Workshop:
Institute on Teaching and Learning

Madison, Wisconsin • June 20–24, 2016

Workshop Program
and Abstracts

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APS Institute on Teaching and Learning

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Acknowledgements

The Workshop Organizers and The American Physiological Society gratefully recognize the generous financial support from the following:

ADInstruments, Inc.
## 2016 APS Teaching Workshop: The APS Institute on Teaching and Learning
### Week-at-a-Glance Schedule

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<th>Thursday, June 23, 2016</th>
<th>Friday, June 24, 2016</th>
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</thead>
<tbody>
<tr>
<td>7:00 AM</td>
<td>Registration for Ultrasound Workshop (7:00 AM-4:00 PM)</td>
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<td>7:30-8:30 AM</td>
<td>Breakfast</td>
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<tr>
<td>8:45-9:00 AM</td>
<td>Daily Orientation and Announcements</td>
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<tr>
<td>9:00-10:00 AM</td>
<td>Plenary Lecture I: Defining the Role of the Instructor in an Active Learning Environment, Speaker: Harold Modell</td>
<td>Plenary Lecture III: A New Paradigm for Student Learners, Speaker: Terry Doyle</td>
<td>Plenary Lecture V: Supporting Faculty: Resources from Professional Societies and On-line Communities, Speaker: Marsha Lakes Matyas</td>
<td>Plenary Lecture VII: Educational Leadership: Benefits of Stepping Outside the Classroom, Speaker: Tom Pressey</td>
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<td>10:00-10:30 AM</td>
<td>Networking Break</td>
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<tr>
<td>10:30 AM-12:00 Noon</td>
<td>Concurrent Workshop I: Using Recorded Lectures for Flipped Classrooms, Speaker: Chaya Gopalan</td>
<td>Concurrent Workshop II: Strategies for Creating a Culture of Academic Integrity, Speaker: Kim Hennie</td>
<td>Concurrent Workshop III: Integrating Discovery-based Research into the Undergraduate Curriculum, Jay Labov, and Catherine Middlecamp</td>
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<td>Concurrent Workshop III: Educational Scholarship: A Step by Step Guide to Implement and Publish Your Classroom Research, Speaker: Valerie O'Loughlin</td>
<td>Concurrent Workshop III: Instructors Understanding of Student’s Misconceptions can Improve Meaningful Learning, Speaker: Ann Wright</td>
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<td>12:00 Noon-1:00 PM</td>
<td>Lunch</td>
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<td>1:00-2:00 PM</td>
<td>Plenary Lecture II: Team-based Learning in a Large Enrollment Class, Speaker: Jon Kibble</td>
<td>Concurrent Plenary Lecture IVA: The Changing USMLE and NBME Medical School Services, Speakers: Steven Haist &amp; Agata Butler</td>
<td>Concurrent Plenary Lecture VII: Central Role of Physiology in the Professional Curriculum, Speaker: Rob Carroll</td>
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<td>1:00-2:00 PM</td>
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<td>2:30-4:00 PM</td>
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<tr>
<td>2:30-4:00 PM</td>
<td>Concurrent Workshop V: Using PULSE rubrics to Assess Departmental Transformation to Student-centered Learning, Speaker: Pamela Pape-Lindstrom</td>
<td>Concurrent Workshop V: Using Conceptual Frameworks in Teaching and Learning Physiology, Speaker: Jenny McFarland</td>
<td>Concurrent Workshop V: Facilitating Small Group Discussion-Basic, Speakers: Sydella Blatch and Carol Schmidhauser</td>
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</tr>
<tr>
<td>2:30-4:00 PM</td>
<td>Concurrent Workshop VI: Accreditation (Role of Course/Block Directors), Speaker: Mike Levitzky</td>
<td>Concurrent Workshop VI: Preparing Students for Board Exams, Speaker: Rob Carroll</td>
<td>Concurrent Workshop VI: Facilitating Small Group Discussion-Advanced, Speaker: Betty Jones</td>
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<tr>
<td>3:00-8:00 PM</td>
<td>ITL Registration Opens</td>
<td>Best Practices in Professional School Physiology Poster Session</td>
<td>Innovative Curricula Throughout Educational Levels Poster Session</td>
<td>Best Practices in Undergraduate Physiology Poster Session</td>
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<tr>
<td>4:00-5:30 PM</td>
<td>Group Dinner (5:30-6:30 PM)</td>
<td>Group Dinner</td>
<td>Dinner on own</td>
<td>Group Dinner</td>
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<tr>
<td>5:00-7:00 PM</td>
<td>Welcome and Opening Reception</td>
<td>Collaborations and Special Topics</td>
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<tr>
<td>7:00-8:30 PM</td>
<td>Keynote Lecture: The Changing National Landscape in Undergraduate STEM Education: Connecting the Dots, Speaker: Jay Labov</td>
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</tbody>
</table>
Location:
The 2016 APS Workshop: The APS Institute on Teaching and Learning will be held June 20—24, 2016 at the Madison Concourse Hotel located at: 1 W. Dayton St., Madison, Wisconsin, 53703, telephone (608) 294-3022.

Onsite Registration Hours:
Monday, June 20 …………..………………3:00—8:30 PM
Tuesday, June 21 …………………7:00 AM—5:00 PM
Wednesday, June 22 …………..…7:00 AM—5:00 PM
Thursday, June 23 …………………7:00 AM—5:00 PM
Friday, June 27 …………………………7:00—11:00 AM

On-Site Registration Fees:
- APS Member ......................................................... $750
- APS Retired Member ............................................. $550
- Invited Presenter ................................................... $750
- Nonmember .......................................................... $950
- APS Postdoctoral Member ....................................... $600
- Postdoctoral Nonmember ........................................ $700
- APS Student Member ............................................. $550
- Student Nonmember ............................................... $600

Payment Information:
Registrants may pay by institutional or personal check, traveler’s check, MasterCard, VISA or American Express or in United States Dollars. Checks must be payable to “The American Physiological Society” and drawn on a United States bank payable in US dollars.

Student Registration:
Any student member or regularly matriculated student working toward a degree in one of the bio-medical sciences is eligible to register at the student fee. Nonmember postdoctoral fellows, hospital residents and interns, and laboratory technicians do not qualify as students. Nonmember students who register onsite must provide a valid university student ID card. APS student members should present their current APS membership card indicating their student category status.

Postdoctoral Registration:
Any person who has received a Ph.D. degree in physiology or related field, within four years of this workshop, as attested to by the department head is eligible to register at the postdoctoral fee. A statement signed by the department head must accompany the registration form and remittance when registering.

Included in your Registration:
Your registration to this workshop includes entry into all scientific sessions, program book, opening reception, poster sessions, networking socials, and meals. There are no substitutions or refunds. You must pay the registration fee regardless of whether you are not able to stay for the entire workshop or partake in any of the meals during the workshop program. Guests of attendees are not permitted in the scientific sessions.

Press Registration:
Press badges will be issued at the APS registration desk, only to members of the working press and freelance writers bearing a letter of assignment from an editor. Representatives of allied fields (public relations, public affairs, etc.) must register as nonmembers.

Meal Service:
Meals will be served promptly in the Madison Ballroom according to the following schedule:
- Breakfast ……………………………..7:30—8:30 AM
- Lunch ……………………………...12:00 Noon—1:00 PM
- Dinner*: ……………………………….5:30—7:00 PM
*Except Wednesday, June 22: Dinner is on your own.

Photograph/Video Recording:
The photographing and/or the video recording of any the workshop sessions for personal or private use is strictly prohibited.

Code of Conduct:
APS is committed to providing a friendly, safe, and welcoming environment for all, regardless of gender, sexual orientation, disability, race, ethnicity, religion, national origin, or other protected characteristics. We expect all attendees, media, speakers, volunteers, organizers, venue staff, guests, and exhibitors to help us ensure a safe and positive workshop experience for everyone. Alert the APS Registration Desk if you notice a dangerous situation, someone in distress, or violations of this Code of Conduct.

Program Objective:
The purpose of this workshop and the APS Institute on Teaching and Learning (ITL) is to engage educators (community/4-year college through professional school) in interactive sessions on best practices in teaching, learning, and assessment. Whether you are an experienced educator or new to teaching, it will challenge you to gain skills in designing and implementing educational research in your classroom and in learning how to share your findings with colleagues.

Target Audience:
The intended audience for this workshop includes educators teaching in community colleges, 4-year colleges, as well as those who are experienced educators or new to teaching.

Did you register early?
The drawing for the iPad Pro will be held on Thursday, June 23 at 8:45 AM during the Daily Orientation and Announcements.
DAILY SCHEDULE

MONDAY, JUNE 20, 2016

1.0 KEYNOTE LECTURE
Mon., 8:00—9:00 PM, Madison Ballroom.
8:00 PM 1.1 The Changing National Landscape in Undergraduate STEM Education: Connecting the Dots. Jay Labov, Natl. Acad. of Sci.

TUESDAY, JUNE 21, 2016

2.0 DAILY ORIENTATION AND ANNOUNCEMENTS
Tues., 8:45—9:00 AM, Madison Ballroom.
8:45 AM 2.1 Daily Orientation and Announcements.

3.0 PLENARY LECTURE I
Tues., 9:00—10:00 AM, Madison Ballroom.

NETWORKING BREAK
Tues., 10:00—10:30 AM, Wisconsin Ballroom.

4.0 WORKSHOP I*
Tues., 10:30 AM—12:00 Noon, Madison Ballroom.

5.0 WORKSHOP II*
Tues., 10:30 AM—12:00 Noon, University AB.
10:30 AM 5.1 Strategies for Creating a Culture of Academic Integrity. Kim Henige, California State Univ., Northridge.

6.0 WORKSHOP III*
Tues., 10:30 AM—12:00 Noon, University CD.
10:30 AM 6.1 Integrating Discovery-based Research into the Undergraduate Curriculum. Jay Labov, Natl. Acad. of Sci., and Catherine Middlecamp, Univ. of Wisconsin, Madison.

*Concurrent workshops/lectures.

7.0 PLENARY LECTURE II
Tues., 1:00—2:00 PM, Madison Ballroom.
1:00 PM 7.1 Team-based Learning in a Large Enrollement Class. Jon Kibble, Univ. of Central Florida.

NETWORKING BREAK
Tues., 2:00—2:30 PM, Wisconsin Ballroom.

8.0 WORKSHOP IV*
Tues., 2:30—4:00 PM, Madison Ballroom.
2:30 PM 8.1 Interactive Teaching and Learning. Dee Silverthorn, Univ. of Texas at Austin.

9.0 WORKSHOP V*
Tues., 2:30—4:00 PM, University AB.
2:30 PM 9.1 Using PULSE Rubrics to Assess Departmental Transformation to Student-centered Learning. Pamela Pape-Lindstrom, Everett Comm. Coll., WA.

10.0 WORKSHOP VI*
Tues., 2:30—4:00 PM, University CD.
2:30 PM 10.1 Accreditation: Role of Course-Block Directors. Mike Levitzky, Louisiana State Univ.

Poster Session I

11.0 BEST PRACTICES IN PROFESSIONAL SCHOOL PHYSIOLOGY
Tues., 4:00—5:30 PM, Wisconsin Ballroom.
Facilitator: Thad E. Wilson, Marian Univ. Coll. of Osteopathic Med., Indianapolis.

Poster Board

1 11.1 A Flipped Classroom Approach With Emphasis on In-Class Active Learning Improves Student Performance on Application Style Questions in a Graduate Level Anatomy Class. S. Inglis, Univ. of South Dakota.


3 11.3 Impact of Pre-testing in Laboratory Performance in Optometry. M.
L. A. Fortepiani. Univ. of the Incarnate Word, San Antonio, TX.


7 11.7 Effectiveness of Lecture Compared to Independent and Active Learning Modalities in a Medical School Curriculum. M. Sheakley. Western Michigan Univ. Sch. of Med.


**WEDNESDAY, JUNE 22, 2016**

12.0 DAILY ORIENTATION AND ANNOUNCEMENTS

8:45 AM 12.1 Daily Orientation and Announcements.

13.0 PLENARY LECTURE III

9:00 AM 13.1 A New Paradigm for Student Learners. Terry Doyle, Ferris State Univ., MI.

NETWORKING BREAK

Wednes., 10:00—10:30 AM, Wisconsin Ballroom.

14.0 WORKSHOP I*


15.0 WORKSHOP II*

10:30 AM 15.1 Student Role in Learning: What is the Goal and How Do We Get There? Beth Beason-Abmayr, Rice Univ., Houston, Texas.

16.0 WORKSHOP III*


17.0 PLENARY LECTURE IVa*

1:00 PM 17.1 Changing USMLE and NBME Medical School Service. Steven Haist, and Agata Butler, Natl. Brd. of Med. Examiners.

18.0 PLENARY LECTURE IVb*

1:00 PM 18.1 Funding for Educational Research and Curriculum Change. Barbara Goodman, Univ. of South Dakota.

*Concurrent workshops/lectures.

**Join your colleagues for the Opening Reception on Monday, June 20, 2016 from 6:30—8:00 PM**
DAILY SCHEDULE

NETWORKING BREAK
Wednes., 2:00—2:30 PM, Wisconsin Ballroom.

19.0 WORKSHOP IV*
Wednes., 2:30—4:00 PM, Madison Ballroom.

2:30 PM
19.1 Using Social Media to Enhance Student Learning. **Patricia Halpin.** Univ. of New Hampshire, Manchester.

