Enzyme Explorations through Cheesemaking: A Qualitative Approach for Learning about Enzyme Function  
Presenter: Aimee Phillippi  

Abstract  
Typical general biology enzyme labs involve the quantitative, yet technologically challenging skill of spectrophotometry. Students can sometimes miss the important knowledge about the roles of temperature, pH, concentration, and substrate type in enzyme function if they are too overwhelmed with the mechanical aspects of the equipment and analysis. Cheesemaking offers a practical and fun approach to exploring enzyme properties. Students can experiment with temperature, pH, enzyme concentration, and substrate type. While the experiment provides primarily qualitative data, the ability to see, feel, and taste the results aids in their conceptual understanding and their interest in the topic. This workshop allows participants to go through the process of making cheese, exploring the stages in the process and how altering the conditions can affect enzyme function, and therefore the final product.

‘What Happened to Alice Newfield?’: An Investigative Case Study to Engage Non-science Majors’ Interest in the Diversity of Life and the Nature of Science. 
Presenter: Lori Ann Rose  

Abstract  
This lab exercise was inspired by a “Conversion Immersion” workshop presented at the 2008 ABLE Conference. It is designed to engage the interest of non-science majors in an introductory level general biology lab. Students in the class are divided into groups of five or six to facilitate cooperative learning through collaborative work and discussion. After a brief pre-lab quiz of reading materials and previous lab topics, students are presented with a crime scene scenario (written paragraph and power-point presentation) and evidence that has been collected in the field; the scenario and ‘evidence’ used can/should be what is locally relevant. Each learning team must then analyze the samples, identify any organisms, or pieces of organisms, present to the
extent of their knowledge and the keys made available in lab, propose a hypothesis regarding how the crime was committed and present their work to the class for review. During class discussion, each team must support their hypothesis by presenting the data they have collected, indicating what inferences were made from it and why. The lab instructor then leads a discussion to reinforce the key concepts in “the nature of science.” Additionally, this workshop will include by demonstration and discussion the implementation of team learning in freshman biology labs. Among the key points will be: how to form learning teams, ways to assess individual student and team progress, the importance of individual accountability in the cooperative learning process and the use of an immediate feedback (scratch-off) quiz form during group quizzes.

Using Flour Beetles, *Tribolium confusum*, in Population Growth Studies
Presenter: Sheryl Shan Holtzer

Abstract
The flour beetle, *Tribolium confusum*, is an excellent experimental subject that allows measurement of population growth patterns and growth potential in one semester. It is easy to culture and count, and has a high growth rate. It thrives in a scoop of dry flour, can be grown in fruit-fly vials, does not fly, and matures in 40 days at 28°C. A semester-long exercise in population growth for non-major’s biology labs, determines the effect of food resources on population growth. A condensed lab for environmental science compares growth curves to the theoretical. Both graph and analyze data.

Landscape Ecology: Quantifying Spatial Information the Hard Way, using Microsoft ExcelTM
Presenter: Timothy Menzel

Abstract
This laboratory exercise has been designed to teach the basics of landscape ecology to upper level undergraduate biology students. The students are given square images with a 10 x 10 grid overlaid and are asked to create thematic maps showing forest and non-forest areas in Microsoft Excel. Those maps are then used to generate metrics for landscape composition, configuration and connectivity. The metrics from all students in the lab are combined and treated as replicates in a landscape level analysis. In this analysis, the relationships between those metrics are explored using the simple linear regressions that Excel will perform automatically. Before performing these tasks, students are presumed to have discussed different models of deforestation (in lecture or lab). Two models presented with this lab are the “chipping away” model where forest is lost in a wave, and the “fragmentation” model, where roads reach into forest interior and forests are broken apart from the inside. Students will be asked to interpret their results in this context (Has deforestation occurred in a wave or by fragmentation?). In
lecture or lab, students will also learn about landscape thresholds and the relationship between landscape composition and landscape connectivity. Students will be asked to determine the critical landscape threshold for a forest creature in the landscape they are studying.

