POSTER SESSION
INFORMATION &
ABSTRACTS

May 17, 2003
12:30 – 2:30 P.M.
Baltimore Room, Stamp Student Union

10th Undergraduate Microbiology
Education Conference

University of Maryland
College Park, MD
Post Session
Saturday, May 17, 2003
12:30 to 2:30 p.m.
Baltimore Room, Stamp Student Union

All posters will be available for viewing in the Baltimore Room, Stamp Student Union from 12:30 – 2:30 p.m. and from 5:00 – 7:00 p.m. on Saturday, May 17, 2003. Abstract numbers represent session-location.

Session 1: Authors will be at their posters from 12:30 – 1:30 p.m.

1-1 Immunoproteomics: A Novel Strategy for Studying and Teaching the Importance of Post-translational Modification
Michael D. Boyle*
Juniata College, Huntingdon, PA

1-2 Prepared Models of Viruses, A Self Learning and Do It Yourself Method
Krishna Pratap Singh
Al Jazeira Hospital, Abu Dhabi, United Arab Emirat

1-3 Activities to Enhance Microbiology Education
Poonam Gulati*
University of Houston-Downtown, Houston, TX

1-4 A DAB and MAGIC Tool: Public Domain Gene Evolution and Microarray Analysis Bioinformatics Tools Appropriate for Undergraduate Curriculum
A. Malcolm Campbell*, Adam Abele, Brian Akin, Danielle Choi, Soren Johnson, Parul Karnik, Rahul Karnik, David Moskowitz, and Laurie J. Heyer
Davidson College, Davidson, NC

1-5 Internet Based Computer Analysis of DNA
Jerry Goldstein*
Ohio Wesleyan University, Delaware, OH

1-6 A Novel Educational Program for Bioterrorism Preparedness Among Laboratory and Safety Professionals in New York City
Alice Agasan*, J. Caravanos, M. Goldberg, D. Johnston, and R. Linder
Hunter College, New York, NY

1-7 Peer-Led Team Learning for Microbiology
Beth Gaydos*
San Jose City College, San Jose, CA

* Submitting Author
■ Travel Grant Recipient
1-8 Teaching Epidemiological Principles Through Active Learning
Beverly J. Brown* and Carol E. Roote
Nazareth College, Rochester, NY

1-9 Learning Across Cultures: Microbiological Collaborations between College and High School Students
Lee A. Abrahamsen*
Bates College, Lewiston, ME

1-10 Incorporating an Internet Project-Based Learning Activity into the Undergraduate Microbiology Course
Geoffrey W. Gearner*
Morehead State University, Morehead, KY

1-11 Incorporating Quorum Sensing into the Undergraduate Microbiology Laboratory
Christine L. Weingart*
Denison University, Granville, OH

1-12 Accommodations for and Success-rate with a Visually Handicapped Student in a General Education Microbiology Class
Jennifer L. Koehl*
Saint Vincent College, Latrobe, PA

Marion Field Fass*
Beloit College, Beloit, WI

1-14 Merging Ethnobotany and Microbiology in the Undergraduate Research Laboratory: Can Thai Medicinal Plants Inhibit Formation of Pseudomonas aeruginosa Biofilms?
Mary E. Allen*, Andrea Jones, and Linda Swift
Hartwick College, Oneonta, NY

1-15 Collaborative Problem-Based Learning in Immunology and Virology
Karen K. Klyczek*
University of Wisconsin-River Falls, River Falls, WI

1-16 To Reject or Not to Reject: Skin Grafting in Xenopus laevis as a Project-based Measure of Cellular Immune Responses in an Immunology Course
Kathleen S. Jagger*, Elizabeth Crouch, and Kevin Kinney
Transylvania University, Lexington, KY

1-17 Microbiology and Discovery: Biology Majors, Non-Majors, Non-Science Students and High School Students
Deb L. Wohl*, P. B. Lessem, and J. B. Reed
University of Richmond, Richmond, VA

Session 2: Authors will be at their posters from 1:30 – 2:30 p.m.

* Submitting Author
■ Travel Grant Recipient
2-1 Risking Reform to Enhance Learning
Richard L. Mower* and Teddie Phillipson-Mower*
Indiana University, Bloomington, IN

2-2 Integrating Traditional Inupiaq Ways of Knowing with Clinical Microbiology
Tina Melin*
Maniilaq Health Center Laboratory, Kotzebue, AK

2-3 Near-Peer Mentors: The Reciprocity of Scientific Mentoring
M. Z. Anderson*, R. Haller, D. Yourick, and M. Jett
Walter Reed Army Institute of Research, Silver Spring, MD

2-4 Adaptation of the "Dark Winter" Exercise for use in a General Microbiology Group Project
Jonathan. B. Kidd*
Wesley College, Dover, DE

2-5 The Use of Role Play in Learning: the trp Operon as an Example.
Jeffrey J. Byrd*
St. Mary’s College of Maryland, St. Mary’s City, MD

2-6 Disease Database: An Internet Resource Contributed To and Maintained by Major and Non-Major Microbiology Students
Donald P. Breakwell*
Brigham Young University, Provo, UT

2-7 Practical Tools for Evaluating Instructor and Student Skills in a Microbiology Course
Michele D. Zwolinski*
University of Wisconsin – Stout, Menomonie, WI

2-8 Integrating Biotechnology, Molecular Biology, and Microbe Appreciation into a Biology Methods Laboratory
D.C. Higgs and M.P. MacWilliams*
University of Wisconsin-Parkside, Kenosha, WI

2-9 A Personal Laboratory Approach to Increasing the Non-science Major's Awareness about Microbial Diversity and Antimicrobial Agents
Maria Borovilos**, Joanna S. Brooke*, and Rasha Ghattas
DePaul College, Chicago, IL

2-10 Incorporation of DNA Sequencing into an Undergraduate Introductory Biology Laboratory
John W. Urbance* and Shannon J. Flynn
Michigan State University, E. Lansing, MI.

