*

#### **2:25 PM/Battelle Hall 254**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

This Statistical Concepts course was chosen for redesign because it was a difficult gateway course on students' way to graduation. According to a report from Complete College America (2011), for part-time students, the percentage chance of graduating with a 4-year bachelor's degree within 8 years is 24.3%. On average, about a thousand low-income, first generation college students take this course per year. Most students take this course online and often cannot attend synchronous online sessions. As a part of the course redesign, twenty-eight web-based interactive multimedia lectures were built to compensate for the lack of systematic instructional support for online students. Course assignments and assessments were redesigned based on cognitive learning theory principles. As a result, attrition rates went down

from 26% to 10%. The average percentage of students who received A, B, and C grades went from 44% to 74%. Students find this redesigned course rigorous, but manageable.

### **Assessing the Impact of the Flipped Classroom in Introductory Calculus**

*Kathleen Koenig, University of Cincinnati; Mahendra Thapa, University of Cincinnati*

#### **3:20 PM/Ruff Learning Center 260**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

As part of a recent initiative to improve the DFW rate in our introductory calculus courses, efforts were made to increase student learning through more activity-based approaches to teaching. Of 14 calculus instructors across 23 sections, five engaged in a fully flipped classroom model. The other instructors used a variety of approaches to teaching which spanned total lecturing to more of a semi-flipped teaching model. A study was conducted to determine the impact of these different approaches on student learning as measured by common course exams and the Calculus Concept Inventory (CCI). This data was supplemented with classroom observations using COPUS as well as student surveys which measured how much each student engaged in required course components, such as watching videos, reading the text, completing homework exercises, etc. The results of this study will be presented along with suggestions for future reform efforts as well improvements to the research design.

### **Self-Reflection Videos to Overcome Learning Hurdles**

*Dominik Konkolewicz, Miami University*

#### **3:00 PM/Ruff Learning Center 202**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

Students often are faced with hurdles that can inhibit progress to understanding and proficiency in STEM fields. When students cross these fundamental “Thresholds” they see an integrated picture of the subject area, which often leads to almost irreversible long-term knowledge of the subject or a transformed picture of the field of study (Meyer and Land 2003, 2005). STEM fields are full of these thresholds that students must cross to succeed, appreciate the topic and move on to more advanced material. In this project, the students were asked to create self-reflective YouTube videos discussing a key concept they struggled with (or “Threshold”), and how the student resolved the issue, or “crossed the threshold”. The students are requested to present an example to confirm that they mastered the

concept. The YouTube examples will be taken from organic chemistry, although this could be applied to other STEM fields.

### **Portfolio Based STEM Classes: Goal Focused Learning and Assessment**

*Matt Kretchmar, Denison University*

**10:20 AM/Battelle Hall 254**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

We present a portfolio-based pedagogy implemented in a sophomore computer science class. The aim of this alternative course structure is to better match student learning with graded assessment. Though this course features regular assessment tools such as projects, homework assignments, quizzes and exams, the instructor provides only summative feedback, no grades. Students are given multiple opportunities to interact with these tools and re-submit them in one of the course portfolios where they must demonstrate their understanding of the course learning outcomes and must also articulate a case for a specific level of achievement. This "flipped pedagogy" encourages students to take risks and learn from their mistakes, provides greater ownership of learning, engages students in metacognition about their learning success, and allows the course professor to function as a partner/coach rather than grader. This pedagogy also provides underprepared students with a greater opportunity for success and persistence in the major.

### **Writing Intensive STEM Courses**

*Matt Kretchmar, Denison University*

**3:00 PM/Battelle Hall 254**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

We review the conversion of two traditional STEM courses (a general population statistics course and an elective artificial intelligence course) into writing intensive seminars. We have found that the successful integration of writing into STEM courses necessitates a general reformulation of the course structure. While many faculty who work with writing assignments in their STEM courses feel they must sacrifice course content to fit in the writing, we have shown that through a change of the course perspective we can leverage the writing activities to enhance the course learning outcomes rather than compete against

them. We show how student learning (depth of comprehension) is a likely outcome of a writing based pedagogy.

