Workshop: Institute on Teaching and Learning

Madison, Wisconsin
June 18–22, 2018

Workshop Program and Abstracts

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1: Keynote Lecture I

1.1 Student-Instructor Interactions in a Large-group Environment
Prem Kumar¹
¹ Univ. of Birmingham, Col. of Med. and Dent. Sci.
The gradient of the knowledge-doubling curve in our digital age demonstrates the futility of delivering an increasingly out of date curriculum using didactic methods. Such methods drive an instrumental approach to learning and reduce the meaning, feeling and relevance of the taught material. In contrast, effective active learning returns control to the student and personalizes the experience by relinquishing content delivery for understanding. This interactive lecture will describe the challenges and enjoyment of implementing flipped teaching to large physiology classes.

3: Plenary I

3.1 Teaching Best Practices
Jae-Eun Russell¹
¹ Univ. of Iowa, Office of Teaching, Learning & Technology
What specific knowledge, skills, and competencies do we want our students to gain when they complete the course? Although lecture has been a traditional mainstay of any university campus, abundant research indicates that effective learning is supported when students are actively engaged in the learning process. Dr. Russell will briefly sketch teaching best practices and will provide the participants with useful rules of thumb to effectively implement them in the classroom.

4: Concurrent Workshop I: Assessment

4.1 Nuts and Bolts of Exam Analysis
Anne Schoening¹
¹ Creighton Univ., Col. of Nursing
This session answers the question, "What do those exam stats mean anyway?" Participants will review the definitions of common statistical terms used in exam analysis and individual item analysis and will analyze statistical data for selected response items. Discussion will focus on using exam item analysis data as a means for quality improvement and making meaningful decisions about student learning.

5: Concurrent Workshop I: Professional Development

5.1 Compiling an Educator Portfolio for Promotion and Tenure
L. Britt Wilson¹
¹ Univ. of South Carolina
Educator tracks in medical schools are becoming more common. In this presentation we will discuss ways to create an educator portfolio for promotion and tenure. The look of this portfolio should accentuate the guidelines of your institution. Thus, if you are at an institution that has an educator track, please consider bringing the guidelines to facilitate our discussion.

6: Concurrent Workshop I: Tricks of the Trade

6.1 Introduction to the CREATE Strategy - Deep Analysis of Primary Literature Benefits Both Students and Faculty
Christopher Trimby¹
¹ Univ. of Delaware
CREATE courses use close analysis of linked sets of journal articles as a portal into the research laboratory. Faculty bring their deep research understanding to class, decreasing prep time and building students’ independence and transferable skills. Workshop: (1) Brief CREATE overview; (2) Major focus: participants act as “CREATE students” in hands-on literature-based activities that introduce the CREATE strategy and toolkit; (3) Consider ways to apply CREATE approaches in physiology courses.

7: Plenary II

7.1 Why Collaborative Learning Works and How to Make it Happen
Robin Paige¹
¹ Rice Univ., Ctr. for Teaching Excellence
Is group work an effective means to teach disciplinary content and skills or does it simply teach cooperation and teamwork? In this talk I will present research on how carefully organized student interaction through collaborative learning techniques enable students to engage in knowledge production, develop complex and critical thinking, and build fluency with the course material. I will discuss strategies for planning, managing, and assessing collaborative learning.
8: Concurrent Workshop II: Assessment

8.1 Objective Assessment of Instruction: How do you know your students are learning?
Jae-Eun Russell

1 Univ. of Iowa, Office of Teaching, Learning & Technology

Assessments should reveal how well students have learned what you want them to learn while instruction provides paths for them to learn it. How do you know your students are learning? Formative assessment is critical to support your student learning and to improve your instruction. This workshop will focus on developing and sequencing a formative and summative assessment plan to provide rich learning experiences that will support your student learning and performance.

9: Concurrent Workshop II: Professional Development

9.1 Embracing Diversity and Combatting Bias
Sydella Blatch

1 American Society of Cell Biology

Inclusive environments are key for all to succeed. But everyone (yes everyone!) has biases, so how can you as the leader, foster an inclusive environment when everyone is operating with bias? Biases go beyond race/gender, which are not the sole focus here. In this workshop you will use methods to identify various types of bias in an environment, practice using tools to decrease it, and learn strategies to help you bridge the needs of students coming to you with a host of personal experiences.

10: Concurrent Workshop II: Tricks of the Trade

10.1 Collaborative Learning
Beth Beason-Abmayr

1 Rice Univ.

Collaborative group work can be an effective method to facilitate inquiry-based learning. By scaffolding assignments throughout the semester, students work in teams to progress from structured to open-ended and independent levels of inquiry. In this workshop you will work with one example of a team-based project to help students learn animal physiology and brainstorm strategies to incorporate similar projects into your own courses.


11.1 Case-Based Review Sessions Incorporating the Student Response Polling Feature of an Active Learning Platform Give Faculty and Students Real-Time Formative Feedback in Pre-Clerkship Medical School Courses
Rebecca Sullivan, Thomas Fanrak

1 Physiology, Lewis Katz School of Medicine at Temple University, 2 Information Technology, Lewis Katz School of Medicine at Temple University

The Lewis Katz School of Medicine at Temple University annually welcomes a diverse class of 210 students to the MD program. Our goal is to create an interactive and collaborative experience to promote deeper levels of learning for large groups of students, while offering the attention, guidance and expertise of our faculty.

Course directors are tasked with increasing the active learning component while decreasing the passive lecture component of the pre-clerkship courses. The availability of course recordings of lectures, coupled with the attendance policy that attendance at lectures is not required, has shifted the classroom culture such that lecture attendance is low.

A challenge faculty face with large class sizes is obtaining valuable feedback as to which concepts the students struggle to learn, or adopt misconceptions which come from either prior knowledge or the misunderstanding of course material. Formative practice questions are provided to students as a study tool, but are neither required nor collected, and therefore cannot be used as feedback by the faculty. Often, faculty receive most feedback from the summative assessment.

Attendance in optional pre-exam review sessions has also been in decline. Facilitators of these sessions seek methods to provide meaningful review of a multitude of topics while gaining and keeping the attention of the students. Past methods include lecture-style reviews, Q&A style reviews, and case-based reviews during which students are called on individually.

To address these issues, we piloted a new review session format in a second year, pre-clerkship medical course. This format incorporates case-based learning with real-time formative assessment using student response polling software available in the Echo360 Active Learning Platform. The goals were to increase student engagement in the large class setting and to offer a method by which both students and faculty gained real-time insight into whether students understood key concepts. Faculty designed the sessions to build on cases previously introduced in lecture and/or workshops to integrate the structure/function relationships of
disease. This allows faculty to address big picture and high-yield concepts while modeling how to differentiate disease states. It also allows for spaced retrieval of information, which has been shown to improve learning (1). Another benefit of this method includes providing a method by which faculty can model how to approach board-style questions, which is of particular interest to the students as they prepare for their first Step exam at the conclusion of this academic year.

Faculty appreciate the students’ enthusiasm and that they can instantly discover which topics students find challenging and clear up confusion and misconceptions. Students comment that they appreciate how a large amount of material can be covered in a meaningful way in a short period of time, that they can practice questions and cases with immediate faculty feedback, and that due to the timing of these sessions, they can refine their study plan and improve their time management.

Based on the success of this pilot program, we plan to expand these methods to other courses as well as other lecture and small group-based activities.

References:

11.2 Classroom attendance patterns and examination performance in pre-clinical medical students.
Christine Kauffman¹, Jonathan Kibble¹, Megan Derazin¹, Abdo Asmar²
¹Medical Education, University of Central Florida College of Medicine, ²Internal Medicine, University of Central Florida College of Medicine

Studies completed with undergraduate populations have shown that attendance positively correlates with academic performance. These were primarily done before the current era of the internet with online streaming of in-class sessions and multiple sources for content. In recent years, a marked decline in classroom attendance within medical school has been noticed with the advent of this online material. The goals of this study included a description of classroom attendance patterns, a determination of learner traits associated with voluntary attendance (using self-regulated learning theory as a theoretical framework), and the associated performance on summative assessments in this modern era.