2-11 Internet Teaching of Microbiology
John R. Stevenson* and P. Helen Stevenson
Miami University, Oxford, OH

2-12 Hands-on Educational Workshops for Underrepresented Undergraduates in
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S.M. Pfiffner*, K.L. Davis, and E. van Heerden,
The University of Tennessee, Knoxville, TN

2-13 Undergraduates as Outreach Teachers Among NH Volunteer Lake Monitors
Richard Blakemore*, Alan Baker, and Janet Campbell
University of New Hampshire, Durham, NH

2-14 Another use for Independent Research in a Microbiology Course
John R. Phythyon*
St. Norbert College, DePere, WI

2-15 A Maine Science Corps Promoting Excellence and Equity in High School Biological Science Education
S. Monroe Duboise*, Marisa Hackim Amaral, Kimberley Fantasia, Beth Lindroth Hill, Barry Larman, Elizabeth Richards, Jacqueline Seguin, Daniel Swett, and Marisa Zenahlik, University of Southern Maine, Portland, ME

2-16 Outcomes of a Research-Driven Microbiology Laboratory Course Designed to Enhance Undergraduate Contributions to and Preparation for Original Research
Madeline E. Rasche*
University of Florida, Gainesville, FL

2-17 Impact of Pre-requisites on Student Success in Introductory Microbiology at Community College
Marie T. Panec*
Moorpark College, Moorpark, CA

2-18 Inquiry Guided Learning Across a Microbiology Curriculum
Mike Hyman*, Virginia Lee, and Gerry Luginbuhl
North Carolina State University, Raleigh, NC

1-1

* Submitting Author
■ Travel Grant Recipient
Immunoproteomics: A Novel Strategy for Studying and Teaching the Importance of Post-translational Modification

Michael D. Boyle*
Juniata College, Huntingdon, PA

Recent studies from our laboratory have described an immunoproteomic assay that can be used to monitor post-translational modification of surface bacterial proteins. This assay involves a specific antibody capture step followed by analysis of bound antigens using surface enhanced laser desorption ionization time-of-flight (SELDI-TOF) mass spectrometry. The procedure involves three steps, each of which illustrates an important biological concept. In the first step a specific antibody is immobilized onto a bacterial surface via a Fc-binding protein. In the second step the immobilized antibody is used to capture its cognate antigen and in the third step the antigen-antibody complex is transferred into a mass spectrometer to analyze the molecular size of antigenically-related molecules. Each step in the assay provides examples of fundamental aspects of microbiology, immunology, and protein chemistry. The first step involves the immobilization of a specific antibody via its Fc region. This provides an opportunity to discuss the structure of immunoglobulin and the existence of selective Fc-binding structures on certain bacteria. The next step of the assay involves antigen capture and allows the concepts of specificity, on and off rates, and affinity to be addressed. The third step involves the analytic aspect of the assay and the use of time of flight mass spectrometry to analyze difference in the size of antigenically-related molecules bound to the immobilized antibody. This provides an opportunity to discuss methods of analyzing proteins and the importance of post-transitional modification in defining the proteome. The immunoproteomic method will be illustrated using examples of post-translational modification of the anti-phagocytic M protein of *Streptococcus pyogenes* by a secreted cysteine protease, SpeB. Comparison of the results of the immunoproteomic analysis and parallel gene expression studies underscore the limitations of relying solely on transcriptional or gene microarray analysis to relate the genotype of an organism to its phenotype.
Prepared Models of Viruses, A Self Learning and Do It Yourself Method

Krishna Pratap Singh
Al Jazeira Hospital, Abu Dhabi, United Arab Emirate

The medical student or science student finds the structure of virus an imaginary object. Today this is being described as a very complex structure, depicted in the form of diagrams, photos, and electrom micrographs. The models of viruses prepared, specially based on the details of icosahedron in the simplest form will be described using different colors for the capsomeres present on the apices, edges, and surfaces. The counting of the capsomeres is not described by the complex and uninteresting methetical formulae and by simple logic one can count the total number of the capsomeres by counting the number of edges, apices and surfaces by this method. The students can prepare the model by themselves and learn how to count the capsomeres. The cut template is first pasted on the used old ray plates and then folded and prepared by this method. When one cuts and folds the icosahedron for the 32 capsomer structure, one finds interesting a soccer ball structure in his hand. In this methods the icosahedron of 72, 92, 162 , and 252 capsomeres structures are prepared and the models remain in the hands of the student. The base template prepared by the author is unique and is not described by others and the folded and prepared models are stronger and long lasting. Once prepared, the models can be kept on the table and while reading a particular group of viruses, the model remains with you as a three dimensional structure. Once the simple base has been formed, the details and complexities can be understood more easily by the student.
Activities to Enhance Microbiology Education

Poonam Gulati*
University of Houston-Downtown, Houston, TX

The Leeuwenhoek Society, a student branch of the American Society of Microbiology, is composed of an active group of primarily microbiology majors involved in varied activities, many of which I have developed. The first activity involves the Leeuwenhoek members teaching basic microbiology to local elementary school students. Groups of three to four university students visit a science classroom once a week for four weeks and deliver short lectures and conduct simple experiments. The results from an assessment quiz at the end of the session indicates that the school students know more about microbes, have had fun, and identify with the college students as role models. Our students have gained the invaluable experience of teaching, have had the satisfaction of helping the younger students, and have enjoyed themselves. Another activity is to teach our students about microbial diversity by field sampling and isolating bacteria. The students visit a wetland environment and collect samples from different areas and depths. Two students continued the project and isolated and identified microorganisms from this environment. A third activity that was recently begun is called "Microbial Jeopardy." Using the Jeopardy game format, microbiology and related areas were tested. It was a high-energy, fun-filled, exciting and competitive atmosphere. The students loved the activity and indicated its usefulness in a post-game survey. These types of activities get students excited about science, solidify concepts, and teach them about science outside their classroom. Forums like our Leeuwenhoek Society should be used to enhance the learning experiences of students.
DAB and MAGIC Tool: Public Domain Gene Evolution and Microarray Analysis Bioinformatics Tools Appropriate for Undergraduate Curriculum

A. Malcolm Campbell*, Adam Abele, Brian Akin, Danielle Choi, Soren Johnson, Parul Karnik, Rahul Karnik, David Moskowitz, and Laurie J. Heyer
Davidson College, Davidson, NC

Genomics has opened many areas of research but teaching in this area is daunting. We have developed two software tools to facilitate undergraduate research and teaching: Divide And BLAST (DAB) and MAGIC (MicroArray Genomics Imaging and Clustering) Tool. DAB (www.bio.davidson.edu/DAB) is a unique Perl program that works on all platforms. The user enters a gene sequence of interest; DAB chops the sequence into overlapping sequences of user-defined length and BLASTs these fragments. BLAST results for the full gene are subtracted from the fragments results to uncover unexpected functional domains. DAB helps you uncover conserved domains that can reveal the evolution of genes, which can be used in microbiology courses or student research projects. MAGIC Tool (www.bio.davidson.edu/MAGIC) is written in Java and works on all platforms. With MAGIC Tool, you can perform every step in microarray analysis, from processing TIFF files and spot finding to several algorithms of clustering and data exploration. Its user-friendly graphic interface and simple spot-finding process make MAGIC Tool ideal for courses and student research. DAB and MAGIC Tool were created by undergraduates, are freely available, and permit teachers to bring genomics into microbiology and related courses.
Internet Based Computer Analysis of DNA

