“What Works”
Poster Abstracts

A. Curriculum or Program Development

1. Ellen M. Carpenter - University of California, Los Angeles
   Project Brainstorm: A Neuroscience Outreach Program at UCLA
   Project Brainstorm is an outreach course offered to undergraduate majors in neuroscience. The course offers opportunities to design and implement classroom lessons and hands-on teaching activities on neuroscience for K-12 students. To begin, UCLA students select a topic and develop and hone their presentations in front of their peers. Students incorporate materials including 3D models, schematic diagrams, and video clips into their presentations. After a dress rehearsal before faculty, staff, and graduate students, the UCLA students travel to classrooms in local K-12 schools in the Los Angeles area to present their lesson plans and to engage elementary, middle, and high school students in a variety of interactive neuroscience activities. Lesson plan objectives focus on providing K-12 students a framework in neuroscience, including brain structure, features of a neuron, and basic principles of synaptic communication. Each lesson plan is then customized to present a specific topic such as learning and memory, optical illusions, brain injury, the five senses, and circadian rhythms. At the end of the classroom presentation, K-12 students are divided into groups that rotate through a series of stations providing hands-on activities including brain structure, brain injury, and topic-specific activities such as memory challenges. Project Brainstorm helps undergraduates to develop their speaking skills and refines their ability to tailor complex neuroscience concepts to a naïve audience. In turn, classroom visits provide exposure to neuroscience in the local community.

2. Samantha Gizerian and Elizabeth Carney - Washington State University
   Using Focus Groups in Program Assessment and Development
   “Closing the loop” of program assessment involves creating solutions to concerns identified through the assessment process. One drawback of this process is that solutions are typically developed by the same people responsible for the identified issues in the first place: faculty. Biases created by the faculty’s experience and their perceived ownership of both curriculum and instruction can act as “blind spots” obscuring effective and rapid course correction. To address this, we have incorporated student focus groups facilitated by a neutral party in addition to more traditional assessments (grades, exam questions, course evaluations) as a tool to identify gaps and concerns in the Neuroscience program at WSU. Senior students enrolled in the Neuroscience Capstone course are asked to participate voluntarily in a focus group during final exam week. Participants fill out questionnaires as well as responding to questions in large and small groups. To date, this process has identified two distinct gaps in the curriculum, perceived by the students but unrecognized by faculty: no formal introduction to scientific literature in the lower division courses and a dearth of information on experimental techniques presented across the curriculum. Without student input these gaps would remain unaddressed and our curriculum would be less effective.

Baldwin Wallace University – The Society for Neuroscience Undergraduate Program of the Year 2012 BWU’s Neuroscience major is research-intensive, and all students are required to produce an empirically-based senior thesis which challenges program resources especially faculty time. An intentional 3-step peer mentoring system that encourages students to collaborate and learn from each other. Peer mentoring and the curriculum: In our courses, students may work in small teams to review the relevant literature and then design, conduct, and report their own empirical studies. Peer mentoring is provided by more-senior students who have completed these courses and serve as lab assistants. Students are also paired with senior neuroscience majors who have developed particular lab skills and may be called upon to act as supplementary mentors. Peer mentoring and work in faculty labs: Within a highly structured tiered training system, more-experienced students, who have worked in a faculty laboratory and met strict competency criteria serve as coaches and supervisors of new students. Peer mentoring and Senior Theses: Neuroscience students working on their senior theses are paired with more-junior neuroscience majors. The students performing their thesis research benefit from having an extra set of hands and the mentored younger students learn new lab skills – techniques that will be used later as they perform their own thesis research.

4. Allison Batties, Rebecca Borden, and Mary E. Morrison - Lycoming College

Brains Are Us! Learning by teaching: Neuroscience education in elementary schools with undergraduates as activity leaders