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

*Kimberly Loscko, Mount Carmel College of Nursing; Darrell Spurlock, Mount Carmel College of Nursing; Heather Houchard, Mount Carmel College of Nursing*

**1:45 PM/Battelle Hall 103**

Format: Oral

Theme: Student Learning Outcomes and Assessment

Adaptive Learning technology was implemented in a first-year Anatomy and Physiology course. Components of the program included 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), interactive lectures, physical and virtual labs. Our study evaluated the use of this data-driven approach to learning by evaluating student engagement, content acquisition, and subject matter mastery in Anatomy and Physiology. Study participants included n=102 nursing students. SPSS Statistics (version 22) was used to analyze data collected through an adaptive supplemental courseware.

### **Finding Place and Success in College: Using Holistic Support to Increase Underserved STEM Students' Success**

*Jim McCargar, Baldwin Wallace University; Stephanie Forstner, Baldwin Wallace University*

**3:40 PM/Ruff Learning Center 202**

Format: Oral

Theme: Meeting the Needs of Underprepared 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). Learn how the School of Natural Sciences, Mathematics and Computing at Baldwin Wallace has achieved a 91% fall-to-spring retention rate with a cohort of at-risk, first-year STEM students who struggled to adjust to the rigors of college. Described will be a faculty and staff collaboration to identify and make connections with underserved STEM majors early in the semester (week 4), providing time for meaningful interventions. Meaningful intervention

entails directing identified at-risk students to appropriate support services, setting academic expectations and engaging in self-evaluation and reflection on the qualities that impact individual and group success, such as work ethic, grit, talent, intellectual curiosity and “selflessness”. The approach outlined is theory- and evidence-based and can be tailored specifically for STEM students. Attendees will discover new tools that can be modified and scaled to promote retention and success among all students.

### **Using Oral Histories of Persons with Schizophrenia to Enhance Student Learning of Mental Illness**

*Tracy McDonough, Mount St. Joseph University*

**3:20 PM/Battelle Hall 254**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

In order to understand people and the difficulties they struggle with, both scientific and person-centered knowledge are necessary. As an adjunct to standard diagnostic learning, instructors can utilize the life histories presented in The Schizophrenia Oral History Project to promote both elevated learning of severe mental illness as well as increased understanding of the diversity of experiences of persons with such illnesses. Because oral history allows persons to speak for themselves, this format can allow critically thinking students to go beyond standard classroom instruction to acquire a more sophisticated understanding of the diagnosis as well as challenge media promoted myths about violence in such persons. Evidence of both improved diagnostic understanding as well as appreciation for diversity in such marginalized persons will be discussed in this mixed methods project incorporating oral history into scientific classroom instruction.

### **What Can Ohio PKAL Do for You?**

Brad Mallory, University of Cincinnati; Kathy Koenig, University of Cincinnati

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Contribute-a-Theme

OH-PKAL’s vision is to create a regional community of practice to promote and enhance learner-centered STEM education through evidenced-based best practices, faculty development and community engagement and education. As OH PKAL ends its second year, we are looking for ideas for how this

group can benefit the broader Ohio STEM educator community. Stop by the poster and provide feedback on some of our ideas and share with us some of your own regarding future efforts of OH PKAL.

### **Making Connections: Impact of Primary Literature Assignments on Lecture and Laboratory Learning**

*Keith Miller, University of Mount Union*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

One of the most daunting tasks for undergraduates is reading and writing about primary literature. To improve undergraduate skills working with primary literature, a curriculum scaffold was introduced in a two semester biochemistry lecture and laboratory setting. During the first semester, students were expected to locate a primary peer-reviewed research article that implemented that week's laboratory technique/lecture concept and write a summary on one of the figures. During the second semester, this assignment expanded to include critiques and presentations covering all the figures in an article. These assignments were intended to develop student learning from passive to active engagement by applying their knowledge to reading and critiquing science. The primary literature curriculum was assessed using student evaluations, student writing samples, and research faculty evaluation of their students. Conclusions drawn demonstrated that students were better prepared in locating, reading, and assessing primary literature and had improved scientific communication skills.

