POSTER SESSION

ABSTRACTS

8th Undergraduate Microbiology Education Conference

University of Central Florida
Orlando, Florida

May 19, 2001
Poster Session
Saturday, May 19, 2001
7:00 to 9:00 p.m.

All abstracts will be available for viewing from 12:00 p.m., Saturday, May 19, 2001 through 11:30 a.m., Sunday, May 2001. Abstract numbers represent session-location.

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      University of Michigan, Dearborn, MI* and Rollins College, Winter Park, FL

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      Manchester Metropolitan University, Manchester, UK

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1-07  Interaction of Tributyltin-Sensitive and -Resistant, Biofilm-Forming Bacteria Isolated
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      R. J. Tang*† & J. J. Cooney
      University of Massachusetts Boston, Boston, MA

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      University of Southern Mississippi, Hattiesburg, MS

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Philadelphia University, Philadelphia, PA

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P. David Foglesong* and Cheryl A. Anderson
University of the Incarnate Word, San Antonio, TX

1-12 Euro-Sim: A Model for an Interdisciplinary Learning Community
Sharon L. Zablotney*, Laurie Lanze*, and Henry Steck²
¹State University of New York College, Fredonia, NY and ²State University of New York, Cortland, NY

1-13 An Investigative Laboratory Approach to Antibacterial Resistance for Introductory Biology Students
Maura J. Meade-Callahan
Allegheny College, Meadville, PA

1-14 From Frankenstein to "Frankenfoods": Exploring the Social Implications of Biotechnology
Marion Field Fass
Beloit College, Beloit, WI

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Elisabeth F. M. Schlegel*, Jeffrey Perchuk² and Ellen Fiasconaro¹
¹Harriet Tubman Institute for Special Education, Clara Barton High, New York, NY and ²Midwood High School, New York, NY

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Ellen F. Fynan
Worcester State College, Worcester, MA

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Rochester Institute of Technology, Rochester, NY
1-18  Teaching Students How to Use Molecular Techniques to Test a Hypothesis on Microbial Diversity
Michelle A. Furlong
Clayton College and State University, Morrow, GA

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Manchester Metropolitan University, Manchester, UK

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Richard R. Sudweeks, William S. Bradshaw, and John D. Bell*
Brigham Young University, Provo, UT

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Betty Burns Sipe
Ivy Tech State College, Anderson, IN

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Midwestern University, Glendale, AZ

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Russell Nordeen*
University of Arkansas at Monticello, Monticello, AR

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J. J. Roth*
University of Salzburg, Salzburg, Austria

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California State University Northridge, Northridge, CA

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Michigan State University, East Lansing, MI

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National Science Foundation, Arlington, VA

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Hobart and William Smith Colleges, Geneva, NY

2-14 Use of Case Studies to Aid Learning in Introductory Microbiology
Lunching Sun* and Marcia Cordts
University of Iowa, Iowa City, IA

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Ouliana Djaman* and Sandra Kato Wright
University of Illinois Urbana-Champaign, Urbana, IL

2-16 Microbiology Literacy of Students in Science Classes
Margaret E. Heimbrook* and Carol A. Fortino
University of Northern Colorado, Greeley, CO

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Liz Sockett*, Dariel Burdass, Jane Westwell and Janet Hurst
Society for General Microbiology (SGM) and University of Nottingham, Nottingham, UK

2-18 Utilization of the Winogradsky Column and Purple Nonsulfur Photosynthetic Rhodospirillaceae for Improving the Teaching and Learning of Metabolic Diversity in Bacteria
Roberto Grau* and Alejandra Mussi
Rosario National University, Rosario, Argentina

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1-01    Keys and Trees: Experience in Two Laboratory Settings

Linda E. Fisher* and Eileen Gregory
University of Michigan, Dearborn, MI* and Rollins College, Winter Park, FL

During the 7th Undergraduate Microbiology Education Conference, held at California State Polytechnic University in Pomona, working groups developed outlines of laboratory exercises on the two topics covered in keynote addresses: immunology and bioinformatics. Our working group (members names) designed a framework for developing a laboratory exercise appropriate for a majors' microbiology laboratory experience. We titled the exercise Keys and Trees to indicate our desire to have our students compare two ways that bacteria can be studied and classified. Traditionally, students solve one or more unknowns using a combination of biochemical testing, staining techniques and microscopy. To this we have added a component that has the students solving the same unknowns using analysis of 16S rRNA sequences. The dichotomous keys and phylogenetic trees that result are then used as a basis for the students' understanding the nature of the information obtained by each type of analysis, as well as for understanding the reasons for the similarities and differences in the keys and trees that they have generated. The exercise is designed to be an open-ended, project lab done over the course of several weeks.

We report our experience with two versions of Keys and Trees, used with two groups of students. Feedback from both instructors as well as from our students indicate that we largely succeeded in introducing the concepts of bioinformatics in this format and in enhancing students' understanding of the relationship between phenotypic and genotypic similarities among bacteria.
A case study approach was used as a collaborative learning tool for ecosystem-scale iron fertilization experiments (IronEx I, II and III), their effects on phytoplankton growth and carbon dioxide draw down, and their potential ramifications on global temperatures and other aspects of the environment. The case is presented as a scientific and ethical dilemma involving the use of iron fertilization in an entrepreneurial ocean fish farming venture. In an advanced class, student teams prepare position statements in debate teams, taking the views of an ocean farming entrepreneur, scientists involved in the iron fertilization experiments, scientists concerned about ecosystem-scale experiments, and members of the interested public. In a freshman discussion class, students were divided into task force teams to consider all issues regarding the use of ecosystem scale nutrient fertilization and ocean farming. Each task force then presents the different views of each team member and the final position statement from the task force. In the process, students learn about (1) the controversy regarding global warming and greenhouse gases, (2) the Kyoto protocol, (3) the detrimental effects attributed to global warming such as the occurrence of West Nile virus encephalitis in the United States, (4) the role of microbes in the biogeochemical cycling of carbon, (5) the effects of iron fertilization on primary production in high nutrient low chlorophyll (HNLC) oceans, and (6) the factors limiting primary production in HNLC. After team presentations, the class discusses what measures individuals, a country, and the global community can take to minimize the emission of greenhouse gases. Comparisons of results from pre-test and post-tests show that participants learn better than students who did not participate. Except for one student, all participants enjoyed the case study approach and the collaborative learning. In conclusion, a case study approach is an effective tool in teaching a very complex subject to freshman and advanced students.
1-03  Implementation of a Food Safety Minor Using a Multidisciplinary Approach