Undergraduate Neurobiology students designed classroom activities for 6th-8th graders, based on the Society for Neuroscience pamphlet “Neuroscience Core Concepts: The essential principles of neuroscience.” We worked with the same 21 middle school students 6 times over 6 weeks. We built and reinforced their neuroscience knowledge through hands-on activities. These included Jello Brain (an edible lesson in basic brain anatomy), Protecting Your Brain (the ever-popular egg-drop activity), Optical Illusions, How do we see? (including cow eye dissection), Making sense of your senses (including split-brain patient simulations and sensory deprivation with bubble wrap), and Build-A-Brain (comparative brain anatomy to inspire sculpting brains of imaginary organisms with enhanced brain processing powers). At the end of the 6-week period, the students were able to answer most of the questions posed above, in addition to MANY more questions of their own, and a fun time was had by all. This outreach activity demonstrates that the best way to know whether you’ve mastered a concept is to explain it to others simply. It also shows that engaging undergraduate students in public outreach activities is a powerful way to harness their excitement about all we’ve learned in neuroscience, and to pass it on to the next generation.

5. Ilsun M. White and Wesley White - Morehead State University

Multidisciplinary Neuroscience Degree Program with Existing Resources

The undergraduate neuroscience program (B.S.) at Morehead State will commence in fall 2014. This interdisciplinary program is the first of its kind at a public institution in the state of Kentucky. Features of the program made it acceptable in a challenging resource environment. The core consists of introductory (freshmen year) and advanced (senior year) survey courses and three courses focused on the brain and drug use, gender, and aging. Neuroscience electives must be taken in each of three areas including: Behavioral, Social and Health sciences; Biological and Chemical
B. Teaching Innovation

6. Stephanie Albin - HHMI Janelia Research Campus
   Post-doc in the classroom: Teaching neuroscience to High School Seniors
   There is growing public interest in understanding how the brain functions, yet secondary school curricula rarely cover neuroscience in depth. The newly revised AP Biology curriculum devotes specific learning objectives to neuroscience and mandates that hands-on lab work constitute 25% of instructional time, yet its associated lab manual has no lab with a neuroscience focus. With the recent development of a low-cost, commercially available device that can detect neuronal activity in large invertebrates (SpikerBox from Backyard Brains), conducting experiments that focus on fundamental neuroscience concepts is now feasible in the classroom. Importantly, incorporating such experiments into the lab curriculum can be greatly facilitated by working with postdoctoral neuroscientists. This collaboration benefits both the postdoc, who gains valuable experience in teaching and science outreach, and the school, whose students’ interactions with a professional neuroscientist may enhance their interest in science curricula and provides information on pursuing a career in science. This poster will present my experiences as a post-doc who developed and taught an AP Biology neuroscience unit in the Loudon Country Public School’s Academy of Science program. The unit included an inquiry-based lab using the SpikerBox and both earthworm giant fiber and cockroach leg preparations.

7. Sara Bagely - Loras College
   Exploring the Brain Through TBI: A Novel Special Topics Neuroscience Course
   A novel special topics neuroscience course focused on Traumatic Brain Injuries (TBI) was taught in Fall 2013 at Loras College. This course brought a human element into the classroom by using case studies, survivors, and guest professionals in the field. The class met twice a week for 80 minutes each. Student performance was assessed through exams, a service learning experience, case presentations, class discussions, connection/reflection papers, and a ‘living with TBI’ presentation. Not only were written and oral communication skills enhanced, but knowledge of brain structures and function was solidified. Students experienced a richness in connecting brain function to the human experience. This is a model course that should be added to any neuroscience curriculum.

8. Lora A. Becker - University of Evansville
   A successful comprehensive final exam
   We can test students for retention on neuropsychological information, but do they really retain the material after the test? I developed a final exam for a junior level Neuropsychology course that
results in many students contacting me years after the fact declaring their amazement about how much of the material they retained. This effect is achieved by asking the students to use critical thinking skills, analysis of the material, and to apply the material to a current human condition or medical situation. The test consists of seven to eight essay questions that combine concepts from several systems and processes from the semester. The students are challenged to answer the questions on their own and memorize the answers. Guidance is provided to students up to two days before the exam. Students attend the final exam session and write out the answers to the questions. They walk away with seven to eight ‘stories’ about the semester that stay in their memory. As information in our field changes at a rapid pace, it is important for students to have the essential components locked in their memory so they can add to and understand changes to that material.