The study was performed during the second-year Gastrointestinal and Renal systems module of the 2017/18 academic year. Curriculum was divided into mandatory and voluntary sessions. The mandatory sessions included team-based learning and small group case-based learning sessions. In contrast, the voluntary sessions consisted of lectures and small group application exercises of material previously covered in the curriculum. All lectures were recorded and all other materials (e.g. PowerPoint files, small group case materials and answers) were available to students online whether or not they attended in person. Attendance was recorded for all sessions using a Bluetooth enabled smart-phone application (Tealpass). Performance was determined based on the 118 multiple-choice question final examination at the end of the 6-week module covering all material presented. Students voluntarily completed the Motivated Strategies for Learning Questionnaire (MSLQ). Spearman’s rho correlation coefficients were calculated to assess the relationships between percentage of classes attended and each of the 15 subscales for motivation and learning strategies measured by the MSLQ. This study was IRB-approved and students gave informed consent.

The study group consisted of 78 students (68% of 114 total) of which 48 completed the MLSQ. The percentage of attendance in the study group was not different than that of the whole class. Attenders made up 67% of the group with 33% attending none of the non-mandatory sessions. High levels of self-efficacy and the ability to self-regulate effort were predictive of low attendance. Attendance was positively predicted by an orientation towards peer-learning and help-seeking. The non-attenders performed better on the final exam than the attenders group. However, there was no correlation between the percent of classes attended and performance on the final exam.

We conclude that different facets of self-regulated learning predict attendance, with highly confident students being the least likely to attend and that attendance at in-class sessions is no longer a good marker for those who will do well in a course. Further work is needed to characterize the nature of student engagement and effective approaches to study.
11.3 Flipping the Course: Independent Study of Online Videos and Interactive Sessions in a Medical Pathophysiology Course

Thomas Pressley¹, Gilbert Berdine²

¹Medical Education, Texas Tech University Health Sciences Center, ²Internal Medicine, Texas Tech University Health Sciences Center

The intensity and depth of learning required in medical school poses challenges for both students and faculty. Students must constantly adjust priorities as they juggle scheduled content delivery such as lectures with the need for independent study. Like many medical schools, we record live lectures for digital distribution to the students. As each class progresses in its training, however, we have found that an increasing number of students rely exclusively on the recordings rather than attend the live presentations. As a result, they spend less and less time interacting with faculty members and each other. At the same time, increasing demands in the laboratory and clinics have made it more and more difficult for our faculty to invest the time needed for live lecture. Rather than fighting these trends, we adopted a model for our second-year pathophysiology course in which the bulk of subject material was delivered as prerecorded videos that were made available online. Although some videos were custom-made, most were adapted from recordings made in previous years. A suggested schedule of study was posted for the students, and each afternoon, we scheduled interactive sessions in which students could apply their learning. These included case studies, patient interviews, class discussion of vignette-style questions, and various hands-on clinical simulations. Some sessions were mandatory, but most were optional. With this flipped strategy, we hoped to enhance active engagement by students while reducing the time commitments for faculty. A field-test was conducted in 2015 with the respiratory section of the course, and performance and student feedback were encouraging. By the current year (2018), the entire course is conducted using the online material and interactive sessions. Student performance, as measured by in-house exams and high-stakes standardized exams, has not declined, and in many respects is improving. Moreover, evaluations of the course suggest that most students appreciate the flexibility and independence available with this approach. We believe that the flipped strategy for a course in the pre-clinical years facilitates student learning while optimizing faculty engagement.

11.4 Utilization of an Interprofessional Simulation Experience to Change Student Perception of Interprofessional Education

Chris Wingard¹, Beth Quinn¹

¹Doctor of Physical Therapy, Bellarmine University

Rationale: Collaborative practice in healthcare results in improved patient safety, quality healthcare delivery and overall optimal health services (Interprofessional Education Collaborative Expert Panel 2011). To produce a healthcare workforce that is “collaborative practice-ready”, interprofessional education must be introduced and intentionally incorporated into the appropriate curriculums to allow students to learn about, from and with other healthcare professionals. Similarly, simulation-based education has demonstrated effective results in improving patient care services and better patient outcomes in a learning environment that is safe, structured and reproducible (Schmidt et al 2013; Thomas et al 2017). The purpose of this study is to determine if an interprofessional simulation experience changes Doctorate of Physical Therapy (DPT) and Bachelor of Respiratory Therapy (RT) students’ perception of interprofessional education and effectively meets learning objectives established to promote interprofessional communication, collaborative implementation of skilled therapy and effective team assessment of the patient’s intervention response.

Participants: 70 students enrolled in Cardiopulmonary Physical Therapy in the DPT and 15 students enrolled in Respiratory Therapy Science III in the RT program, both at Bellarmine University.

Methodology: All students were invited to participate in an anonymous survey prior to the scheduled simulation experience. The survey included: identification of program enrollment, any prior interprofessional education training, and the Student Perceptions of Physician-Pharmacist Interprofessional Clinical Education-Revised (SPICE-R) Instrument. An interprofessional simulation lab experience was designed to include both DPT and RT students in the early mobilization of a ventilated high-fidelity simulation mannequin with complex cardiopulmonary clinical presentation. Immediately following the lab, students were invited again to complete a second anonymous survey that included the SPICE-R Instrument and Simulation Effectiveness Tool-Modified.

Summary of Results: 80 students participated in the Pre-experience survey and 60 participated in the Post-experience survey. In general, there was a positive shift in student perception as noted between SPICE-R surveys. The simulation experience appears to have had the greatest impact on student’s feeling that their education
is enhanced when working with students from another health profession. 23.8% responded Strongly Agree pre-experience and 70.0% responded Strongly Agree post-experience. Students also perceived that patient satisfaction is improved when a patient is treated by a team that consists of individuals from two or more health professions. 31.3% responded Strongly Agree pre-experience and 70% responded Strongly Agree post-experience.

**Conclusion:** Survey results demonstrated a positive shift in student perception of interprofessional education. IPE embedded into health professional curriculums can have a positive impact on student perception on the value of IPE as well as the positive patient outcomes that result from interprofessional collaboration.

**Reference List:**


**11.5**
**Benefits of Early Clinical Exposure Using Simulated Patient Encounters for First-Year Medical Students**

James Bunch¹, Dan Webster², Gregory Brower²

¹School of Medicine, Texas Tech University Health Sciences Center, ²Medical Education, Texas Tech University Health Sciences Center

Early clinical exposure has the potential to improve retention of important physiological concepts in undergraduate medical education. Experiential learning has been linked to improved skill development, with one benefit being facilitating the transition between pre-clinical and clinical education. First-year medical students at Texas Tech University Health Sciences Center School of Medicine partake in Emergency Department Simulations during the Major Organ Systems (Systems Physiology) block, and again in the second year as part of the Systems Disorders block. With the goal of improving retention of clinical pathophysiology and quality of clinical reasoning, we embarked on a three-fold quality improvement project in conformance with Institutional guidelines. We produced and distributed an electronic module introducing students to the layout and clinical features of our model Emergency Department Simulation room. Additionally, we developed new simulation activities based on cardiac, endocrine, gastrointestinal and renal physiology and the recognition of several common clinical conditions (e.g., pre-renal azotemia). Finally, we developed an Advanced Clinical Skills elective to provide School of Medicine Teaching Assistants the relevant clinical expertise needed to effectively explain the clinical reasoning relevant to diagnosis and treatment of the pathophysiology encountered in these new simulations. Student performance was assessed by a pre-and post-test focused on clinical management of emergent disease and evaluation of clinical write-ups (i.e., SOAP notes) documenting the simulated patient encounters. Early analysis of the data indicates that this intervention has produced improved clinical reasoning skills in first-year undergraduate medical students.