North Dakota State University, Fargo, ND

Seventy-six million Americans suffer from foodborne illnesses annually at a cost of $6.5 to 35 billion. The impact of these illnesses has prompted the federal government to create the National Food Safety Initiative to address food safety issues all along the food chain. Realizing the tremendous need for food safety expertise, NDSU obtained funding through a USDA Challenge Grant to create a minor course of study centered about the single issue of food safety. Faculty involved in development of the minor included 19 individuals from seven departments and three colleges at NDSU. In less than one year, this group developed a multidisciplinary, novel, food safety curriculum that was delivered as a minor course of study largely obtainable in a single eight-week summer session. In the summer of 2000, this minor and the four food safety courses (three lecture courses and a practicum) developed for it, were offered for the first time to a diverse group of 24 students, majoring in microbiology, food science, animal and range science, food and nutrition, and agricultural economics. Delivery of the curriculum was based on a “farm to fork” philosophy in order to best allow students to gain an understanding, and to troubleshoot food safety issues regardless of where they arise in the food chain. Teaching strategies known to promote critical thinking, problem-solving, and collaborative skills were used to present the curriculum. A science educator, using pre-test and post-test examinations, student evaluations and questionnaires, and personal observations, evaluated our success in curriculum development and implementation in terms of student learning and perception. The faculty will implement curriculum modifications and overall recommendations for course improvement in the summer of 2001. Overall, assessment of the project showed that this multidisciplinary minor approach to teaching food safety was successful and suggests that our experiences may be a useful model for others as they, too, attempt food safety curriculum development.

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1-04  A Laboratory Class Exploring Oral Biofilms

Joanna Verran
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The students are in the final year of honours programmes in Biomedical Science or Biological Sciences, taking an ’Environmental Microbiology’ course, which is also part of a Microbiology route through the programme. There are usually approximately 40 students on the course. Nine lectures on biofilms accompany the lab class, which comprises two 3 hour sessions. The aims of the class are to enable the students to appreciate the complexity of the oral microflora, and to be aware of difficulties encountered in its study. They sample plaque, and study it using electron microscopy, darkfield microscopy and light microscopy. The sample is cultured on a range of selective media and students calculate the number of microorganisms per mg plaque. Findings are compared with microorganisms cultured from their own used toothbrushes. The limitations of visual and culture methods are considered. Students work in pairs and class results are pooled. Problems associated with different microbiological techniques, and the limitations of cross sectional information may be explored. Relationships between a range of parameters are considered, presented graphically, analysed statistically and considered critically. Lab reports are submitted either by each pair, or individually – the choice is given to the students. Requirements for the report are indicated in the sheet provided at the beginning of the class. The opportunity is provided for an extensive, critical report, thus enabling good discrimination between students. Evaluation is favourable. The students find the report ‘hard work’, but enjoy the open ended and explorative nature of the exercise.
Didactic strategies are discussed that promote the acquisition of skill in analyzing experimental data in a cellular biology course of 150 students. The model of teacher as presenter of information is replaced by the model of teacher as coach. In this new role, the teacher must make careful choices regarding methods to provoke student involvement in the classroom, and the breadth and depth of coverage. The choices of coverage are required by the extreme volume of information available. Consequently, the teacher must narrow the content to allow sufficient time for students to practice applying concepts and to wrestle with the design and execution of the experiments whose results have generated those concepts. Also, if the fundamental concepts are diluted by transient memorization of excess detail, students may fail to acquire the basic foundation upon which new information can later be added by independent effort. Text reading assignments are annotated to focus student attention, and students assume full responsibility to acquire the fundamental language appropriate to the subject at hand. Classroom activities require students to communicate (speak, engage in group discussion, formulate the question being posed in a particular experiment, practice interpreting the information in figures and tables). Examination questions assess both the ability to apply biological concepts to a broad context and to draw appropriate conclusions from data relevant to those concepts. Resources include the use of computer simulations of experimental methods (chromatography, electrophoresis, etc.), and attendance at small group, faculty-directed mentoring sessions.
Assessing Student Performance on Data Interpretation Tasks in a Cell Biology Course

Richard R. Sudweeks, William S. Bradshaw and John D. Bell*
Brigham Young University, Provo, UT

We present an assessment of student performance in a cellular biology course that is directed to the acquisition by students of skill in understanding, analyzing, and interpreting experimental data. Our results demonstrate that students are able to perform admirably on rigorous examinations that test these skills directly by requiring them to draw cogent conclusions from sets of experiment results. Analysis of student performance on these tasks demonstrates that our scoring rubric is statistically reliable. An analytical task may be successfully presented in multiple choice or short essay formats. A pre- and post-semester comparison of test scores validates marked student improvement in a set of analytical tasks. A didactic focus on data analysis does not preclude the acquisition of fundamental facts. Comparisons, using examination scores, between courses with different teaching goals and methods show that data analysis skills are not casually acquired without directed help. Possible relationships between choices of ancillary activities (computer resources, homework problems, mentoring sessions) and performance on exams are presented. These relationships are compared to survey data that report student attitudes and confidence in practicing the intellectual skills common to biological scientists. Analytical exam questions may differ with respect to subject matter content, relative difficulty of the experimental design and protocol, complexity of the data presented, and the amount of relevant preparatory practice performed by students.
Interaction of Tributyltin-Sensitive and -Resistant, Biofilm-Forming Bacteria Isolated from Boston Harbor, MA