20.0 WORKSHOP V*
Wednes., 2:30—4:00 PM, University AB.

2:30 PM

21.0 WORKSHOP VI*
Wednes., 2:30—4:00 PM, University CD.

2:30 PM
21.1 Roundtable Discussion of Preparing Students for Board Exams. **Rob Carroll.** East Carolina Univ.

Poster Session II

22.0 INNOVATIVE CURRICULA THROUGHOUT EDUCATIONAL LEVELS
Wednes., 4:00—5:30 PM, Wisconsin Ballroom.
Facilitator: **Erica Wehrwein,** Michigan State Univ.

Poster Board

14 22.4 Big Brother is Watching. **C. J. Urso and Edward Tall.** Seton Hall Univ., Orange, NJ, and Montclair State Univ., NJ.

15 22.5 Moving from Memorization to Curiosity: Encouraging Student-Directed Learning in an Advanced Physiology Class. **J. Fry.** Curry Coll., Milton, MA.

16 22.6 Physiology Understanding Week (PhUnWeek): K-12 Outreach Program Promotes Both Engagement and Impact. **M. Stieben and M. Lakes Matyas.** APS.

17 22.7 Educators Rate Life Science Teaching Resource Community as Both Useful and Usable. **M. Byse and M. Lakes Matyas.** APS.

18 22.8 Expansion of Undergraduate Programs during the Vision and Change Era: Physiology and Other Life Science Fields. **M. Lakes Matyas.** APS.


21 22.11 Team-based Assessment of Nephron Structure and Urine Formation Used as a Forced Retrieval Activity to Improve Student Learning. **J. Chapman.** Heartland Comm. Coll., Normal, IL.

*Concurrent workshops/lectures.

**R. Nadal, and C. Lelis-Santos.** Univ. Fed. de São Paulo, Brazil.

*Did you register early?
The drawing for the iPad Pro will be held on Thursday, June 23 at 8:45 AM during the Daily Orientation and Announcements.
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<thead>
<tr>
<th>Time</th>
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<tr>
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<td><strong>DAILY ORIENTATION AND ANNOUNCEMENTS</strong></td>
<td>Thurs., 8:45—9:00 AM, Madison Ballroom.</td>
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<tr>
<td>9:00 AM</td>
<td><strong>PLENARY LECTURE V</strong></td>
<td>Thurs., 9:00—10:00 AM, Madison Ballroom.</td>
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<tr>
<td>10:30 AM</td>
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<td>Thurs., 10:30 AM—12:00 Noon, Madison Ballroom.</td>
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<td>10:30 AM</td>
<td><strong>WORKSHOP II</strong></td>
<td>Thurs., 10:30 AM—12:00 Noon, University AB.</td>
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<tr>
<td>10:30 AM</td>
<td><strong>WORKSHOP III</strong></td>
<td>Thurs., 10:30 AM—12:00 Noon, University CD.</td>
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<td>1:00 PM</td>
<td><strong>PLENARY LECTURE VIa</strong></td>
<td>Thurs., 1:00—2:00 PM, Madison Ballroom.</td>
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**NETWORKING BREAK**
Thurs., 10:00—10:30 AM, Wisconsin Ballroom.

**WORKSHOP IV**
Thurs., 2:30—4:00 PM, Madison Ballroom.

**WORKSHOP V**
Thurs., 2:30—4:00 PM, University AB.

**WORKSHOP VI**
Thurs., 2:30—4:00 PM, University CD.

**BEST PRACTICES IN UNDERGRADUATE PHYSIOLOGY**
Thurs., 4:00—5:30 PM, Wisconsin Ballroom.
Facilitator: **Lynn M. Diener, Mount Mary Univ., Milwaukee, WI.**

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**Concurrent workshops/lectures.**
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<th>An Interrupted Case Study Approach for a Diabetes Lab Exercise. N. Aguilar-Roca. Univ. of California, Irvine.</th>
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</thead>
<tbody>
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<td>24</td>
<td>33.4</td>
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</tr>
<tr>
<td></td>
<td>27</td>
<td>33.7</td>
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<tr>
<td></td>
<td>29</td>
<td>33.9</td>
<td>A Grading Scheme to Inspire Hope and Foster Grit in a Large Undergraduate Physiology Course. K. Strang. Univ. of Wisconsin, Madison.</td>
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<tr>
<td></td>
<td>31</td>
<td>33.11</td>
<td>Assessing the Effectiveness of Student Learning and Engagement in a Content Heavy Flipped Class. Joost Monen. Ramapo Coll. of New Jersey.</td>
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<tr>
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<tbody>
<tr>
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<td>Daily Orientation and Announcements.</td>
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<tr>
<td>9:00 AM</td>
<td>Plenary Lecture VII</td>
</tr>
<tr>
<td>10:30 AM</td>
<td>Plenary Lecture VIII</td>
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**Don’t forget to join in the discussions during the daily Poster Sessions from 4:00—5:30 PM**

**Thank you to the generous support of this workshop from ADInstruments**
2016 APS Workshop
APS Institute on Teaching and Learning

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1:0 KEYNOTE LECTURE

1.1 THE CHANGING NATIONAL LANDSCAPE IN UNDERGRADUATE STEM EDUCATION: CONNECTING THE DOTS

Jay Labov¹

¹Brd. on Life Sciences, Natl. Academies of Sci., Engineering, and Medicine, Keck Ctr. 638, 500 Fifth St., NW, Washington, DC, 20001.

This session will focus on recent national trends to improve undergraduate and K-12 STEM education and how understanding both the education system and education policy can lead to more informed decision making at the local and state levels. Learning goals for this session include: 1.) Briefly reviewing recent national reports on the improvement of undergraduate education in STEM and how they might inform discussions on your campus. 2.) Exploring the changing relationships among several components of the undergraduate STEM education “ecosystem.” 3.) Recognizing and understanding the growing influence of K-12 education on what you do and your role in influencing K-12 education to increase the number of college-educated STEM graduates.

3:0 PLENARY LECTURE I

3.1 DEFINING THE ROLE OF THE INSTRUCTOR IN AN ACTIVE LEARNING ENVIRONMENT

Harold Modell¹

¹Director, Physiology Educational Research Consortium, P.O. Box 51187, Seattle, WA, 98115-1187.

An active learning environment is one in which the learners engage the material in ways that help them build, test, and refine their mental models of the system being studied. The primary goal in this environment is to help students use the information they are acquiring to solve problems. Although most faculty agree that the role of the instructor in this environment is to facilitate learning by helping the learner to learn, classroom practice is not always consistent with this role. This interactive discussion will focus on exploring the role of the instructor in the active learning environment by examining a number of questions that must be considered before faculty can adopt a mindset that directs appropriate classroom practice. In addition, currently advocated “active learning tools” (e.g., group work, think-pair-share, clickers) will be discussed in the context of the “helping the learner to learn” mindset to develop criteria for choosing appropriate tools for specific classroom situations. Reference: Michael, JA. and Modell, HI. Active Learning in Secondary and College Science Classrooms: A working model for helping the learner to learn. (2003) Mahwah, NJ: Routledge. ISBN 978-0-8058-3948-7.

4:0 WORKSHOP I*

4.1 USING RECORDED LECTURES TO FLIPPED CLASSROOMS

Chaya Gopalan¹

¹Applied Health & Nursing Dept., Southern Illinois Univ., Edwardsville, Box 1126, Edwardsville, IL, 62026.

Recorded lectures play a vital role in the flipped classroom model of teaching as these are the ones students depend on and use multiple times to prepare for the active learning sessions during class period. Although there are a variety of well known high quality resources to choose from, instructor-recorded lectures are favored due to the fact that the content and the vocabulary being consistent with assessments. There are a number of gadgets available to record lectures today but the technological skills required and the ability to lecture without audience feedback are challenges to consider while creating these videos. The focus of this workshop is to address the advantages and challenges of using lecture videos in the flipped classroom.

5:0 WORKSHOP II*

5.1 STRATEGIES FOR CREATING A CULTURE OF ACADEMIC INTEGRITY

Kim Henige¹

¹Kinesiology, California State Univ., Northridge, 18111 Nordhoff St., Northridge, CA, 91330-8287.

Within American universities, the typical approach to academic integrity involves the “3 Ps of Academic Integrity”: Prevention, Policing, and Punishment. In this workshop, participants will discuss an enhanced approach, with a focus on creating a general culture of integrity. Such an approach may have positive consequences beyond the college years. The session will begin with a review of recent statistics on cheating in school and its association with other types of dishonesty. The 3 Ps of Academic Integrity will be briefly addressed, with an emphasis on introducing and discussing recommended general and concrete strategies for creating a culture of integrity. The strategies will be divided into five categories: 1.) Communicate about integrity, 2.) Role model integrity, 3.) Create space for integrity, 4.) Integrate ethics into the curriculum, and 4.) Respond to cheating. References: Bertram Gallant, T. Creating a culture of integrity: An alternate proposal for educators. Workshop presented at California State University, Northridge April 17, 2015. Josephson Institute. Survey results, 2009. Retrieved: February 26, 2016 from http://josephson-
ABSTRACTS OF INVITED AND VOLUNTEERED PRESENTATIONS


6:0 WORKSHOP III*

6.1 INTEGRATING DISCOVERY-BASED RESEARCH INTO THE UNDERGRADUATE CURRICULUM

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The 2012 report, "Engage to Excel," from the President’s Council of Advisors on Science and Technology (PCAST) urges the STEM education community and funding agencies to "Advocate and provide support for replacing standard laboratory courses with discovery-based research courses." Emerging evidence suggests that engaging undergraduates in discovery research as early as possible during their undergraduate years is one of the best strategies for supporting and retaining STEM students and improving aspects of scientific literacy. But providing all students with individualized mentored research experiences, one of the traditional routes to a career in science, is not possible given the large numbers of beginning STEM students and limitations in lab space, supply budgets, and available research mentors. Acting on the PCAST recommendation, many undergraduate STEM educators are now experimenting with various strategies for engaging more students in research, and a variety of tested models are emerging. These successes are catalyzing interest in replacing standard "cook-book" laboratories with discovery-based research and related activities in labs associated with lecture courses or in stand-alone laboratory courses, utilizing on-campus, off-campus, and on-the-web resources. This presentation will report on a convocation around these issues that was organized by a committee of the National Academies of Sciences, Engineering, and Medicine. It will summarize successes and challenges that were discussed during the convocation and are presented in the report. The report is available for electronic download without cost at http://www.nap.edu/catalog/21851. Session participants will receive a printed copy of the report.

7:0 PLENARY LECTURE II

7.1 TEAM-BASED LEARNING IN A LARGE ENROLLMENT CLASS

Jonathan Kibble\(^1\), and Lisa Barkley\(^2\)
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According to the TBL Collaborative\(^3\), "[TBL]...is an evidence based collaborative learning teaching strategy designed around units of instruction, known as "modules," that are taught in a three-step cycle: preparation, in-class readiness assurance testing, and application-focused exercise. A class typically includes one module." In this session we will provide an overview of each of these major components of TBL; we will present ideas about implementation and will discuss common challenges from our perspective as TBL practitioners. Our aim is to have an interactive session to explore the four underlying principles of TBL\(^2\): 1.) Proper formation of diverse groups, 2.) Student accountability for preparation and team performance, 3.) Use of assignments that promote learning and team development, 4.) Use of feedback (2). References: 1. Team-Based Learning Collaborative http://www.teambased-learning.org/definition/ [2/24/2016]; Michaelsen LK, Sweet M. Fundamental Principles and Practices of Team-Based Learning. In Team-Based Learning for Health Professions Education: A Guide to Using Small Groups for Improving Learning edited by Michaelsen LK, Parmelee DX, McMahon KK, Levine RE, Sterling Virginia: Stylus Publishing, 9-31, 2007.

8:0 WORKSHOP IV*

8.1 INTERACTIVE TEACHING AND LEARNING

Dee Silverthorn\(^1\)
\(^1\)Dell Med. Sch., University of Texas at Austin

In this session we will discuss different ways to create interactive classrooms, from clickers and small group learning to pre-recorded lectures for 'flipped classrooms.' Participants should come prepared to share both their best practices and their lessons learned.

9:0 WORKSHOP V*

9.1 USING PULSE RUBRICS TO ASSESS DEPARTMENTAL TRANSFORMATION TO STUDENT CENTERED LEARNING

Pamela Pape-Lindstrom\(^1\)
\(^1\)Life Sciences, Everett Comm. Coll., 2000 Tower St., Everett, WA, 98201.

Workshop participants will use the PULSE Vision & Change Rubrics 2.0 available at http://www.pulsecommunity.org/page/recognition. The rubrics were developed for departmental self-assessment based on recommenda-
From teacher-directed exercises to student-centered efforts, laboratory work, hypothesis creation and testing are becoming more prominent, and this report shifts the focus to scientific reasoning and ability to think critically. Therefore, it is important to emphasize scientific reasoning and ability to think critically in education research. The consensus among life sciences educators regarding student-centered learning of core concepts and competencies is based on evidence from cognitive science, neuroscience and science education research. The V and C recommendations emphasize scientific reasoning and ability to think critically within a discipline, instead of mastery of disciplinary facts alone. Laboratory work, hypothesis creation and testing assume a new prominence, and this report shifts the focus from teacher-directed exercises to student-centered efforts.