Jerry Goldstein*
Ohio Wesleyan University, Delaware, OH

The metabolic pathways of bacteria, animals, and plants are very similar. The DNA sequences of genes that code for enzymes that perform the same function in different organisms should be somewhat similar in structure. Computer programs freely available on the Internet can be used to obtain gene sequences from many organisms to compare the nucleotide structure of the genes and the amino acid sequence of enzymes. As an assignment in the Bioinformatics Seminar, students were asked to select a gene that codes for an enzyme activity present in bacteria, plants, and animals. The students obtained the gene sequence from one organism using the Entrez program from the National Institutes of Health website. Using the BLAST program, several similar genes in other bacteria, animals, and plants were identified and the gene sequences from 4 bacteria, 4 plants, and 4 animals were downloaded. The genes were analyzed for their Open Reading Frames after introns were removed from eukaryotic genes. Students aligned the nucleotide sequences of the genes and the amino acid sequences of the proteins to determine similarity of structural patterns. The nucleotide sequences were also analyzed for the presence and the location of restriction enzyme sites on the genes and signal sequences for cellular localization of the enzymes. Students designed PCR primers for DNA amplification of a piece of DNA from their genes that was greater than 500 base pairs in size. Finally, the evolutionary relatedness of the sequences was also determined using a web based computer program.
A Novel Educational Program for Bioterrorism Preparedness Among Laboratory and Safety Professionals in New York City

Alice Agasan*, J. Caravanos, M. Goldberg, D. Johnston, and R. Linder
Hunter College, New York, NY

Threats of biological and chemical terrorism in the U.S. present a unique challenge to the educational community. The experiences of Fall 2001 demonstrated a critical role for clinical and environmental laboratories for early detection, diagnoses, treatment and prevention related to these threats. To better prepare the health and safety professionals of New York City for these emergencies, a program for Bioterrorism Preparedness was developed. Under the auspices of our Continuing Education Department, an interdisciplinary collaboration between the Environmental and Occupational Health and Medical Laboratory Sciences Programs provided an appropriate background to design a curriculum. Started in September 2002, the Program consists of four sequential modules; Procedures and Safety Management, Procedures and Safety Management Laboratory, Biology of Microbial Weapons and Government and Public Health Regulations. The students are derived from the clinical laboratories and safety departments of local hospitals, academic and industrial institutions. They are working professionals trained as managers, technologists, infection control nurses and biosafety officers. The Faculty is composed of a director/coordinator and instructors who are biosafety officers, clinical, molecular microbiologists, public health epidemiologists and law enforcement officers. Classes meet three hours weekly for eight weeks per module. The program has attracted considerable interest among individuals from diverse professions in law enforcement, fire, transit, hospital and health care groups. Continuing curriculum development is underway to accommodate diverse practitioners as well as export the model to other communities.
Peer-Led Team Learning for Microbiology

Beth Gaydos*
San Jose City College, San Jose, CA

An exciting new method of instruction called Peer-Led Team Learning has been successfully used for several years in chemistry classes at a number of colleges. This method has now been applied to lower division microbiology, with great results. Peer-Led Team Learning (PLTL) consists of groups of 6 to 8 students led by a student mentor who has previously done well in the class. These groups meet weekly to work on carefully structured problems in a safe and supportive environment that helps each student build their understanding of microbiology. Students feel free to learn from their mistakes as the leaders guide the collaborative problem solving. Anxiety and isolation is reduced as self-confidence in their ability to understand and learn material is increased. A series of activities, designed to promote active learning in these workshops has been developed for introductory microbiology. In classes using PLTL, both student retention and learning increase. Over two years of implementation at San Jose City College, retention rates have gone up from 65% to 100%. The percentage of students in science courses with PLTL with grades of C or better has increased. Examples of microbiology workshop materials and a demonstration of how they are used will be presented. Handbooks on the methods on PLTL will be available.
Teaching Epidemiological Principles Through Active Learning

Beverly J. Brown* and Carol E. Roote
Nazareth College, Rochester, NY

The threat of bioterrorism is a common topic in the media today. The potential spread of bioterrorist agents makes understanding the principles of epidemiology more important than ever. Students frequently have trouble grasping these principles and can master them more easily when they are actively engaged with the material. We used an interrupted case study developed by the Center for Disease Control and Prevention to demonstrate epidemiological principles. The case is based on a food poisoning outbreak in the state of New York. Students took on the role of health officers sent to the site to determine the source of the outbreak. Data collected in the interviews were entered into an Excel spreadsheet. Students used Excel to graph and analyze these data and create an epidemiological curve. We completed the exercise within a 3-hour laboratory period with students working in pairs to complete each stage of the case. We found students to be highly motivated during the lab and very focused on the subject matter. The majority of the students said that the exercise helped them understand the material more deeply and would recommend it to future students.
Learning Across Cultures: Microbiological Collaborations between College and High School Students

Lee A. Abrahamsen*
Bates College, Lewiston, ME

In two upper-level elective Biology courses (Bacteriology and Virology) college students are given the option of partnering with a high school biology class to study some aspect of microbiology. The goals are to enhance science education by providing resources to high schools and by encouraging college students to become involved in science teaching. The college students design lessons, activities, and laboratories that are done at the high school and at Bates College. High school students are required to make posters to present their scientific work. The posters then serve as the results section of a presentation that the college students make at a Bates sponsored student research symposium. The high school students, their parents, and teachers are invited to the symposium. Assessment occurs at several levels. The college students and high school teacher assess the learning of the high school students with tests, quizzes, informal question/answer sessions, journal entries, surveys and evaluation of the quality of the posters. If the college students opt to use the partnership as part of their own grade, assessment is based on a proposal and progress reports, a written presentation of the entire project with accompanying lesson plan, participation, a self-assessment of their own learning, and the quality of their final symposium presentation. Results gathered between January and December of 2003 suggest that the partnerships have encouraged additional high school students to consider applying to college (an increase of 19%) and have encouraged college students to consider teaching science (an increase of 18%).
Incorporating an Internet Project-Based Learning Activity into the Undergraduate Microbiology Course

Geoffrey W. Gearner*
Morehead State University, Morehead, KY

The purpose of this study was to develop a project-based learning activity whereby students utilized the Internet to search, retrieve, and compile current information regarding an assigned microbial pathogen. Each group would then develop a website devoted to the assigned microbe. During the Fall 2002 semester, 25 students enrolled in Principles of Microbiology were placed into one of six groups of 3-4 students. Each group was assigned a bacterial pathogen (*Listeria monocytogenes, *Coxiella burnetii, *Escherichia coli O157:H7, *Helicobacter pylori, *Neisseria meningitidis, *Chlamydia trachomatis, *Haemophilus influenzae, and *Streptococcus pneumoniae) and tasked with using the Internet to find specific information on their assigned microbe, including: taxonomy, morphology, biochemical/metabolic characteristics, genome characteristics, cultivation methods, growth characteristics, laboratory identification, disease(s) caused, epidemiology, disease symptoms, pathogenesis, prognosis and clinical diagnosis, and virulence factors. The students constructed a set of linked web pages using their Internet research results as content. Each group’s web page was evaluated using a grading rubric. The scores ranged from 80% - 92%, with an average of 86.4%. The students were asked to complete an assessment survey of the project and of what they learned. In general, most responses were favorable (16/20 response items >3.00 on a Likert scale of 5). Items gauging how much the students learned from the activity showed that the students did in fact deepen their understanding and knowledge of bacterial pathogens. Items gauging if project instructions were clear showed that improvements can be made in instructing the students on how to construct web pages.
Incorporating Quorum Sensing into the Undergraduate Microbiology Laboratory