R. J. Tang* & J. J. Cooney
University of Massachusetts Boston, Boston, MA

Microbial biofilms are major initial agents leading to biofouling of surfaces immersed in seawater. Despite antimicrobial compounds containing organotins to inhibit microbial growth, biofilms still develop on boat hulls coated with organotin paints. In order to find the interaction between bacterial flora capable of colonizing organotin-coated surfaces, biofilms were initiated in Modified Robins Devices (MRD) using coastal seawater as the source of inoculum and nutrients. Tributyltin (TBT), the most effective ingredient in some antifouling paints, was applied to discs on the interior surface of MRDs. Biofilms were sampled and streaked onto tryptic soy agar containing TBT to select for TBT-sensitive and -resistant strains. Pure cultures of TBT-sensitive and -resistant stains were reintroduced into MRDs. Their interactions were examined. The preliminary results show that some TBT-sensitive strains could form a biofilm on a TBT coated surface 72 h after inoculation. The amount of TBT-sensitive cells in these biofilms did not change regardless of the presence or absence of TBT-resistant ones.
Effective learning is enhanced by well defined instructional objectives that relate to evaluation items. The objectives provide the instructor with a plan to facilitate instruction and provide the student with a guide to prepare for evaluation. Objectives are statements that describe the knowledge, skill, or attitude that a student is expected to demonstrate after the instructional activity. Objectives in the cognitive domain are leveled into categories based on the expected outcomes of the instructional unit: level I, recall; level II, application; and level III, analysis. Examples of a microbial concept at the three levels of cognition include 1) Level I: Label the cell membrane; 2) Level II: Discuss the functions of the bacterial cell membrane; 3) Level III: Differentiate between the functions of the cell membranes of amoeba and of an aerobic respiratory organism. Well written objectives define conditions that will exist, performance expected and level of achievement required for success. Objectives serve as a de facto study guide for the student if instructors use objectives to determine items for evaluation and use of level III objectives promotes critical thinking skills.
Pitcher plant microbial communities are ideal systems for use in undergraduate research on aspects of microbial community ecology. This poster describes several undergraduate projects investigating aspects of the microbial/invertebrate communities that form inside leaves of the pitcher plant Sarracenia purpurea L. This plant produces large pitcher shaped leaves that fill with water. Small animals, including ants, grasshoppers, flies, spiders and frogs fall into the leaves where they become trapped and drown. Collectively referred to as necromass, these organisms provide food for members of a small community of prokaryotes and invertebrates. Pitchers sampled during two summers at Mud Lake, an incompletely formed sphagnum bog in upstate New York, contained bacteria, algae, various protozoans, mites, midges and the larval stages of several dipterans and of a mosquito. Upon viewing these communities undergraduates can easily develop questions regarding interactions between members of the community. Research projects done by undergraduates on this system include investigations of: the indirect effects of necromass, which serves as prey for mites, on bacterial population sizes; the effect of protozoan grazing on microbial community structure; and biofilms forming on the inside of pitcher plant leaves. These projects are briefly summarized and additional ideas for using this system in undergraduate teaching and research are discussed.
1-10  Designing Assignments that Provide Students with Historical, Global and Environmental Perspectives of Microbiology

Diana R. Cundell
Philadelphia University, Philadelphia, PA

Philadelphia University is a Masters College and University which strives to provide an integrated "seamless learning" experience, with students taking a variety of liberal arts, writing, and science courses. Students taking microbiology come from a variety of majors so that the design of assignments needs to be both appropriate for all of them and involve the examination of global perspectives of the subject. The seamless learning component of the course developed students' problem-solving and active learning skills and involved two written assignments. In the first assignment students wrote a newspaper obituary of a famous microbiologist, in which they explored both the importance of this scientist and examined their role in the development of Microbiology. For the second paper students produced an account of an historical epidemic, seen through the eyes of a Microbiologist (scientist or physician). This required a historical and scientific understanding of the era in which the epidemic was set and allowed students to develop creative skills. To address the diversity of majors, problem-based learning exercises were designed in which students developed algorithms to identify a series of microbes recovered from soil, water and patient samples when given information on their colonial morphology, staining, and differential characteristics on agar. In conclusion, the use of varied assignments has allowed students to gain a perspective on the historical, global, and environmental importance of Microbiology as a subject. Further, for clinical microbiologists, physician assistants, and environmental scientists these exercises provided them with the initial tools for their future careers.

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The Use of Blackboard 5 in General Microbiology

P. David Foglesong* and Cheryl A. Anderson
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Blackboard 5 is software that enables faculty to manage courses through the creation of a website. This software is very user-friendly; faculty do not need to know UNIX in order to create a website under Blackboard 5. University of the Incarnate Word (UIW) is a private comprehensive university with a Catholic tradition. The University embraces the use of technology to advance education of our students. Recently, UIW became a laptop university. This means that within two years all of our faculty and students will have an IBM Thinkpad Model 2628 laptop computer equipped with wireless access to the internet. Several major academic buildings are already equipped with wireless systems, including Science Hall, which houses courses in microbiology, and the library. Therefore, it will soon be possible for faculty to request that students bring their computers to a classroom for work that requires internet access. Previously, that was only possible in classrooms with computers that were hard-wired into the internet.

Blackboard 5 provides a website dedicated to an individual class with access codes provided by the professor. We set up such a website for General Microbiology for Spring Semester, 2001. The home page of the website contains several links to other information for students: a brief curriculum for the professor (P.D. Foglesong), a course syllabus containing complete information about the schedule of lectures and grading policies, study guides for the tests, links to numerous websites relevant to microbiology, and a link to the UIW library page, which provides access to databases of library holdings as well as online journals. These resources are very helpful for the students in writing their required term papers which must include references to the current scientific literature. Students are specifically trained in the use of PubMed to obtain current references in microbiology as they develop their term papers. Lastly, the e-mail address for the professor was also given as a link to facilitate communication with the class.