### **Documenting and Assessing Process Skills in a POGIL Classroom**

*Tracey Arnold Murray, Capital University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Process Oriented Guided Inquiry Learning (POGIL) is a teaching philosophy that uses active, student-centered learning. There are many available resources for science and math content, but little available to document and assess process skills. Since the development of process skills is one of the things that separates POGIL from other "flipped" classroom teaching strategies, it is important to document and assess the development of process skills in a POGIL classroom. Teaching assistants were used in the

Biochemistry I course (CHEM 451) at Capital University to assist the professor in documenting and assessing process skills. Different forms and surveys were used to gauge their usefulness. Student and teaching assistant opinions about these forms will be discussed. In addition, student self-assessment of their process skill development showed gains in all skills, with the greatest gains seen in teamwork, communication, and managing time in a group.

### **Creating an Effective Flipped Classroom Setting in an Anatomy and Physiology Course**

*Paul I. Nodzak, University of Cincinnati*

#### **10:40 AM/Ruff Learning Center 202**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Challenges in the flipped classroom include adequately preparing students with content prior to class as well as effectively engaging students in group learning activities in a large lecture of over 300 students. To address the former, students view an animation outside of class followed by selected online questions in various formats such as labeling, sequencing events and matching terms. Students must achieve 100% to receive credit. These outside-of-class activities target physiological concepts for which students are known to struggle; documented by accrued past exam data. To address the second challenge, undergraduate Learning Assistants promote in-class active learning by answering questions and facilitating group work. This presentation will provide an example of how Transcription and Translation in Protein Synthesis is taught in this format. Comparisons between student exam performance during the treatment term and a previous term will be shared for overall impact as well upper quartile and lower quartile performance.

### **Opportunities to Improve STEM Instruction with Programming Content: Experiences from Introductory Physics**

*Chris Orban, The Ohio State University; Gregory Ngirmang, The Ohio State University*

#### **10:40 AM/Ruff Learning Center 260**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

As websites like code.org reach wider and younger audiences, the possibilities expand for incorporating programming into introductory STEM courses at the university level. We discuss the processing.org

framework which is designed to give first-time programmers a powerful interface for creating interactive graphics and games. The processing.org framework was used to develop eight different programming exercises that were integrated into two introductory physics classes at OSU's Marion campus that do not normally include programming content. We discuss the learning objectives of these exercises, including broader goals in STEM education, and present student outcomes from working through the required programming assignments. Possibilities for incorporating programming exercises into courses in other disciplines is also briefly discussed.

### **Improving Introductory STEM courses via Smartphone-based Virtual Reality**

*Chris Orban, The Ohio State University; Jonathan Brown, The Ohio State University; Chris Porter, The Ohio State University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

While some efforts have been made to use virtual reality (VR) technology in STEM coursework, widespread use of VR in undergraduate STEM courses has been frustrated by the expense and cumbersome nature of VR technology. Recently, Google created a cheap, high-quality VR solution called Google Cardboard, which uses a cardboard cutout headset and two lenses to allow most smartphones to serve as a stereoscopic VR display without any additional electronics. We will show VR visualizations that are being used to improve introductory physics classes at OSU's Marion campus, and present data on the effectiveness of using VR content in this context.

### **Leveraging a Collaborative Process to Improve Student Outcomes through the Design of Space**

*Paul Orban, BHDP Architecture; Giancarlo Del Vita, BHDP Architecture*

**3:00 PM/Battelle Hall 103**

Format: Oral

Theme: Student Learning Outcomes and Assessment

Modern teaching environments for the sciences must be flexible, inspiring and allow for various modes of learning. Ultimately, the space must support student success and measurable learning outcomes by influencing human behavior. In order to achieve the goals of the educators, the team must first understand the success criteria by which the outcomes will be measured. Once the desired student

behaviors and metrics for measuring success are defined, a collaborative design process to align space with the desired behaviors can be used to increase the overall project effectiveness. This process must build consensus among sometimes large and diverse user groups.