The rubrics were developed to assess the degree to which departmental work and support align with the V and C recommendations. They also form the basis of a tiered recognition program, with an underlying assumption that exemplar levels of achievement will lead to improved student learning outcomes. The Faculty Practice/Support rubric has 20 criteria reflecting issues that are driven by or affect faculty. The Student Higher Level Learning section of this rubric evaluates faculty efforts to provide engaging, evidence-based, student-centered exercises. Student willingness to reflect on and engage in activities that require higher level cognitive efforts is also assessed. The rubrics were developed to be applicable to all institution types and statistical analysis demonstrates that the instrument shows no bias by institution type. Participants will work with an abbreviated form of the recognition rubrics (PULSE Progress Snapshot Rubric) and be introduced to the full rubrics. Use of the rubrics will allow faculty and their departments to move toward more student-centered learning of biological concepts and competencies. (NSF EF-1350120 & DB1-1323223).


10.1 ACCREDITATION: ROLE OF COURSE /BLOCK DIRECTORS
Michael Levitzky1
1Physiology, LSU Hlth. Sci. Ctr., 1901 Perdido St., PO Box P7-3, New Orleans, LA, 70112-1393.

In this workshop we will discuss the role of course directors and block directors in the accreditation of higher education institutions. We will first give an overview of higher learning institution accreditation in the United States. We will then discuss accreditation by the seven regional accreditating bodies recognized by the U.S. Department of Education and by the Council for Higher Education Accreditation (CHEA). We will then briefly mention some national accreditors, before discussing specialized and professional accreditors, such as the Liaison Committee on Medical Education, the American Dental Association, and other accrediting bodies for allied health and nursing schools. We will then discuss the importance of Continuous Quality Improvement and the assessment of Institutional Effectiveness in regional accreditation, including the feedback loop of stating expected outcomes, assessment of achievement of the outcomes, and evidence of improvement based on analysis of the assessment. Finally, we will discuss the roles of course directors or block directors in preparing for accreditation self-studies and site visits. These include the important and sometimes controversial subject of faculty qualifications to teach courses (and how to justify those faculty who may not meet accrediting body guidelines) and the importance of demonstrating that course content meets the requirements of specialized accrediting bodies.

11:0 BEST PRACTICES IN PROFESSIONAL SCHOOL PHYSIOLOGY POSTER SESSION

11.1 A FLIPPED CLASSROOM APPROACH WITH EMPHASIS ON IN-CLASS ACTIVE LEARNING IMPROVES STUDENT PERFORMANCE ON APPLICATION STYLE QUESTIONS IN A GRADUATE LEVEL ANATOMY CLASS
Stuart Inglis1
1Basic Biomed. Sci., Univ. of South Dakota, 414 E. Clark St., Vermillion, SD, 57069.

A flipped classroom design was implemented for the musculoskeletal unit of a graduate level gross anatomy class that had been previously taught using a traditional didactic design. Prior to the redesign, first year OT, PT, and PA students attended a 1 hour lecture with no structured review activities between classes. With the flipped classroom, students were assigned a prerecorded podcast to view the night before class, containing the material previously presented in lecture. Class time was reorganized as active learning sessions, in which students were presented with clinical scenarios and, working in groups, applied their understanding of anatomy presented in the podcasts to make a diagnosis. At the conclusion of the unit, identical test questions used in the unit tests for both groups were identified, characterized, and compared between groups. In both traditional didactic and flipped classroom course designs, students scored distinctively better on questions requiring the recall of memorized material when compared to the appli-
6. ABSTRACTS OF INVITED AND VOLUNTEERED PRESENTATIONS

11.2 FACILITATING PEER-TO-PEER INTERACTION IN A DISTANT LEARNING PROGRAM USING INTERACTIVE TELEVISION

David Geenen1

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The Physician Assistants Department in the College of Health Sciences at Grand Valley State University is incorporating a distant learning format into their curriculum. The purpose of this format is to develop and implement the delivery of its didactic courses to graduate students in a Grand Rapids, Michigan cohort while broadcasting the live lectures to a second student cohort in Traverse City, Michigan through Interactive Television (ITV). Presentation of the physiology and pathophysiology lectures by the instructor using ITV is challenging because of the difficulty of noticing visual cues from students at the distant learning site and the desire to incorporate peer-to-peer interaction between students at both sites. In addition, it is necessary to present information to both student cohorts simultaneously when the ITV system is unavailable, for example, during a review session. Thus, we used two different electronic approaches to address these concerns (1) an online interactive question and answer format called “Socratic” available free of charge to both students and instructor, and (2) Blackboard Collaborate. Using Socratic, the instructor creates quizzes with multiple choice, true/false, or open-ended questions and presents these to both sites using the ITV system. The students log on to Socratic with smart phones, laptops, or tablets and answer the questions loaded onto the site by the instructor. One of the advantages of using this internet-based system is that groups of students can compete against each other and groups can be formed within or between the cohorts. This interactive program allows the instructor to observe students working through problems and to receive student responses in real time. Blackboard Collaborate has been used to review for exams at times when the ITV system is unavailable to both cohorts and instructor. PowerPoint slides and lecture material can be displayed on screen at remote sites and presented to the students wherever they can connect online. Students then “join a session” and interact through audio and video feeds with the instructor and each other during the review. We frequently have students working in small groups during Blackboard Collaborate sessions, which also facilitates peer-to-peer interaction. These two resources for interactive learning have helped the program promote an esprit de corps between the two ITV sites and enabled student interaction with the distant learning format.

11.3 IMPACT OF PRE-TESTING IN LABORATORY PERFORMANCE IN OPTOMETRY

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In health professions, training in preclinical curricula such as physiology and pathology is fundamental for clinical practice. However, many students find the transition from pre-clinical to clinical training challenging. In an attempt to increase understanding and performance during this transition, we targeted a course with clinically relevant techniques and evaluations but without a direct patient care component. We hypothesized that testing students on laboratory skills prior to the laboratory session (pre-lab testing or PLT) may increase understanding and retention of the information presented and impact their performance in practical or theoretical testing when compared to testing during the laboratory session (in-laboratory testing or ILT). This study was performed using four (two ILT and two PLT) cohorts. There were a total of four laboratory sessions included in the course, and all students participated in all the sessions. All the students enrolled in the course also took a test based on the theoretical and practical facts included in the lecture portion and handout for each laboratory session. The two PLT groups submitted the tests prior to laboratory, while the ILT groups completed the assignments during the laboratory session. At the end of the semester the students took a final theoretical test and a final practical test that included activities from every laboratory session. While the scores on the pre-test in the PLT groups appeared to better predict scores on the practical portion of the final exam than did the laboratory assignment scores for the ILT groups, the overall performance of both student groups (PLT and ILT) was similar for the laboratory testing and final practical and theoretical exams. These results indicate that the time of testing does not seem to modify the score of
the students in either practical or theoretical portions of an
optometry preclinical course.

11.4
USE OF ULTRASOUND FOR ASSESSMENT
OF LIVER MEASUREMENT ACCURACY
DURING EARLY MEDICAL TRAINING
Gregory Brower1, Rebecca McDonald-Thomas1, Valerie
tipton1, Vaughan Lee1, and Fiona Prabhu1
Stop 6525, Lubbock, TX, 79430-6525.
Documentation of competency in performing entrustable
professional activities requires the incorporation of new
techniques and technologies in medical education. Abo-
dominal examination is a challenging skill for First Year med-
cial students to master. A specific learning objective in our
Development of Clinical Skills (DOCS) course is that stu-
dents develop proficiency in evaluation of subcutaneous
structures when performing physical examinations. Assess-
ment of the abdominal system with respect to the liver typi-
cally includes palpation, percussion and/or the scratch test
to determine localization of the liver edge and measure-
ment of liver span. Historically it has been difficult to estab-
lish the student’s proficiency in performing this aspect of
the physical examination. Moreover, studies show that cli-
nicians routinely underestimate the liver span as compared
to that measured by ultrasonography. Thus, more effective
methods to enhance learning of abdominal examination
techniques are needed. Thus, we have implemented an
approach that incorporates real-time ultrasound imaging to
provide immediate feedback when teaching examination of
the liver. The dimension of liver span and location of the
liver edge along the right midclavicular line are determined
by percussion and palpation in a standardized patient. The
accuracy of the student’s estimated measurements are then
compared to the liver span as determined by ultrasound
imaging (GE LOGIQ ultrasound). We found ultrasound-assi-
ted determination of liver edge localization and span to
be a useful adjunct to traditional means of teaching abdo-
nominal examination skills. A distinct advantage of utilizing
this approach is the student can obtain immediate feedback
with respect to their percussion skills, thus improving their
accuracy for times when ultrasound is not available. Fi-
ally, it contributes to providing our students with a solid
foundation in point-of-care ultrasonography.

11.5
PROMOTING STUDENT ENGAGEMENT IN
A MEDICAL PHARMACOLOGY COURSE:
AN EXPERIENCE WITH LEARNING CATA-
LYTICS
Ricardo Pena Silva12, Jose Mantilla Rivas1, and Astrid
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Student participation is an essential component of active
learning. Student response systems promote student en-
gagement and have been used for years with good results.
Learning Catalytics (LC) is a recently developed alterna-
tive, to which students can connect using their personal
communication devices and Internet. In contrast to other
systems, LC includes multiple types of questions that facili-
tate assessment of different components of learning. The
purpose of this study was to assess the effectiveness of LC
as a teaching and learning tool in a medical pharmacology
course. We included data from 3 cohorts of second year
medical students (2014-2, 2015-1 and 2015-2) corres-
ponding to 184 students. First, we surveyed the perceived
benefit of using LC to students and teachers. This survey
assessed satisfaction with the tool, commitment to study
and prepare lectures before class, interactions between stu-
dents and professors, perceived learning during the activi-
ties, and limitations of the tool. Second, we also asked for a
numerical grade (1-5 scale) and comments about the per-
ceived benefit of the experience with LC. We compared
this perceived benefit to academic performance (final
grade), educational environment (DREEM questionnaire)
and gender. Data was analyzed with chi square test or one
way ANOVAs followed by post hoc test. Results: More
than two thirds of students agreed with statements related
with high satisfaction, increased interactivity, more com-
mittance to the preparing lectures and better learning using
LC. These statements almost always agreed with the per-
ceptions of the course director. Perceived benefit of LC in
the learning process was high among students (4,37 ± 0,72
mean±SD, 4,5 median). We did not find a correlation be-
tween final grades or gender, and the perceived benefit of
LC. Students that scored in the upper quartile (Q4) in the
learning environment questionnaire, perceived a higher
benefit of LC than students in the lower quartile (Q1)
(P<0,05). Technical issues such as network connectivity
during the sessions were the most reported limitation of
LC. In summary, students perceive that the learning process
and social interactions improve while using LC. Most stu-
dents appear to benefit from using LC and no differences
were found between genders of between different levels of
performance in the course. Learning Catalytics appears to
be a useful tool for the teaching of pharmacology. Funding:
Conecta-TE, Universidad de los Andes.

11.6
EXAM BLUEPRINTING IN A FIRST-YEAR
MEDICAL SCHOOL PHYSIOLOGY COURSE
Thomas Pressley1
Most educators would agree that the assessment of a student’s mastery of a subject should be based on sound, quantitative principles. Although statistics allow the analysis of exams after students take them, faculty often do an inconsistent job when building the exam in the first place. Developing the skills needed to improve exams would increase longitudinal consistency and minimize the need to revise scores after the fact. Blueprinting, a practice more traditionally associated with standardized, high-stakes exams, offers a potential mechanism for achieving balance and reproducibility. Accordingly, I used exam blueprinting for systematic help in developing the cardiovascular exam for our first-year medical course in physiology. A simple spreadsheet was created that listed the various subjects covered, as well as the approximate amount of time devoted to each. With a target of 55 questions for the exam, I could use the relative amounts of time to estimate the number of questions that I needed for each subject. Of course, the estimates were not always integers, so some leeway was required when allocating the actual number of questions. The resulting blueprint provided a guide when assembling the exam from a database of questions used in previous years. I also used blueprinting to estimate how difficult the exam might be for students. This was accomplished in two ways. The first was to take advantage of the cognitive domains outlined in Bloom’s taxonomy of educational objectives (Bloom 1956). I divided questions into those that rely on knowledge, comprehension, or application/analysis using the guidelines outlined by Crowe et al. (2008). The second was based on previous success rates for the questions. These were simply averaged to provide an overall estimate of the outcome for the exam. My predicted score was 82.8%, and the actual outcome for the exam was 83.3%. Moreover, a retrospective analysis of last year’s cardiovascular exam using a similar blueprint showed similar success in predicting the outcome of that older exam. These results suggest that blueprinting provide a robust means of predicting the exam’s outcome, and they argue that the routine use of blueprinting for in-house exams offers the potential to generate more consistent assessments across multiple years and classes. (Supported by an APS Teaching Career Enhancement Award). References: Bloom B. S. (1956). Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain. New York: David McKay Co. Crowe, A., Dirks, C., and Wenderoth, M.P. (2008) Biology in Bloom: Implementing Bloom’s Taxonomy to Enhance Student Learning in Biology. CBE& Life Sci. Educ. 7:368-381.