**11.6**
**Students in a graduate-level physiology class believe participation in group assessments improves their understanding of course concepts but knowledge retention is reduced in low-performing students.**

Renee McFee¹, Katie Bidne²

¹School of Veterinary Medicine and Biomedical Sciences, University of Nebraska-Lincoln, ²Animal Science Department, University of Nebraska-Lincoln

Group assessments have been shown to benefit both low and high-performing students and several studies have reported positive student perceptions of collaborative testing, including improved learning. Unfortunately, there is conflicting evidence regarding the impact on knowledge retention. Group quizzes have previously been utilized in our systemic physiology course for graduate and professional students; students complete quizzes individually and are then organized into groups of 3 to retake the same quiz. However, questions on formative weekly quizzes typically assess lower-level learning while questions on summative unit exams assess a higher-level of learning. Therefore, use of both group quizzes and exams was evaluated for the 2016-17 academic year. Group quizzes and individual exams were administered during the fall semester and individual quizzes and group exams were administered during the spring semester. The group testing format was the same...
between quizzes and exams with the exception that quiz groups were assigned randomly and exam groups were randomly sorted until there was no significant difference in mean course grade between groups. Students indicated that participation in group assessments improved their understanding of physiologic concepts (quizzes = 83%, exams = 83%) and were a valuable use of class time (quizzes = 92%, exams = 93%). Students appreciated the opportunity to discuss ideas with fellow students and believed the group format was similar to interactions they will have with future colleagues. However, high-performing students did not appreciate being regularly grouped with low-performing students and certain students admitted to reducing their study efforts if knowingly paired with high-performing students. In addition, the difference in individual and group assessment scores was significantly greater ($P < 0.003$) for low-performing students (scoring in the bottom 1/3 of the class; 25.8%) than high-performing students (scoring in the top 1/3 of the class; 3.0%). Knowledge retention was assessed by taking select questions from quizzes and exams and administering them again at the end of the semester as part of an unannounced, ungraded posttest. Student performance was significantly lower ($P < 0.02$) on the posttest compared to individual assessments for all testing formats: group quizzes (55.6% vs. 82.1%), individual quizzes (68.2% vs. 81.0%), group exams (60.9% vs. 80.5%), and individual exams (69.0% vs. 80.8%). When only low-performing students were evaluated, scores were significantly lower ($P < 0.008$) on the posttest compared to individual assessment scores for group quizzes (41.7% vs. 70.8%) and exams (42.9% vs. 63.2%) but not individual quizzes (59.0% vs. 65.8%) and exams (62.5% vs. 68.8%). This suggests that participation in group assessments reduced knowledge retention in low-performing students. This study is being repeated for the 2017-18 academic year with 3 modifications to address some of the identified shortcomings to determine if student perceptions and knowledge retention can be improved: 1) All student groups will be assigned in a strictly random manner. 2) Students will not be aware of their fellow group members until just before the group assessment. 3) Individual and group assessments will no longer be weighted equally, rather, students will have the opportunity to earn a limited number of bonus points towards their individual assessment score by earning a higher score on the group assessment.

11.7 Individualised student learning and feedback in large medical student cohorts: flipping respiratory physiology
Clare Ray1, Prem Kumar1
1Institute of Clinical Sciences, University of Birmingham
Successful transition to University requires students to adapt to new styles of teaching and learning. Traditionally, the teaching of physiology to medical students is by a series of didactic lectures accompanied by tutorials. This approach fulfils the requirements of efficient content delivery, but with increased cohort size, does not provide students with many opportunities to assess their understanding at an individual level. The challenge therefore is to design modules which engage all students in a large cohort with the subject material and yet give them the chance to obtain personalised feedback to test their own understanding. We therefore sought to redesign the delivery of our respiratory physiology module to address these concerns.

We now use a ‘flipped classroom’ approach1 to engage approximately 350, year 1 medical students at the University of Birmingham with their learning, and to support their understanding of respiratory physiology. Lecture podcasts, recorded using lecture capture software (Panopto), are made available to the students via their VLE (Canvas, Infrastructure) to review in their own time before attending interactive sessions held in a lecture theatre. These sessions use mobile interactive response software (ResponseWare, Turning Technologies) and multiple-choice questions to give students the opportunity to apply their knowledge and get immediate and individualised feedback on their learning. Peer teaching and bespoke lecturer explanations, guided by the students’ responses, help to consolidate understanding. Students are further supported by tutorials in which they can apply their knowledge to clinical scenarios.

73% of students agreed that the flipped approach had supported their learning. Whilst 20% of the cohort did not like having to review the podcasts prior to the interactive sessions, 86% of them said they spent no more than 1-2 hours in such preparation which is less than the allocated independent study time per delivered hour. Additionally, for many students the best part of the flipped approach was felt to be the opportunity to review podcasts at their own pace. To increase the efficacy for individual students, we have found it to be important to use questions with a range of difficulty to stretch the most able students without undermining the confidence of others. Our evaluation suggests that we have been able to achieve this as only 13% of students thought that the questions were too difficult and just 2% that they were too easy.
Following the success of this approach for respiratory physiology we are now using it successfully for the teaching of cardiovascular physiology to year 2 medical students. As the doubling time for medical knowledge is predicted to be just 73 days by 2020, wider use of the flipped approach may increase student confidence in their ability to learn and understand independently in a fast-changing environment. This will equip them with the skills that they require for a career of life-long learning and we should focus on the understanding of core principles in the initial years of medical education.


11.8 Teaching reform practice and reflections based on undergraduate Pathophysiology course in Tongji University in the past ten years
Kun Li1, Gong Qian2, Yongyu Li3, Yanna Li3, Yuxian Li3, Maomao An4, Mingzheng Zhou5, Ling Zhu5, Junfang Zhang5, Yan Zhao6
1Department of Pathophysiology, Department of Pathophysiology, 2Editorial Department of the Journal of Tongji University, Editorial Department of the Journal of Tongji University, 3Department of Physiology, Department of Physiology, 4Department of Pathophysiology, Department of Pathophysiology, 5Functional experimental center, Functional experimental center, 6Department of Pathology and Morphology, Department of Pathology and Morphology

Entering to 21st century, teaching reform was carried out in full swing in China. Tongji University is one of the key universities of the Ministry of Education, and innovations in medical education are imperative as well as other subjects. As an important basic subject of undergraduate education in Chinese medical colleges and universities, Pathophysiology is deeply involved in the teaching reform action in Tongji University, covering a large amount of debates on curriculum development, teaching methodology, student assessment, curriculum evaluation, teacher’s training, and so on. Here only review the construction practice of some teaching reform projects based on undergraduate theory and experiments course in the past ten years, including excellent course construction of experimental hemorrhagic shock (2008), curriculum integration based on organs and system (2009), shock - problem based learning course (since 2010), bilingual education (2012), excellent course construction of experimental hypoxia (2013), experimental teaching reform project experimental hepatic encephalopathy (2016). This article also addresses some thinking to the teaching reform practice on undergraduate: their knowledge, skills, good attitudes and abilities to meet the challenge of the expanding body of medical knowledge and the social demands.

13: Plenary III

13.1 Forgetting as a Friend of Learning
Robert Bjork1
1 Univ. of Calif., Los Angeles
It is natural to think that learning is building up skills or knowledge in one’s memory and that forgetting is losing some of what was built up. The relationship between learning and forgetting is not, however, so simple and in some important respects is quite the opposite: Conditions that produce forgetting can enable additional learning, and learning or recalling some things can contribute to forgetting other things. In this talk I focus on why forgetting enables, rather than undoes, learning.

14: Concurrent Workshop III: Assessment

14.1 Defining Competency in Physiology
Jeff LaRochelle1
1 Univ. of Central Florida
Effective peer leaders augment student learning and engagement. Faculty in a number of STEM fields incorporate peer leaders in the classroom, and this approach is growing in undergraduate anatomy and physiology courses. This workshop will examine practical approaches to designing a peer leader program while addressing logistical concerns. Considerations will include peer leader roles, session design, effective communication, and constructive assessment tailored to your course.

15: Concurrent Workshop III: Professional Development

15.1 Crossing Over to the Dark Side: The Path to Academic Administration
Joseph Benoit1
1 Burrell Col. of Osteopathic Med.
Academic careers offer many opportunities for advancement that can extend beyond the traditional classroom. Each step provides exciting opportunities but often are accompanied by trade-offs that should become part of the decision to “Cross over to the dark-side.” Join us for an exciting interactive session designed to help you develop an administrative portfolio and assess your readiness for academic advancement.
16: Concurrent Workshop III: Tricks of the Trade

16.1 Effective Use of Peer-Learning and -Teaching
Kathleen Hughes¹
¹ Columbus State
Effective peer leaders augment student learning and engagement. Faculty in a number of STEM fields incorporate peer leaders in the classroom, and this approach is growing in undergraduate anatomy and physiology courses. This workshop will examine practical approaches to designing a peer leader program while addressing logistical concerns. Considerations will include peer leader roles, session design, effective communication, and constructive assessment tailored to your course.

17: Plenary IV

17.1 Transcending Content and Teaching Context: How to Foster Meaningful Scientific Literacy in the 21st Century
Cyndi Brandenburg¹
¹ Champlain Col.
The rate of scientific discovery makes content mastery a challenge even for experts. Meanwhile, while objectivity in science is highly valued in theory, in reality, the process is mediated by flawed humans in a complex and subjective world, thereby limiting its absolute potential. This presentation makes an argument for why contextualizing the role of science in society may be more important than teaching science content in and of itself, and provides one possible framework for doing so.