9. Brad Carter – Whitehead Institute

Quality lab notebook records are an important aspect of scientific progress, both for individual efficiency and particularly in projects involving multiple researchers/undergraduates over time. Learning good lab notebook skills is thus an early priority for new students in a research lab; however, many of the benefits of good record keeping are not immediately obvious and are more likely to be apparent at a later time. To simulate that later utility, I have found using scavenger hunt exercises for information from current and past lab notebooks to be a useful method for giving students this perspective. These exercises can be designed to emphasize specific elements of importance to individual labs and include 1) self-assessment of one’s own lab notebook, 2) peer assessment of a partner student’s lab notebook, and/or 3) assessment of past student notebooks. Follow-up individual and/or group discussions are also important to engage students in identifying and creating best practices together for future lab notebook records.

10. Christian G. Fink - Ohio Wesleyan University

An Introductory Course in Modeling Neural Systems and Analyzing Neural Data

An introductory computational neuroscience course intended for students with relatively little background in mathematics (the course does not involve calculus) and no previous computer programming experience is offered at Ohio Wesleyan University. Students learn to program in MATLAB and apply this skill to simulate various neural circuits, including those that underlie the vestibulo-ocular reflex, visual edge detection, central pattern generation, and auto-associative memory formation. These exercises are taken from the textbook Tutorial in Neural Systems Modeling, by Thomas Anastasio. Students also participate in weekly lab exercises in which they apply fundamental analysis techniques to real-world neural data. Students write code to extract firing rate information from the raw voltage signal recorded from the cockroach tactile spine neuron, they construct tuning curves for neurons in the primary motor cortex of the macaque monkey, they apply time-frequency analysis to characterize epileptic seizures in a mouse model, and they start from raw data files to generate a movie of calcium fluorescence in a neuronal culture. This course demonstrates that students with no previous background in computer programming can gain considerable facility with computational methods in just one semester.
11. Alexia Pollack - University of Massachusetts-Boston
Bringing the person/personal to the teaching of the neurobiology of addiction
When I first developed my Addiction course at UMass-Boston, it focused exclusively on the acute and long-term effects of psychoactive substances on the brain. After teaching the course one time, I realized that a strictly biological view failed to capture the effects of addiction on the whole person. Students had no insights into an addict’s thoughts, behaviors and relationships. To remedy this, I have students read two non-fiction memoirs, one by a teen addict: “Tweak” by Nic Sheff, the other by his father: “Beautiful Boy” by David Sheff. Reflecting on and writing about these texts allowed students to see the impact of addiction on individuals. In written assignments, students related these texts to the effects of drugs on brain and behavior, and examined the role of bystanders (family/friends/society) on drug use and recovery. Inspired by the diary structure of “Tweak”, students monitored and described their daily behavior patterns and rituals, and then contemplated the impact of removing them from their daily routines – like the addict after rehabilitation. These texts and assignments engaged students with fascinating personal accounts and asked them to apply their scientific knowledge in novel ways, creating a more comprehensive picture of addiction beyond simply describing its underlying neurobiology.

12. Jennifer Round - Ursinus College
Figure Facts: Encouraging Undergraduate to Take a Data-Centered Approach to Reaching Primary Literature
The ability to interpret experimental data is essential to understanding and participating in scientific discovery. Reading primary research articles can be a frustrating experience for undergraduates because they have very little experience interpreting data. To enhance these skills, students used a template called “Figure Facts” to assist them with primary literature-based reading assignments in a cellular neuroscience course. Figure Facts encourages students to adopt a data-centric approach, rather than a text-based approach, to understand research articles. Specifically, Figure Facts requires students to focus on the data presented in each figure and identify conclusions that may be drawn from the results. Students who used Figure Facts for one semester spent a greater percentage of time examining figures in a primary research article, and regular exposure to primary literature was associated with improved student performance on a data interpretation skills test. Students reported decreased frustration associated with interpreting figures, and their opinions of the Figure Facts template were overwhelmingly positive. Here, we present Figure Facts for others to adopt and adapt, with reflection on its implementation and effectiveness to improve undergraduate science education.