Studying Photosynthesis and Respiration in *Hedera helix*

Presenter:

Abstract
Although photosynthesis is arguably one of the most crucial metabolic pathways carried out on earth, it is difficult to find a reliable protocol that can be used by students to study it. The method presented here is a compilation of aspects of the floating leaf disk assay (FLDA) from at least three sources (Armstrong, 1995; Pitkin, 2004; Steucek and Hill, 1985). The goal of this compilation was streamlining the protocol, eliminating problematic steps (e.g., aspirators to produce the vacuum and the need for multiple solutions) and developing a procedure that consistently and quickly produced reliable data. The protocol can also be used as the basis for independent student experimentation. The FLDA utilizes the rate at which oxygen is produced or consumed as a measure of the processes of photosynthesis and respiration, respectively. Disks of leaf tissue are vacuum-infiltrated to replace intercellular air with liquid. After infiltration, the disks sink. As photosynthesis takes place and oxygen is produced, the gas imparts buoyancy to the leaf disks so that they float. Conversely, oxygen is consumed as respiration occurs in the dark, and the floating leaf disks sink. A series of calculations results in the rates of both processes, photosynthesis and respiration. In this workshop, participants will carry out the FLDA with leaves from *Hedera helix* (English ivy) using various positions on a light table as the light source. The rate of photosynthesis and cell respiration for disks at various light intensities will be determined and plotted in a graph that is started in Excel and finished in Paint.

Cloning and Characterization of Ubx Fusion Proteins in a Biochemistry II Laboratory

Classroom:  Bringing Together Techniques and Technological Applications

Presenters:  Donna L. Pattison and Sarah Bondos

Abstract
A curriculum module for the Biochemistry II Laboratory course at the University of Houston was developed which merges molecular biology techniques, protein purification, and biomaterials assembly and applications into a true research experience for undergraduate students. The Ultrabiothorax (Ubx) protein from *Drosophila melanogastor* is a Hox protein that serves as a transcription factor *in vivo*, regulating fly development. In vitro, the protein forms remarkably stable, elastic, heat-resistant ordered materials (Greer et al, 2009). Because these materials self-assemble rapidly in gentle buffer conditions, assembly of Ubx fusions with other proteins should maintain the activity of the fusion protein, making Ubx a promising candidate for
development of a wide variety of binding, catalysis, and sensing applications. During the first pilot of this module, students attempted to clone an assortment of fluorescent proteins into the Ubx expression vector. Students then designed their own experiments to test the characteristics of the fusion proteins. The experience provided students with a chance to formulate their own questions and hypothesis, develop a protocol to test their hypothesis, the opportunity to try their experiments, evaluate the results (or lack thereof) and redesign protocols, and finally to report the data in a written paper and to share the results with the class in an informal seminar-type talk. Later classes will clone β-lactamase and other antibiotic resistance genes of interest for groundwater cleaning and filtering projects into the Ubx expression vector. Students learn primer design, PCR, restriction digests, plasmid purification, cloning, gel electrophoresis (agarose and polyacrylamide), Bradford assays, and protein purification through their participation in this project. This workshop will provide an overview of the entire project sequence. Hands-on training will be provided on the protein purification and materials formation protocols. The pilot was run with 4 sections totaling 69 students with the assistance of 4 teaching assistants and three preparatory assistants. If teaching assistants are not available, I recommend you use undergraduate students as teaching assistants to keep the workload manageable. Once the project has been run once, former students can be invited to serve as teaching assistants and are usually eager and willing to do so and best of all, you have already trained them and they understand the project.