Blackboard 5 provides for several other features that have not yet been attempted in this first semester's experience. It is possible to set up discussion groups in Blackboard 5, and to have threaded discussions with extensive input from the professor. We plan to try this in coming semesters particularly in connection with service learning projects. Blackboard 5 also allows professors to post grades that can only be accessed by individual students with averages calculated. Features such as these may also prove very helpful in teaching microbiology.
The Euro-Sim is a multi-institutional, international simulation of the European Union (EU). Expanding this successful program to embrace the philosophy and instructional strategies of a learning community promoted enhanced student learning and tangible professional benefits for faculty. The revised Euro-Sim combined the pedagogy of gaming and simulation with those of cooperative and collaborative learning, the hallmark attributes of a learning community. Student participants assumed the roles of the officials and representatives of participating countries of the European Union and debated the validity of the proposal to establish a European Food Authority. Preparation included a comprehensive knowledge of political, socioeconomic, cultural implications and a thorough understanding of the scientific basis and need for such a regulatory organization. Assessment of student learning employed methodological triangulation to collect assessment data: exit survey, debriefing sessions, participant-observer notes, and expert observation. Results demonstrated enhanced student learning and skill development, and broader perspective of the relevance of science. Collaborative relationships fostered by the learning community furthered the goals of the simulation through the enhancement of faculty teaching and faculty and student scholarship. This model supports the use of an interdisciplinary, learning community instructional strategy to deepen student learning and to support the professional development of faculty.
An Investigative Laboratory Approach to Antibacterial Resistance for Introductory Biology Students

Maura J. Meade-Callahan
Allegheny College, Meadville, PA

The introductory biology sequence at Allegheny College includes one sophomore-level laboratory course, Investigative Approaches in Biology, which is divided into three modules providing different experimental experiences. In each module students perform a basic experiment following a protocol provided by the instructor, then use their results as a basis for formulating and testing their own original hypotheses. The following two weeks of the module are spent performing experiments to test the hypothesis and analyzing data. Finally the results are presented to the class in a 10-15 minute oral presentation, followed by a written laboratory report. The goals of the class are to introduce students to the scientific method, the primary literature, and discipline-specific oral and written communication skills. A new module testing resistance of bacteria to natural and synthetic antimicrobial products was introduced in spring 2001. The instructor-directed laboratory involved conducting a disk diffusion assay and phenol-coefficient type experiment to determine the ability of various products and plant extracts to inhibit bacterial growth. Students were administered an anonymous survey rating their experiences in this module. Data collected from the first group of 19 students surveyed indicated that only 10% of students felt they had a strong background in microbiology before beginning the experiment. Sixty eight percent of respondents indicated that conducting the experiments in this module significantly increased their appreciation for microbiology and their interest in the topic of antibacterial resistance. The experimental format, sample independent projects, and survey data of 51 students will be presented.
Recent concerns about genetically engineered foods and about the possibilities of human cloning have demonstrated the need for scientists to understand the ethics as well as the science that underlies their work. This interdisciplinary course, offered at Beloit College in Fall, 2000, both taught the science of biotechnology and explored expectations, realities and responsibilities of scientists and the public.

The Social Implications of Biotechnology built upon considerations of culture, science, economics, media, ethics and public policy to help students construct a complex and multilayered understanding of the future of biotechnology. The course was structured around problems based on the applications of biotechnology, from the development of new and powerful medicines to the genetic modification of agricultural products. The ASM video series, Unseen Life on Earth, provided some examples for student discussion. Students from sciences, social sciences and humanities were able to discuss and debate issues ranging from the quest for a perfect baby to the just and equitable uses of biotechnology in the developing world. The mixed student group demonstrated to the students that different disciplines approached topics in different manners, and that it was important to understand disciplinary perspectives in order to engage in meaningful dialog and to develop compromises necessary in a democratic society.

Microbiologists sit on the cutting edge of progress in biotechnology, and the tools of microbiology drive innovation. An understanding of the potential social considerations of scientific work is critical for our students. This course suggests one way to approach these important issues.
The practical study of microbes is often a neglected subject in the science laboratories of Special Education in public schools. It is very hard to meet the needs of students who have a wide range of different learning disabilities like Attention Deficit Disorder (ADD), Attention Deficit Hyperactivity Disorder (ADHD), Dyslexia or Dyspraxia (1). Experience shows that Special Education students respond best in situations that emphasize multi-sensory hands-on activities that are adapted to the students' concentration span. So new learning strategies must be developed to put Special Education students in touch with microbiology and the five human senses: Microbiology by Multi-sensory learning. Multi-sensory Learning is the process of using as many of the senses as possible while doing exercises. It requires concentration and effort from the student. Concentration causes brain stimulation and makes the individual more receptive to learning.

The goal is to show students the importance of food microbiology in their lives (2) (3). In inexpensive exercises students utilize dried yeast Saccharomyces cerevisiae and Streptococcus sp. / Lactobacillus sp. cultures to produce bread, yogurt and buttermilk. The fermentation processes are explored by smelling, tasting and touching as well as by using magnifiers, microphones and loudspeakers. The exercises can be done all at once or can be broken down into shorter "sprints". The work setting can either be in groups or in traditional rows for independent work. Results and findings are collected on posters and shared with the class.
Development and Evaluation of a Microbiology Course for Non-Science Undergraduate Students