Christine L. Weingart*
Denison University, Granville, OH

Quorum sensing, a bacterial signaling mechanism, is used to coordinate the expression of specific genes involved in activities such as bioluminescence, plasmid transfer, antibiotic production, and virulence factor production. Quorum sensing involves the production of an autoinducer (the bacterial signal), an autoinducer receptor that is a transcriptional regulator, and an autoinducer synthase. Studies suggest that bacteria may use noncognate autoinducers to stimulate their quorum sensing systems. We used this information to develop a laboratory exercise that would enable students to determine whether *Burkholderia cepacia* could respond to noncognate autoinducers from other bacteria. In addition, we used this exercise to improve hypothesis-testing, critical thinking, and data analysis skills. Students worked in groups of 3-4 to complete the two-part exercise. The objective of Part I was to familiarize students with quorum sensing. This was facilitated with background information, a figure of various autoinducer structures, and data that suggested bacteria can respond to noncognate autoinducers. Using this information, the students analyzed the data and developed conclusions regarding quorum sensing and the role of noncognate autoinducers. In Part II, students designed an experiment to determine whether *B. cepacia* could respond to noncognate autoinducers from other bacteria. Although we provided bacterial strains and media, the students developed the experimental protocol. We evaluated students on their ability to develop proper controls, the appropriate choice of experimental strains, and their understanding of quorum sensing. The students discussed their procedures as a group but their answers were composed independently to foster independent thinking and individual writing skills.
Accommodations for and Success-rate with a Visually Handicapped Student in a General Education Microbiology Class

Jennifer L. Koehl*
Saint Vincent College, Latrobe, PA

As more and more physically disabled students approach the challenge of higher education, it is important for instructors to share and exchange successful and unsuccessful teaching strategies and concepts. During the fall 2002, a visually handicapped student enrolled in the "Bacteria, Friends or Foes?" class at Saint Vincent College. This class helps fulfill the science core for students who do not major in any science (biology, chemistry, physics, psychology, etc.). Accommodations were made for this blind student to accentuate learning in the laboratory including the incorporation of a junior Biology major as an aid. Since this course is for non-science students, the main goal of the laboratory is to have students learn basic microbiological techniques. Exercises revolve around central concepts such as preparing and pouring media, isolation of bacterial unknowns, microscopy, testing of water, and preparation of foods and beverages. Basic accommodations included removal of a Bunsen burner for an incinerator, the use of sterile swabs versus a wire loop to decrease agar tearing, and quizzes and exams on computer. Overall, both the student and his aid indicated through personal surveys that the student fulfilled the main goal of the class to the best of his ability. Additional recommendations were made for future visually handicapped students including physical models of bacterial shapes for the student to touch, alternative laboratories for microscopy, and proximity of materials in the lab.
In an area of the world where the epidemic of HIV/AIDS continues to infect large numbers of young adults, universities have begun responding with undergraduate common courses to teach students about both the biology and social impact of HIV/AIDS. Biologists and especially microbiologists are leading the development of these critically important courses but their efficacy is limited by access to textbooks and materials for both professors and students.

Through a joint project of American Colleges and Universities SENCER project (Science Education for New Civic Engagements and Responsibilities) and African Women in Science and Engineering, I visited five universities in Kenya and Tanzania in October 2002 to work with professors on course development and to discuss collaborations with U.S. scientists. Each of the universities have made progress in implementing courses about HIV/AIDS. Microbiologists in Kenya and Tanzania are also eager to collaborate with U.S. scientists, and badly need new and recent textbooks for themselves and their students. Members of ASM can assist them by sending recent books and beginning e-mail discussions of possible collaborations. Contact information for microbiologists and geneticists in Sub-Saharan Africa will be available at this poster.
Merging Ethnobotany and Microbiology in the Undergraduate Research Laboratory: Can Thai Medicinal Plants Inhibit Formation of *Pseudomonas aeruginosa* Biofilms?

Mary E. Allen*, Andrea Jones, and Linda Swift  
Hartwick College, Oneonta, NY

In many parts of the world plants have been valued for their antimicrobial properties for centuries. For small groups of tribal peoples in Thailand it is hoped that some of these plants will serve as a valuable source of income to replace that lost when mass cultivation of poppies was prohibited (to slow the opium trade). One possible source of income would be the production of plants with medicinal uses. This poster describes an undergraduate research project designed to test whether *Curcuma longa*, a native Thai plant traditionally used to treat microbial infections, can inhibit the formation of biofilms by *Pseudomonas aeruginosa*. Biofilms were grown in 24-well plates on a tilt table. The effect of *C. longa* extract on the growth of planktonic cells was measured as change in optical density of the liquid culture above the biofilm. Biofilm cell density was determined by measuring the relative quantities of crystal violet needed to stain the biofilms (measured as optical density of extracted dye). *C. longa* effectively slowed the growth of planktonic cells. In contrast, biofilms formed faster in the presence of the plant extract than in its absence. It is possible that *C. longa* induces a stress response in *P. aeruginosa* and thus encourages biofilm formation. This poster demonstrates one use of biofilms in undergraduate research. Biofilms are good systems for undergraduate research because they are relatively easy to grow and are relevant to many different systems, making them broadly appealing.
Collaborative Problem-Based Learning in Immunology and Virology

Karen K. Klyczek*
University of Wisconsin-River Falls, River Falls, WI

This poster will summarize six years of experience using an extended, open-ended problem-based learning (PBL) approach to enhance student learning in Immunology and Virology courses. The PBL process we have used is based on the University of Delaware model which includes 1) creating and exact statement of the problem, 2) identifying information needed, 3) identifying resources, 4) assessing information obtained, 5) generating and analyzing possible solutions, and 6) presenting the results. Collaborative groups are assigned and these groups interact during class time as well as via bulletin board discussions outside of class. The problems used have generally been very open-ended scenarios based on current news and research reports. These problems are not well defined, so students spend substantial time on the first step of determining the nature of the problem. Student groups then decide what they need to learn and how they will learn it. Both groups and individuals are accountable for documenting what they have learned and also for documenting the PBL process. Groups are given 3-4 weeks to work through a problem therefore 2-3 PBL projects are included each semester. Data presented will include student performance on problem-oriented exam questions, student survey responses, and analysis of student contributions to the bulletin board discussions during the problem solving process. Student response to this approach generally has been positive and the data suggest that students learn a significant amount of content through the PBL process that builds what is presented via traditional lectures.
To Reject or Not to Reject: Skin Grafting in *Xenopus laevis* as a Project-based Measure of Cellular Immune Responses in an Immunology Course