Exploring Systematics and Phylogenetic Reconstruction Using Biological Models
Presenters: Hans Lemke & Jeffrey Jensen

Abstract
Systematics and phylogenetic reconstructions are among the most difficult concepts for students to understand in introductory biology. They are also fundamental to understanding how biologists view the evolutionary history of the world around us. This exercise uses models to teach basic tree construction and interpretation. Students first construct a tree of extinct shark species by hand. They then use the computer programs MacClade and PAUP to construct and analyze a tree of Caminalcules.

A Toolbox for Giving Your Lab a Pedagogical Makeover
Presenters: Mark Walvoord and Mariëlle Hoefnagels

Abstract
Biology instructors are usually so busy keeping up with departmental commitments, biology research, and their sub-field(s) of biology (just as they should be) that there may little time left to educate themselves in other topics relating to teaching and learning. Some of these topics may impart useful information for helping students learn in a post-secondary, biology laboratory
environment. These other fields include research on the psychology of learning, best practices in education, uses of new technologies, and academic assistance. Our workshop will include background information and discussion about clicker (PRS) use, PowerPoint® use, encouraging students’ critical thinking, and the psychology of learning. In particular, the topic on critical thinking will include Socratic questioning, peer teaching, and concept mapping. Our psychology of learning set will focus on learning styles, motivating students, and creating an environment of learning. Time-permitting, we’ll move beyond the four major topics to discuss issues such as motivating TAs to do high quality work, managing lab classes with multiple sections, and using ABLE resources. These areas were chosen because of concerns expressed by ABLE members at previous annual meetings and because of the presenters’ backgrounds and interests. Participants will walk away with a pedagogically sound set of ideas to implement in their biology laboratory or classroom.

Temperature Loggers: A Hot Technology for Gathering Large Environmental Data Sets to Promote Students’ Hypothesis Testing Abilities
Presenter: Scott R. Smedley

Abstract:
Helping students develop their ability to think critically about quantitative data is challenging, especially in a non-majors course or lower-level course intended for majors. This workshop is based on one such effort from a non-majors winter ecology course where the students used temperature loggers to collect field data upon which to conduct hypothesis testing. During the proposed workshop, participants will undertake a conceptually similar project, gaining hands-on experience with temperature loggers, a relatively inexpensive technology that could be adapted to test hypotheses in a variety of courses. In the winter ecology course, student teams each identified two microhabitats in close spatial proximity (e.g., opposite sides of a large tree trunk; above and beneath a fallen log). They next hypothesized whether or not the thermal environment would differ between the microhabitats and then planted a temperature logger in each microhabitat. These recorded at 0.5 h intervals for over 75 days. Upon retrieval of the temperature logger data, the students tested their original hypothesis. When I initially taught this course, it was apparent that these non-science majors found this quantitative project rather daunting. Consequently, I developed two instructional modules that took place prior to data retrieval. These modules utilized ecological datasets relevant to the course. The first module focused on the basics of spreadsheet use and effective graphical representation of data, while the second dealt with a simple statistical approach to hypothesis testing employing confidence intervals. At the close of the semester, each team reported to the class on the results of their hypothesis test. From this workshop’s temperature monitoring and hypothesis testing project ABLE participants will gain the necessary background to use this approach, either directly or in modified form, in their own teaching.
Thursday June 16th Mini-Workshop Schedule

Human Microsatellite DNA: Population Genetics and Forensic Application
Presenter: Kuei-Chiu Chen