Ellen F. Fynan
Worcester State College, Worcester, MA

At Worcester State College, microbiology has been offered primarily for students majoring in the biological and health sciences. This semester, a course was offered specifically to present topics in microbiology to undergraduate students majoring in disciplines other than science. The course was divided into three main sections: 1) biology of microorganisms, 2) laboratory exercises, and 3) social aspects of microbiology such as emerging diseases, biological weapons and biotechnology. A survey was administered to the 25 students on the first day of class to assess their scientific background and interests (multiple responses accepted). While 88% of the students registered to fulfill science elective requirements, 44% cited personal interest in the subject as a reason for taking this course. They rated their current knowledge in several areas from 0 (low) to 5 (high). On average as a class, students indicated an understanding of health issues (3.32), science in general (2.64), biology (2.52) and infectious diseases (2.32). Interestingly, however, they ranked their knowledge of microbiology low (1.0). When students were asked about their interest in specific topics to be covered, 76% were interested in emerging infectious diseases and 72% expressed an interest in three additional topics: disease transmission, HIV/AIDS and biological weapons. Only 24% noted an interest in the biology of microbes and 36% in laboratory activities. Upon completion of the course (May 2001), students will be asked to evaluate the course and those results, along with course materials and suggestions for improvement, will be presented.
Active-Learning in the Laboratory: Produce T4 Transductants after Using a Purchased Kit Demonstrating Transduction

Jean A. Douthwright
Rochester Institute of Technology, Rochester, NY

Students in a sophomore/junior level required microbial lecture and laboratory course carry out T4 phage transduction of an ampicillin-resistant gene using a kit purchased from a biological supply company. The procedure is very well defined or "cookbooked" for students. Students are given T4 transducing phage which transduce an ampicillin-resistance gene. Students test for transduction frequency and plate for survival of the phage on a susceptible host strain. Transduction is carried out on a strain that the phage will not normally plaque on.

Students are then asked to design an experimental protocol to produce transducing phage and carry out transduction to prove that their phage are capable of transduction. Students are given T4 phage and two strains of E.coli. The E.coliCR63 strain allows the T4 to form plaques and the other strain E.coliBE is not susceptible to T4 infection and can be used to detect transformation.

The project requires students to construct or isolate an antibiotic-resistant E.coliCR63 in order to produce T4 transductants and to then demonstrate transduction using the E.coliBE strain. There were a variety of protocols developed by pairs of students to isolate antibiotic-resistant mutants so as to have a gene to transduce. The protocols also varied in the methods students used to isolate transducing phage. Initially students struggled to design a series of experimental protocols to fulfill the assignment which was to produce T4-transductants and prove that these transductants can carry out transduction.

This laboratory is very inexpensive and works with simple tryptic soy broth media with and without antibiotics.
The goals of this project were to teach Microbiology students molecular biology techniques used in research and to teach the concept of microbial diversity in the framework of the scientific method. Students were instructed to test the hypothesis that groundwater aquifers contaminated with organic pollutants (i.e. trichloroethylene, vinyl chloride, perchloroethylene) contain a more diverse bacterial community than pristine (uncontaminated) aquifers. DNA was extracted from two groundwater samples. One sample was from a region in an aquifer that had been contaminated with organic industrial waste and the other was from an uncontaminated region in the same aquifer. Two 16S rDNA clone libraries were constructed from bacterial DNA that was PCR amplified within each sample. Each student was given a clone containing DNA from the pristine groundwater and another from the contaminated groundwater. The students were instructed how to grow their clones using antibiotic selection, how to extract the plasmid DNA from their clones, and how to perform a restriction fragment length polymorphism (RFLP) analysis to characterize bacterial communities. The RFLP analysis was used to teach students how to use restriction enzymes, agarose gel electrophoresis, and how to interpret data. The RFLP analysis showed that the contaminated groundwater contained a higher number of unique operational taxonomic units (OTUs) than the pristine groundwater; thus supporting the hypothesis that groundwater contaminated with organic chemicals is more diverse than pristine groundwater.
Evaluation of ‘Unseen Life on Earth’ and ‘Intimate Strangers’ for UK Audiences

Joanna Verran*, Maureen M Dawson and John Willcox
Manchester Metropolitan University, Manchester, UK

This poster is primarily a call for interest and a description of a project to be carried out over 12 months, from March 2001 to March 2002.

There is a need for good quality educational material for undergraduates in the UK, particularly that which could be used for large class teaching, either within the classroom, or as a support resource, or as part of a student centred/distance learning package. The Unseen Life on Earth/Intimate Strangers packages could provide valuable resources in this context, thus we intend to evaluate them with two applications in mind: i) The television series to be used as the core of a free-standing, student centred course for first year students, entitled ‘Man and Microbes’. An existing course, ‘Plagues, Pestilences and People’ uses 4 keynote lectures, and videos, with assessment comprising case studies/presentations, and formative and summative multiple choice tests related to the videos and lecture content. ii) The 12 video set to be considered for use within more formally taught courses, either within group sessions, or as part of directed activity outside the classroom. We will involve students and teaching staff from our own university and local schools/colleges (16+ education) in the evaluations. Our findings/suggestions will be disseminated through publications and presentations at relevant conferences in the UK.

We hope that during the poster sessions, we can exchange ideas and experiences with colleagues. These activities will assist us in the evaluation of the packages, and ultimately in the dissemination of our findings to interested audiences.
The Reliability of a Performance Assessment in Cell Biology

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A performance assessment was developed to assess scientific reasoning skills for a cellular biology course. The course was designed to enhance students' knowledge and understanding of the subject-matter content of cell biology and to increase their skills in interpreting research findings and drawing defensible conclusions from data. The assessment exercise includes three different tasks each requiring about 40 to 55 minutes to complete. In each task, students are asked to interpret research data presented in the form of five or more summary tables, charts, or graphs and to formulate conclusions from the data. Students write their responses in the form of statements which express conclusions supported by the data given. Each student's responses were then graded by at least two trained raters using pre-specified scoring criteria. Generalizability theory was then used to determine the reliability of the ratings and to recommend changes in the evaluation design that would lead to improved assessment procedures and criteria. Consistent results have been obtained over multiple semesters. These results indicate a large main effect for tasks and a large student-by-task interaction. The rater and occasion effects were small. These findings demonstrate the need to avoid assessing students' ability on the basis of their performance on a single task. More dependable inferences about students' level of achievement can be obtained by computing a mean rating for each student averaged across multiple tasks and multiple raters, but using multiple tasks enhances the reliability of the ratings more than using multiple raters.
Chance of a Lifetime? The Development of New Principles of Microbiology Course

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How many times has each of us muttered under our breath when we were teaching, "If only I could have designed this course...?" I find myself in the enviable but challenging position of chairing a committee charged with developing a "shiny new" four-hour principles of microbiology course with lecture and laboratory for a statewide community system in Indiana. This session will chronicle the adventures of naive and starry-eyed microbiology teachers as they develop such a microbiology course.

