Spring Semester 2003
Volume 11.1

PENNSTATE

Undergraduate Newsletter

The Department of Biochemistry and Molecular Biology

In its efforts to keep the BMB undergraduate student body informed about people, programs and events in the BMB Department, the ***Undergraduate Newsletter*** is pleased to offer a series of interviews that will hopefully provide a new dimension to the BMB faculty who teach departmental courses and to the exciting areas of research conducted in their labs with the assistance of undergraduates, graduate students and postdoctoral fellows. We hope our readers will find this feature both interesting and, perhaps, valuable to future endeavors. Herewith, we present —

An Interview with Dr. Sarah E. Ades

What is the immediate goal of the research being conducted in our laboratory?
The immediate goal of my research is to identify and characterize signal transduction pathways that communicate information between the cell envelope and the cytoplasm of the Gram-negative bacterium *Escherichia coli*. In order to survive, a cell must be able to sense and respond to changes in its environment. A central problem in biology is that this information is often sensed in one cellular compartment and must be transmitted to another cellular compartment where the response is generated. In Gram-negative bacteria, signal transduction pathways that communicate information between the cell envelope and cytoplasm are crucial for maintaining the integrity of the cell envelope when cells are stressed, and for coordinating cytoplasmic and cell envelope processes during normal growth. The ability of the cell to respond to challenges to the cell envelope is also of considerable medical importance as it is the target of the host immune response and several important classes of antimicrobial drugs. We are using two approaches to better understand how events in the envelope are communicated to the genetic machinery in the cytoplasm where a response can be generated. The first is to investigate the signaling pathways that control the activity of a transcription factor, ^{E}, which is activated in response to damaged proteins in the cell envelope. The second is to identify new envelope-sensing pathways that are activated when bacteria are treated with antibiotics that target the cell envelope.

What are the larger implications/applications for the findings of your research?
Bacterial diseases have received considerable attention lately due to the threat of bioterrorism, although they have always been a major health problem. In addition, recent studies have shown that the occurrence of multidrug resistant bacteria has risen significantly due to the overuse and misuse of antibiotics. In order to better combat these problems, it is important to understand how bacteria survive insults to the cell envelope such as those posed by the action of the host immune response and antimicrobial drugs. The cell envelope stress responses that we study have been shown to be essential for the survival of several pathogenic bacteria in the host and to be activated in response to antibiotic treatment. Our work currently focuses on identifying and understanding the fundamental mechanisms of the signaling pathways that relay information about the integrity of the cell envelope to the genetic machinery in the cytoplasm. This work will lead to a better understanding of how bacteria combat damage to the cell envelope which is crucial for the development of new, more potent antimicrobial drugs. In addition, by learning how these pathways function, we will gain insights into how nature has solved a basic problem in biology, signal transduction between cellular compartments.

Why did you choose to pursue a career in academic research and why in this particular field?
When I entered college, I really did not know what I wanted to do with my life. For a while, I even thought that I would major in French and become a diplomat. What really got me hooked on science was an introductory Biology course that I took during my sophomore year. I found the molecular aspects of biology fascinating. My career path was clinched when I began to work in research labs and saw things that I had read in my textbooks come alive. I remember how excited I was the first time that I purified DNA. I still feel that same excitement whenever we make a new discovery in the lab. Another aspect that I love about research is that my job is always intellectually stimulating. I am continually trying to figure out how things work. I chose a career in academic research as opposed to one in the biotechnology industry for a number of reasons. I preferred the freedom of academic research. I can follow my research wherever it takes me and I am not bound by the commercial goals of a company. Another important part of academic research for me is the opportunity to interact with students and to share my excitement about science with them. Over the course of my research career, I have worked on a wide range of research problems from the biochemistry of DNA-binding proteins to the immune response

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New BIOTC Course Approved

In cooperation with the Agronomy Department, the BMB Department will be offering a new BIOTC course next Spring semester. BIOTC(AGRO) 460, ***Molecular Genetics of Transgenic Plants***, will be taught by Dr. Surinder Chopra of the Department of Crop and Soil Sciences. The description submitted in the course proposal states:
Molecular Genetics of Transgenic Plants is an introductory course that provides basic concepts and understanding of transgenic or genetically engineered plants. The focus is on genetic and molecular biology of different traits that have been introduced into genetically engineered crop plants. In addition, the laboratory component of the course allows students to design and perform experiments to study and understand the biology of plant gene expression through the use of transgenic plants.