13. Amy Jo Stavenezer and Jennifer Yates - College of Wooster, Ohio Wesleyan University
A Summer Seminar Series with 5 Regional Neuroscience Programs
We received funding from the Great Lakes Colleges Association (GLCA) Expanding Collaboration Initiative, funded by the Andrew W. Mellon Foundation, for a summer visit series among five regional Neuroscience programs. The aim was to provide significant and meaningful opportunities for conversation, collaboration, and education for GLCA Neuroscience faculty at the College of Wooster, Kenyon College, Earlham College, Ohio Wesleyan University, and Oberlin College. Participating faculty and their summer research students met five times, once at each institution. Faculty served as resident experts, teaching their specific research techniques to all other members
of the group. By harnessing the breadth of research expertise within our consortium, we deepened the knowledge and hands-on experience of all faculty on several techniques. Not only will this enrich classroom and laboratory instruction, but knowing the research projects and techniques that are used in close proximity will allow for future research collaborations. Summer research students also benefited in meaningful ways with opportunities for professional development related to career planning, writing personal statements for graduate or professional school applications and public presentation of scientific plans and results, and learned all of the techniques as well. Pre-post assessment demonstrated meaningful gains in confidence with and knowledge of the highlighted methodologies and several future-oriented collaborative relationships were formed.

14. Patrick Sonner - *Wright State University*
The Box: an interactive tool for students to experimentally determine anatomical and functional connectivity of a network
I recently attended a workshop provided by the College of Science and Mathematics at Wright State University. The goal was to inspire different ways of teaching and preparing instructors to design engaging lessons for students. An approach presented and employed for preparing such a lesson was that of backward design. I began by determining the desired learning objectives for students to obtain from the lesson, followed by developing assessments that will be utilized to determine whether students have achieved an understanding of the learning objectives. Lastly, I designed the activities that will be employed to convey the information comprising the learning objectives. During the process of developing the lesson peer feedback and discussions were ongoing, aiding in the refinement of the lesson. The lesson developed focuses on the Basal Ganglia, and for the activity students are given an interactive box that has been wired to indicate connectivity between Basal Ganglia nuclei, via a scheme of colored lights, such that students will be able to discern which nuclei are connected and if the connection is excitatory or inhibitory. With this assignment, students are able to experimentally determine the anatomical and functional connectivity for the Basal Ganglia circuitry.

C. **Laboratory Exercises**

15. Joseph Burdo - *Boston College*
Project PNEURAL: Simulating neurophysiology using physical computing
Neurons use their dendrites and axons as miniature decision engines. Dendrites produce excitatory and inhibitory potential changes from pre-synaptic cell input, and axons collect that voltage information. If the voltage in the axon rises above threshold, the cell will fire an action potential and pass information to the postsynaptic cell. This type of basic neural information processing, while critical, is not necessarily easy for students to understand. Project PNEURAL involves the construction of model neurons using common household or laboratory items such as PVC piping, vacuum pumps and electrical wires in conjunction with Arduino microcontrollers. This system allowed me to produce a PNEURON that uses positive and negative air pressure (pneumatics) to simulate the electrical signals that are processed within neural networks. This PNEURON can be used by the instructor to demonstrate electrophysiological concepts such as graded and action potentials, EPSPs and IPSPs, temporal and spatial summation, and time and length constants.
However, I believe that student construction and coding of PNEURONS can be a powerful learning tool, bringing together numerous interdisciplinary concepts into a unique end product that gives students a deep sense of project ownership and knowledge construction.

16. Irina Calin-Jageman and Robert Calin-Jageman - Dominican University
A student lab investigating the transcriptional correlates of long-term memory. We have developed an inquiry-based lab sequence in which students explore the transcriptional correlates of long-term memory. Students administer unilateral long-term sensitization training to Aplysia californica, harvest the CNS, extract and quantify RNA, and perform semi-quantitative PCR to probe learning-related changes in transcription. Students benefit from a strong positive control, the transcription factor C/EBP, which consistently exhibits a large increase in expression immediately after training. Each team can then select an additional gene for analysis, providing an opportunity to research candidate genes, formulate a novel research hypothesis, design primers, measure gene expression, and interpret their results. The lab sequence provides an opportunity for independent research at relatively low expense and with relatively high probability of success. We are currently working on adapting this lab for use with a cheaper model organism (earthworm).