Our goals include structuring the course using recommendations and standards developed by the Undergraduate Microbiology Education Conference attendees during the last several years. Challenges include no science prerequisites for students, poor lab equipment and storage, sharing labs with other life science courses, no lab assistants, and inexperienced teachers.
Virology is an integral part of undergraduate microbiology education. Research and experience, however, indicate that the topic is a difficult one for many students. We have found that the methods and applications of virology can be effectively demonstrated using a hands-on investigative laboratory exercise. Students act as virus hunters, monitoring the presence of coliphage in various field-collected water samples by direct plaque assay. They are responsible for data collection, analysis, and interpretation of results. This activity provides experience with basic principles of phage culture, inactivating conditions, dilution series, filterability, and plaque forming units. Complete assay methods, evaluation procedures, and student responses are presented. Results indicate that having students solve real-world problems enhances instruction and student satisfaction. It also provides an important model for undergraduates to emulate.
2-5  **ABCs of EIDs**

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Students in an undergraduate Microbiology course were assigned a paper on emerging infectious diseases (EIDs) to increase awareness of these diseases and improve writing skills. The student audience was predominantly Nursing and Allied Health majors. The paper was assigned as an individual project for extra credit. A total of 71% of students completed this assignment. The students were given CDC and WHO web sites to begin their search for information and allowed to choose their own disease to write on. While it was suspected that students would choose zoonotic diseases due to the rural location of the college (12% chose Lyme disease) an unusual popular choice was Toxic Shock Syndrome (9%). Student reports included a variety of web sites and insightful information on EIDs. The grading rubric was based on completeness of addressing the following issues: 1. What type of organism causes the disease? 2. Where is the disease found? 3. What groups are susceptible? 4. How is the disease treated? The grading rubric was also based on writing style (grammar, spelling, citations, etc). Awareness of EIDs and enhancement of literary skills were clearly evident from the presentations. This exercise supported one of the missions of our university which is reading and writing across the curriculum and the ASM Introductory Microbiology Lecture Core Curriculum. Although reading of the reports involved a considerable time input the quality of the reports and information students presented made this a worthwhile exercise. Samples of student reports will be presented.
Different Carbon Sources - A Way to a Cheaper Kombucha Tea Production?

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Biotechnology is a very important topic in the teaching of microbiology in Austrian education programs. Therefore a special teaching model was developed using the Kombucha tea as model for the biotechnological production of food. The students should find ways to decrease the costs for Kombucha tea production by testing several carbon sources. Kombucha is a symbiotic culture of yeasts and acetic acid bacteria. The best carbon source for the Kombucha is glucose which is a monosaccharide. Disaccharides would be cheaper, but special enzymes are necessary to split them into monosaccharides. To find out which one of the necessary enzymes are synthesized by the Kombucha several disaccharides were tested: Saccharose (enzyme: saccharase), Maltose (enzyme: maltase) Lactose (enzyme: ß-galactosidase). The results showed that saccharose can be used as carbon source. In the presence of maltose as carbon source the cells starved to death because they can not synthesize the maltase. In the case of lactose the cells did not die but the metabolic activity was too low to produce Kombucha tea. Probably only the acetic acid bacteria can synthesize the ß-galactosidase. Therefore only saccharose could be used as carbon source instead of glucose. The experiments in this model can be carried out very easily and help to understand the basics of biotechnology.
With the vast majority of microbial life on our planet undescribed, there is no richer area in which to study diversity than in the prokaryotes. Discarding a Bergey's-like taxonomical approach to the study of diversity, I took the opportunity to redesign a course titled Bacterial Diversity that was not offered for many years. The lecture portion of the course exposes the student to the biochemical and structural diversity of prokaryotes. Discussion of how diversity is measured and how it could arise is followed by presentation of strategies and mechanisms of autotrophic, and heterotrophic diversity. Throughout this portion an underlying theme of energy transformations is stressed using biogeochemical cycling as a unifying theme. The second portion of the lecture presents examples of the bacterial diversity used to overcome obstacles to survival. In the laboratory portion of the course, the traditional enrichment/isolation approach was enhanced through the addition of experiments involving molecular microbial ecology, and molecular phylogeny. Enrichments for thirteen different types of bacteria are initiated that include lithotrophs, phototrophs, and anaerobes. A long term class project to characterize heterotrophic members of a biofilm community is used to acquire skills in molecular biology. To see if the student has cultivated a dominant member of the community, the 16S rRNA gene from each student's biofilm isolate is amplified by PCR, subjected to TTGE analysis, and compared to that of the community. A portion of the 16S rRNA gene is also sequenced from each isolate and used to do phylogenetic analysis. Development of an independent project using these techniques is used to foster creative thought.
Pedagogical laboratory exercises involving immunology and virology techniques were developed to demonstrate the overlapping nature of these disciplines. To accomplish this, virology students completed one part of the exercise and immunology students performed another part. Each class discussed what the other class had done in preparation for this experiment. Permission was obtained from the Weber State University Animal Care and Use Committee to immunize rabbits with our protocol. The immunology class assisted in immunizations and in collecting the serum at various times throughout the experiment. The rabbit was inoculated with an emulsion of complete Freund's adjuvant and partially purified T7 phage (PPT7) that had been prepared by a previous virology class. Boosters consisted of only PPT7. Sera was assayed for the presence of precipitating antibodies. The virology class used the immune sera to demonstrate viral neutralization using a plaque assay. Finally fresh T7 phage were partially purified for use in next year's immunology class. This year-long exercise provided students in these discrete courses with hands-on understanding of principles behind the primary and secondary immune response, the role of adjuvant, care and use of animals, immunoassay, viral neutralization assay, viral purification, and molecular biology. Based on examination scores, student surveys and comments, the instructors were satisfied that this active learning approach provided students with a better understanding of these principles as well as illustrating the broad applicability of immunological and virological techniques.
An Interactive Tutorial for Ribosomal RNA Phylogenetic Analysis