Kathleen S. Jagger*, Elizabeth Crouch, and Kevin Kinney
Transylvania University, Lexington, KY

Students in immunology courses seldom have the opportunity to do extended lab work with live animals or to measure cell mediated immune responses. Instead, many labs focus on serological assays or immunization experiments that lead to measuring antibody responses. In an upper level undergraduate immunology course, we asked whether inquiry based projects with skin grafts in *Xenopus* frogs could fill a need for students to explore cell-mediated immune responses. One advantage of this model system is that, due to strong nonspecific defenses, problems with secondary infections are minimal. In addition, a small number of animals are required for each project team. Disadvantages include the need to monitor animals daily after grafting to look for signs of rejection, and the length of time required for the experiment if secondary responses are included. The technique of skin grafting is not difficult but requires some careful instruction, patience and practice. The model system allows students to plan experiments that test core immunological principles such as self-nonself recognition, specificity, and memory. Experimental designs generated by pairs of students illustrated the variety of ways students could approach study of a particular immune response. In final lab reports, all students demonstrated a basic understanding of the process of graft rejection in spite of the fact it was not covered as a lecture topic. Student responses to this laboratory project concept were positive in spite of their observation that project labs required a considerably greater time investment than a typical 3 hour per week lab.
Microbiology and Discovery: Biology Majors, Non-Majors, Non-Science Students and High School Students

Deb L. Wohl*, P. B. Lessem, and J. B. Reed
University of Richmond, Richmond, VA

With the support of a National Science Foundation grant, we are offering experiential learning opportunities to three different populations of students; University of Richmond undergraduates (biology and non-science students) and high school students enrolled in GRAHEC programs. To maximize student learning and efficiency in presentation, we have developed one general course design that can be delivered to three targeted populations. During the spring semester, undergraduate students enrolled in Microbiology (biology majors) and Unseen Life (non-science majors) collected water samples from wells and surface water in Rayon Park, VA. All laboratory exercises, in both courses, have used these samples and isolates to explore basic concepts of microbiology, such as microbial physiology, morphological and biochemical classification, and microbial diversity. Students were then encouraged to design group projects to either investigate antibiotic resistance or the reversion of antibiotic resistance using isolates (or the water) from Rayon Park. Results were presented at a joint on-campus symposium. This summer a version of the course will be offered to the high school students. Thus far, we have found the real-world application of their projects to stimulate learning and discussion. We have also observed a "learning cascade" has evolved through this project. We have observed biology majors tutoring and/or mentoring non-science majors and several non-science majors have expressed an interest in future involvement with the summer high school component of this course.
Community Profiling and Isolation by DGGE & TTGE in Conjunction with Microbiological Techniques

Delaram Araghi & Larry Baresi
California State University, Northridge, CA

Extreme environments such as Blue Barnes Springs, provides an ideal habitat for bacterial community analysis that can elucidate other fields such as microgeology. This high pH (10.5-11.5), environment is one that is not halophilic or thermophilic like other alkaline environments. The unique features of this spring may also serve as a source for alkalophilic bacteria isolation, which may be significant from an industrial point of view. Industrial applications such as development of biological detergents and chemical production can depend on enzymes produced and isolated from extreme conditions. Additionally, enzymes produced by these organisms could be used in food and waste water treatment plants (Horikoshi, 1996). Cultivation and isolation of bacteria from extreme environments are not always successful. In this study, both the traditional microbiology methods and new molecular techniques are employed in parallel to yield optimal results. Many new organisms isolated from the springs are being sequenced and identified some of which may have not been cultured previously. Isolation and identification of the community members and the overall profile of the population by DGGE or TTGE helps understand the biodiversity of microbial habitat and their role in evolution. The concepts from this study are suitable to be utilized in a classroom setting. This way the importance of microbiological and molecular techniques both together and independently can be demonstrated. By employing these methods students will develop great insight as they carry out a range of challenging experiments.
Risking Reform to Enhance Learning

Richard L. Mower* and Teddie Phillipson-Mower*
Indiana University, Bloomington, IN

Reform teaching is risky business when an instructor's position is partially determined by student evaluations and those evaluations are good. However, in this case, dissatisfaction with a traditional lecture-lab teaching style and level of student conceptual understanding led to an interest in reform-based teaching. A mixed-methods research design was employed to address the following questions. 1. Does reform-based teaching facilitate increased student achievement and interest levels? 2. Are there identifiable groups that are not benefited from reform-based teaching? 3. If so, what factors may contribute to this? Reform-based teaching was measured by the Reform Teaching Observation Protocol (RTOP). This instrument was developed by the evaluation team of ACCEPT at Arizona State University and is based on the theoretical framework laid down by reform documents (NSES, Benchmarks) and a constructivist perspective. Other instruments used in this study included a pre-post interest survey, the class final exam, individual and collaborative assignments, student evaluations, open-ended quizzes, self reported demographic data, and the Kolb Learning Style Preference Inventory. Participant recruitment, data collection, and initial analysis were conducted by the non-instructor researcher in an effort to minimize conflict of interest and confidentiality issues. Following the submission of final grades for the course, both the faculty member and graduate student completed the analysis. All classes used in scoring the extent of the reform teaching were videotaped and these were used to establish inter-rater reliability. Results and interpretation from the first of two study phases will be shared at the poster session.
Integrating Traditional Inupiaq Ways of Knowing with Clinical Microbiology

Tina Melin*
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The Clinical Laboratory Scientists at the Maniilaq Health Center Clinical Laboratory has teamed up with young scientists of the Northwest Arctic Region to work in the field of Clinical Microbiology. We plan to learn more about the effects of plant and tree extracts on pathogenic bacteria in vitro. We are working with botanical products of distillation testing indigenous plants and trees as well as those from around the world. The young K–12 students are teaming up with Elders, health care providers, teachers, community science coaches, and Clinical Laboratory Scientists in the field of research conducted in the Clinical Microbiology Laboratory. We are working together on projects to be shared with the community and at local and state science fairs.

The students have learned valuable traditional knowledge from the Elders and community members through their seasons spent outdoors in the arctic wilderness and at camp. We have all heard stories about the uses of plants for healing. The students wish to learn more about the traditional knowledge of plants with regards to helping combat bacterial infections. When we work with botanical extracts, we get an educational experience in indigenous healing traditions, world geography, ecology, science, and conservation of our environment.