18: Concurrent Workshop IV: Assessment

18.1 Team Teaching: Is it Worth the Hassle?
Aaron Kostko¹
¹ Univ. MN at Rochester, Ctr. for Learning Innovation
This session focuses on the pedagogical merits and challenges of team teaching. After a brief survey of various team teaching models, participants will be introduced to results from the author’s research on the impact of team teaching on student attitudes and classroom performance. Participants will then consider how they could implement team teaching within their own courses and discuss the institutional and pedagogical barriers of doing so.

19: Concurrent Workshop IV: Professional Development

19.1 Moving Beyond the Classroom (and Becoming a Media Star)
Mary Poffenroth¹
¹ San Jose State
Should you share your research with non-academics? With your already demanding schedule, it’s so much easier to just talk to other professionals in your field. But sci-curious, non-academic audiences are out there and they want to hear about your research directly from you! Start creating engaging digital content for wider audiences using video, podcast, live events, and popular writing by joining Mary Poffenroth, University Biology Lecturer and Science Communicator, for this hands-on workshop.

20: Concurrent Workshop IV: Tricks of the Trade

20.1 Implementing Universal Design of Learning in Science
Stacie Rose¹
¹ Heartland Comm. Col.
Reaching every student is a daunting task. Universal Design in Learning is a comprehensive framework based on three areas we know influence learning: engagement, content, and assessment. This workshop will introduce you to the concept of UDL, provide concrete examples, and aide instructors in the implementation of UDL in their own classrooms.

21: Poster Session II and Group Discussions: Best Practices in Undergraduate Physiology

21.1 Engaging Middle Schoolers and Undergraduates with Zehr’s Becoming Batman
Heidi Walsh¹
¹ Biology Department, Wabash College
Wabash College is an independent liberal arts college for men, whose mission is to educate students “to think critically, act responsibly, lead effectively, and live humanely.” Approximately 20% of incoming freshmen indicate an interest in health professions, which has shifted the population of student who take our physiology course (BIO315) from those needing an elective for the Biology major to those fulfilling a requirement for admission to professional school. Traditionally, BIO315 was taught with an emphasis on organismal physiology, but the large degree of pre-health student enrollment drove me to reconsider the course’s focus. Because health professionals must be proficient in communicating complex physiological concepts to a diverse population of patients, I adapted
the laboratory section of BIO315 to include a community-engaged learning project where Wabash students developed their own “superhero physiology” lessons for local middle school science classes, inspired by the book Becoming Batman: The Possibility of Superhero by Paul Zehr. This project had three aims: 1) Enhance working knowledge of physiological concepts by creating lessons to educate others. 2) Gain expertise in communicating science to general audiences. 3) Engage with the local community to promote science and health. During the first third of BIO315 in Fall 2016, Wabash students learned physiology concepts through traditional classroom instruction, human physiology laboratory exercises using iWorx, and reading Zehr’s book. After multiple brainstorming sessions, three groups of students developed interactive lessons based on Thor (muscle physiology), Spiderman (nervous system & reflexes), and Superman (respiratory physiology). Students ran these lessons during November 2016 in 6th, 7th, and 8th grade science classes at Crawfordsville Middle School in Crawfordsville, IN. While the Wabash students had hoped to incorporate iWorx more fully into their lessons, the middle school class sizes and time constraints made simpler activities more feasible. One of the most successful activities, however, involved a replica of Thor’s hammer linked to the iWorx FT-220 hand dynamometer. A 5-gallon bucket was filled with quick-dry cement with a small shovel placed in the middle to form the handle of Thor’s hammer. Once dry, the bulb of the hand dynamometer was attached to the handle so that force applied while squeezing the handle to lift the hammer could be measured with iWorx. Both Wabash and middle school students responded positively to the lessons, as did the middle school science teachers. For Fall 2018, we will perform more systematic assessments of the Superhero Physiology project, and incorporate more exposure to pedagogy prior to lesson plan design. This work was funded by a Lilly Endowment Faculty & Staff Mini-Grant.

21.2 Course Delivery Format, Content Knowledge, and Motivation Factors in Undergraduate Human Physiology

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¹Health & Human Physiology, The University of Iowa, ²Office of Teaching, Learning, & Technology, The University of Iowa, ³College of Education, The University of Iowa

Introduction: The purpose of this study was to examine the effects of course delivery format (traditional lecture, online, and blended) upon end-of-semester content knowledge and motivation factors (self-efficacy, anxiety, and intrinsic value) in an undergraduate human physiology course. Methods: Students enrolled in HHP:3500 Human Physiology during the Spring 2017, Summer 2017, and Fall 2017 semesters were recruited for participation in this study, which included: (1) collection of demographic information (major, class standing, gender, first generation status, underrepresented minority status), (2) survey completion (perceptions of course activities, motivation factors, instructor characteristics), and (3) assessment of physiology-specific content knowledge (baseline, formative, and summative assessments). This course was offered in three delivery formats: traditional lecture, online, and blended, and each section progressed through the same course content at the same pace. All students had access to the same pre-recorded lectures and completed weekly adaptive learning assignments. The traditional lecture presented the same content as in the pre-recorded lectures during two 75-min in-class sessions per week; review of the pre-recorded content was optional and supplemental. Online students reviewed the pre-recorded lectures and engaged in asynchronous online discussion activities approximately every two weeks. Students in the blended section met in a classroom once per week for 75 min to review concepts presented in the pre-recorded lectures, complete in-class formative learning activities, and engage in guided peer discussions. Results: A total of 414 students participated in this study: 255 out of the 350 students (73%) enrolled in the traditional lecture sections, 105 out of 147 (71%) from the online sections, and 54 out of 67 (81%) from the blended section. There were no significant differences in students’ prior knowledge across the three course delivery formats. No significant differences in cumulative exam scores were noted relative to course delivery format after controlling for students’ prior learning (72% (15.7 SD), 72% (14.7), and 74% (14.9) respectively for traditional lecture, online, and blended course formats; P = 0.60). However, performance on a post-course knowledge assessment was significantly higher for the blended format versus the traditional lecture and online formats (73% (13.3), 65% (14.4), and 66% (15.2) respectively; P = 0.007). Of motivational factors, self-efficacy and anxiety were significant predictors of both cumulative exam scores (P < 0.001 self-efficacy, P = 0.001 anxiety) and the post-course knowledge assessment (P = 0.004 self-efficacy, P = 0.036 anxiety). Furthermore, students in the blended section reported significantly lower anxiety at the end of the semester compared with students the online section (4.22 versus 4.98 on a 7-point scale, P =0.027). The blended course format was associated with lower D/F/W rates (4.5%) compared with traditional lecture (18.1%) and online (18.8%) course...
formats ($P = 0.02$). **Conclusions:** The D/F/W rate for the blended course delivery format was lower, and anxiety lower, compared with the traditional lecture and online sections of Human Physiology. Thus, the blended course structure may be an effective course delivery format to facilitate perseverance and mastery of human physiology content knowledge.

### 21.3 Utilization of a critical thinking framework to teach students to think through concepts in a second year Exercise Science course

**Jeremy Dicus**, **Brock Jensen**

**1Exercise and Rehabilitative Sciences, Slippery Rock University**

The typical Exercise Science program may see students pursue a multitude of directions upon program completion. Destinations commonly range from entering a fitness profession to a variety of health-related graduate programs (e.g. MD, DPT, etc.). All of these desired paths require substantial content-knowledge for success. However, it has been suggested that employers value critical thinking more than the acquisition of discipline-specific knowledge. Therefore, programs and instructors are tasked with preparing students with both content knowledge and the ability to think critically. In order to bridge this gap, we have designed this course around critical thinking theory and identified tactics that develop basic critical thinking skills while students process course concepts. The Paul-Elder model of critical thinking provides a rich conception of critical thinking. Substantial investigation into the Paul-Elder has provided the framework to design a sophomore-level course in which students develop an understanding of critical thinking theory while leaning course concepts. There were six significant components to the successful design and implementation of this course. The first step was to identify and design the course around the most significant concepts of the subject. Second, students were provided with an introduction to the theory and language of critical thinking. The third component required the creation of opportunities for students to prepare for class sessions by clarifying their understanding of a course concept. Fourth, Socratic questioning was used to cultivate discussions that intentionally utilized the language of critical thinking. Fifth, assignments were designed to deliberately address one or more Elements of Thought as students processed a course concept. The final component was to provide ample opportunity for meaningful feedback through the use of Intellectual Standards.