BIOTC (AGRO) 460, Molecular Genetics of Transgenic Plants

A selected list of topics covered in the course includes: transgenic plants impact on ecology/biodiversity, designing a transgenic plant, classical versus engineered resistance genes, resistance genes and their role in weeds and crop plants, advances in transgenic crops and value-added traits, stable and unstable inheritance, genetics vs epigenetics, regulatory agencies and restriction, and movement, importation and field testing of genetically engineered plants.

The course will be very small – limited to 12 students – so faculty-student interaction will be extensive and laboratory experiments will focus on group projects. Prerequisites for the course are BIOL 230W or BMB/MICRB 251, or equivalent. This course would be a valuable elective for BIOTC majors who might be interested in the vast potential and importance of agricultural biotechnology and, specifically, genetically engineered crop plants.

…and yet Another Elective for BIOTC Majors

Looking for elective courses related to biotechnology, BIOTC majors? If you think you would be interested in learning more about biofermentation systems from the perspective of a microbiological engineer, check out ABE 468, ***Microbiological Engineering***. The prerequisites for the course are Phys 211 or 250; ABE 408 or MICRB 201; and BMB 211, all of which are required in the BIOTC curriculum. Selected topics in ABE 468 include: immobilized enzyme systems, stirred tank reactors, batch fermentation and microbial growth, continuous fermentation and kinetics, 2-vessel fermentors, fed-batch systems, scale-up strategies, product recovery and purification, separation of soluble products to include dialysis, reverse osmosis, cross flow ultra-filtration, and electrodialysis. Dr. Ali Demirci welcomes BIOTC majors into this 3-credit course with lab. ABE 468 is offered regularly in Spring semesters.

. . . for SENIOR SCHREYER SCHOLARS

Want to reduce the angst of writing your senior thesis? Want to know how your thesis stacks up against other theses? If so, check out the departmental collection of theses written by former Schreyer Scholars that is housed in the glass cabinet in the BMB Undergraduate Study Center in 101 South Frear. Theses going back to the very beginning of the Honors College can be found in the Center. Among the theses, you will find those of a Marshal Scholarship winner, numerous Goldwater Scholarship winners, NSF Scholarship awardees, and many more. Take a few minutes to review these fine examples of recent senior theses as a gauge for writing your own thesis.

ADES

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of fruit flies to my current work in microbiology. In the end, I chose to work with bacteria because it provides me with the opportunity to examine a problem on many different levels from the physiology of a response to the biochemical and molecular interactions that underlie the response. I chose my specific area of research in microbiology, communication between the cell envelope and cytoplasm, because I feel that it is a fundamental problem that is crucial for our understanding of how bacteria survive in the environment and evade the action of antibiotics.

What do you look for in selecting an undergraduate student to do research in your lab?

I have only been at Penn State since June 2002 and have had the opportunity to work with two outstanding undergraduates who are currently doing research in my laboratory. I have had a great time working with them. In choosing a student, I am looking for someone who is genuinely interested in science and is not just looking for something else to put on a CV. What makes doing research fun and rewarding is really wanting to know the answer to a scientific question, then planning and performing the experiments to uncover the answer. Good grades and relevant coursework are important, too, since it is key that a student have the background to understand what he or she is actually doing in the lab. Finally, a student must be willing to commit the time needed to actually do a research project, this means several hours a week for more than one semester. It can take a while for a new lab member to learn their way around the lab so that he or she can actually begin work on a project in earnest.

Attention BIOTC Majors

BIOTC 479, Methods in Biofermentations, will be moving to a Fall semester offering.

Biotc 479, which has traditionally been offered in Spring semester, will now be offered only in Fall semesters. This means that **Biotc seniors**, in particular, should plan to schedule Biotc 479 in FA03, if they have not already completed the course. Taught by Mr. Mark Signs, Methods in Biofermentations, is primarily a laboratory course supported by a weekly lecture and consultations with the instructor and teaching assistant. The course is divided into six major laboratory exercises: 1) stock culture preparation, 2) confirmation of strain, including DNA restriction mapping, protein expression and analysis, 3) growth rate measurement and medium optimization, 4) fermentation in a 5 liter stirred bioreactor, 5) protein purification, 6) scale-up to a steam-in-place bioreactor. The course is designed to emulate a typical fermentation development project, with student groups working independently to complete their projects. The course is scheduled for **T 1:25-2:15** and By Appointment.

BMB MAJORS. . .Please remember. . .