Abstract
As forensic DNA lab topics have become popular in high schools, colleges and universities, offering a professional-level forensic DNA lab still faces technical and financial challenges. In this study we attempt to overcome these issues in order to provide concepts in molecular biology, population genetics, and mathematics typically found in a professional forensic DNA procedure. We choose ten of the 13 FBI designated microsatellite markers from its Combined DNA Index System. These markers, also known as short tandem repeats (STRs) in the forensic community, are DNA sequences comprised of tetra-nucleotide repeat units and are located in various sites on human chromosomes. In addition to STR markers, we also use the amelogenin marker to identify gender of the sample donors. Participation in DNA extraction is on a voluntary basis and student participants are required to sign a consent form. Concentration of DNA extracted from cheek cells is controlled by narrow range of surface area of resin beads on which DNA molecules are binding during extraction. Extracted DNA samples are then assigned a code known only to the specific DNA donors. Alleles from all 10 loci are amplified simultaneously using a PCR multiplex kit. PCR products are submitted for genotyping analysis using DNA sequencing facilities available at university campuses or commercial laboratories. The results are shown in peaks corresponding to base pair of that specific allele. Participants calculate their own random match probability based on Hardy-Weinberg equilibrium principle. In some individuals, the probability of random match of a genetic profile may be as low as one in more than 10 billions. Participants will discuss paternity determination using paternity index and deduce individual genetic profiles from a mixture of multiple DNA donors.

Using Classical Genetics Simulator (CGS) to teach students the basics of genetic research
Presenters: Jean Heitz, Mark Wolansky, and Ben Adamczyk

Abstract
In large introductory biology classes some labs are difficult to do because of space, time and funding constraints. Among these are classical Mendelian genetics investigations. As a result, we have turned to cyber labs. Working with our introductory biology program, Ben Adamczyk developed a Classical Genetics Simulator (CGS), which gives students the opportunity to perform test crosses with model organisms much like a geneticist would do in a modern laboratory. CGS is a computer simulator that provides populations of fruit flies (Drosophila melanogaster), Arabidopsis or mice with unknown patterns of inheritance and gives students the tools to design and perform experiments to discover these inheritance patterns. Students cannot play it like a video game and expect it to give away any answers. Instead, CGS requires students to understand what they are doing, why they are doing it and how they should do it. As a teaching tool, we find that CGS is superior to other genetics simulators because 1) It hosts simulations for three different model organisms; 2) It has an easy to use instructor interface; 3)
The genetics of the character(s)/ trait(s) used are programmable; 4) It provides options to setup a number of populations with varying inheritance patterns under a single account; 5) It is inexpensive; 6) It is an online program – i.e.: involves no software; 7) It allows students the opportunity to develop the logic and thought processes needed to solve real-life problems in genetics; and 8) It promotes deep understanding of topics in classical genetics. This workshop will introduce you to the CGS program, provide you with two different examples of how to incorporate it into large, introductory genetics labs and give you the opportunity to use the program from both a student and instructor prospective. We will conclude the session with a brainstorming session on using CGS in different settings and will answer any questions you may have.

Using a Variety of Techniques to Make the Study of Plants More Exciting to Students.
Plants - Don’t Just Sit There, Do Something!!!
Presenters: Marsha E. Fanning and Karen McDougal

Abstract
Many botany labs involve having students look at flowers, seeds, and fruits, but often omit some of the “neat things” that are more hidden from view. Some of the most fascinating botanical phenomena are rarely included in the introductory laboratory, and yet they are easily seen if appropriate techniques and plants are used. These aspects of plant biology offer interesting questions for investigation, but without proper techniques they are often ignored. In this workshop we show how to prepare simple setups to view pollen tube germination, to see endosperm and early embryos of dicots, and to make preparations of chromosomes in broad beans. All of the techniques have the potential for use in a variety of student exercises and research projects.

An inquiry-based bioinformatics exercise incorporated into a newly developed molecular biology laboratory course.
Presenters: Liane Chen and Kathryn G. Zeiler

Abstract:
BIOL 341 (Techniques in Molecular Biology) is a third year laboratory course being developed for the University of British Columbia. It is expected to have a large computer-based component, and must handle large enrolments. We have developed a written assignment that will introduce students to bioinformatics tools, in the context of scientific inquiry. Students conduct research on genes of unknown function, possibly linked to materials used in the wet-lab portion of the course, or to genomics research carried out by faculty members. The NCBI databases are used to analyze nucleotide and protein sequences, search for genes with similar sequences, and identify conserved domains and structures. Hypotheses about the structure and function of their unknown gene product (protein) are generated, supported by further research on conserved domains and
homologous genes. Findings are written up as a research paper, but the assignment could be adapted for oral and poster presentations. Because poorly characterized genes are used, students cannot conduct literature searches on the genes themselves to find previously published results. Thus, students must focus on the scientific process and synthesize new ideas from their bioinformatics data, and have the opportunity to add to the knowledge base. Additionally, this assignment provides the students with further practice in using scientific literature and should improve their technical writing skills.