### **Designing Faculty Development to Support the Transformation of STEM Education**

*Kathryn M. Plank, Otterbein University; Joan Esson, Otterbein University; Paul Wendel, Otterbein University; Anna Young, Otterbein University*

**12:15 PM - 1:30 PM/Capital Center Field House**

Format: Round Table

Theme: Meeting the Needs of Underprepared STEM Students

In a collegial environment, faculty can grow in their ability to meet the needs of underprepared and underrepresented students. However, long experience indicates that simply telling faculty about effective evidence-based practices is not sufficient. This roundtable will explore the role of faculty development in supporting efforts to transform STEM education. Facilitators will share data from faculty surveys, interviews, focus groups, and classroom observations indicating differences (some of them based on department, rank, and gender) in such things as the ways faculty learn about and decide to use various teaching practices. Participants will be asked to share their perspectives on these results and explore implications for faculty development. Together we will strategize potential approaches to faculty development that will better meet the needs of faculty so they in turn can meet the needs of all our students. Supported by NSF #1347234.

### **A Fully Integrated Theme-Based Inquiry of Introductory Chemistry**

*Joseph J. Reczek, Denison University; Frank Hassebrock, Denison University*

**10:00 AM/Ruff Learning Center 202**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Like many introductory STEM classes, introductory chemistry often aims to provide a foundation of knowledge and skills upon which subsequent classes in chemistry and/or biochemistry curriculum rely. It therefore often requires the coverage of a broad range of topics and competences that can be challenging to tie together in a cohesive way that students of a diverse college classroom find relevant and engaging. Problem-based learning has emerged in science classrooms and teaching laboratories as a

technique to engage and inspire novice students in the investigation of modern scientific challenges. However, this approach is often limited in utility for fully engaging introductory chemistry due to the extreme difficulty of developing basic chemistry principals within the context of advanced concepts. A potential solution to this challenge may be to expand the problem-based approach to encompass the majority of a course under a single unifying theme in modern chemistry that is of interest to the instructor. If, over the course of a semester, this theme can be broken down into many fundamental elements that match well with the introductory chemistry curriculum, it would provide a cohesive and relevant context for students to simultaneously learn the essential knowledge and skills of basic chemistry along with the modern day relevance of its practice. In this talk, we will explore how this fully integrated theme-based inquiry approach was used in teaching an atoms first, 1st semester chemistry class and lab. How topics related to the workings and construction of perovskite solar cells, an area of intense ongoing research, were integrated into course materials throughout the semester will be discussed. Results of student performance and their attitudes about the course and chemistry in general will be presented.

### **Using the 12 Principles of Green Chemistry to Promote Sustainability**

*Carolyn Suzanne Reid, University of Mount Union*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Meeting the Needs of Underprepared STEM Students

A new 200 level undergraduate course Introduction to Green Chemistry showed that making small changes to everyday practices can contribute to a more sustainable world. Green chemistry is the design of chemical processes or products that reduce or eliminate the use or generation of hazardous substances. Students engaged in a diverse set of activities which included; case studies, group work, online discussions, laboratory experiments and field trips. By discussing past presidential green chemistry challenge awards which are based on outstanding innovations in academia and industry, students develop their own ideas for solutions to global environmental challenges and made recommendations for improvements they would like to see. A final project in which students designed their own “green” product helped them to make connections between classroom activities and real-world applications.

### **Learning from Science Centers: Inclusion of Informal Science Practices in General Chemistry**

*Rebecca A. Ricciardo, The Ohio State University; Ted M. Clark, The Ohio State University; Tyler Weaver, The Ohio State University*

**1:45 PM/Ruff Learning Center 260**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

Introductory STEM courses in higher education, like General Chemistry, are often large-enrollment offerings with hundreds of students in lecture and many, many labs. In lab the large number of Teaching Assistants (TAs) providing instruction have varied experience, content knowledge, and confidence. Training and support of TAs as laboratory instructors in these courses are wedded with the tasks TAs (and their students) perform in the lab. Aims of STEM laboratory instruction, like student problem solving, interpreting sensory data, and discussing observations, are common to both school-based and informal science environments. In informal settings, like science and nature centers, participants often experience phenomena in a self-directed way, “doing something” and receiving prompt feedback. In this presentation, ideas from informal settings, such as interactive posters, and their inclusion in General Chemistry labs is described along with a pedagogical and logistical rationale for why such practices can improve traditional laboratory instruction.