It is our goal that these concerted efforts may help encourage students at an early age to explore and learn more about the exciting field of scientific research and development. This knowledge and understanding may help improve the quality of life for the communities in which they live. We hope that working together on science projects that integrate the traditional scientific ways of knowing will serve as a foundation that may help turn science to the service of our communities with a springboard to the future.
Near-Peer Mentors: The Reciprocity of Scientific Mentoring

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8:00 a.m.: "Dr. Anderson, guess what? I made it into the National Honor Society!!!" exclaimed a student who has completed four pre-college research internships and who begins this summer as a near-peer mentor. The innovative Near-Peer Mentoring paradigm developed for undergraduate and pre-college students by Walter Reed Army Institute of Research, Department of Molecular Pathology, has successfully bridged the gap between the scientific novice and the active researcher. Near-peer mentoring is structured to articulate the research internship with the professional practice of education. Near-peer mentors are generally third year undergraduates with a strong background in the qualitative discipline and volunteer activities and who possess a passion for science. The near-peer mentors teach and mentor more than 150 pre-college students on assigned days while continuing their independent research the other days. Thus they are trained as laboratory researcher assistants and learn how to design inquiry-based research projects for the pre-college classroom. Pre- and post-survey instruments/interviews have independently documented the validity of this novel approach. These attitudinal and behavioral surveys were designed to measure changes in confidence, work habits, communication skills, all facets of scientific endeavors, acquisition of teaching skills, and the most importantly, the impact of long-term mentoring upon a student's aspirations and goals. Our results have shown that the opportunity to be mentored and in turn to mentor goes beyond social-economic status, minority constraints, or community boundaries. Therefore, the underlying constructs of near-peer mentoring resolve the obstacles commonly encountered in retaining students in the qualitative disciplines.
Adaptation of the "Dark Winter" Exercise for use in a General Microbiology Group Project

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Because of its topical nature, biological warfare has become a common discussion issue in college microbiology courses. A variety of microbiology principles can be investigated including epidemiology, pathogenic mechanisms, microbial physiology, and biotechnology. In addition, the topic allows for dialogue in the areas of politics, policy development, and homeland security and thus broadens the student learning experience.

"Dark Winter," an exercise conducted in the summer of 2001, was developed by the Johns Hopkins Center for Civilian Biodefense, Center for Strategic and International Studies, ANSER, and the Memorial Institute for the Prevention of Terrorism. It simulates a smallpox attack on the United States against a backdrop of political unrest, civil strife, and medical uncertainty. Students have different learning styles and engaging them in cooperative group projects allows students and instructors to interact in ways that differ from the formal lecture. The author has permission from the Center for Strategic and International Studies, Washington, DC, to edit and revise the original "Dark Winter" script to adapt it for educational use. The modifications result in a group of four receiving scripts for four leadership positions, such as President and Secretary of Defense. Each script is different and the group must meet to "role play" the exercise. A series of questions is used to prompt discussion and research. It is the author’s intention to share this project with interested instructors in order to receive feedback and constructive comments. After considering such comments, the project will be modified and submitted to the ASM Educational Resources site for use by interested microbiology educators.
The Use of Role Play in Learning: the trp Operon as an Example.

Jeffrey J. Byrd*
St. Mary’s College of Maryland, St. Mary’s City, MD

Microbial genetics has many concepts that require the student to think three-dimensionally about the topic to fully understand the material. One of these topics is the trp operon. I include the trp operon in the discussion of regulation so that the students can analyze a regulation system that is more complex than the lac operon. Students find the trp operon challenging and more difficult to understand than the lac operon. With this in mind I set out to make the trp operon conceptually more comprehensible. After a lecture-style discussion of the trp operon, so they would have a basic understanding of attenuation, I convinced the students to act as if they were the parts of the operon: attenuator sequence, polymerase, and ribosome. By role playing as the trp operon, both those students that participated and those that observed were able to see the trp operon function in three-dimensions. Assessment of learning stemming from this exercise was accomplished by pre- and post-activity tests. The questions on the tests required the students to apply the learned information to an advanced situation. The questions were not discussed in either the lecture or activity. One-half of the class received the pre-test and the other half the post-test, so as to be able to administer the same question to all students. The use of this exercise increased student learning by 30%, when compared with a basic lecture presentation. Similar exercises will be presented for mitosis/meiosis and replication.
Disease Database: An Internet Resource Contributed To and Maintained by Major and Non-Major Microbiology Students

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Brigham Young University, Provo, UT

Encouraging students to read, write, and synthesize information from a variety of course texts, library materials, or the Internet is a challenge facing many microbiology educators. To respond to this challenge an interactive web-based resource called “Disease Database” was developed. The main goal of this project was for students to contribute to, maintain, and access an up-to-date compilation of information about infectious diseases. Another objective was to determine the usefulness of this tool as a resource for students. In fall semester 2000, the database was developed by Brigham Young University’s Instructional Media Center using Microsoft Access and was housed on a server in the College of Biology and Agriculture. Since winter semester 2001, student volunteers in non-majors allied health microbiology and a major’s medical microbiology courses have been used as authors and editors. In any given semester, approximately one-third of students in these courses submitted entries to or edited previous entries in the database. Currently, the database consists of 122 entries covering a range of diseases from acne to yellow fever. In a survey of approximately 110 non-major students taking microbiology over two semesters, more than 80% of respondents agreed, strongly agreed, or very strongly agreed that the database was an effective way of retrieving information about infectious diseases. This poster will demonstrate key features of “Disease Database,” provide examples of student entries, and explain how using a student-driven database can contribute to learning outcomes in non-majors and majors microbiology courses.
Practical Tools for Evaluating Instructor and Student Skills in a Microbiology Course

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University of Wisconsin – Stout, Menomonie, WI

Instructor evaluations designed for lecture-based teaching are inappropriate for measuring progress toward course goals in a small-group, interactive, classroom setting. These surveys, commonly done at the end of each semester, may not be taken seriously by students who will not be impacted by the results. Student mastery of course content is measured by grades on exams and labs, but course goals involving social skills such as group communication, are rarely assessed. To improve, instructors and students need to have frequent and practical feedback on their progress toward meeting all course goals. I have developed a package of evaluation tools that I use in a semester-long Microbiology course. This packet includes practical evaluation forms that assess the students’ social skills and the instructor’s use of different teaching strategies. These evaluations are easy to disseminate and score. The evaluations include formal mid-term and final instructor evaluations, evaluation forms for outside course observers (instructor-instructor evaluations), and forms for student-student evaluations. Frequent opportunities to evaluate the course provide students with a sense that they are responsible for the quality of the course and for their own learning. Outside observers provide important perspectives for improving teaching skills, and an easy-to-use evaluation form makes the observations more effective. Student peer evaluations build social, interpersonal, and constructive criticism skills, while enhancing group performance. This poster showcases these evaluation tools, summarizes student responses, and demonstrates the effectiveness of these instruments by discussing how I have used this feedback to make improvements to my course.
Integrating Biotechnology, Molecular Biology, and Microbe Appreciation into a Biology Methods Laboratory

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Microbes serve as rich sources of novel enzyme activities for molecular biologists. Although molecular biology has become an essential part of biology education, the student may not make the connection between the enzymes they use in the laboratory and the biotechnology that lies behind the tube. We have designed a lab module with the goal of integrating enzyme production and purification strategies with molecular biology techniques that use the product.