11.7 EFFECTIVENESS OF LECTURE COMPARED TO INDEPENDENT AND ACTIVE LEARNING MODALITIES IN A MEDICAL SCHOOL CURRICULUM
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Introduction/Rationale: Didactic lectures, once the mainstay of undergraduate medical education, are diminishing in favor of more student-centered, active forms of classroom learning in many medical curricula. Nonetheless, the material formerly taught in didactic lectures is still important to the foundation of medical knowledge, and still must be mastered by students. To serve this purpose, a variety of vehicles to deliver this content for independent learning outside of the classroom have been developed and implemented at a variety of medical schools. However, the question regarding the efficacy of student learning in didactic lectures compared to independent learning events remains.

Methods: The curriculum at Western Michigan University Homer Stryker M.D. School of Medicine (WMed) was designed to include didactic lectures, independent learning events, and active learning events each week. In this curriculum, an independent learning event is an eBook developed by a faculty member, containing learning objectives and specific content, which the students are required to master outside of the classroom. An active learning event is a classroom session where an interactive form of learning occurs, such as problem solving tutorials, case studies, debates, and team-based learning. A typical academic week consists of approximately 6 hours of didactic lecture, far less than a traditional medical school curriculum, 3-5 hours of active learning, and 5-7 hours of independent learning events. To assess whether learning is different between didactic lectures, active learning events, and independent learning events within our curriculum, statistical analysis is being used to evaluate student performance on end-of-course (summative) exams for each Foundations of Medicine course in the undergraduate medical curriculum (years M1 and M2). This serves to compare individual students’ performance on assessments from didactic lectures versus independent learning events versus active learning events. In addition, the data is further elucidated by comparing the performance on assessments for students in the upper and lower ranks of the class. Outcomes: Initial analysis of the data shows that students perform significantly better on the summative assessment questions from Independent and Active Learning events, relative to didactic lecture events.
11.8
LINKING IRAT AND GRAT QUESTIONS THROUGH CLINICAL CONCEPTS
David Averill1, Mario Cornacchione2, and Magrit Shoemaker

Background: Many programs which employ Team Based Learning (TBL) use individual readiness assurance tests (IRAT) and group readiness assurance tests (GRAT) to evaluate students’ initial comprehension of foundational information. Michaelson and colleagues originally proposed that the same set of questions should be used in the IRAT and GRAT in a TBL session. In part, the repetition of the same questions in the group setting was proposed as a way to foster collaborative thinking and team development. In some programs such as medical education these questions emphasize higher order cognitive thinking in the domains of application, synthesis, prediction, and prioritization. Description: At The Commonwealth Medical College the third year clinical curriculum is delivered through a combination of longitudinal integrated clerkships (LIC) and block clerkships. Internal and Family Medicine have used TBL as their primary instructional and assessment format during didactically oriented learning activities which occur every 4-5 weeks. In previous years the IRAT and GRAT used identical questions. Upon review of these learning activities there was a perceived need to enrich the learning of students. To extend students’ learning in clinical medicine, the IRAT and GRAT were redesigned such that the IRAT and GRAT used different questions but each pair of IRAT and GRAT questions were linked to a common concept or topic. For example, IRAT questions may focus on specific aspects of differential diagnosis whereas the GRAT questions might focus on development of treatment plans pertinent to the diagnosis of the IRAT question.

11.9
CLINICALLY RELEVANT APPLICATION EXERCISE WHICH EMPHASIZES DECISION MAKING
David Averill

Background: Team Based Learning encourages a pedagogical approach composed of three sequential steps. The first step, individual readiness assurance test (IRAT), evaluates how well individual students assimilate foundational information. The second step, group readiness assurance test (GRAT), evaluates the collaborative efforts of group members to answer the same questions used in the IRAT. The third step, application exercise, requires the group to apply foundational knowledge in the solution of a complex problem. Application exercises used during the initial years of medical student education can be a powerful strategy to consolidate foundational information in a clinically relevant setting. Another important skill set which medical students need to develop is the ability to make knowledge-based decisions in a team setting. We are in the process of developing a set of self-directed application exercises which can be used to evaluate the decision making process of medical students. Description: The application exercise begins with an initial brief description of a clinical problem. Each group can request additional information to formulate an initial differential diagnosis. Since the number of choices is limited, the group needs to prioritize the type of information they believe is important. Based upon the development of the differential diagnosis, the group can request various clinical tests or procedures to further refine the differential diagnosis. Once again, the number of choices is limited and the group must make knowledge-based decisions in the prioritization of tests or procedures “ordered”. The application exercise ends with groups discussing the rationale used in solving the clinical problem. Results: The application exercise described above has been implemented as a self-directed presentation. Depending on the clinical case and the design of the application exercise, “break points” may be inserted when groups suspend their movement through the activity so discussion among groups may take place. Movement through the activity resumes after a brief discussion. Future plans include the implementation of this self-directed activity on a platform which will allow us to analyze the decision making process of medical students. Conclusion: Based upon results of initial surveys, medical students value this type of application exercise because it requires them to make knowledge-based decisions in a clinically relevant setting.
level of enthusiasm for learning and the application of physiological concepts during a first year medical student basic sciences course. Design & Methods: Students enrolled in Medical Physiology (n=439) completed a St. George's University and Smart Sparrow™ designed online interactive clinical case module as a prerequisite to a facilitated small group session. The module consisted of four components: patient history, physical exams, history notes, and test results. Student progress through several decision branch points was recorded, and student performance quantified during and after the module. Formative assessment was via questions at key branch points, with immediate feedback. Cumulative assessment was via rubric scoring of the patient notes, and incorporation of two multiple choice questions in the survey and midterm exam. Student feedback was obtained via an exit Likert scale survey. Results: Students spent an average of 1 hour on the module, with analysis of formative branchpoints. Findings indicated an increased understanding of the diagnosis: 68% of the students made the correct diagnosis after the interview phase, 86% were able to make the correct diagnosis after the interview, examination, notes & tests phases, and 76% of the students were able to correctly answer the post module Multiple Choice Questions. In the Likert survey, 70-85% of the students indicated that the module stimulated an increased enthusiasm in critical thinking, related to lecture content, basic science knowledge and clinical reasoning. Conclusion: The innovative online module effectively integrated basic science knowledge with clinical skills, as determined by student feedback and MCQ performance. It also improved in-class dynamics and identified key conceptual difficulties. Acknowledgements: 1. The Clinical Tutors of the Department of Physiology and Neuroscience, School of Medicine, St. George's University. 2. Allison Murray and Smart Sparrow™ Team.

14:0 WORKSHOP I*

14.1 TIPS FOR TEAM-BASED LEARNING
Jonathan Kibble¹, and Lisa Barkley²
¹Med. Educ., Univ. of Central Florida, Hlth. Sci. Campus at Lake Nona, 6850 Lake Nona Blvd., Orlando, FL, 32827, ²Clinical Sci., Univ. of Central Florida, Hlth. Sci. Campus at Lake Nona, 6850 Lake Nona Blvd., Orlando, FL, 32827. This is a hands-on workshop in which participants will experience each component of TBL. The session will cover proper small group formation, the conduct of readiness assurance testing and deployment of application focused exercises. The session will culminate with discussion about key topics such as conduct of appeals, incorporation of peer evaluation and establishment of grading schema in collaboration with learners.

15:0 WORKSHOP II*

15.1 STUDENT ROLE IN LEARNING: WHAT IS THE GOAL AND HOW DO WE GET THERE?
Beth Beason-Abmayr¹
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As we modify our teaching methods and incorporate active learning strategies to make our classes more student-centered, one of the biggest challenges we face is how to get buy-in from the students so they will engage in the learning process. This new learning environment requires students to take on new roles and responsibilities that are likely quite different from those associated with the traditional college class or what they may have experienced in high school. So how do we motivate students to take ownership of their own learning? How do students learn what their role will be? Why do students resist learner-centered teaching? What factors contribute to a student’s poor performance? Why are students poor judges of effectiveness of study strategies? How does a student know when they have mastered the material? And what about us? What is our role in this process? How do we provide students opportunities to practice taking on their roles and evaluate whether they are
performing their roles satisfactorily? How do we implement evidence-based teaching strategies while at the same time making students realize the value of desirable difficulties? How do we evaluate our own teaching? How do we ensure our evaluation of students is consistent with the roles they have been required to take on in the course? In this workshop, we will discuss questions and challenges such as these and explore strategies and approaches you can implement and integrate in your classes to help your students become lifelong learners. References: Brown, P. C., Roediger, H. L., and McDaniel, M. A. (2014) Make It Stick. Doyle, T., and Zakrjasek, T. (2013) The New Science of Learning. Doyle, T (2008) Helping Students Learn in a Learner-Centered Environment.

**16:0 WORKSHOP III**

**16.1 EDUCATIONAL SCHOLARSHIP: A STEP-BY-STEP GUIDE TO IMPLEMENT AND PUBLISH YOUR CLASSROOM RESEARCH**

Valerie O'Loughlin, 1


Cross and Steadman (1996) defined classroom research as a continual, progressive intellectual inquiry by a teacher about the teaching and learning within one's classroom. As one assesses the effectiveness of an instructional method or educational intervention, the findings not only help improve teaching and learning, but also may lead to further questions about how our students learn. Classroom research is a subset of educational research, which may examine teaching and learning beyond the scope of a single classroom. Educational scholarship refers to the practice of making educational research public, by presenting your findings to peers for review. While most scientists are familiar with the process of publishing in our specific bench research areas, few of us have training in developing a publishable Scholarship of Teaching. San Francisco, CA: Jossey-Bass, and O'Loughlin, V. D. (2006) A 'how to' guide for developing a publishable Scholarship of Teaching project. Adv Physiol Educ 30:83-88.

**17:0 PLENARY LECTURE IVa**

**17.1 THE CHANGING USMLE AND NBME MEDICAL SCHOOL SERVICES**

Steven Haist1, and Agata Butler2


The United States Medical Licensing Examination (USMLE) Composite Committee (CC), the governing body of USMLE, requested an in-depth review of the USMLE program in terms of purpose, design, and format. The USMLE underwent a comprehensive review between 2006 and 2008 by the Committee to Evaluate the USMLE Program (CEUP). The CEUP Committee made six recommendations, five of which were accepted by the CC. The five recommendations were: 1) the examination program should support two decisions, entry into supervised practice and entry into independent practice; 2) the design, development, and scoring of the of the examinations should be driven by a general competencies schema; 3) foundational science should be assessed throughout USMLE; 4) clinical skills assessment should remain a component of USMLE and enhancement of testing methods assessing clinical skills should be considered; and 5) USMLE should introduce a format to assess an examinee's ability recognize and define a clinical program, access appropriate references to address the problem, and to interpret and apply that information in an effective manner. Since 2008, a great deal of progress has been made. Extensive practice analyses were conducted to inform changes, and more recently, a new Step 3 was introduced and is now two examinations, Step 3A, Foundations of Independent Practice and Step 3B, Advanced Clinical Medicine. The major changes in Step 3 examinations include an increased emphasis on foundational science and evidenced-based medicine. Two new formats, pharmaceutical advertisements and scientific abstracts, have been introduced. While many changes have occurred in Step 1 and Step 2, in the near future, more significant changes will occur. Some of the potential changes include new formats assessing communications skills, additional emphasis on patient safety, enhancing the assessment of evidence-based medicine skills, and use of clinical decision making tools during an examination, such as a metabolic map when answering biochemistry/metabolism questions. The purpose of the USMLE section of the pre-
sentation is three-fold: 1) information sharing, 2) getting feedback on the proposed new formats, and 3) brainstorming regarding other possible competencies or sub-competencies to assess. The NBME presentation provides an overview of the NBME services to medical schools and students and an update on the changes and initiatives that are underway with the Subject Test Program, Customized Assessment Services, NBME Self-Assessment Program, and NBME-U. The NBME section will also give participants an opportunity to provide recommendations on how to improve services and what the NBME can do to better meet the needs of medical schools, medical educators, and students.

19.0: WORKSHOP IV*

19.1 USING SOCIAL MEDIA TO ENHANCE STUDENT LEARNING
Patricia Halpin

Social media has become ubiquitous and Twitter is one of the most popular sites used with 500 million tweets per day. While many would assume this use of social media is for disseminating information only, it can also be used as part of a college science course. Twitter is used to hold weekly asynchronous discussions on specific topics related to the assigned course material. By requiring brevity, 140 character limit, students need to choose wisely about what they will tweet. Credible sources (The Scientist, Nature, Science, Smithsonian) can be followed on Twitter and used as sources of articles for class discussions. Posting articles from these credible sources and asking the class a question about the article enhances class discussion. Students become accustomed to the high quality and high quantity of science information that is posted daily on Twitter and appreciate the choices of articles they can use to tweet. In this workshop you will sign up for a Twitter account, and learn how to participate in a robust class discussion on Twitter. The uses of: hashtags, following, URL shortener, messaging and retweeting will be explored. During the workshop we will use all these tools to hold our own robust discussion on a current science topic. If time permits, the use of a closed group in Facebook to promote informal learning will also be demonstrated. Reference: Using Twitter in a Non-science major science class increases students’ use of reputable science sources in class discussions. Journal of College Science Teaching [In Press].