### 21.4 Scaffolded approach to primary literature in a non-majors biology course: a pilot study

**Melissa Petreaca**

**1Biology, DePauw University**

Although undergraduate research experiences have a substantial impact on student retention and success in STEM fields, relatively few students have the opportunity to participate in individual research opportunities, and these research opportunities are frequently reserved for more advanced students. To increase the numbers of introductory-level students engaged in biology research, I incorporated student-designed group research projects in my introductory-level, non-majors Inflammation course. In these research projects, students developed project proposals that included a hypothesis based upon evidence from previously published studies and a series of experiments that tested the hypothesis. However, before the students could develop a hypothesis and rationale for their projects, they needed to learn how to read and understand the primary sources that could provide evidence for their hypotheses. To guide students through the process of reading and understanding these primary sources, I created and implemented a series of scaffolded student-centered activities, mini-lectures, and short writing activities. I used data from pre- and post-course CURE surveys as well as comments in student opinion surveys to assess student confidence gains in several key areas, and both CURE survey results and student opinion surveys suggest that students in this class made substantial gains in their abilities to read and understand scientific literature. Using this type of approach to scaffold the process of comprehending scientific literature may make students more confident in their understanding of the literature, which may make student-designed research projects more feasible for introductory-level courses.

### 21.5 Context as a source of difficulty in human physiology

**Tara Slominski**, **Jennifer Momsen**

**1Biological Sciences, North Dakota State University**

Students struggle to succeed in Human Anatomy and Physiology (HA&P) for several reasons [1, 2]. Many students enter science classrooms with naïve, informal knowledge constructs that complicate or conflict with the concepts they are learning in class. These ideas originate from observing natural phenomena in the real world [3,4,5] and often conflict with formal instruction. As a result, a student must undergo considerable conceptual conflict and reformation of that knowledge if they are to be a successful learner [6].
Findings from my earlier research [1,2] on student difficulties suggest students may rely on intuitive reasoning and experiential knowledge to frame their thinking about physiology. For example, when asked to reason about neurotransmitters, students may associate this concept with an everyday example of movement or flow (e.g. water moving through pipes or electricity moving along a wire). Superficially, building links to existing knowledge structures may help students reason about biological phenomenon; however, this type of framing may lead students to make incorrect assumptions and reason inappropriately. Using the neurotransmitter example, if a student attempts to learn synapse physiology by relying on previous experiences from the real world (i.e. signal flow requiring physical contact like electricity moves along a wire), they will likely struggle to understand the actual mechanisms of synaptic transmission.

Although my previous research provides some evidence that students use experiential or intuitive knowledge to shape their reasoning about neurophysiology, the results from this single study are limited. My current research expands on this work by directly investigating the role of students’ intuitive ways of thinking in HA&P classrooms. Specifically, I am researching if, when, and how students employ intuitive reasoning strategies when presented with a physiology problem or scenario and how these reasoning strategies affect student understanding of HA&P content.

I used surveys and interviews to investigate the impact of context, specifically human physiology context, on student reasoning. Through collaborating with physicists, I developed a set of isomorphic tasks that ask identical questions but present the questions in different situational contexts. By comparing student responses in each context, I can identify the impact of context on student reasoning. In addition, this experimental design enables me to control for student ability and isolate the effect of physiology context. I collected data in multiple iterations of HA&P and physics courses at NDSU, resulting in over 700 data points. In addition, I conducted semi-structured, think-aloud interviews with 12 HA&P students. Each participant was given one set of the isomorphic task and asked to reason through the question set. During the interviews, students’ explanations were probed to gather deeper insight into their reasoning patterns.

The data gathered from students in both the classroom setting and the interviews provide insight into how students reason about human physiology. More importantly, the results from this study provide instructors and researchers with new insight into the minds of HA&P students and bring to light the unique challenges students experience when learning physiology.

References.

21.6 Engaging A&P Students in Communities of Practice Inside and Outside of Class.

Jane Chapman 1

1Biology, Heartland Community College

Objective: To engage A&P students in communities of practice both in and outside of class.

Methods: Several changes were made to the design of the course to both in-class, fact-to-face time and outside, information acquisition time, to engage students in social learning and develop a community of practice in and out of class. Changes inside of class included: 1) creating permanent and diverse student groups with whom the students would work on collaborative learning lab activities, case studies, concept questions and peer instruction; 2) converting all exams to a team-based learning format using the team-based assessment in Learning Catalytics that were focused more on application rather than recall of the material. These assessments include an individual round followed by a team round and allow for implicit confidence level scoring options. Assessment of group functionality was made by instructor observation as well as with peer evaluation surveys via the CATME.org website. Changes outside of class added an annotation component to the pre-class reading assignment which is to be completed prior to completion of the pre-quiz. The annotation uses the social learning e-platform, Perusall, and provides students with the opportunity to interact with each other outside of class. Automated Perusall scoring determines how well the students are annotating the material and interacting with classmates.

Results: Inside of class: Student groups: Within a fairly short period of time these groups transitioned into positive support networks all working toward a common goal – learning anatomy and physiology. Student behavior in the groups was informally observed by the instructor and formally evaluated by their peers in 3 peer evaluation surveys throughout the semester – two formatively and a third summatively, administered.
through CATME.org. The peer evaluations helped guide the students through the ‘forming, storming and norming’ stages of group/team formation. Team-based Exams: Group discussions during team round were robust and in-depth which indicates there was a lot of learning happening; additionally, teams that discussed questions the most tended to do better on the exams. Outside of class: Students are actively reading, via annotating in Perusall, the pre-class reading assignments. Approximately 80% of the students completed 75% or more of the assigned readings before exams. Students are interacting with their classmates, outside of class, while annotating in Perusall, by answering questions posted by classmates, by ‘liking’ classmate’s comments, and by posting questions that classmates answer.

Conclusions: With intentional design and supportive activities A&P students can engage in social learning within a community of practice inside and outside of class.

21.7 Assessing and Adjusting: Student-Directed learning in an Advanced Physiology Class.
Jessica Fry
1 Math and Natural Sciences, Curry College

The college experience is ideally designed to develop students’ creative, critical, and independent thinking skills. At Curry College, a small liberal arts college primarily serving a population of students who score low on standardized tests or are otherwise underprepared, we find that some of our students are more comfortable with memorization as a mechanism of learning and resist other modalities. In 2016, to support student-directed learning in this population of students, Advanced Physiology, a 3000-level course with the prerequisites of Cell Biology and Genetics, was designed to encourage curiosity and creative learning within a Human Physiology framework. The inaugural semester experimented with three different student directed learning methods: The first, to research, design and carry out a group physiology experiment. The second is a student-led book club, in which each student group is responsible for integrating a chapter of Robert Sapolsky’s “Why Zebras Don’t Get Ulcers” with the physiological concepts presented in class. The third is a midterm assignment where students ask and answer their own physiology questions, demonstrating knowledge covered in class. Initial assessment indicated that students recognized the value in this teaching strategy as well as benefited from this exercise based on their performance on a more traditional final exam. However, in subsequent semesters, the same level of engagement has not been achieved by the same assignments, resulting in a reworking of the assignments to increase student motivation by using metacognitive strategies. The assessment of these alterations will be presented.

21.8 Students report enhanced learning when using TeamUp!, a digital assessment tool that provides immediate feedback in blended classrooms
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1 Department of Physiology, University of Toronto, 2 Human Biology Program, University of Toronto, 3 Department of Cell and Systems Biology, University of Toronto

We trialed two blended learning approaches in two classes of our introductory physiology course: Basic Human Physiology. The course covers all organ systems of the body, and is normally delivered via one two-hour lecture/week to a class of 160 students. In the trial, some of the typical lecture content was delivered via a 20-30 min online video to be viewed before the class. The class started with the rest of the lecture and the final 30-40 min of class time consisted of an active learning session. For the first active learning session, students worked in small groups to complete a worksheet that included both multiple choice and short answer questions. For the second active learning session, students used a digital assessment tool called TeamUp!, developed by one of us (Neumann). TeamUp! allows students to form groups, engage in peer teaching, submit group answers, and provides immediate feedback: all of which have been reported to improve student learning (1-3). Groups get full marks if they select the correct answer on the first try and partial marks with subsequent attempts.