BMB majors...and particularly seniors who will be graduating in FA03 or SP04...please be aware that BMB 446 – a course required for the BMB degree - is offered **ONLY** in Fall semesters. If you have not yet taken BMB 446, you

should be planning to include it in your schedule of courses for FA03. DO NOT OVERLOOK THIS COURSE!! There are NO comparable courses that cover the principles and techniques of this laboratory course.

Heather Agnew Wins Gates Scholarship

Heather Agnew (09 BMB, Chem) has been selected as the recipient of a prestigious Gates Cambridge Scholarship to pursue graduate study at Cambridge University, England. The scholarship has a value of $150,000 to cover all expenses, including a stipend, for four years of study. The Scholarship is awarded to students who are likely "to become leaders in addressing global problems related to learning, technology, health and social equity." Heather is a Schreyer Scholar and is conducting research for her senior thesis in the laboratory of Dr. Mary Williams of the Chemistry Department. At Cambridge, Heather plans to undertake her graduate study in the laboratory of Dr. Trevor Rayment where she will investigate molecular recognition using scanning probe microscopy. The BMB Department proudly recognizes Heather's truly exceptional accomplishment.

THINKING OF STUDY ABROAD??

Although deadlines are extremely short for applying for study abroad for Fall semester, anyone who has entertained the notion of spending part of the undergraduate experience in another country should begin now to investigate academic institutions and course offerings in the countries of interest. Most students consider study abroad for one semester or a full year during the sophomore or junior years. So, if you are now a first year student or sophomore, it is not too early to begin the planning process. Penn State and the BMB Department do all in their power to advise students on the selection of schools and, especially, the choice of courses that are equivalent to PSU courses so that any student studying abroad will be able to make normal academic progress toward the baccalaureate degree. In this regard, it should be noted that, unlike Penn State, not all schools accept study abroad as part of an undergraduate curriculum. Some schools view study abroad as something above and beyond the established academic curriculum. The International Programs office (222 Boucke) maintains a web site of institutions and courses offered by those schools that previous PSU students have taken and that have been evaluated against existing PSU courses. The web site is http://www.international.psu.edu/students_study_abroad/accredit_psu.htm

Using the information from this site, students can make fairly detailed plans well in advance of beginning study abroad. Particularly if you are thinking of studying abroad next Spring semester, it would be a very good idea to visit the International Programs office at your earliest convenience to secure information and the necessary forms to begin the process. Finally, the Eberly College of Science maintains a student-exchange program with a number of British institutions. For information about this program contact the Cooperative Education office in 520 Thomas.

DON'T OVERLOOK COOPERATIVE EDUCATION!!

"Why..." you might ask yourself, "should I even consider a cooperative education position?" There are several **very good** reasons to do so. Let's begin with the intangibles. Do you want to see how the classes you are taking at Penn State apply to what you might do after graduation? Do you want some first-hand insight on what elective PSU courses might be important to your career goals? Do you want an opportunity to evaluate whether you will like working in industry – in research, development, manufacturing, or quality control – at the BS level or whether you should pursue a graduate degree? A cooperative education experience will go a long way in helping you answer such questions. Now, think about the tangibles. Do you like $$$? You are paid by the industry while in a co-op position. Would you appreciate a break from the classroom and the stress of exams, papers and projects? Could you use some letters of recommendation for future endeavors? Might having the inside track on job opportunities at a company be useful? Do you think having working experience on your resume would raise you above other candidates being reviewed for a permanent position? If your answer to these few questions is **yes**, a co-op experience is something you probably ought to consider. Deadlines have already passed for certain companies, but there are still positions available for the summer and fall. The Cooperative Education office in 520 Thomas stands ready to provide information and give advice to students willing to consider participating in the program.

Would you appreciate a break from the classroom and the stress of exams, papers and projects?

While Biotc majors are **strongly urged** to undertake a co-op experience, BMB and MICRB majors can certainly benefit – in ways mentioned above! – from the same experience. A first step in this process might be to make an appointment with Dr. James McDonel, the BMB departmental representative for cooperative education to discuss the general nature of Penn State's program. Follow up that visit with a trip to the Co-op office, and from there, as they say, the sky's the limit!

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BMB Undergraduate Newsletter is a publication of the Department of Biochemistry and Molecular Biology. Items for inclusion in the newsletter should be sent to BMB Undergraduate Newsletter, 108 Althouse Laboratory, University Park, PA 16802 Tel. (814) 865-5497; Fax. (814) 863-7024. U.Ed. SCI 03-101