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The Ribosomal Database Project (RDP) has provided annotated and aligned ribosomal RNA sequences as well as sequence analysis functions to investigators for over ten years. Included in the last release by the RDP are 16,277 prokaryotic, 2,055 eukaryotic and 1,503 mitochondrial aligned sequences and ten analysis functions. The next release will include over 5,000 aligned eukaryotic sequences and additional analysis functions. To facilitate access to these resources, we also will provide in the next release a tutorial for the RDP analysis functions (<http://www.cme.msu.edu/RDP>). The tutorial targets upper undergraduate science majors and investigators unfamiliar with the RDP analysis functions. The basic design of the tutorial juxtaposes a tutorial window with the RDP analysis windows such that the reader can move between the two windows, receiving guidance from the tutorial while directly interacting with the RDP. The introduction to the tutorial provides the reader with an overview of the RDP. This is followed by a systematic demonstration of each analysis function of the RDP by providing the reader with the required raw data that can be rapidly loaded from the tutorial browser window into the RDP analysis window. The expected results are provided within the tutorial and can be compared with the results obtained during an active session with the analysis function. The principles of each analysis function are discussed and references for more detailed discussions of relevant topics are provided. The tutorial is structured with a laboratory exercise in mind. To that end, study questions conclude each section of the tutorial.
Funding Opportunities for Education Related Projects

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Funding opportunities currently available for educational activities both in the education and the research divisions will be presented. We will also review key information often omitted by proposers. As a means of highlighting important components of a submission to NSF programs, participants will have an opportunity to review and comment upon a proposal. Details of the programs to be discussed are available on the NSF Web site (www.nsf.gov) under "Biology," "Education," and "Crosscutting."
2-11 Expanding on Tradition: Old Dogs Can Learn New Tricks

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Presenting general concepts in microbiology within a laboratory setting is a relatively easy task for instructors, given the numerous laboratory manuals in print. Students generally do not have much difficulty following the "cookbook" laboratory exercises and learning applied concepts in microbiology. Most laboratory exercises stop at this point, but we feel a valuable learning experience is lost and students are left on their own to draw further conclusions from the exercise. We felt the learning experience could be enhanced without increasing the cost involved in preparation or dramatically increasing in-class laboratory time. For example, the typical Kirby-Bauer exercise demonstrates the basic concepts of bacterial resistance, allowing students to analyze and interpret susceptibility data. We expanded this exercise in a manner that facilitates the extension of data analysis and allows students to draw novel and/or relevant conclusions as well as present their results. This exercise gives the student an opportunity to explore not only the science of microbiology, but to integrate concepts in microbiology with other disciplines, such as mathematics. Such modifications of the standard "cookbook" laboratory exercises are applicable to microbiology students in various programs. As an added benefit, instructors have additional tools to assess student learning and comprehension.
A survey was designed to assess students' understanding of concepts and familiarity with biology terminology at the beginning of a new introductory genetics course. The class, which serves as the first college biology course for all students majoring in Biological Sciences or fulfilling premedical requirements, assumes no prior knowledge and enrolls mainly first-year students. The survey asked students to rate their familiarity with over 80 words in genetics and to define a selection of these terms. Students were also asked to answer a few conceptual questions as well as provide background information on their previous experience in science and their reason for taking the course. A similar instrument is being used to posttest students at the end of the semester to allow pre- and post-course comparison for individual students as well as correlations with other course factors (e.g., performance on traditional examinations). As the amount of vocabulary in a college science course often exceeds that in even a language course, it will be especially interesting to compare students' performance with their perceived and actual understanding of important terminology.

Preliminary results from the survey suggest that students often overstate their own degree of understanding and can be, in fact, confident in their incorrect understanding of the subject. Results of the survey will serve not only to assess the effectiveness of the class in enhancing understanding and comfort with introductory genetics, but also provide a baseline of pre-class knowledge to aid in the development of an inventory of conceptual understanding in genetics and biology.
An Introductory Biology Curriculum: An Evolutionary Narrative Rooted in Microbiology