To gauge the effectiveness of the blended formats, we conducted a student survey at the end of the trial. We also compared student performance on term test questions related to the active learning component to overall test scores. In the survey, the majority of students (n = 110) reported that the blended format helped them learn the material better and that they enjoyed the approach more (62% vs 38%). Of the students who preferred the blended format, the majority stated that they preferred TeamUp! to worksheets in terms of both learning (71%) and enjoyment (81%). The performance of the students on test questions related to the group work vs the test overall was not significantly different. The group work, however, addressed conceptually difficult content, and we have not yet assessed long-term knowledge retention by analyzing performance on the final exam. Also, test performance is only one way to assess the effectiveness of a teaching intervention. Indeed, the instructor reported that the students were more engaged during the blended learning classes and
that attendance increased. We conclude that incorporating active learning sessions into traditional lecture courses, especially with the use of TeamUp!, enhances student engagement, enjoyment and perceptions of learning.


21.9
A Framework for Integrating the events of the cardiac cycle: Electrical, mechanical, pressure, valve, volume (EMP double V)
Lisa Carney Anderson

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The cardiac cycle can be described and explained by the Wigger Diagram, a complex graph showing the changes in cardiac electrical activity, ventricular volume and cardiac pressures during the cardiac cycle. Students may be able to follow individual outcome variables over time, but it can be a daunting exercise for students to consider multiple variables simultaneously. Furthermore, while students may understand that two cardiac events are associated in time, they may not realize that one event is caused by a previous event. For example, depolarization of the ventricles causes the release of calcium ions that permit the ventricle to contract; students may know that an increase in ventricle pressure occurs after the QRS complex, but they may not fully understand that the increase in pressure is caused by cardiac contraction or that contraction of the ventricles is caused by depolarization of ventricles. The following framework (electrical, mechanical, pressure, valve, volume) was developed by the author after several years of trying to help students learn and integrate the events of the cardiac cycle. Using this framework, students identify an electrical event, either a deflection or an isoelectric event within the electrocardiogram. Then the student identifies the mechanical event (contraction or relaxation) that occurs because of the electrical event. The mechanical event causes a pressure change that allows a valve to open, stay open, close or stay closed. If a valve is open, then ventricular volume can change; if all four valves are closed then the ventricular volume stays the same. Students can engage in active learning activities to work through the Wigger Diagram using this framework. Examples of active learning activities based on this framework will be presented with the poster presentation.

22: Keynote Lecture II

22.1
What Determines the Physiology That Students Learn
Tony Macknight

1 ADInstruments

The different ways that students are motivated to learn will be discussed. These will include some historical perspective, the role of examinations, different modes of presentation, and some newer tools that are now available to promote learning.

24: Plenary V

24.1
Integrating Research into the Undergraduate Experience
Paula Mazzer

1 Dakota Western Univ.

Our STEM majors arrive on campus as rule followers—“Tell me what to do, and I’ll do it” is their refrain. To break this mindset, we redesigned our suite of lab courses to scaffold research throughout the major. Every lab incorporates both discipline-specific and research-specific skills. Foundational courses introduce skills, leading to upper level student-driven research. This model should be extensible to any curriculum, and makes research an integral part of the undergraduate career.

25: Concurrent Workshop V: Need Your Homework

25.1
Expanding the Classroom with Social Media
John Kanady

1 Univ. of Arizona

In this workshop, I’ll show you how you can use social media (primarily Facebook) to provide added value to your classes. We'll discuss some benefits/pitfalls of incorporating social media into your teaching and consider how you can analyze student participation. I'll share some of my tips for best practices, and you'll spend hands-on time creating a framework of content you can deploy for your very next course offering! Please make sure to bring a laptop and/or smartphone for this session.
26: Concurrent Workshop V: The One-minute Paper and Other Interactive Tricks for a Large-group Class

26.1 The One-minute Paper and Other Interactive Tricks for a Large-group Class
Rebecca Teed
1 Wright State
The best techniques to allow instructors to meaningfully engage with large groups of students often involve asking what they understand. I’m going to review ways to make even a lecture class more interactive using informal assessment, structured student discussion, and problem-solving exercises. We’ll discuss challenges posed by class size, how to get student buy-in, and how to use technology (including index cards and whiteboards) to engage and assess almost all the students in the classroom.

27: Concurrent Workshop V: Developing Multimedia

27.1 Developing Multimedia
Renee Link
1 Univ. of California, Irvine
Tools allowing instructors to develop custom media are widely accessible, but making a video can be daunting. Have you wanted to make videos for your class but aren’t sure where to start? Are you unsure of what software to use? We will review best practices for making videos and make one. Bring a computer and materials to use for a short video. We will use Camtasia in the workshop. Please download the free trial version in advance. The facilitator will be available before the workshop for help.

28: Plenary VI

28.1 Engaging in the Scholarship of Teaching and Learning
Jennifer Friberg
1 Illinois State
Problems, opportunities, and wonderments: these are the hallmark of college-level teaching for many. Course instructors encounter problems due to their classroom environment, instructional context, or other variables they cannot control. Opportunities exist to change that, from study abroad to simulation encounters to out-of-class learning experiences (to name a few). As teachers, we have wonderments, too -- ideas we consider as possible pedagogies in our classrooms -- though we are unsure of their impact or efficacy.

The scholarship of teaching and learning (SoTL) is a form of research that focuses on just that, teaching and learning. SoTL is comprised of three consistent components, according to most definitions: systematic study, focus on teaching and learning, work that is made public. This plenary will introduce attendees to the concept of SoTL and discuss the need to build a disciplinary evidence base to inform decisions about course design, implementation, and assessment of student learning. Friberg will explain how SoTL research can inform what we do to solve problems in our courses and how we measure the impacts of any opportunities we implement or wonderments we explore. Friberg will provide examples of SoTL work from clinical disciplines to frame this plenary. A follow-up workshop offered immediately after the plenary will help those interested in SoTL to convert their teaching into SoTL.

29: Concurrent Workshop VI: Practicing Scholarship Sessions - Converting Your Teaching into SOTL

29.1 Practicing Scholarship Sessions – Converting Your Teaching into SOTL
Jennifer Friberg
1 Illinois State
Picking up where Dr. Friberg’s “Engaging in the Scholarship of Teaching and Learning” plenary address left off, this workshop will focus on making SoTL operational in your own institutional context. In this 90-minute session, participants will identify a potential SoTL research question and plan how that question could be converted into an interesting and informative research project. Advantages and disadvantages of various research methods and data sources for studying teaching and learning will be discussed. Ideas for disseminating SoTL work will be provided. Universal and readily accessible supports for SoTL will be identified. It is intended that this workshop will be interactive and that each participant will leave the workshop with an outline of a SoTL project that could be completed after this conference.

30: Concurrent Workshop VI: Effective Management of Team Teaching

30.1 Effective Management of Team Teaching
Thomas Schmidt
1 Univ. of Iowa
Faculty directors for team taught courses should exhibit excellent communication, organizational, networking and mentoring skills, and be recognized as enthusiastic and dedicated educators. Directors must know how to effectively recruit new team members and how to make all faculty expectations explicit. Students should be given multiple opportunities to anonymously evaluate course
content and organization, the effectiveness of course directors, and the teaching skills of individual faculty.

31: Concurrent Workshop VI: Designing Curricula for Professional Schools

31.1 Mapping the Future of Health Sciences Education – Incorporating Online Resources Into Your Educational Program
Simon Williams¹
¹Texas Tech Univ. HSC
Integrated curricula and the burgeoning on-line resources available can create tensions between the use of traditional resources such as texts and primary literature and the digested and self-directed learning platforms increasingly available. This workshop will review curriculum design practices that enable the seamless incorporation of educational resources in ways that maximize educational benefits and student outcomes in ways that fit into institutional budgets.

32: Poster Session III and Group Discussions: Assessment, Programs, Resources

32.1 Roll For Essay: a mechanism for increasing self-accountability within summative assessment
Andrew Petzold¹
¹Center for Learning Innovation, University of Minnesota Rochester
Preparing appropriate summative assessments that accurately test a student’s breadth of knowledge and critical thinking can be a difficult task. Often times, to do this in a simple response format can be difficult generally leading to the creation of overly complex questions. To combat this, professors often rely upon a long-answer essay question to gauge the student’s depth of knowledge and critical thinking skills. Unfortunately, students often have negative associations with essay only exams, either due to writing phobia, discomfort answering open-ended questions or being unsure of expectations or concepts being covered. To address these issues, I have employed an extemporaneous essay approach that uses random chance to provide students with a number of prompts in a written summative assessment that I call “Exam Roulette.” Specifically, students are given twelve potential essay prompts a week prior to sitting for the examination with the instructions that they are able to ask clarifying questions, but are unable to seek affirmation of content. On the day of the exam, a 12-sided die is rolled once for each unique question being asked, with students answering the question that appears on the die. Students report a greater motivation in studying, better retention of knowledge prior to and following the exam and reduction in associated stress.