### **Hands-on Laboratory Training with 3D-printable Smartphone Spectrophotometer**

*Adam W. Smith, University of Akron*

**10:20 AM/Ruff Learning Center 260**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

An essential part of undergraduate STEM education is laboratory instruction. It serves a pedagogical need to reinforce the concepts and principles taught in the classroom. It also achieves the practical goal of helping students acquire skills that will be useful in a variety of STEM careers. The cost of laboratory education, however, can be prohibitive. I will present on a device called the SpecPhone, which was recently developed in my lab for teaching visible absorption spectroscopy. It uses a smartphone interface and a 3D-printable housing, making it accessible to a wide range of students and institutions. The do-it-yourself (DIY) nature of the SpecPhone increases student engagement and draws them into the theory and practice of the method. The presentation will focus on applications of the SpecPhone in chemistry and physics curricula. It will also explore the general strategy of using 3D printing and other DIY approaches for laboratory instruction at the undergraduate level.

### **Perusall: Every Student Prepared for Every Class**

*Matthew W. Stoltzfus, The Ohio State University*

**10:00 AM/Battelle Hall 254**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

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 in the flipped classroom has been given to creating and delivering lecture videos, however, when students watch lecture videos the transfer pace is set by the video, the viewer is passive, the students attention tanks as time passes, and it is an isolated/individual experience. In contrast, students are active and the transfer pace is set by the reader when reading a textbook. Perusall capitalizes on these aspects of the text and places students in an interactive environment where they are automatically graded on their online engagement to ensure they are prepared for class. Students are essentially graded for reading and annotating the text. Instructors are also provided with a simple, concise "confusion report" so they can address the most pressing questions in class. Results from the beta test administered in two Ohio State General Chemistry courses (500 students total) will be share and compared to previous years where Perusall was not used. More details can be found at [www.perusall.com](http://www.perusall.com).

### **A Tiered Approach to the Preparation of First Year Chemistry Laboratory Reports**

*Paul Szalay, Muskingum University; Lois Zook-Gerdau, Muskingum University; Eric Schurter, Muskingum University; Deepa Perera, Muskingum University*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Meeting the Needs of Underprepared STEM Students

Over the past several years, it has been observed that students in General Chemistry have been having a difficult time making the transition from preparing experiment summaries in high school to college level laboratory reports. The area they have most struggled with is discussion sections. These require the experimental results to be summarized, explained, and supplemented with an accounting of the supporting chemistry content. This helps ensure the students have a comprehensive understanding of their experimental work and aids in unifying the lecture and laboratory content. To help students make the transition to this higher level of reporting expectation we have adopted a tiered approach to the preparation of discussion sections. The experiments have been divided into four tiers with each successive tier requiring an increased level of report sophistication and autonomy. Evaluations were carried out via an assessment rubric. The results of these efforts will be presented.

### **Enhancing STEM Education with Vernier's Data Collection Device for Interactive Based Learning**

*Johnathan M. Tedesco, Lake Erie College; Deborah B. Schulman, Lake Erie College; Richard Dale Sheptak Jr., Lake Erie College; Richard H. West, Lake Erie College; Allen Fazenbaker, Lake Erie College*

**12:15 PM - 1:30 PM/Capital Center Field House**

Format: Round Table

Theme: Meeting the Needs of Underprepared STEM Students

Students entering higher education institutions are aware of the growing need of highly specialized skills to be successful in today's market. Most students entering STEM programs at the collegiate level are, however, not meeting the expectations of their programs, due in part to a lack of resources at the high school level. To address this issue, Lake Erie College faculty in the sciences and education held a four day workshop for teachers from local high-need school districts. The program, funded through a grant from the Ohio Board of Regents, provided Vernier probe equipment and training in development of effective classroom exercises. To accommodate varying interests, sessions were held on topics in Chemistry, Physics, and Biotechnology. Education faculty provided training and feedback regarding pedagogy and alignment with state standards. In short, the currently available data indicates students showed significant improvement overall; increased retention from 20% to 111% in chemistry topics.