20.0 WORKSHOP V*

20.1 USING CONCEPTUAL FRAMEWORKS IN TEACHING AND LEARNING PHYSIOLOGY
Jenny McFarland

Learning of physiology involves the development of an enduring understanding and application of the core concepts of our discipline. Core concepts in physiology have been identified (Michael & McFarland 2011) and our group has also developed and vetted conceptual frameworks for three core concepts: Flow Down Gradients (Michael & McFarland 2011), Homeostasis (McFarland et al. 2016) and Cell-Cell Communications. A conceptual framework is a hierarchical “unpacking” of the ideas underlying a core concept that are important for understanding. Each core concept is made up of “critical components”, essential aspects of an accurate mental model of the core concept. “ Constituent ideas” are necessary for working understanding of the critical components. Conceptual frameworks serve many functions in teaching and learning. They help students organize their growing understanding and develop sound explanations of phenomenon. They allow learners to fit factual knowledge into a logical structure that relates these facts to the core concept. Thus, students can more easily assimilate new information and prior knowledge as they progress through a physiology course or courses. Frameworks give faculty a lens to view the student learning outcomes, and guide courses, curriculum and programs toward helping students gain meaningful understanding of physiology core concepts, as well as mastering content knowledge. Frameworks can provide a progression of outcomes across a series of courses, with introductory courses introducing specific core concepts and critical components. Faculty in upper division courses might expect students to appropriately apply and explain constituent ideas. For faculty using backwards design, the frameworks can direct formative and summative assessment and make these assessments more meaningful for students. In this workshop, participants will use one of three conceptual frameworks (homeostasis, cell-cell communications and flow down gradients or flux) to explore how these might be used in course design, student assessment and learning. There will be time for questions and discussion and applications in physiology teaching and learning. (NSF DUE-1043443) References: Michael, J. and McFarland, J. (2011) The core principles (“big ideas”) of physiology: results of faculty surveys. Adv Physiol Educ. 25:336-341. McFarland et al. (in press 2016). A conceptual framework for homeostasis: development and validation. Adv Physiol Educ.
UNPACKING THE CORE CONCEPT OF CELL-CELL COMMUNICATIONS FOR UNDERGRADUATE OR PROFESSIONAL LEVEL PHYSIOLOGY COURSES

Joel Michael¹, Jenny McFarland², Ann Wright³, Harold Modell⁴, and William Cliff⁵


A conceptual framework (CF) is an “unpacking” of a core concept into its constituent ideas (1). We have published a validated CF for homeostasis (1). More recently we unpacked the core concept of cell-cell communications and validated the CF that resulted (2). The cell-cell communications conceptual framework (CC-CF) is made up of seven critical components and 44 constituent ideas arranged in a hierarchy with as many as three levels. It is large, complex, and encompasses many physiological mechanisms. The CC-CF is more comprehensive, contains more ideas, than students in a typical undergraduate introductory physiology course are expected to learn. On the other hand, students in a professional level physiology course (medical, dental) might well be expected to learn it all. This thus raises the question of how to edit (“trim”) the CC-CF to meet the needs of a particular course. In the process of preparing and then validating the homeostasis CF (1) we applied a simple rule: if fewer than 30% of our respondents rated the item as Essential it was dropped from the framework. The same rule applied to the CC-CF results in 17 items being eliminated, reducing the size and complexity of the CF. However, some of the items eliminated may be deemed important by a particular physiology teacher. An alternative rule would call for elimination of all items at the 4th level in our hierarchy (four items would be removed). While algorithmic approaches are appropriate for preparing CFs for dissemination to a wide audience, they may not serve the individual teacher well. A CF is, by its very nature, highly structured, and removing items according to some arbitrary rule may create a distorted representation of the core concept. CFs are meant as teaching and learning tools, and such tools must be adapted to the particular needs of the students. Nevertheless, the cell-cell communications conceptual framework offers teachers of physiology at any level a tool that can be customized to meet their needs. References: (1) McFarland et al., (in press). A conceptual framework for homeostasis: development and validation. Adv Physiol Educ. (2) Michael et al. (2016). A conceptual framework for the core concept of cell-cell communication. Abstract 553.20, Experimental Biology 2016, San Diego, CA. (3) McFarland et al (in preparation). (4) Modell et al. (2015). A physiologist’s view of homeostasis. Adv Physiol Educ 39: 259-266.

LEARNING TO WORK TOGETHER: IN-CLASS TRAINING TO ENHANCE STUDENT COLLABORATION AND INCREASE LEARNING OUTCOMES

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Skill sets associated with team-based productivity are increasingly sought after by employers. As such, it is necessary for students to have opportunities to develop, evaluate, and hone these skills during their undergraduate programs. Anecdotally, students report poor experiences working in teams even though, individually, all students in the team are intelligent and capable of completing the task. This suggests that there are certain skills that must be learned in order to work effectively in a team. Therefore, it is necessary to develop tools that aid in training students to collaborate effectively. To begin addressing these issues, we sought to determine whether effective teams were capable of improving learning outcomes for students in those groups. In our undergraduate core natural sciences course, Scientific Literacy for the 21st Century, students work together in teams of four for the duration of the semester. In an effort to aid students in identifying what an effective team is, students in one section of our course were shown YouTube videos about teams working together with varying degrees of success. This led to an in-class discussion about factors that characterize “good groups” or “bad groups”. Afterward, each team was tasked with developing their own rules that they would abide by in order to be an effective group. Each team member signed the document upon agreement of the rules. Teams were provided time every two to three weeks to reflect and discuss whether they were meeting the established rules for their team. This section constituted the experimental group, and each student was given an anonymous group effectiveness assessment at the end of the semester to evaluate qualities of their team and the impact their team had on their learning in the course. These results were compared against graded assessments in
the course, as well as pre- and post-course assessments. A different section underwent a similar group effectiveness assessment with comparison to graded tasks in the course, as well as the pre- and post-course assessment, however, this section was not given the extra tools to identify factors of an effective team throughout the semester. Preliminary analysis suggests that students exposed to tools that aid in the identification of factors that may contribute to an effective team typically have greater learning outcomes and higher grades.

22.3 EXERCISE PHYSIOLOGY MOBLAB-BASED PROTOCOL PROMOTES LEARNING AND STUDENT ENGAGEMENT
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The MobLabs (mobile learning laboratories) are smartphone applications (Apps) or small portable devices that facilitates teaching and learning process by acquiring scientific data. This pedagogical tool can alternatively optimize physiology practical lessons and meet the necessity for innovative and engaging didactic approaches by digital natives students. We aimed to create a practical lesson protocol to teach exercise physiology by using Apps in classes for higher education and K-12 students. Specific exercise physiology Apps were not available on virtual stores. However we identified, selected and applied several Apps, developed for different purposes, into one protocol of exercise physiology hands-on activity. To explore their potential for providing physiological status before and after physical activities, we tested a practical lesson protocol that includes endurance jogging, house cleaning, meditation and a control group. Six Apps were identified as useful to provide reliable and statistically significant results about heart and respiratory rate, forced expiration, vasodilation, muscular tonus and reaction time. Additionally, the protocol was effective to promote learning of exercise physiology concepts and student engagement. Thus, exercise physiology is an appropriate topic to use smartphone as MobLab, which allows student to experiment data collection similar to conventional laboratory methods. Funding sources: OCRC-FAPESP.

22.4 BIG BROTHER IS WATCHING
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Several summative assessments are often required before instructors can identify students at high risk for course failure. Since it is common in large lecture courses to have only a few hourly exams per term, this realization may not come until late in the semester. The widespread incorporation of online learning and course management platforms such as BlackBoard, Canvas and Moodle in universities across the country affords instructors access to a trove of student online behavioral data. In today’s world in which government and commercial entities utilize data mining and analysis software with success, student activity report spreadsheets represent valuable sources of untapped data. Is it possible to discern online behavioral patterns that correlate with student performance on high-stakes, summative assessments? Might the student who has never downloaded the lecture notes fall into a predictive category of risk? Or, might the student who completes online assignments the same day they are posted be in some way predisposed for better assessment outcomes than a student who completes assignments an hour before they are due? Asking questions like these and others, we identified online behavior parameters that correlate with summative assessment performance in a cohort of undergraduate nursing students of Anatomy and Physiology. We then algorithmically integrated these parameters and assessed the algorithm for predictability post-hoc. Herein we report on our algorithmic approach to analysis of student online behavioral data for early-semester identification of students at high-risk of scoring poorly on lecture exams. Deploying similar models an early-warning system, instructors may be able to preemptively align students with learning resources of which they may be unaware such as supplemental instruction, free on-campus tutoring, office hours, and the like.

22.5 MOVING FROM MEMORIZATION TO CURIOSITY: ENCOURAGING STUDENT-DIRECTED LEARNING IN AN ADVANCED PHYSIOLOGY CLASS
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The college experience is ideally designed to develop students’ creative, critical, and independent thinking skills. This goal is seemingly at odds with a traditional introductory Anatomy and Physiology course that emphasizes the memorization of nomenclature and the acquisition of facts. 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 prefer it to more
inquiry-based methods. 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. Eleven third- and fourth-year students are enrolled in the inaugural semester of this course in Spring 2016. Three student-directed projects are integrated into this course, the first being an inquiry-based lab where students design, apply for IRB approval, and carry out a simple physiology experiment using the iWorx IX-TA teaching lab system that has been used throughout the semester. The second is a student-led book club, in which each student is responsible for integrating a chapter of Robert M. Sapolsky’s “Why Zebras Don’t Get Ulcers” with the physiological concepts presented in class and leading a group discussion with their peers. The third student-directed project is a midterm assignment in which students write four physiology questions related to topics covered in the first half of the semester, and then answer them. Students are encouraged to ask questions that really drive their curiosity, and are given a rubric that supports inquiry rather than finding a definitive answer or writing a case study. Researching “curious questions” is also used during the second half of the semester to encourage the students to observe physiology in their daily lives and bring that lived experience into the classroom. These methodologies will be assessed quantitatively by student performance on the final exam, and qualitatively by student self-assessment and a class survey.

22.6 PHYSIOLOGY UNDERSTANDING WEEK (PHUNWEEK): K-12 OUTREACH PROGRAM PROMOTES BOTH ENGAGEMENT AND IMPACT
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In 2005, the American Physiological Society (APS) established a member-driven outreach program, Physiology Understanding Week (PhUn Week) with five objectives: 1) Increase student interest in & understanding of physiology in their lives. 2) Introduce students to physiology as a possible career. 3) Increase teacher recognition of physiology in the curriculum. 4) Involve more physiologists in outreach to students & teachers in their communities. 5) Reach a broad base of students (grades, gender, race/ethnicity). This study evaluates # 2, 4 and 5 and describes plans to evaluate # 1 and 3. PhUn Week was held each November, 2006-2016, engaging more than 96,500 students in grades pre-K to 12. APS members worked with local schools and teachers to plan and implement meaningful interactions between physiologists, trainees, and students. APS provided resources (hands-on lessons, career presentations, and follow-up materials). Reaching diverse students: Initially, PhUn Week involved primarily high school classroom visits. However, 2015 data show a balanced mix of primary (24%), elementary (21%), middle (21%), and high school (31%) events. PhUn Week has consistently garnered participation of both female (52%) and male (48%) students, and the percentage of PhUn Week students from minority groups underrepresented in science increased from 34% to 47% in eight years. Involving physiologists: Participation of physiologists and graduate/postdoctoral trainees increased more than 400% in the past ten years, providing students with direct contact with science role models. In addition, PhUn Week has expanded both across US and to 4 countries over the past decade. Although PhUn Week started as individual classroom visits, it has evolved into a variety of event types in museums, on university campuses, and at outdoor venues. These models provide flexibility in planning events and engaging both physiologists and students in different community types and countries. Career education: Career trading cards were developed to encourage students to explore careers at the APS career web following PhUn Week. Demographics are collected on number and length of visits. Data suggest that students not only keep the cards but use the links to access career information. Student interest: The poster will discuss possible evaluation methods for gathering student impact data from an international, volunteer-based program.

22.7 EDUCATORS RATE LIFE SCIENCE TEACHING RESOURCE COMMUNITY AS BOTH USEFUL AND USABLE
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The Life Science Teaching Resource Community (LifeSciTRC, www.lifescitr.org) is a collaborative digital library and online educator community involving nine life science societies in areas including physiology, anatomy, developmental biology, genetics, plant biology, and science policy. In 2015, we conducted the first survey of registered LifeSciTRC users in order to gauge both the functionality and user benefits of the community site. The survey measured: (1) ease of using search, resource sharing, and community tools; (2) usefulness of resource metadata; (3) helpfulness of LifeSciTRC resources in teaching; and (4) satisfaction with the LifeSciTRC. Responses were collected from 316 educators. Overall, responses to all sections of the survey were positive, indicating that respondents found the LifeSciTRC easy to use and beneficial to their teaching. Analyses also will be presented by institutional level, par-
22.8 EXPANSION OF UNDERGRADUATE PROGRAMS DURING THE VISION AND CHANGE ERA: PHYSIOLOGY AND OTHER LIFE SCIENCE FIELDS

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The Vision and Change in Undergraduate Biology Education reports cite the critical role of professional societies in undergraduate life science education and, since 2008, have called for their increased involvement in support of undergraduate education. A 2014 survey by the Professional Society Alliance for Life Science Education (PSALSE) explored the level of support being provided by societies for undergraduate education and documented changes in support during the Vision and Change era. Society representatives responded to a survey on programs, awards, meetings, membership, teaching resources, publications, staffing, finances, evaluation, and collaborations that address undergraduate faculty and students. A Comparison Group of societies responded to similar surveys in both 2008 and 2014. Results indicate that life science professional societies are extensively engaged in undergraduate education in their fields, setting standards for their discipline, providing vetted education resources, engaging students in both research and education, and enhancing professional development and recognition/status for educators. Comparison Group responses indicate that there has been a significant expansion of undergraduate efforts in several areas since 2008. This poster will also document changes in undergraduate programs by the American Physiological Society during this period, describing increased offerings of undergraduate research experiences, faculty development, and teaching resources. Directions for future undergraduate programs and resources will be discussed. References: AAAS. (2009a). Vision and Change in Undergraduate Biology Education: Preliminary Reports of Conversations. Washington, DC: AAAS; AAAS. (2009b). Vision and Change: A Call to Action. Washington, DC: AAAS; AAAS. (2011). Vision and Change in Undergraduate Biology Education: A Call to Action. Washington, DC: AAAS; AAAS. (2015). Vision and Change in Undergraduate Biology Education: Chronicling Change. Inspiring the Future. Washington, DC: AAAS.