32.2 A New Course Makes Study Abroad More Accessible to Commuter Students
Patricia Halpin¹
¹Department of Life Sciences, University of New Hampshire at Manchester
Our college is a commuter campus and most students work part-time to help defray the cost of attendance. For many, a study abroad experience is out of reach due to the high cost. In order to increase access to study abroad opportunities, a new semester-long course was designed with a study abroad trip to Belize occurring during spring break. The cost of the study abroad portion was made a course fee so it could potentially be covered under a financial aid package that provides funds for tuition and fees. An information session was held in the fall with the instructor, department chair, study abroad director and financial aid director. Ten students enrolled in the spring semester course, four of them obtaining their first passports prior to travel. Financial aid covered the additional cost of the trip for four students, and three students received partial coverage. The students were placed into four groups and performed background research on the specific ecosystem selected: coral reef, mangroves, and rain forests of Belmopan or Punta Gorda. Guest speakers came into class prior to spring break to provide information on the flora, fauna, and marine ecosystems of Central America. In Belize they performed research, learned about Mayan culture and travelled to many different locations. Many reported that, in addition to learning about Belize, they learned more about themselves and felt more comfortable getting out of their comfort zone. All of the students (100%) stated this course increased the likelihood that they would travel abroad again and that they would recommend the course to a friend. Each group displayed their research findings in poster format at the Undergraduate Research Conference (URC) and presented their travelogue videos at the URC Cinema Arts Day. Individual student’s reflective writing was published as a blog on the university’s Center for International Engagement and Global Education website. This course fulfills an upper level biological science elective for both Biology and Biotechnology majors and an elective for the Global Studies minor. Due to the successful first offering, the course will be offered again in spring 2019.
32.3
Becoming a physiologist or not: Perspectives on student barriers and success at a small liberal-arts college

Josef Brandauer1, Jennifer Cole2
1Health Sciences, Gettysburg College, 2Academic Advising, Gettysburg College

If the aim of higher education science programs is to train the next generation of physiology researchers and educators, it is critical to understand how some students benefit from advantages while others may face barriers to success. In the context of today's diversifying student body, we studied the academic progress of early-career physiology students by analyzing records of courses that are required to complete basic core competencies in human anatomy and physiology at our institution. These courses consist of a required 2-semester course sequence in introductory biology (Bio 1, Bio 2) followed by a 2-semester human anatomy and physiology course sequence (A&P 1, A&P 2). In addition, we also assessed the relationship between several social, educational, and other characteristics on grade-point average (GPA) in these four courses.

We examined 18993 course records from 2226 individual students at a residential small liberal-arts college. We analyzed grades in these courses along with information on gender, social activities (Greek life, Varsity athletics), formalized educational support (individual educational accommodation plan; IEAP), ethnicity, and the number of college-level courses a student had completed.

Average course GPAs for students completing the four-semester course sequence were within 0.13 of one another. That is, students who complete a four-semester course sequence of Bio 1, Bio 2, A&P 1, and A&P 2 can be characterized as a group which attains consistency throughout these courses.

We also sought to determine whether academic performance in introductory science courses predicts later success in A&P 1 and 2. Student grades in Bio 1 were 0.11 GPA points, \((p = \text{n.s.})\) lower in students who only completed 3 (Bio 1, Bio 2, A&P 1) rather than all four courses (Bio 1, Bio 2, A&P 1, and A&P 2) of the sequence. Conversely, average Bio 2 grades were significantly lower in students who only completed one rather than 2 semesters of A&P (0.29 GPA-point difference, \(p = 0.0001\)). This suggests that a lack of success in first-year biology may prevent academic success in subsequent anatomy and physiology courses. In support of this, student grades among all courses were highly correlated. For examples, Bio 2 grades correlated well with A&P 2 grades \((r = 0.644, p < 0.005)\).

Overall, women outperformed men in all courses. Involvement in extracurricular activities (Greek life, Athletics) was generally associated with numerically lower course GPA in all four course levels. Students with a documented Individual Education Accommodation Plan (IEAP) underperformed students without an IEAP. Analysis of ethnic background showed that students who self-identified as Black or Hispanic/Latino underperformed in early-career sciences courses relative to Caucasian students. Importantly, students who reported completing at least one college-level course outside our institution (e.g., Advance Placement, International Baccalaureate, etc.) performed substantially and highly statistically significantly better over students who received no academic credit for such courses. Average GPA differences between students who reported at least one such course and those who did not ranged between 0.74 and 0.31 GPA points and were especially prominent in introductory Biology courses.

Our data provide important information on academic progression of early-career physiology students. Academic institutions may alter curricular or structural approaches in order to emphasize academic achievement among early-career science students based on such data. We intend to follow up on this project by further exploring our data and designing interventions intended to target students at risk as well as critical junctures during students' academic careers.

32.4
Undergraduate Summer Research Programs Encourage Life-Long Research Pursuits

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Background: The American Physiological Society (APS) Undergraduate Summer Research Fellowship (UGSRF) Program is designed to provide laboratory-based research opportunities for undergraduate students and encourage them to pursue a career as a basic scientist. The program aims to 1) teach students the scientific method, 2) encourage presentation of data and attendance at a national scientific conference, 3) demonstrate a commitment to research and 4) enroll in graduate or professional education which includes research. Methods: Data regarding this program is collected through pre- and post-program surveys, completion of online professional development activities and follow-up surveys about educational and career pursuits. Results: Since 2000, 348 students have participated in this program. Data collection (program aims 1-3) was divided into two segments, initial (2000-2003 program years) and current (2010-2017 program years). During the initial program, >92% of participants developed a hypothesis and conducted their own experiments. In the current program, 100% of participants developed a hypothesis and conducted experiments, as well as drafted a scientific
abstract. Greater than 95% of initial and current participants attended a national scientific meeting and 68% and 80%, respectively, published an abstract about their summer research. Of the UGSRFs in the initial segment, 85% were interested in a career in physiology research. Sixty-six percent of current participants planned to enter a research-involved career. Follow-up survey data (92 respondents, program aim 4) indicated that 38% of past UGSRFs were enrolled in a PhD or MD/PhD program (N=18) or employed in a research-based career (N=17). **Conclusions:** These data suggest that participation in a summer research program teaches students the scientific method and promotes use of their knowledge through presentation of their data. It also suggests that participation in summer research enhances or confirms a commitment to a research-based career (N=17).

### 32.5 Taking Advantage of the LifeSciTRC and What it Offers

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¹Sciences Department, Mount Mary University, ²Education, American Physiological Society

The Life Science Teaching Resource Community (LifeSciTRC) is an online community for life science educators at all levels formed through a partnership of ten professional scientific societies. The communities and educational resources found on the site are free and accessible worldwide. Access to high quality, peer reviewed resources is one of the benefits of the LifeSciTRC, but there are numerous additional ways to benefit from involvement in the community. LifeSciTRC members publish original educational resources, serve as reviewers, participate in communities of practice, write blogs and contribute to forums. During this session, participants will be able to join the community, learn to submit resources, sign up to author a blog post and submit a forum question and explore the myriad of communities available in the LifeSciTRC. Participants will also learn about earning badges, commenting on resources, and ways to have a voice through the monthly newsletter. A data presentation will also be included highlighting visits to and downloads from the LifeSciTRC, submissions per year, information about specific highly-sought after resources and more.