Using Microfossils to Demonstrate Ecology and Evolution: (In Memorium of Charlie Drewes)  
Presenter: Ann Yezerski  
Abstract:  
At the Annual ABLE meeting in 2005, I had the pleasure of attending the workshop presented by Charlie Drewes on Devonian microfossils. Since that time I have used the resources provided during this workshop to develop a three-week laboratory module for freshman. I presented a mini-workshop on this topic in 2008, and participant feedback suggested that I expand the topic into a major workshop. During this workshop I will summarize how these tiny fossils are an excellent teaching tool for evolution and ecology. The techniques and concepts covered include microscopic manipulation, the formation of fossils, geologic history, construction of phylogenetic trees, calculating a diversity index, environmental sampling, and how the tree of life shows both current and historic relationships amongst organisms. The laboratories are arranged in three major sections: 1) identifying, sampling, and calculating a diversity index on the fossil sample, 2) learning how to construct a phylogenetic tree, 3) combining the first two exercises with additional information, such as web resources and observations of extant relatives of the fossils, to create a phylogenetic tree for these Devonian organisms. These exercises can be used individually, or combined as an ongoing project that touches on many of the topics emphasized in a first year course.

Effect of Environment and Modulators on GI and Heart Function in Invertebrates: Shrimp and Drosophila  
Presenters: Rachel Holsinger and Robin L. Cooper  
Abstract:  
The crayfish hindgut is easy to make physiological recordings through visually monitoring peristaltic activity, which can be used as a bioassay for various peptides, biogenic amines, neurotransmitters and environmental substances. This preparation is amenable to student laboratories in physiology and for demonstrating pharmacological concepts to students. This preparation has been in use for over 100 years, and it still offers much as a model for investigating the generation and regulation of peristaltic rhythms and for describing the mechanisms underlying their modulation. Additional experimentation on invertebrate hearts, can
also be followed up for pharmacological testing and environmental stimuli. The neurogenic crustacean heart and the myogenic Drosophila larva heart rate are investigated to environmental stimuli (temperature, CO2) and modulators (serotonin, nicotine, dopamine) that enter the hemolymph. Also multiple influences in the form of environmental and modulator cocktails are able to provide student individuality in experimentation. These robust preparations are well suited to training students in physiology and pharmacology. Addition levels of these experiments can be performed depending on available equipment such as force transducers to measure force and rate of GI contractions or excised Drosophila larval heart for examining pacemaker type of activity. The fundamental experiments will be performed by workshop attendees and other level will be demonstrated and available for attendees to perform.

Evidence-Based Teaching Strategies: Assessment of Student Learning in the College Science Classroom
Presenter: Karen Sirum