17. Michael Ferragamo, and Janine Wotton - Gustavus Adolphus College
Learning the methods of behavioral neuroscience using a battery of behavioral tests to distinguish between two mouse strains.
Understanding the neural mechanisms underlying behavior depends on our ability to define and to measure these behaviors in the model animal. In this upper-level course we aim to provide students with hands-on experience with the methods of behavioral neuroscience. There are many well-established behavioral tests which are relatively easy for students to conduct that can be used to determine the performance of animals in such tasks as memory, anxiety and motor performance. Laboratory mice bred specifically to exhibit particular behavioral characteristics are readily available from vendors along with well documented behavioral profiles for these strains. We used two albino strains CD1 (outbred, n=13) and Balbc (inbred, n=13) from Charles River as our model animals. Students were given the task of identifying the strains based on the results of a battery of behavioral tests but were not given information about the mice. These two strains were chosen for their clear differences particularly in tests of anxiety. Students conducted elevated plus maze and zero maze tests, open field test, light-dark exploratory task, rotarod, balance beam test, T-maze or Y-maze single trial learning. The results of the tests enabled students to correctly identify the two mouse strains.

A persistent problem in neuroscience education is resource limitations in a field that often demands sophisticated instrumentation and analyses. Conventional wisdom holds that laboratory courses must be conducted in a brick-and-mortar environment and that digital laboratory experiences are pedagogically weak. Neither of these suppositions need be correct. We hit upon the solution of repurposing actual raw research data, modeling tools, and research web tools to create fully digital teaching modules that require only a computer. These modules are not canned and are not mere
simulations but rather provide genuine inquiry-based laboratory experiences. We have developed and field-tested five digital labs: (1) Swimmy, which includes electrophysiology and central pattern generators, (2) Bioinformatics, which includes QTL analysis, (3) Bird Song System, which addresses anatomical sex differences and effect of early estradiol on the bird song system, (4) RatSCIA, which examines sex differences and effects of anti-androgen on the development of rat spinal cord, and (5) Gel Scramble, which tackles molecular neuroscience and unexpected data. These labs are available without cost to end users at https://mdcune.psych.ucla.edu/. Sponsored by NSF Grant DUE 0717306.

19. Christopher R. Dunne and Elizabeth C. Marin - Bucknell University
Structured inquiry-based learning: Drosophila GAL4 enhancer trap characterization in an undergraduate laboratory course
We have developed a series of structured inquiry exercises for an upper level undergraduate laboratory methods course at Bucknell University. We use a set of Drosophila melanogaster GAL4 enhancer trap strains in two linked but separable exercises. In the first, students learn to perform inverse PCR to identify the genomic location of the GAL4 insertion, using FlyBase to identify flanking sequences and the primary literature to synthesize current knowledge regarding the nearest gene. In the second, we cross each GAL4 strain to a UAS-CD8-GFP reporter strain, and students perform whole mount CNS dissection, immunohistochemistry, confocal imaging, and analysis of developmental expression patterns. We have found these exercises to be very effective in teaching the uses and limitations of PCR and antibody-based techniques as well as critical reading of the primary literature and scientific writing. Students appreciate the opportunity to apply what they learn by generating novel data that could be of use to the wider research community. Enhancer trap strains can be chosen to align with the research area of a particular instructor. Finally, these lesson plans could be used by instructors at a wide range of institutions, with modifications possible in the case of more limited facilities.

20. David Nichols - Roanoke College
Simulations of Action Potentials and Memory Networks
The current set of laboratory exercises serve as an introduction to computational simulations and provide a well-controlled environment in which modifications to experimental parameters yield predictable results. Following along with the structure of the corresponding lecture class, the first two labs involved simulations of action potentials and the third lab involved simulations of larger scale interactions of a neural network. All labs utilized MATLAB. Simulations of Hodgkin and Huxley equations were used to explore individual action potential generation and timing between action potentials. Simulations of integrate and fire neurons were used to explore elements of the equations and the effect of single and combined EPSPs. Simulations of Hopfield memory networks were used to explore robustness of memory networks based on synaptic connections in the face of noise. A primary utility of computational simulations in a neuroscience laboratory course component is seen as the reliability and controllability of the outcome of the results which were much harder to achieve using action potential recording in invertebrates and electroencephalography in a classroom setting. Modifications will be made in the future regarding the specific tasks used in the assignments and tying laboratory questions more closely with lectures.