References: LifeSciTRC website: [https://www.lifescitr.org](https://www.lifescitr.org)

### 32.6 Online Professional Development Increases Teacher Knowledge, Confidence, and Use of Effective Pedagogy

**Margaret Stieben¹, Emma Hedman¹, Marsha Maytas¹**

¹Education, American Physiological Society

**Background:** Despite the fact that there is little evidence that they are effective, short, one-time workshops continue to be the most common type of K-12 teacher professional development (PD) [1, 2]. Effective PD must be content-focused, incorporate active learning, support collaboration, use models of effective teaching practice, provide coaching and expert support, offer feedback and reflection, and be of a sustained duration [3]. Online PD can provide these key components as well as providing a sustaining community of practice for educators [3]. PD impacts must be assessed carefully, especially programs that are implemented broadly, rather than in specific schools or districts. For nationwide programs, data on student achievement is not readily available; therefore, changes in teachers’ content and pedagogical knowledge, their confidence their preparation to use proposed pedagogies, and their actual use of targeted pedagogies is critical. **Methods:** In the current study, we sought to determine if a nationwide online PD program could positively impact participating teachers at three levels (knowledge, preparation, and actual use) in 9 areas: STEM Career Education, Up-To-Date Scientific Content, Animal Research, Basic and Clinical Research, Authentic Assessment, Equity and Diversity in the Classroom, Technology, Reflecting on Teaching and Learning, and Student-Centered Learning. Participants were 6 middle school and 20 high school science teachers from 13 states and 25 schools who successfully completed the APS Frontiers in Physiology-Six Star Science Online Professional Development Program. This 10-month interactive online PD program addresses the 9 areas listed above. The Online Teachers (OTs) completed pre- and post-program surveys with self-reports on knowledge, confidence/preparedness, and actual use in each area. Reliability for subscales ranged from .612 to .977. **Results:** OTs reported increased understanding and confidence/preparedness in many of the PD areas including 1) teaching about biomedical career options, the use of humans/animals in research, basic versus clinical research; and 2) using current science content, authentic assessment, technology in teaching, and student-centered pedagogy. They also reported increases in frequency of classroom use of current content, student-centered pedagogy, authentic assessment, information on biomedical research careers, use of humans/animals in research, and strategies to engage students from groups underrepresented in science (women, minorities, and persons with disabilities). In addition, OTs reported that
they reflected on their teaching and participated in online teacher communities of practice more often. **Conclusions:** The Six Star Science Online Teacher Professional Development Program is impacting teachers in areas of pedagogical and content knowledge and in preparedness and usage of student-centered teaching methods. **Funding:** Funding was provided by the APS and a grant from the National Institutes of Health (R25OD016492).

**References:**

**32.7 Student strategies when answering open-ended exam questions.**

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While there is lots of information in the literature about student strategies in preparing for examinations (Biggs and Collis, 1982; Nolen, 1988; Dunlosky et al., 2013), there is very little information about the strategies that students employ during examinations, particularly for open-ended (or free-response) questions. Also, we have observed that students struggle to concisely answer open-ended questions on our examinations, often including a great deal of extraneous information in their answers. For this reason, we surveyed our students on the strategies that they employ while answering open-ended questions on midterm exams. Our class is an upper division physiology class on human reproduction, which is an elective class for biology students. The class is composed of seniors (85%) and juniors (15%). Our class has two midterms, both of which occurred during a 50-minute class time. After both midterms, we deployed an online survey to our students that remained open for 48 hours. One of the questions asked of the students was: “Did you have any specific strategies when answering the free-response questions? If so, please describe any strategies that you used.” Of the 248 students enrolled in our class, 165 students (67%) provided an answer to this question after midterm 1, and 170 students (69%) provided an answer after midterm 2. In-between midterm 1 and 2 students were given an exercise to reflect on their strategies used, and their inclusion of extraneous information in their answers. A rubric was developed and agreed upon by the authors based on student responses, and one of the authors coded the responses from the surveys after midterms 1 and 2. We will present our findings of the different strategies that students report using during open-ended exam questions. We will compare our data from midterm 1 to midterm 2, indicating if students alter their strategies between the two midterms. We believe that our data offer an insight into an area that has not - to our knowledge - been investigated before: student strategies on open-ended exam questions.

**32.8 Developing a rich conception of exercise physiology by placing critical thinking at the core of the course experience**

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The typical Exercise Science program may see students pursue a multitude of directions upon program completion. Destinations commonly range from entering a fitness profession to a variety of health-related graduate programs (e.g., MD, DPT, MPA, DOT, etc.). All of these desired paths require substantial content-knowledge for success. However, it has been suggested that employers value critical thinking more than the acquisition of discipline-specific knowledge. Therefore, programs and instructors are tasked with preparing students with both content knowledge and the ability to think critically. In order to bridge this gap, we have identified strategies which requires the process of critical thinking to foster a deep understanding of content in an Advanced Exercise Physiology course. Advanced Exercise Physiology is a follow-up course to a lower-level Exercise Physiology course and has equal-parts of lecture and laboratory. We designed the course around the most significant content-specific concepts that can be elaborated on with a required use of previously taught critical thinking skills. Also, students were provided with an introduction to an inquiry-based laboratory. Course opportunities for students included determining significant lecture and laboratory questions, gathering relevant information to form accurate inferences free of faulty assumptions, and determining the complexities of content-specific information with a senior-level point of view. Assignments were designed in alignment with the Paul-Elder critical thinking theory and required the deliberate use all of the Elements of Thought, and many of the standards, by students as they processed lecture and laboratory concepts.
Student populations are becoming more diverse, and it is critical for educators and institutions to implement practices that ensure the success of all students. Practical approaches, including small changes in the classroom and laboratory, can have a huge impact on student experience, success, and retention in the sciences. Diversification of successful scientists is essential for optimal scientific progress and innovation, as well as addressing important issues of equity and social justice.

Five online, on-demand modules were pilot-tested for their effectiveness in teaching trainees (graduate students and postdoctoral fellows) about publication ethics topics: authorship (AUT), conflicts of interest (COI), data fabrication & falsification (DFF), data management & integrity (DMI), and overlapping publications (OP). The modules included both didactic and student-centered activities that focused on increasing student knowledge of and skills in applying professional standards of practice related to ethics issues in these five topical areas. Participants were recruited via APS member listservs and social media. Students were encouraged to share the promotion with colleagues. This work was supported by a grant from the National Science Foundation (SES-1238368).

Participants were asked to rate their skills in dealing with professional ethics topics in each area, students’ self-ratings increased significantly on all five modules. We also polled the field-test students on their preferences for the final versions of the online modules. They expressed clear preferences for: 1) On-demand, any time modules that they could access and re-access as needed; 2) Having feedback from experts recorded rather than individual, asynchronous interaction; 3) Requiring registration but no fee; 4) Having computer-graded multiple choice tests rather than getting instructor feedback; and 5) Receiving an automated email certificate to indicate that they completed the module and passed the posttest. Their feedback was more mixed about whether and how they wanted to interact with other participants. About 44% recommended no interaction among participants, as was done in the field test modules, but 32% said they would like the modules offered during a period of time (e.g., 8 weeks) and have live but asynchronous discussions among participants.

The final versions of the online, on-demand courses will be housed at the APS online training center at www.schoology.com. Some courses will include asynchronous discussions and all will include recorded expert voices feedback. Each course will also link students to the classroom versions of the materials to encourage them to share the materials with their advisors and RCR instructors to promote classroom and lab group use. This work was supported by a grant from the National Science Foundation (SES-1238368).
underlying this correlation is murky (Houtveen et al., 2004; Cera et al., 2013). It is likely that high self-efficacy increases metacognitive performance. Megacognitive performance improvement via high self-efficacy may be due to a positive effect of self-efficacy on intrinsic motivation, which enhances metacognitive performance (Zimmerman and Kitsantas, 1999). Alternately, self-efficacy improve use of effective learning strategies (Zimmerman and Martinez-Pons, 1990; Zimmerman and Bandura, 1994).

It is unclear whether the reverse—a positive effect of metacognitive performance on self-efficacy—exists. This study hypothesized that improved metacognitive performance increases self-efficacy. If so, metacognitive training could increase academic performance indirectly through increased self-efficacy in addition to its direct effect. Metacognitive training would thereby be of increased value due to the synergistic effect of metacognition and self-efficacy on academic performance. If self-efficacy could be increased through metacognitive training, the effect would be especially important in courses perceived as “challenging” (such as upper division biology courses) because self-efficacy is situation-specific such that general academic ability may not determine self-efficacy in the challenging course.

This study found that metacognitive training preserved and increased student metacognitive practices, as measured by the Motivated Strategies for Learning Questionnaire (MSLQ) Metacognitive Self-Regulation scale (Pintrich et al., 1991). Student metacognitive practices, however, did not correlate with average or final exam score, exam score improvement, or final course grade. Student self-efficacy measured by the New General Self-Efficacy (NGSE) scale (Chen et al., 2001) correlated with exam scores and this correlation strengthened throughout the course. This correlation was stronger in control students than in students who received metacognitive training. Average self-efficacy measured by the MSLQ Self-Efficacy for Learning and Performance scale was lower at the end of the course than at the beginning but metacognitive training reduced this loss in self-efficacy. Overall, metacognitive training improved student metacognition and attenuated decreases in student self-efficacy. Neither of these effects increased academic performance measures such as exam scores and final course grades.
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