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Introductory biology curricula and the corresponding textbooks have not changed a great deal in decades. The traditional approach, a pedagogy that has launched the careers of innumerable scientists, has tended to address discrete topics in biology: molecules and cells, molecular biology, plant and animal physiology, ecology, and evolution. Yet as more has been learned about the diversity of life on earth and the underlying cellular mechanisms responsible, the boundaries between fields are becoming more blurred. An introductory curriculum which underscores biology as an exhilarating historical narrative was designed and implemented at both the Hotchkiss School, an elite secondary school, and at Hobart and William Smith Colleges, a selective undergraduate institution. The course began by presenting the chemical environment of early earth and by discussing the hypotheses focused on biomolecular evolution. The students became familiar with the life of the ancient world, the ecosystems inhabited solely by an increasingly dazzling array of microbes. Time and emphasis given to these prokaryotic domains, their cellular structure, metabolism, contribution and threats to the Biosphere, enabled students to better understand the evolution of more complex organisms, and to appreciate more deeply the forces that have driven that evolution; students have had a challenging opportunity to witness the grandeur in Darwin's view of life.
A set of case studies was developed to present students in an Introductory Microbiology course with an array of real world situations where various microbiology concepts (cell structures, metabolism, microbial genetics, etc.) are discussed in context, and are applied to solve problems that are relevant to students. As students work on the case, they 1) relate the concepts to real world situations, 2) connect and assimilate different microbiology concepts, and 3) develop analytical skills. Each case study is implemented as a cooperative learning activity (for groups of two to four students) in four laboratory sessions. There are a total of 66 students in two sections. In the first session, students are presented with the background of a real world situation. A set of questions is included to ask the students for a logical solution/explanation to the situation based on their observation of the case materials (illustrations and microbiology materials), interpretation of data (graphs and tables), and assimilation of the concepts learned in lectures. In the second session, students are presented with the real world solution/explanation to the situation, and a set of questions to assess their understanding of relevant concepts. Answers to all the questions are collected, critiqued (without grade assignment) and returned in the following session. In the third session, teaching assistants discuss all the questions with the students. In the fourth session, a quiz is given to each student for assessment. The case studies will be evaluated at the end of semester for their impact on learning.
Developing and Teaching the Introductory Microbiology Course within the Pre-College Academic Upward Bound Program

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Upward Bound is a federally funded program created to offset academic deficiencies of economically challenged students through the provisions of tutorials, classroom instructions and educational/cultural activities. There are over 500 Upward Bound programs located at various colleges and universities throughout the country. The Summer Residential Component is an intensive six-week sessions typically taking place on a University Campus. During Summer 2000 Session, I developed a course in Microbiology offered as Advanced topics in Science. The curriculum was centered on students acquiring the skills which will not only help to be accepted into a college or university but once accepted, competing on an equitable plane with their peers. The course was designed to go far beyond the traditional high school program but taking into consideration the background and preparedness of enrolled students. The poster will discuss the strategies to stimulate learning and motivation as well as technical aspects and materials used in the program. Further, the benefits of managing a diverse group of young students and the impact of this experience in developing teaching skills will be discussed.

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Microbiology Literacy of Students in Science Classes

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In the ASM News of April 1999, Cynthia Needham wrote about the microbiological knowledge of the general population before and after viewing the films "Intimate Strangers." We took the same questions (a true-false format) and gave them to students in science classes in middle school, high school, junior college, college, and elementary teachers in graduate classes in science education. At the college level, students enrolled in a microbiology course had the questions as a pre-and post-course. Students in Life Science Concepts class, primarily an elementary education course, answered the questions prior to, and after, a unit on microbiology. Other classes used the questions for discussion about the role of microbes in the environment. Areas of initial difficulty and ‘remaining educational opportunity’ include natural changes in the environment leading to new infectious diseases, microbial transformations of chemicals, determining genetic relatedness among organisms, microbes’ roles in sustaining complex ecosystems, and the persisting belief that most microbes are easily cultivated in the laboratory and cause disease. Students often link microbes with science fiction and disease rather than with the positive interactions microbes can have in an environment. This research addresses student knowledge of the diverse microbial world and suggests they need to learn about the ecological and biological relationships of microbes with other members of the biosphere.
Active Learning in Microbiology: A UK Story

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Active learning in Microbiology is promoted by strategies both in grade/high school visits by scientists and by devising novel learning scenarios in the undergraduate classroom. In the UK the National Curriculum for grade schools and junior high includes a small variety of microbiology topics. UK microbiology organisations target their activities to provide support for non-specialist teachers in delivering these activities. In addition, as the time allocated to science in the grade school curriculum is small, strategies to incorporate microbiology into literacy and numeracy activities are employed.

At senior high school level, training and safety advice is supplied to encourage teachers to explore the practical aspects of microbiology with their pupils. The curriculum content can also be supported by the provision of posters for classrooms such as the SGM posters on food microbiology. It is proposed that joint SGM-ASM posters on biofilms be produced to get the message into high schools and colleges that micro-organisms do not often act alone. At the undergraduate level, a variety of active learning strategies including role-play-based scenarios support learning by undergraduates. Making these relevant to career destinations also promotes the active engagement of the students. One such active learning activity on a fictional "outbreak" scenario will be described. General leaflets and information on the SGM's educational activities will be available at the poster.
Utilization of the Winogradsky Column and Purple Nonsulfur Photosynthetic Rhodospirillaceae for Improving the Teaching and Learning of Metabolic Diversity in Bacteria

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Different kinds of metabolisms exhibited by microorganisms, such as their ability to live phototrophic, chemotrophic, organotrophic and heterotrophically, are issues poorly understood by students, including those enrolled in Microbiology courses. During the last decade we have developed in deep the Winogradsky’s column (R. Grau et al, Biochemical Education 19(3)91:143-147) as a didactic, simple, and inexpensive tool to show the tremendous metabolic versatility of bacteria. In this work, we’ve taken advance of the goodness of the Winogradsky’s column to enrich microbial populations of the purple nonsulfur bacteria (Rhodospirillaceae family). Members of this group are able to grow phototrophically under anaerobic conditions in the light without producing oxygen. All species are able to grow photoheterotrophically using organic substrates as electron donors and carbon sources. Many representatives grow under photoautotrophic conditions either with sulfur compounds or with hydrogen as electron donors. In addition, most of the known species are facultative chemotrophs growing equally well under aerobic or anaerobic conditions in the absence of light. Purple facultative photosynthetic strains isolated from the bottom part of light-exposed Winogradsky’s columns exhibited all the alternative metabolic pathways expected from this physiological group under different environment conditions such as light intensity, oxygen tension and medium composition. Importantly, we success with the aim of showing that microbes are disperse for everywhere on Earth and that under special conditions they are able of explosive growth showing their key role in the dynamics of the transformation of the organic matter in specialized ecological niches.