### **Comparative Study of Different Teaching Techniques in Introductory Calculus**

*Mahendra Bahadur Thapa, University of Cincinnati; Kathleen Koenig, University of Cincinnati*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Among various approaches to teaching, activity-based teaching could improve student learning if students fully participate in activities. In our study, there were 23 sections of introductory calculus courses handled by 14 instructors with no instructor teaching more than two sections. The instructors used a variety of teaching approaches ranging from fully flipped class to lecturing. Each of the instructors was observed twice by two investigators independently and data were recorded using COPUS tool. The data were coupled with a student survey regarding engagement in outside-of-course assignments and a faculty survey on teaching practices. Student learning was measured through common course exams and the Calculus Concept Inventory (CCI). Results will be shared regarding impact of teaching techniques and level of student engagement on student learning.

### **Recruiting and Retaining Minority Students in Healthcare Education: What is Working at UC**

*Kendra Varner, University of Cincinnati; Leann Mey, University of Cincinnati*

**11:15 AM-12:15 PM/Capital Center Field House**

Format: Poster

Theme: Cultivating the Value of Diversity in Science to Attract and Retain Students

In February 2015, the Urban Universities for HEALTH (Health Equity Alignment through Leadership and Transformation of the Health Workforce) project team at the University of Cincinnati (UC) held focus groups seeking to understand the contributing factors of underrepresented minority (URM) students' decision to study within the Academic Health Center (AHC), which include: College of Allied Health Sciences, College of Medicine, College of Nursing and College of Pharmacy. Participants from these healthcare professions provided feedback on the effectiveness of current recruitment practices and retention strategies. They shared insights into perceived needs and potential barriers to diversity. Participants made recommendations throughout the sessions which provided rich process improvement data for the AHC leadership.

### **An Analysis of Perspectives about Alternative Approaches to Teaching Math to Young Children**

*Victoria Wangia-Anderson, University of Cincinnati*

**12:15 PM - 1:30 PM/Capital Center Field House**

Format: Round Table

Theme: Meeting the Needs of Underprepared STEM Students

Math is a STEM discipline and a foundational discipline for other STEM disciplines; specifically, technology and engineering disciplines. There is now realization that a large percentage of the students trained in the U.S. education systems are unprepared to meet the STEM workforce gap, and the disparity is greater for underrepresented minorities. I begin to address this challenge through this study as I seek to promote early childhood development of math knowledge and skills. The suggested strategy focuses specifically on beginning to introduce math earlier in life and exploring the effectiveness of tools used in countries developing STEM talent at a high rate. The Abacus is a tool that was used in ancient times before numbers were introduced and has been used with young children to advance math skills in some countries. It has also been shown to advance math skills of struggling children in other countries. In this qualitative study perspectives of educators and parents of children who have experience with the Abacus learning approach are analyzed. Data is drawn from various web sources, individuals and educators. The findings show strong support for this visual memory approach to teaching math at an

early age. The findings from this study will be presented to those who attend the roundtable and discussion will be encouraged. Participants will be probed to think of the opportunities, weakness and strengths associated with this approach. Participants will discuss this in the context of the disparities observed in math skill development.

### **Can Challenge Based Learning be Implemented in an Online Course?**

*Victoria Wangia-Anderson, University of Cincinnati; Heekyoung Jung, University of Cincinnati; Lakshmi Tirumala, University of Cincinnati; Whitney Gaskins, University of Cincinnati*

**2:05 PM/Battelle Hall 254**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Challenge Based Learning (CBL) is an active learning environment that allows students to plan their own learning. To reduce negative experiences and increase motivation in K-12 classrooms, Apple, Inc. developed the pedagogy of challenge based learning (CL). The challenge involves leveraging technology to solve real world challenges and starts with a “big idea”. This approach is making its way into higher education as educators seek to challenge students to explore utilizing technological solutions to address challenging real world problems. The research on CBL has focused on CBL in classroom settings. This study explored the feasibility of implementing challenge based learning in an online course. Distance learning students worked in teams and designed a technology solution aimed at addressing a health challenge in our society. Faculty from four (health, engineering, e-media and communication design) different disciplines developed the assignments and served as subject matter experts and resources for the students. Guiding questions, resources and activities were critical for the project assignment. Effectiveness and attitudes towards the approach were captured. The findings showed that this approach could be implemented in an online course but different resources were needed.