22.9 AGENTS OF CHANGE - MOVING FROM SURVEY TO EXPERIENTIAL LEARNING:

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The University of Alaska Anchorage (UAA) department of Biological sciences became “agents” of change and revitalized their curriculum to start in academic year 2015/2016. The cornerstone of the transformation was to take a two semester introductory biology survey course (8 total credits) and create a one semester lab intensive introductory biology course (6 credits; BIOL A108). Experiential learning is essential for many professions, including scientific fields of study. UAA biology students were immersed in the scientific method to explore biological questions based on current knowledge and to experience the challenges of experimental design and data collection. Pre/post tests were given to track student progress and quantify student retention of relevant material. One of the major goals of AAAS Vision and Change is to help higher education biology courses retain more students thereby improving student continuation in STEM related fields. In this we were successful: historically the 2 semester survey introductory course reported withdrawal rate of 16%, however when including failure rates this percentage consistently increased to over 20% for each semester analyzed (2012 to 2014). In contrast, 96% of students passed (defined as a C or better grade) with a withdrawal rate of 2% in the first semester (Fall 2015) of our experiential learning introductory biology course (BIOL A108). Data from the current semester (Spring 2016) suggest similar trends. A second goal of the program revision was to increase student learning and engagement in the process of science; in this our data suggest we were successful. Within one month of BIOL A108, students have improved their use of the scientific method to tackle challenging biological questions and core concepts. Preliminary assessment data show 96% of BIOL A108 students can successfully create and use hypotheses statements correctly. Additionally, BIOL A108 student pre/post data indicate a 25% improvement in their comprehension of Mendel’s principles. Since UAA draws students from the local area which has a highly diverse population, the increased student retention and learning in UAA’s new introductory biology course may lead to a greater proportion of non-traditional and minority students continue in biology and other STEM related fields.
22.10
REINFORCING AND TRACKING PREREQUISITE CONCEPT MASTERY IN PHYSIOLOGY USING TWO-STAGE COLLABORATIVE TESTING
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Instructors and administrators frequently establish prerequisite requirements to ensure that entering students possess the background knowledge to succeed in their course. However, prerequisite courses can only benefit students if they have mastered the course concepts, and can only benefit instructors if they can accurately measure student mastery. In this study, we used two-stage collaborative testing to assess and reinforce student understanding of key prerequisite concepts across a two-course physiology sequence. The final exam of the first course included ten questions addressing concepts particularly relevant for the second course. During the first week of the second course, students were given a paper quiz consisting of the same ten questions, and were asked to provide their individual answer and then use IF-AT scratch cards to discover the correct answer. The activity was followed with an extensive instructor debriefing, and students recorded when they first understood the concept addressed by the question prior to the activity. 52% of the time. Of the concepts that were not understood the concept addressed by the question prior to the activity, 56% were understood after the group discussion and 41% after the instructor explanation; only 3% were not understood after the activity. Student perception data revealed that they found the activity useful and enjoyable. In conclusion, no-stakes collaborative testing can be an effective introductory activity for courses with prerequisite requirements, enabling students to activate previous knowledge and to prepare for future collaborative learning activities. This activity also enables instructors to identify prerequisite concepts requiring remediation prior to covering new material, and to identify students needing extra help.

22.11
TEAM-BASED ASSESSMENT OF NEPHRON STRUCTURE AND URINE FORMATION USED AS A FORCED RETRIEVAL ACTIVITY TO IMPROVE STUDENT LEARNING
Jane Chapman, Ph.D.1
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An underlying topic in A&P is the complementarity of structure and function. In the urinary system it is crucial for students to understand that structure will determine function. The relationship of the structure to the function of the nephron is a perfect example of this theme. Students tend to overlook this relationship. Additionally, the kidneys play a major role in many homeostatic control mechanisms. Students' success in subsequent courses and programs depends upon a good understanding of this learning outcome. The nature of urine formation runs contrary to most physiological processes and is a source of confusion for the students. Feedback from students on the pre-quiz, addressing the Unit Learning Outcome: Describe the structure of the nephron and relates its structure to the functional processes of urine formation, indicates students have difficulty with this topic. The goal of mastery and more durable learning of the unit learning outcome prompted the development of a new in-class forced retrieval activity and new exam question. As with all topics in the course, students are initially exposed to the material via a pre-class reading assignment followed by a pre-quiz that is to be completed before coming to class. In-class exposure to the material is via concept questions and peer discussion/instruction. Both the concept questions and peer instruction force students to retrieve material they have previously read. Forced retrieval leads to more permanent and durable learning. Another activity was developed to assist and assess student learning of the learning outcome stated above in addition to other forced activities currently used in this course. The activity included a collaborative learning session as part of a 'team' peer instruction opportunity where students were required to come to consensus regarding the answers and in an attempt to make the learning more authentic students were allowed to use class notes and textbooks. This team-based, forced retrieval activity was designed to be a formative assessment that provided low risk/low stress feedback to students and instructor alike and was followed up with a new question for the unit exam to assess student learning of the learning outcome stated above. The answers for the activity were discussed in the following class meeting. Distribution of student responses for each question was examined for both the individual and team-based assessment to identify misconceptions and weaknesses in understanding. This information was used to write the unit test question. Student
responses to the unit test question demonstrated improved understanding of the topic and better than acceptable achievement of the learning outcome.

24:0 PLENARY LECTURE V

24.1 SUPPORTING FACULTY: RESOURCES FROM PROFESSIONAL SOCIETIES AND ONLINE COMMUNITIES

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For higher education faculty at all levels and in all science fields teaching is changing rapidly. Incorporation of student-centered teaching methods such as flipped classrooms and authentic research experiences, use of blended and online-only formats for course delivery, expansion of assessment methods to gather richer student data, and online/on demand formats such as MOOCs have compelled faculty to venture away from the tradition and familiarity of the lecture model into new arenas. For many faculty members, especially those at smaller institutions with limited science faculty, these forays into the unknown are done single-handedly, without collaboration or support from colleagues. Fortunately, changing technology also provides opportunities for professional societies and online communities to play an increasing role in supporting faculty development and science teaching. Although working in isolation, the lone science faculty member at a rural college can find resources tested by colleagues teaching the same type of course, join a multi-institutional collaboration to evaluate a new lesson, or have her students team with students from another country to do a research project. More importantly, she can have direct conversations with colleagues about the teaching issues that are most problematic or most rewarding. This presentation will explore sources of teaching resources, professional development, collaboration, and recognition by professional societies and other organizations. Data sources include surveys of life science professional societies and online community users. Opportunities for community involvement, including methods evaluation and research collaborations, will be discussed and ideas for additional society programs and activities will be solicited.

25:0 WORKSHOP I*

25.1 TEACHING PHYSIOLOGICAL CONCEPTS BY ENHANCING STUDENT VISUAL LITERACY

Kathryn Johnson

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Students learn by building on a framework of prior knowledge. As educators, how do we provide experiences for students to recognize and enhance this process? This workshop will engage participants in specific activities for the classroom that prompt student discussions of how assumptions informed by prior knowledge, social identity, diversity, and team dynamics affect learning, data interpretation, decision-making, critical thinking, and creativity in the sciences. As a means to focus on these specific ideas, visual interpretation of patterns and information, often known as visual literacy, provide a platform for discussion that allows for simple implementation and diverse interpretations. Workshop participants will brainstorm and discuss how these activities and discussions benefit their respective student population, including how experience and practice of these reflective exercises will enhance and promote student learning, ability to apply information, and creativity to better understand physiology. References: Jones, M.G. & Brader-Araje, L. 2002. The impact of constructivism on education: Language, discourse, and meaning. American Communication Journal, 5(3), for discussion of constructivism of learning through connecting new information with prior knowledge. Williams, T.L. 2007. “Reading” the painting: Exploring visual literacy in the primary grades. The Reading Teacher, 60(7):636-42, for a basic explanation of visual literacy. Schönborn, K.J. & Anderson, T.R. 2006. The importance of visual literacy in the education of biochemists. Biochemistry and Molecular Biology Education, 34(2):94-102, for specific guidelines for teaching and learning visual literacy in the sciences.

26:0 WORKSHOP II*

26.1 STATISTICS IN EDUCATIONAL SCHOLARSHIP

Douglas Curran-Everett

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When I teach and write about statistics, I want to engage my audience. To do this I use simulations as thought experiments my audience can see. This workshop provides an opportunity to do just that: we will investigate basic concepts in statistics using simulations that will mimic hands-on exploration. Workshop participants will explore how these concepts are critical to the conduct, analysis, and interpretation of educational research. References: Curran-Everett D. Explorations in statistics: hypothesis tests and P values. Adv Physiol Educ 33: 81–86, 2009. Curran-Everett D. Explorations in statistics: confidence intervals. Adv Physiol Educ 33: 87–90, 2009. Curran-Everett, D. Explo-
MEANINGFUL LEARNING

27.1 INSTRUCTORS’ UNDERSTANDING OF STUDENT’S MISCONCEPTIONS CAN IMPROVE MEANINGFUL LEARNING
Ann Wright

Students’ knowledge of physiology derives from previous learning experiences. Bransford, Brown, and Cocking (1999) state that students shape new knowledge and understandings grounded on what they already know. Often times, what students know and believe doesn’t match what is physiologically correct, and that can become a barrier to learning. Identifying students’ misconceptions and helping the students directly confront them is essential for effective teaching. As instructors of physiology, we need to recognize that students have to construct their own conceptual understanding. Students use new information and their current knowledge to make accurate connections with instruction and not merely absorb the knowledge (Wiliam, 1994).

Learning complex material, such as concepts in physiology, can occur differently for every student. For example, a student may have some related knowledge of the to-be-learned concepts but no prior knowledge. Students’ existing knowledge and the process they use to link it with new knowledge influence the learning outcomes achieved. Therefore, both need to be taken into account through teaching. By taking into account students’ thinking, physiology instructors can respond to and interact with the students to provide the opportunity for the student to improve their conceptual understanding. Therefore, the student is able to make a conceptual change and progress from novice to expert. As a physiology instructor, I am astonished when I learn that despite using the best instructional strategies, students do not grasp the concepts covered in class. Some of the top students give the correct answers with correctly memorized words, but when asked for more information, these students reveal their failure to fully understand the underlying concepts. Crouch and Mazur (2001) described students who had high algorithmic ability but had trouble answering parallel conceptual questions. Therefore, the learner has to recognize a feature they had not realized before, either instinctively or by having it pointed out during instruction. It is important for the learner to notice the differences, but they also must be able to accurately remodel their framework. With appropriate instruction the learner’s new framework will more closely match a physiology expert’s framework. The learning goals of the work-shop are: 1.) Descriptions of the types of misconceptions with examples types of some common homeostatic misconceptions. 2.) Methods to identify misconceptions. 3.) Methods to break down misconceptions. 4.) The approach students take to confront and overcome their misconceptions. 5.) The role of misconceptions in the learning process. (Supported by NSF grant DUE-1043443). References: Crouch, C.H. & Eric Mazur, E. (2001) Peer instruction: ten years of experience and results. Am. J. Phys.69 (9) pg. 970-977. National Research Council (NRC) (1999) How people learn: brain, mind, experience, and school, expanded edition. Bransford J.D., Brown A.L., Cocking R.R., editors. National Academies Press; Washington, DC. William, D. (1994). Reconceptualising validity, dependability and reliability for national curriculum assessment. pg.11-34. In D. Hutchison & I. Schagen (eds.), How reliable is national curriculum assessment? Slough, UK: National Foundation for Education Research.
physiology of Disease” (also 3.5). Physiology and Pathophysiology rank in the top 3 disciplines, and are valued because of their relationship to clinical study. Moreover, these rankings have remained constant for the past 4 years. In contrast, these same students rated “Basic science coursework had sufficient illustrations of clinical relevance” as 3.9 of 5.0, and “Required clinical experiences integrated basic science content” as 4.0 of 5.0. These are two areas that physiology instructors must address in order to further strengthen physiology instruction in the medical curriculum. Physiology as a discipline is strengthened when we incorporate select clinical applications to illustrate physiological control mechanisms. In addition, physiology instructors must better collaborate with our clinical colleagues to strengthen the mechanistic emphasis on disease processes in the clinical years.