Students first purified recombinant Taq DNA polymerase from an *E. coli* over expression strain. The purification exploited the high level of protein production in the recombinant system as well as the thermostability of the polymerase relative to most *E. coli* proteins. In the second lab, the students assessed enzyme activity by using their protein prep to amplify DNA via PCR. Aliquots of the PCR reactions were analyzed by agarose gel electrophoresis and product yield was estimated by comparison of DNA products resulting from student Taq preparations versus a commercial preparation of the same enzyme. A laboratory notebook and postlab questions were used to assess student laboratory work and understanding. This lab sequence served as an introduction to thermophilic bacteria and other extremophiles as a rich source of novel enzymes for biotechnology and molecular biology. In addition, students learned first hand about the advantages of regulated, recombinant protein expression systems in terms of increased product yield and facilitation of protein purification. Finally the lab exposed general biology majors to basic molecular biology techniques such as PCR and agarose gel electrophoresis.
A Personal Laboratory Approach to Increasing the Non-science Major's Awareness about Microbial Diversity and Antimicrobial Agents

Maria Borovilos*, Joanna S. Brooke*, and Rasha Ghattas
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The current world events make it important for all individuals have a basic knowledge of disease, microorganisms, their transmission, and their host organisms. To promote microbiology education of undergraduate non-science majors, we have developed a laboratory exercise that allows our students to actively engage in learning about the diversity of microorganisms found on/in themselves and antimicrobial resistance. All appropriate safety procedures are taught and strictly enforced. The laboratory session is designed to allow non-science majors to experience a research-style experiment in a field of science often perceived as very challenging to these students. The exercise teaches students about the isolation and cultivation of microorganisms, and how they can be tested for sensitivity to antimicrobial agents in a clinical microbiology setting. We have observed that students readily connect with material that is personal to themselves. In this exercise the students test the growth of their own microbial flora upon exposure to various household antimicrobial agents. After results are obtained, a class discussion is held that covers the scientific method, the experimental techniques, the observations and critical analysis of the results. Students are encouraged to note the differences in sensitivities between individuals' flora to antimicrobial agents. In this discussion, students typically enter into areas of evolution, mutations, diversity, biofilms, antibiotic resistance, normal flora, health, and biotechnology. Our undergraduate teaching assistants have run this exercise successfully for two years. We have found that this interactive laboratory exercise generates student interest and curiosity about our research projects ongoing in the department.
Incorporation of DNA Sequencing into an Undergraduate Introductory Biology Laboratory

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DNA sequencing and genomic analyses have revolutionized the study of microbiology. Recently, automation has reduced the cost of DNA sequencing such that it can now be affordable in a classroom setting. A multi-week DNA sequencing exercise was incorporated into BS/LBS159H, the honors introductory cell and molecular biology laboratory course at Michigan State University. The students had previously studied termite gut communities by conventional microbiological methods in the companion organismal laboratory course. To use a molecular approach, students, working in teams of three, PCR amplified cloned 16S rRNA genes from a clone library of rRNA genes from a termite gut community and submitted their PCR products to the MSU Genomic Technology Support Facility for sequencing (two priming reactions per team). They then used computer software (Staden) to assemble their contigs and BLAST their consensus sequence against GenBank to identify the termite gut organism their rRNA gene was derived from. Students then wrote a research paper describing the phenotypic characteristics of their unknown and suggesting conditions to attempt its isolation. Finally, identified termite gut organisms from all teams were compiled by instructors and a phylogenetic analysis of the sequences distributed to provide them with a more comprehensive view of the termite gut community. The multi-week exercise was incorporated into the course to serve as a focal point for discussions of PCR amplification, sequencing chemistry, biotechnology, genomics, phylogenetic analysis, molecular strategies for microbial community analysis and computer analysis of DNA sequences and also as a link to the honors organismal biology laboratory course.
Internet Teaching of Microbiology

John R. Stevenson* and P. Helen Stevenson
Miami University, Oxford, OH

Internet Teaching of Microbiology was designed to enhance high school biology courses by providing teachers with the knowledge and skills to introduce microbiology via the Internet. This two-week workshop integrates discussion and implementation sessions directed by instructors to provide a broad spectrum of learning experiences. Discussion sessions cover participant-selected microbiology concepts and strategies to enhance teaching them. Implementation sessions cover use of browsers to find microbiology information and emphasize cooperative development of learning modules to generate web sites that effectively communicate microbiology information in novel ways. Participants learn more microbiology as they progress in this workshop because they must analyze concepts being presented from many viewpoints and must understand them very well to do so. Demonstration and discussion of web pages generated and learning strategies developed enhances participant learning. Anonymous course evaluations indicate participants are highly satisfied with the course and with what they have learned about generating web pages, Internet communication, and microbiology teaching. Communication with participants after they have used their web pages in classes indicates that course objectives are being met. Participants are using their web pages to teach microbiology concepts and are empowered to use technology in the classroom as a result of this workshop. Some participants continue to develop their web pages and have uploaded them to their school servers. We continue to support accessibility of all web pages in the eleven microbiology modules generated by twenty-nine participants since the inception of this workshop in 1998 by maintaining them on our server at http://www.cas.muohio.edu/~mbi-ws.
Hands-on Educational Workshops for Underrepresented Undergraduates in South Africa

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Educational workshops were linked to the NSF Life in Extreme Environment Program Witswatersrand Deep Microbiology Project. The South African gold mines provided a unique international opportunity for connecting educational opportunities to current research investigating microbial processes in deep subsurface environments. Poorly represented groups of undergraduates from U.S. and South Africa (S.A.) participated in educational hands-on workshops (December 2001 and 2002). The workshops provided field laboratory research experience for undergraduates in the fields of Earth, biological, environmental sciences, and engineering. Workshop goals were to engage undergraduate students in educational opportunities not normally available and foster science and technology collaborations between S.A. and U.S. We successfully demonstrated that workshops with underground activities involving students was safe, feasible, and career enhancing. In the mine, students collected biofilm and hot saline waters emanating from gas-rich boreholes. Student activities included chemical analyses, enrichment of aerobic and anaerobic bacteria, DNA extraction and amplification for molecular characterization, and discussions on biodiversity and ethics in research. Students were immersed in a cultural, scientific, and interdisciplinary atmosphere relying on teamwork. This one-week immersion in biogeochemistry of the subsurface developed international networks among students and multidisciplinary international scientists. Surveys, comments, attributes, and program commitment revealed positive impacts on underrepresented S.A. and U.S. minority students. A niche was found and paths were demonstrated for fostering science, educational, and technology collaborations involving South African mines, faculty, and students from U.S. and S.A. universities, government, and industry. http://geomicro.utk.edu.
Undergraduates as Outreach Teachers Among NH Volunteer Lake Monitors

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Project Lake Watch is an NSF-University of New Hampshire partnership. It is a pilot program initiated in 2002 to develop UNH undergraduate students as outreach teachers among NH citizen volunteer lake monitors. Students are exploring geospatial technologies for monitoring water quality in NH lakes. Members of Project Lake Watch (including faculty mentors) spent the first five weeks of the project learning limnological methods, use of lake reflectance measurements, and microbiological techniques. The latter included total cell counts obtained with microscopy of DAPI-stained samples and community biodiversity fingerprinting via sole carbon source utilization patterns.