Abstract
Introductory science classes serve as gateway, facilitating student interest and recruitment to the sciences and scientific ways of thinking, or alternatively, turning students away from the sciences as a major, an area of interest, and even as a value in everyday life. Undergraduate science education goals include development of students’ scientific thinking skills, valuing evidence, and the propensity to use these skills and values in decision-making. How do we know if we are creating learning opportunities that promote achievement of these goals in our classrooms and teaching laboratories? Assessment of student learning involves approaching teaching scientifically, based on the research on how people learn and employing methods and measures to find out if such approaches promote the desired learning outcomes. Interactive Engagement (IE) teaching strategies include methods to facilitate student interaction with not only the course content and with the instructor, but also among students—the benefits to student learning are well documented. A key feature of IE is that it provides frequent opportunities for assessment, providing feedback to the student and to the instructor on student learning. IE pedagogical approaches include peer instruction, active, problem-based, cooperative, and collaborative learning, strategies that are effective not only for the teaching laboratory, but also for the large and small enrollment lecture section of courses. In this workshop session, participants will learn about IE by actually doing it, and we will share ideas about group work as an instructional strategy, including ideas about how technology can be used to make it more effective. In addition, we will discuss practical, readily implementable ideas for assessing learning. While “assessment” is often one of the “seven dirty words you can’t say at a faculty meeting”, when fundamentally applied to the classroom, assessment is an obvious utilization of our science research skills.

A Cross-Curricular Molecular Genetics Lab in Embryology
Abstract
In response to the need for more interdisciplinary, research-based labs that facilitate student learning across the biology curriculum, a three-part lab was developed in collaboration between the Developmental Biology and Molecular Genetics II courses. The overall lab is an original research project that examines the effect teratogens have on a developing embryo. The data analysis involves both qualitative macroscopic observations and quantitative study of differential gene expression using microarrays. This workshop will follow the path of this experience, allowing attendees to participate in several aspects of the multi-week laboratory. Part I focuses on chicken embryology, and participants will have the opportunity to practice their own injections and observe the results of these types of experiments. Part II will cover the basics of how to prepare and hybridize labeled cDNA to microarray slides. Hands-on microarray simulations will illustrate the process for participants. In part III, participants will be able to analyze real data, and identify individual genes that are being overexpressed or down-regulated in response to the teratogen. Previous experience with molecular biology or bioinformatics is not necessary for this workshop! While the three parts of the lab work well together to illustrate all aspects of experimental design, technical methodology, and data analysis, participants might also enjoy the fact that aspects of each section could be run as independent lab activities in a variety of lab courses including molecular biology, developmental biology, introductory biology, and bioinformatics. Finally, we will wrap-up the workshop with a discussion that focuses on the benefits of 1) cross-curricular laboratories, 2) problem-based lab activities, and 3) encouraging students to report their results through oral and poster presentations.

Locomotor Behavior of Sarcophaga bullata Larvae in Response to Light
Presenter: William V. Glider

Abstract
The major objectives of this exercise are to provide students an introduction as to "how scientists do science", an introduction to the study of animal behavior and the basic principles of scientific writing. Flesh fly (Sarcophaga bullata) larvae are used in this exercise to investigate their locomotor behavior with respect to light. This exercise is designed for two, three hour lab periods. During the first lab period students are introduced to the biology of flesh flies including their life cycle, morphology, and basic physiology using both living and preserved specimens. The use of flesh flies in forensics to estimate the time of death is also discussed. Based on information provided by the instructor as well as that obtained by the students via print and/or the Internet, the students are asked to formulate predictions and hypotheses (null and experimental) as to the locomotor response of the larvae to the presence or absence of white light. To test their hypotheses, the students carry out a series of controlled experiments in which the larvae are placed in the center of a plexiglass "racetrack" lined with moist toweling. After a 3 minute time period, the number of larvae found on either side of the center line and at the end
of the racetrack are recorded under two conditions: (1) when the apparatus is covered with a light-tight box and (2) when half of the race track is covered with a piece of aluminum foil and the other end of the race track is illuminated by a high intensity light source. Using the same apparatus, the students are required to design experiments which allows them to determine how the locomotor response of the flesh fly larvae varies with respect to four different wavelengths of light. During the second lab period students analyze and graph their data. They are introduced to the Chi-squared Goodness of Fit Test and calculate chi squared values for their data using an Excel based "Chi-squared calculator". This lab exercise has been used in an organismal biology course for majors and in a general biology course for non-majors, employing both traditional and investigative approaches.