29:0  PLENARY LECTURE VIb*

29.1  THE PIPELINE OF PHYSIOLOGY COURSES IN COMMUNITY COLLEGES

Jenny McFarland1, and Pamela Pape-Lindstrom2


Community colleges are significant in the landscape of undergraduate STEM education (NRC 2012) and are particularly important for biology and pre-professional students. A third of medical school applicants in 2012 had attended a community college (CC): while in high school, in their first 2 years of college and post-baccalaureate. The CC pathway is particularly important for the education and service of traditionally under-represented groups. Pre-medical students who first attend CC are more likely to practice in underserved communities as physicians. (AACC 2012)

There is great diversity amongst CCs. Some 2-year colleges focus on technical degrees, certificates and job training, but the role of CCs has changed over the decades and now emphasizes associates degrees and transfer programs to 4-year institutions. CCs have significant advantages over 4-universities for many students. Pragmatically, they are more affordable, local and offer flexibility to accommodate students’ work and family commitments. Academically, community colleges offer teaching faculty, smaller class sizes and accessible learning support systems. CC student populations are more diverse that their 4-year counterparts. So CCs are fertile ground for 4-year colleges and medical schools to recruit students and lend support. Challenges do exist for CC students (Labov 2012). There are often limited interactions between 2 and 4-years institutions and the ease and types of implementation of articulation agreements vary. There is a need for additional mechanisms to broaden participation of CC students in research, internships, volunteer opportunities and mentoring. Many existing mechanisms do not understand the constraints that limit CC-students’ access to opportunities, including place-bound and financial constraints, language, age and culture. With the growing demand for health care professionals and there is an increased demand for introductory biology, physiology, and anatomy & physiology (A&P) courses. In this talk we will focus on the introductory biology series and A&P courses for life science majors and pre-professional students at CCs. References: NRC & NAE. (2012) Community Colleges in the Evolving STEM Education Landscape. NAP. Labov, J.B. (2012). Changing and Evolving Relationships between two-and four-year colleges and universities. CBE LSE 11:121-128. AACC (2012). http://www.aacc.nche.edu/Publications/datapoints/Document/MedicalPipeline.pdf

30:0  WORKSHOP IV*

30.1  PHYSIOLOGY MAJORS INTEREST GROUP

Erica Wehrwein1


There has been a recent growth and evolution of physiology as a stand-alone undergraduate major (not just departments that offer a course on physiology). While this major has existed in a few isolated cases with great success (e.g., University of Arizona and Michigan State University), the last decade has seen the conversion of several programs from Kinesiology to Physiology, Human Physiology, Integrative Physiology, etc. These programs are typically seeing 3 to 5-fold increases in enrollment over the last five years, and are becoming the primary pathways for many students heading into medicine, physical therapy, and other allied health professions. From an APS perspective, if we want a strong pipeline of future researchers, teachers, faculty, this may be the best place to foster development. Most of these B.S. programs function in isolation and are being created without a broader conversation, each is inventing its own wheel, based on local faculty interests and visions. The symposium will explore: 1) State of Undergraduate Programs in Physiology, 2) National Trends in Undergraduate Physiology Curriculum, 3) NSF funding of Physiology BS programmatic assessment, 4) Professional Skills Development for physiology undergraduates, 5) Career Trends for BS Physiology Students. The goal of this interactive session is to start a national conversation, share ideas among peer programs, and form an interest group. The target audience is members of APS who are currently involved in these programs or may be interested in developing them.
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31:0 WORKSHOP V*

31.1 FACILITATING SMALL GROUP DISCUSSION (BASIC)
Sydella Blatch1, and Carol Schmidhauser1
1Dept. of Biological Sci., Stevenson Univ., 1525 Greenspring Valley Rd., Stevenson, MD, 21153.
Discussion is a powerful tool for active learning. It allows the participants to probe their understanding and misconceptions and to synthesize new ideas while acknowledging and valuing the contributions of others. The key to facilitating small group discussions involves the use of different perspectives and different techniques to create an inclusive environment. In addition, it is important to consider the characteristics of effective discussions and conditions that promote small group interaction and engagement. In this workshop, we will discuss parameters to consider when deciding which types of activities lend themselves well to small group discussions, determining the structure and composition of small groups, strategies for fueling group discussions, and how to assess group work. By working in small groups, by the end of this workshop participants will have created an action plan for using group activities in a course or setting of their choosing.

32:0 WORKSHOP VI*

32.1 FACILITATING SMALL GROUP DISCUSSION: ADVANCED
Betsy Jones1
Our current post-lecture landscape for millennial learners in higher education challenges us to deliver teaching content that is interactive and that engages students in developing skills they will need as scientists and clinicians—among them teamwork, problem solving, and preparing to be lifelong learners. Developing, implementing and facilitating small group activities is an important means for teachers to allow their students to participate in active—rather than passive—learning that is collaborative and self-directed. This workshop will outline characteristics of effective small group learning activities and discuss means to reshape traditional lecture content to take advantage of small group settings. It will address techniques for writing learning objectives, developing materials, and training faculty to participate and facilitate learners’ engagement. Employing those same techniques, participants will have the opportunity to work together to brainstorm, outline, and share small group session ideas. References: Gavriel J. Teaching tips for small-group facilitation. Education For Primary Care: 2015;26(2), 102-104. Kilgour J.M., Grundy L., Monrouxe L.V. A Rapid Review of the Factors Affecting Healthcare Students’ Satisfaction with Small-Group, Active Learning Methods, Teaching and Learning in Medicine, 2016;28:1, 15-25.

33:0 BEST PRACTICES IN UNDERGRADUATE PHYSIOLOGY

33.1 ORIGINAL COURSE-BASED UNDERGRADUATE RESEARCH EXPERIENCE TO DETECT PARASITIC WORMS IN LOCAL PARKS IN TWO UNDERGRADUATE COURSES
Carol Schmidhauser1, and Sydella Blatch1
1Biological Sci., Stevenson Univ., 1525 Greenspring Valley Rd., Stevenson, MD, 21153.
Traditional “cookbook” labs are a missed opportunity for students to participate in novel research and may not strongly reinforce skills needed for or interest in laboratory research. Studies have shown that course-based undergraduate research experiences (CUREs), where students conduct original research as part of a traditional course, can increase student persistence in science and understanding of the scientific process. Many course-based research projects either focus on experimental questions to which the answers are already known, or rely on methods that the instructor has already successfully applied to very similar experimental questions. This course-based research experience differed in that experimental outcomes were not known in advance, and the instructors had little experience with significant portions of the methods used. Thus, students were almost entirely responsible for researching and developing the methods they needed to try. The students were given only their experimental aim and a brief overview of the methods that could be used. The overall aim of the experiment was to identify the presence of Toxocara spp. and Toxoplasma gondii worms in the Baltimore MD area. Parasitology students were tasked with collecting soil samples from a number of local parks, and isolating and identifying the parasite eggs from soil samples using flotation methods. Animal Physiology students were tasked with detecting parasite genes in DNA isolated from soil using PCR. It was the responsibility of the students to locate relevant primary literature, use the literature to propose specific methods, develop experimental controls, determine the materials and equipment needed, perform the methods, analyze the outcomes, and return to the literature to refine unsuccessful methods. Surveys of the students show that their perceptions and thoughts about the experi-
ence were diverse. However, a majority of students felt the experience was frustrating, but improved their research ability, ability to analyze data, understand primary literature and work independently. We provide considerations for the implementation of such experiences. Future studies will examine effects of the experience on specific, measured outcomes of laboratory and quantitative skills, and attitudes towards science. Use of this kind of laboratory research question could easily be adapted to a CURE in biology courses of many types, as the presence of any kind of organism can be detected from a host of environmental samples.

33.2 EFFECT OF COLLABORATIVE EXAMS ON RETENTION IN AN UPPER DIVISION PHYSIOLOGY CLASS
James Cooke¹
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In an attempt to help our upper division physiology students increase their retention of key course concepts, we have been using two-stage group exams. During these exams, students write their exams, submit them, and then get into groups to re-write all/some of the original exam. The idea is that the feedback they receive from peers help clarify any difficult concepts and improve retention of course material (Gilley and Clarkson, 2014). Similar attempts have been made to use collaborative exams in physiology classes (Cortright et al., 2003), but these studies had methodological problems controlling for the ‘testing effect’ (Roediger and Karpicke, 2006), in which multiple exposures to material in a test setting increases retention. The model employed by Gilley and Clarkson (2014) used a pseudo-randomized cross-over design in which each student re-writes a question from the exam individually and in a group setting, and they found that collaborative exams increased retention of course material 3 days after the exam itself. Using their cross-over design to control for the test effect, we wondered whether we would see an increase in retention of material in our physiology class at longer time points (3 and 6 weeks), using open-ended questions instead of multiple choice questions used by Gilley and Clarkson (2014). We followed our initial design with a modification that allowed students to re-write answers to questions individually after discussing the question in a group. We will discuss the results of our study and the implications for whether collaborative exams might be a useful tool to increase retention of key physiology concepts.

33.3 AN INTERRUPTED CASE STUDY APPROACH FOR A DIABETES LAB EXERCISE
Nancy Aguilar-Roca¹
¹Ecology & Evolutionary Biology, Univ. of California, Irvine, 321 Steinhaus Hall, MC 2525, Irvine, CA, 92697

Students are interested in understanding Type 2 Diabetes, but it can be difficult to set-up a relevant teaching lab activity because of safety issues related to using human urine and blood. Rats can be problematic because of the expense, IACUC protocols and the technical difficulties of working with live animals. The approach I used was to substitute a traditional wet lab activity with a dry lab using stuffed animals as part of an interrupted case study. Students were given a population of “rats” and their goal was to determine which rats had diabetes, which rats had diabetes but had been part of an exercise study, which rats had uncontrolled diabetes and which rats were non-diabetic controls. Students were given simulated data in stages, starting with basic information about the rats such as diet, eating/drinking habits and urine output. They had to weigh the rats to receive information about weight gain/loss. Students then made predictions about which rat was which and researched what clinical tests would be the most useful. I created simulated urine strips (Multistix 10) and metabolic panel data for students to read and decide if they should revise their predictions. After students had identified which rats were controls or diabetic, they had to look more carefully at the diabetic rats that appeared to be part of an exercise study. They were told that half of the rats were in a high intensity interval training (HIIT) study and half were from an aerobic exercise study. Students develop hypotheses about which group would be more insulin sensitive, select relevant cellular markers (e.g. protein or mRNA expression), and decide what data they wanted to collect to test their hypotheses. The final set of simulated data was from a VO2-max test, a hyperinsulinemic euglycemic clamp, and assays for GLUT4 and PGC-1alpha. The data may or may not have supported their hypotheses, leading to discussions about lab protocols and cellular mechanisms of diabetes. Overall, students felt that although the stuffed animals were silly, they appreciated having something physical and found it challenging to think critically about all of the test results. This approach could be modified for use in a classroom.

33.4 USE OF ANIMAL GASTROINTESTINAL TRACTS IN UNDERGRADUATE PHYSIOLOGY COURSES
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Non-preserved animal gastrointestinal (GI) tracts are a cost-effective sustainable resource around which low-preparation, student-satisfying, active learning laboratory exercises can be built for undergraduate physiology courses. Porcid
GI tracts, which are virtually available for free all over the US, are best suited for teaching human digestive anatomy and physiology. Tracts from small ruminants (deer, sheep, goats) can be easily obtained, usually at no cost, and used to emphasize the GI adaptations of herbivorous animals. Use of animal organs (offal) is a sustainable and inexpensive way of introducing active learning into the undergraduate physiology classroom. Animal tracts are routinely used as teaching tools in animal science courses, both at the undergraduate and high school level. Slight modifications in the methodology related to their preparation and use can allow for their introduction into non-agricultural programs, also. I will discuss the methodology involved in obtaining, transporting, and processing the GI tracts, as well as some of the safety mechanisms that need to be in place in order to avoid student or instructor exposure to zoonotic diseases. Additionally, I will detail several learning objectives that can be associated with this exercise, which should include, but are not limited to, anatomical and histological identifications, observation of luminal contents throughout the different parts of the tract, and comparing and contrasting the anatomy of omnivore and ruminant tracts if both are available. Some major anatomical differences that should be emphasized include the size of the cecum in the pig compared to the human and the chambers of the stomach in ruminants compared to omnivores, both of which can be used to introduce or expand the discussion of the role of symbiotic microbes in forage digestion. Additionally, the lack of a gallbladder in herbivores, if a tract is available, can lead to a discussion of the function of bile in lipid digestion. Longitudinal data on student satisfaction will be presented, and plans for improvement of this laboratory exercise based on the collected data will follow. I will conclude with a discussion on the use of abattoir offal as teaching tools for other physiological systems (reproductive, respiratory, excretory, and cardiovascular).