Satellite remote sensing and hyperspectral radiometer measurements of upwelling reflectance are of ongoing interest. Landsat 7 and Modis data were obtained for a day in which teams of students were on Squam Lake taking microbiological and limnological measurements. Students are attempting to develop algorithms for relating reflectance measurements to lake water qualities including Secchi disk depth, color dissolved organic matter, and total microbial counts. The microbiological component of the Project also includes an effort to determine whether lakes differing in trophic status can be discriminated on the basis of sole carbon source utilization patterns of heterotrophic bacteria. Students have engaged the help of volunteer lake monitors in sampling and have been provided access to over 20 years of lake monitoring data for use in developing algorithms. They will, in turn, pass Project successes with microbiological community fingerprinting and use of reflectance data to volunteer monitors via training sessions and cooperative fieldwork.
Another use for Independent Research in a Microbiology Course

John R. Phytyon*
St. Norbert College, DePere, WI

A major component of the laboratory experience in the Introduction to Microbiology course at St. Norbert College is an independent research project conducted during the last month of the semester. After mastering basic laboratory skills including aseptic technique, students choose a microbiological problem of interest to them for investigation leading to a poster presentation during the final week of the semester.

The problem with this scenario is that often students do not have the background to propose a suitable (feasible) topic that can be accomplished in the time available. They also lack the critical analysis skills to judge the potential value of a line of research. An alternative I offer to students who have no good research ideas is to allow them to design a laboratory that could be used in an introductory course for non-science majors.

One of my students accepted this challenge and designed a laboratory exercise to illustrate the transmission of foodborne pathogens in a kitchen setting. He used cutting boards as the mode of transfer of *Listeria monocytogenes* in "hot dogs." Subsequently he conducted the lab, taught aseptic technique, and allowed the students to draw conclusions based on survival time of the microorganisms on the cutting board. He also designed a questionnaire as an assessment tool.

This poster will show the student-designed protocol, the experimental results of the laboratory conducted, and the results of a feedback questionnaire that the students in the non-major course completed.
A Maine ScienceCorps Promoting Excellence and Equity in High School Biological Science Education

S. Monroe Duboise*, Marisa Hackim Amaral, Kimberley Fantasia, Beth Lindroth Hill, Barry Larman, Elizabeth Richards, Jacqueline Seguin, Daniel Swett, and Marisa Zenahlik,
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Teachers and students in Maine’s rural schools typically have inadequate access to laboratory resources and work in isolation from the larger scientific community. The Maine ScienceCorps, a collaborative effort of the University of Southern Maine (USM) and the Foundation for Blood Research (FBR), is engaging scientists and graduate students at Maine’s largest comprehensive state university in addressing these problems. Through this program, funded by the NSF Graduate Teaching Fellows in K-12 Education initiative, teams of immunology, and molecular biology graduate student fellows work with cooperating teachers in rural high school classrooms across the state. Laboratory and inquiry-based activities that facilitate teacher’s efforts to meet national and state science education standards are being provided. Now, in the second year, there are nine ScienceCorps fellows bringing molecular biology, immunology, and microbiology laboratory activities into eleven high schools widely distributed across the state. Activities used during the first year are being refined for better alignment with teachers’ curriculum plans and for improved adaptation to various class scheduling constraints. Additional microbiology, immunology, and molecular biology activities are being developed and tested in collaboration with teachers in these rural high schools. Examples of scenario-based laboratory activities will be presented including a case study based activity using an ELISA for diagnosis of Lyme disease and a bacteriophage laboratory presented in the context of possible applications of bacteriophage therapy to treatment of anthrax. Evaluation of benefits of this program to high school students and teachers and to the graduate student fellows will be presented.
Outcomes of a Research-Driven Microbiology Laboratory Course Designed to Enhance Undergraduate Contributions to and Preparation for Original Research

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This work describes outcomes of a research-driven Microbiology Laboratory and Literature Research course intended to enhance undergraduate preparation for and contributions to original research. The laboratory section was designed to teach fundamental molecular biology techniques in the context of an original research project while encouraging critical analysis of data. Site-directed mutants of a gene of interest were constructed, and the effects of the mutations on the resulting enzymes were analyzed. The literature colloquium introduced students to the literature surrounding their project, use of electronic literature databases, and preparation of slides for oral presentations. Student progress was evaluated through examinations, homework assignments, a ten-page written review, an oral presentation, and a laboratory report written as a *Journal of Bacteriology* manuscript. In the semester following the laboratory course, four of the fourteen undergraduate participants were selected to work on individual research projects in the host laboratory. Quantifiable outcomes of the laboratory course and subsequent undergraduate research included (i) production of eight new site-directed mutants and preliminary characterization of the corresponding enzymes, (ii) technical training of four individual undergraduate researchers prior to joining the laboratory, (iii) publication of a manuscript including results from two of the undergraduate researchers, (iv) presentation of two posters with undergraduate co-authors at a national meeting, and (v) on-going generation of original research for future publications. This research-driven approach may be applicable to enhance undergraduate preparation for and contributions to other research projects which have defined goals that are achievable within the timeframe of a single semester.
Impact of Pre-requisites on Student Success in Introductory Microbiology at Community College

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Introductory Microbiology is often a requirement for entry into nursing, dental hygiene, and other health professional training programs. For a variety of both personal and academic reasons, students frequently enroll in microbiology with a minimum of background in biology and then struggle through microbiology. The result is both lowered retention and poor student success in completion of the course. At Moorpark College we offer a single microbiology course for all students including allied health, biology majors, and biotechnology students. In this study we tracked student success over six semesters in our microbiology course that had an introductory biology prerequisite that was not enforced. We compare this to subsequent student success in our microbiology course that currently has a one semester general biology prerequisite that is enforced. As predicted, student success in the two cases dramatically differs. The results conclusively support the use of appropriate and enforced prerequisites to assist students in effectively achieving their educational goals.
Inquiry Guided Learning Across a Microbiology Curriculum

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The Department of Microbiology at North Carolina State University has transformed a series of core courses in our microbiology major into courses that employ inquiry-guided learning (IGL) principles. These courses include: 1) a first year inquiry guided seminar that sets the department’s expectations for the students, 2) a General Microbiology course and accompanying laboratory class, and 3) two capstone courses taken by seniors. We will present examples of new student assignments in the various lecture courses and describe how significant changes have been introduced into our laboratory classes. We will also illustrate how we have used Honors-level courses as an effective mechanism for initiating and sustaining change in our classes. Finally, will also discuss the institutional and cultural factors that have enabled these curriculum-level changes to be rapidly introduced and accepted within this department.