### **Research and Writing (RAW) Model: A Two-Part Model for Scientific Productivity**

*Ruth A. Washington, Kent State University; Llancyllius L. Williams, Youngstown State University*

**1:45 PM/Ruff Learning Center 202**

Format: Oral

Theme: Meeting the Needs of Underprepared STEM Students

Despite the clarion call from graduate schools, industry and the United States government about the need for well-qualified historically underrepresented minority (URM) STEM graduates, undergraduate institutions have yet to adequately respond. Research suggests a plethora of URMs are insufficiently prepared for the rigors of graduate school due to several factors. The deficiencies include the inability to navigate the STEM culture and inadequate preparation for graduate work. The challenge was to introduce research and scientific writing to seniors with little to no exposure and engagement to STEM research. We selected a Biology Seminar Class to restructure to strengthen research exposure and scientific engagement. The model consists of two parts: critically analyzing and presenting an oral presentation of a primary research article and writing and submitting a review article for publication in a scholarly journal. Having completed two iterations, we will share examples of material used, discuss data collection from built in student assessments and reflections and announced the number of publications submitted and generated from the model.

### **STEM Student Learning: A Multi-Departmental Examination of an Institution's Conceptual Gains**

*Paul J. Wendel, Otterbein University; Anna M. Young, Otterbein University; Kathryn M. Plank, Otterbein University; Joan M. Esson, Otterbein University*

**2:25 PM/Battelle Hall 103**

Format: Oral

Theme: Student Learning Outcomes and Assessment

At the beginning and end of three consecutive semesters, researchers administered published conceptual inventories to students in introductory STEM courses at a single institution. Across four departments, mean normalized gains range from 8% to 27%, commensurate with gains characterizing conventional classroom practices (instructor lecture, question & answer, and student listening/note-taking). However, faculty as a whole self-report "moderate" levels of interactivity (Darcy & Henderson, 2010), for which higher conceptual gains would be expected. Results are presented and possible explanations explored. Supported by NSF #1347234.

### **What's Not Working? Innovations That Fail**

*Paul J. Wendel, Otterbein University; Anna M. Young, Otterbein University*

**12:15 PM - 1:30 PM/Capital Center Field House**

Format: Round Table

Theme: Student Learning Outcomes and Assessment

Academics normally report positive results and rarely report negative results. This roundtable offers a venue to report and receive feedback on teaching failures. In 5-minute segments, each participant will describe an unsuccessful innovation in their classroom, including: 1) the goal of the innovation; 2) a description of what happened; and most importantly 3) evidence that the innovation failed. The rest of the group will offer feedback on the quality of the evidence and suggest tweaks or alternatives to the innovation. Hopefully some innovations can be saved, while others might be abandoned. In any case, emphasis will be placed on improvement of data collection. The roundtable is envisioned as a safe space to learn from one another as teachers and as practitioners of the scholarship of teaching and learning.

### **Whiteboards: A Tool to get Students Thinking and Talking in STEM Classes**

*Krista E. Wood, University of Cincinnati Blue Ash College; Louis Tres Kutcher, University of Cincinnati Blue Ash College*

**1:45 PM/Battelle Hall 254**

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Students are often apprehensive about taking first-year Physics and Anatomy & Physiology (A&P) courses because they are conceptually challenging. This presentation describes how two STEM professors used low-tech whiteboards to create collaborative classroom communities, promote distributed cognition – specifically whiteboard cognition, and engage students in active learning in Physics and A&P. Whiteboards were utilized to make learning visible so students could create shared inter-individual meaning scaffolded by the instructor, as needed. We surveyed students to determine their perceptions on the use of whiteboards during group work in our classes. Students appreciated the opportunity to interact with peers, learn from their group and the presentations of other groups, and were motivated to prepare for class when they knew a whiteboard activity would occur. Facilitating whiteboard activities required instructors to create collaborative classroom communities, “seed” information to groups, and reflect on the process to ensure student learning occurred.

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