33.5 PHYS-MAPS: AN ASSESSMENT TOOL TO MEASURE STUDENT LEARNING IN UNDERGRADUATE PHYSIOLOGY PROGRAMS

Katharine Semsar1, Michelle Smith2, Sara Brownell3, Brian Couch4, Alison Crowe5, Scott Freeman5, Mindi Summers2, Christian Wright1, and Jennifer Knight1

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Setting educational goals and assessing student learning of those goals are fundamental steps to improving both teaching and learning. The recent Vision and Change report provides faculty and institutions with a set of core concepts and competencies in biology to use as a guide to assess students’ understanding as they progress through an undergraduate biology curriculum. To meet this assessment goal, we have established an NSF-funded, multi-institution collaboration to develop a suite of assessment tools (Biology Measuring Achievement and Progression in Science: Bio-MAPS) that will measure student learning across a curriculum. By using these tools to measure students’ conceptual understanding at multiple points throughout a program, data will be available to faculty, department chairs, and deans to help understand and gauge student learning, and could also be provided to accreditation agencies as evidence of programmatic success. Here we present the development of one of the Bio-MAPS assessments, the Physiology-MAPS (Phys-MAPS). The Phys-MAPS is designed to address two frameworks of key concepts in physiology: 1) the BioCore Guide, which elaborates on the Vision and Change core concepts, and 2) the top seven Core Principles of Physiology outlined by Michael and McFarland. We iteratively developed questions using faculty feedback (n>32 faculty) and student interviews (n>79 students) to help collect evidence of face and content validity. We conducted a national pilot in Fall 2015, collecting data from 14 undergraduate institutions, 21 courses, and over 2600 students ranging from sophomores to seniors. Using a 3PL item response model, we eliminated poorly discriminating items, and refined others using additional student interviews. The final assessment includes 13 question stems, each with 6 associated statements (78 total items); students select each statement as likely/unlikely to be true. Student performance on the pilot demonstrated that the Phys-MAPS discriminates well, with the top quarter of students scoring an average of 75% correct and the lower quarter of students scoring 49% correct. The assessment also includes items with a range of difficulties in each of the concept categories, allowing the Phys-MAPS to reflect both easier and more difficult sub-concepts within the larger concept categories. Together these data suggest the assessment will be useful for tracking student progress through a physiology program. We are piloting the revised Phys-MAPS nationally in April 2016 and will present these results.

33.6 REVISITING THE PHYSIOLOGICAL COST OF NEGATIVE WORK: A TEAM-BASED ACTIVITY FOR UNDERGRADUATE EXERCISE PHYSIOLOGY STUDENTS

Steven Elmer1, and Matthew Kilgas1

1MCDB, Univ. of Colorado, Boulder, UCB 347, Boulder, CO, 80309-0347.
We implemented a team-based activity in our undergraduate exercise physiology laboratory that was inspired from Abbott’s classic *Journal of Physiology* (1952) paper titled “Physiological Cost of Negative Work”. These investigators connected two bicycles via one chain. One person cycled forward (active muscle shortening, positive work) while the other resisted the reverse moving pedals (active muscle lengthening, negative work) and the cost of positive and negative work was compared. This study was the first to link human whole-body energetics with isolated muscle force-velocity characteristics. Our students (n = 35) were asked to not only review this paper but re-enact the original experiment. The goals of the activity were to: 1) integrate previously learned concepts and techniques into a comprehensive end of the semester experiment, 2) preserve the history of Abbott’s work, and 3) connect negative work to sport training and rehabilitation. For each laboratory section, students (~12/section) split into two teams (positive work vs. negative work). One student from each team volunteered to cycle against the other for 10 min. Remaining students in each team were tasked with collecting: 1) oxygen consumption, 2) blood lactate, 3) quadriceps muscle activity, and 4) perceptual responses. Students discovered that oxygen consumption during negative work was ~1/2 that of positive work and quadriceps muscle activity was also substantially lower. Majority of students (75%) strongly agreed that they stayed engaged during the activity and that it improved their understanding of exercise physiology. All students recommended that this activity be performed again. This laboratory activity was highly engaging, emphasized teamwork, yielded robust results with a good signal to noise ratio, was well received by students, and highlighted classic physiology work.

### 33.7

**TEACHING UNDERGRADUATE ONLINE SCIENCE COURSES WITH LABORATORY COMPONENTS**

Joan Lafuze

I am a systems medical physiologist who has taught undergraduate physiology for 29 years. I attended summer workshops three consecutive summers at Indiana University Bloomington that were held jointly by the Department of Education and the Department of Information Technology to learn how to develop and present courses employing “Distance Education Strategies” (interactive video, hybrid and all online classes). Twenty years ago I launched my first all online class. A decade ago I was challenged by the then Vice-Chancellor of Academic Affairs to design an all online physiology course including laboratory components. Teaching that course has been very rewarding. In this workshop I plan to present what I believe to be critical elements in developing such a course. I will also address how I have advanced in helping learners achieve success, discovering advantages and disadvantages of using such strategies and meeting resistance both from learners and many others related to teaching laboratory science courses online.

### 33.8

**TECHNOLOGY AND PUBLISHERS’ MATERIALS IN TEACHING PHYSIOLOGY TO UNDERGRADUATE LEARNERS**

Joan Lafuze

In this workshop I am hoping to become part of a community of persons who are in conversation about active learning strategies. I have been part of such conversations by participating in Indiana University Workshops, The Institute for Emerging Leadership in Online Learning (IELOL) and Quality Matters. Finding such communities where the conversation has addressed such strategies with undergraduate learners in physiology has been difficult. When it appeared as a topic for this workshop, I made a special effort to attend. I propose to bring my efforts to integrate technology with existing publishers’ materials to address coordinating learning outcomes with text information, using clickers to assess learner progress and to manage employing available voice-over strategies for creating “flipped classroom-like” endeavors. I will share my experiences with choosing technologies, published instructor resources and course delivery. I am also interested in sharing conversations about using active learning strategies to improve student retention and student success in moving from the classes I teach to their future needs for what they are expected to learn in an introductory physiology class.

### 33.9

**A GRADING SCHEME TO INSPIRE HOPE AND FOSTER GRIT IN A LARGE UNDERGRADUATE PHYSIOLOGY COURSE**

Kevin Strang

I am a systems medical physiologist who has taught undergraduate physiology for 29 years. I attended summer workshops three consecutive summers at Indiana University Bloomington that were held jointly by the Department of Education and the Department of Information Technology to learn how to develop and present courses employing “Distance Education Strategies” (interactive video, hybrid and all online classes). Twenty years ago I launched my first all online class. A decade ago I was challenged by the then Vice-Chancellor of Academic Affairs to design an all online physiology course including laboratory components. Teaching that course has been very rewarding. In this workshop I plan to present what I believe to be critical elements in developing such a course. I will also address how I have advanced in helping learners achieve success, discovering advantages and disadvantages of using such strategies and meeting resistance both from learners and many others related to teaching laboratory science courses online.
of college success. The present work represents a multi-year effort to optimize the grading scheme in a large undergraduate physiology class to inspire hope and foster grit among students. Methods employed have included the development of a mathematical method for rewarding improvement in an objective way, using discovery-based presentation to explain the grading scheme, and educating learners about "Fixed" and "Growth" mindsets. Preliminary results suggest that while these efforts have not had a major impact on grades of the class as a whole, individual students who might otherwise have lost hope and given up have benefited significantly. This presentation will address the role of hope, grit, and mindset in student success, and report the results of this grading scheme as it has evolved over the past 4 years.

33.10
INVESTIGATING THE EFFECT OF QUESTION ORDER ON STUDENT UNDERSTANDING OF STRUCTURE AND FUNCTION
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Written assessments provide insight into student understanding by allowing students to assemble their ideas. Surface features, such as the order in which questions are presented, may influence student explanations by acting as a knowledge retrieval cue. Yet, it is critical that physiology students have a robust understanding of concepts like structure and function that they can consistently apply regardless of context. We investigated how changing question order reveals students’ level of physiological understanding. We hypothesized that asking students to give examples provides a retrieval cue to help them formulate definitions. We collected data from 131 students in a junior level general physiology course at a large southeastern public university. The class was randomly split in half and each half received two short answer questions in different orders; 1) (Order DX) Define the principle of complementarity followed by Give an example of the principle of complementarity from the human body, and 2) (Order XD) Give an example of the principle of complementarity from the human body followed by Define the principle of complementarity. We coded student responses for the presence or absence of the concepts structure and function, and whether students linked structure and function in their responses with an interrater reliability of the human coding above 0.70 kappa. We then used text analysis to extract words and phrases relevant to structure and function from student responses. Human coding showed that when asked to define the principle of complementarity, only 2% of students with order DX and 17% of students with order XD were able to link structure and function. When asked to provide examples, students with order DX (41%) performed better than students with order XD (26%). Using text analysis we created 25 categories of words and phrases, and identified levels of organization of the structures within student responses. For both question orders, students used multiple levels of organization when providing examples. However, DX students gave more organ examples, while XD students gave more cellular component and tissue examples. Results from our study indicate that students struggle with linking structure and function regardless of question order. In future studies we will investigate how additional question features, such as cognitive level and guiding context, influence student responses and reveal their physiological understanding.

33.11
ASSESSING THE EFFECTIVENESS OF STUDENT LEARNING AND ENGAGEMENT IN A CONTENT HEAVY FLIPPED CLASS
Joost Monen1
1Theoretical & Applied Science, Biology, Ramapo Coll. of New Jersey, 505 Ramapo Valley Rd., Mahwah, NJ, 07430. Studies have shown that greater student learning gains are achieved during active learning, when students must apply their understanding solving problems, in application exercises, in discussion-based activities, and during team-based learning. Because these active learning approaches can take up valuable class time, leaving less time for content, it is often difficult to integrate them into a content heavy lecture course. Using a “flipped classroom” approach, student-centered learning activities can be routinely integrated into the classroom while not having to sacrifice content. To test the effectiveness of the flipped classroom approach, this study assesses a 300 level Genetics class by comparing outcomes of students in a flipped class to outcomes of students in a more traditional lecture class. To control for student population differences and to ensure that student populations between the classes were comparable, portions of the flipped class experimental group (flipped group) were taught utilizing approaches similar to those in the traditional groups [Units 1 & 3 (Control Units)], whereas other portions of the course were taught utilizing the flipped classroom approach [Unit 2 (Experimental Unit)]. Exam scores during the Control Units showed no statistical difference between traditional groups and the flipped group (Unit 1, p=0.266 & Unit 3, p=0.698); whereas the flipped group performed significantly better than the traditional groups during the Experimental Unit (Unit 2, p < 0.005). Additionally, student surveys indicated that students were more engaged in the class, came to class better prepared, dedicated more time working out problems, felt more confident with the material, better paced themselves, and overall preferred the
flipped class over the traditional class. This study suggests that flipping a content heavy course can improve student engagement and result in greater learning gains.

33.12 USING CONFLUENT CLASSROOM DESIGN TO TEACH UNDERGRADUATE ANATOMY AND PHYSIOLOGY
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In an effort to deliver an undergraduate curriculum that advances an outcome-driven, learner-centered, technology-enhanced pedagogy in the health sciences, we have developed a blended teaching model that provides best environment for all students to learn. To accomplish this, we have utilized multimodal classrooms that are based on recent pedagogical innovations including backward course design and active and semi-flipped classroom engagement to create a collaborative learning space that allows for a student-centered approach to learning. By combining these approaches with a variety of active-learning implementation strategies, we are able to facilitate an environment that is optimized for learning that can be utilized for educational research. This multimodal approach to learning, entitled the “confluent classroom” provides faculty with the opportunity to focus on specific institutional learning and developmental outcomes while able to modularize the curriculum at all levels of the curriculum. The confluent classroom strategy is implemented as of a flipped/student-driven punctuated lecture for introduction to a topic followed by reinforcement through practical application in a collaborative learning situation and finally exploration or further application in a hands-on laboratory experience. This prescribed approach to instruction allows for the “plug and play” of differing modules, or portions without much disruption of the entire curriculum of at the course level. The confluent classroom encourages classroom engagement by the student while encouraging group engagement while still maintaining individual accountability.

35:0 PLENARY VII
35.1 EDUCATIONAL LEADERSHIP: BENEFITS OF STEPPING OUTSIDE THE CLASSROOM
Thomas Pressley\textsuperscript{1}
\textsuperscript{1}Dept. of Med. Education, Texas Tech. Univ. Hlth. Sci. Ctr., 3601 4th St., Lubbock, TX, 79430.

Although most educators have their greatest impact in the classroom, the increasing need for diverse learning activities has created new opportunities for leadership. Moreover, many Tenure and Promotion Committees are finding that it is no longer sufficient to consider only lecture hours when evaluating a faculty member’s contributions to the teaching mission of a school. Accordingly, the career path for an educator in a college or professional school is evolving. A newly-recruited faculty member may start out with classroom responsibilities, but activities other than lecture such as flipped classrooms, online resources, and peer-to-peer teaching are quickly added to the mix. As faculty members gain experience, they often progress to positions of curriculum design or program review within an institution. Similarly, there is a need for administrators who have participated in a variety of learning activities, and schools frequently recruit for these positions from faculty with such exposure. Many senior faculty members leverage this expertise to regional or national levels by authoring textbooks and online materials or serving on advisory boards, review committees, and governance in professional societies and funding agencies. Excelling in these leadership opportunities can have a profound effect on the success of promotion and tenure applications, and they reward a skill set that extends beyond the teaching and organization needed in the classroom.

36:0 PLENARY VIII
36.1 IMPLEMENTING AND MANAGING CHANGE
Barbara Goodman\textsuperscript{1}
\textsuperscript{1}Div. of Basic Biomed. Sci., Univ. of South Dakota, 414 E. Clark St., Sanford Sch. of Med., Vermillion, SD, 57069.

This closing session will be a wrap-up discussion of the experiences of the week and a challenge for continuing as the Physiology Education Community of Practice. In addition to feedback on the 2016 Institute on Teaching and Learning, planning for future grant opportunities and the 2018 ITL will begin. An organizer and an organizing committee for the 2018 institute will be formed. Brainstorming will occur for topics to include and individuals to invite for the 2018 institute. Participants and facilitators for the 2016 ITL will be acknowledged and potential collaborations will be identified and encouraged. Activities to occur between 2016 and 2018 will be discussed.
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