MassBioEd
Massachusetts Biotechnology Education Foundation

Biotech Futures

Tuesday, May 12, 2015


Biotech Futures is a college and career exploration event organized by Worcester Polytechnic Institue (WPI) and the Massachusetts Biotechnology Education Foundation (MassBioEd). It is designed for students interested in life sciences college majors and careers. Today's program will give you an opportunity to explore a premier higher education institution and learn more about the wide range of jobs available in one of Massachusetts' most dynamic career clusters: biotechnology. This fast-growing, dynamic industry is grappling with many of the most challenging questions facing humankind: creating new medicines and medical treatments and addressing issues of food production, renewable energy, and environmental degradation. You have an opportunity to deepen your understanding of these issues and to think about how you can be a part of this great adventure. We hope that today's program provides you with new insights and new ways to imagine your future working, learning, teaching, and growing in science and biotechnology.

BioTeach
Building Bioscience Literacy, One School at a Time

WPI

Event Schedule

8:00	**Registration and Refreshments** Life Sciences and Bioengineering Center at Gateway Park							
8:30	**Welcome and Overview** Michelle Mischke, Ph.D., Director of Biotechnology Education Programs, MassBioEd Foundation Tara Mann, Director of Operations, Office of the Dean of Arts and Sciences, WPI							
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
9:00	Karyotype of Human Cells		From Genes to Proteins Lab	Where's That Flower Lab	Campus Tour / Info Session		Light in Darkness	
10:00	From Genes to Proteins Lab	Where's That Flower Lab	Karyotype of Human Cells		Light in Darkness		Campus Tour / Info Session	
11:00	Lunch at Founders Hall							
12:00	Light in Darkness		Campus Tour / Info Session		Karyotype of Human Cells		From Genes to Proteins Lab	Where's That Flower Lab
1:00	Campus Tour / Info Session		Light in Darkness		From Genes to Proteins Lab	Where's That Flower Lab	Karyotype of Human Cells	

Event Room Locations:

- Karyotype of Human Cells: BETC and Floor
- Campus Tour: Bartlett Admissions Center
- Where's That Flower Lab: Gateway 4104
- From Genes to Proteins Lab: Gateway 4101
- Light in Darkness: Goddard Hall 109 and 110

Lab Descriptions

A Light in the Darkness - Understanding Enzyme Kinetics in Biological Systems Thanks to Our Friends the Fireflies

Biochemists work in a world of amazing complexity due to the incredibly small scale of their subject matter. This complexity drives the development of tools capable of illuminating biological interactions of this fascinating molecular scale world. Nature has proven to be the most adept architect of molecular scale tools. The cells in our body possess the capability to build over 40,000 different molecular machines, known as proteins. Enzymes are proteins that are vital for life serving as catalysts in over 5,000 reactions. In an effort to show this enzymatic world to the students and future scientists, the students will participate in a hands on activity with the latest biochemical techniques to understand how a firefly uses luciferase to carryout bioluminescence. The chemical reaction of firefly luciferase acts on luciferin in the presence of magnesium ions, ATP, and oxygen in a multistep process to emit light in a wavelength range of 510-670 nm. The rate of an enzyme-catalyzed reaction depends on the concentration of enzyme and substrate, which to the biochemist is known as kinetics. The students will vary the concentration of the substrate, D-luciferin, and monitor the kinetics of the reaction. Using the tool of bioluminescence the students will gain an understanding of the role of enzymes in vital biochemical reactions.

Presenters: Professors Drew R. Brodeur and Arne Gericke

Graduate students: Anne-Marie Bryant and Jim McIsaac

From Genes to Proteins - Deciphering Cells, Visualizing Cells, and Discovering Therapeutics

The advent of molecular biology, ability to sequence genomes, and discovery of fluorescent proteins has revolutionized biology, enabling us with the ability to understand gene function, examine cells in real time, and develop better therapeutics. Students will learn about and have hands-on exposure to the "central dogma" of biology: the process of going from DNA-RNA-protein. Students will address the links between DNA/gene function, neuronal circuits, and organismal phenotypes by carrying out behavioral experiments, and use microscopy to learn how fluorescent proteins can be used to identify cells, cellular structures, and in screens for new therapeutics.

Presenters: Professors Jagan Srinivasan and Joseph B. Duffy

Where's that Flower -
Functional Neurobiology in Pollinator Minibrains

Insect pollinators produce 1/3 of the food that we eat and contribute approximately $40 billion to the U.S. economy each year. The ability of flower-visiting insects to carry out these important pollination services depends on the ability of their tiny brains to process a tremendous amount of sensory information from the environment. Students will learn how the brain translates sensory stimuli into behavior and participate in a hands-on lab activity related to how pollinators learn and remember important information about flowers. Finally, they will also use a computer simulation to predict what happens when bees' cognitive functions are impaired by environmental toxins.

Presenters: Professors Elizabeth F. Ryder and Robert J. Gegear

Karyotype of Human Cells

Identification of human chromosome number and morphology is one of the most relevant techniques in medical genetics for early detection of certain genetic diseases. In cell culture technology, the chromosomal characteristics of a cell line can serve as an index of the homogeneity and stability of the cell line. Abnormalities associated with chromosome shape and number can be detected by a simple test called Karyotyping. Karyotype analysis can show parents, for example, if they have abnormalities that could be passed onto their children. Karyotype can also reveal the gender of a fetus. To obtain a Karyotype, chromosomes from a cell are prepared using a protocol for chromosome spreading. Then the best spread is stained and photographed. The photograph is enlarged and cut into individual chromosomes. The identical pairs are identified and paired by size and shape similarities. The sex chromosomes appear separate.

The purpose of this exercise is to introduce students to karyotype analysis and have them perform karyotyping of two sets of chromosomes, one from a male and the other from a female. Students will learn how the chromosome spread is prepared in the laboratory and observe chromosome spreads from cells under the microscope as well as seeing live cells growing in culture. Then they will be given sets of enlarged chromosomes and they will be asked to pair them together based on shape and size to prepare the Karyotype. They will also be asked to identify the sex chromosomes to see the difference between a normal male, a normal female karyotype and an abnormal Karyotype. Detailed explanations will be given about chromosome spreading and karyotype analysis before starting the hands-on work.

Presenters: Dan Mardirosian and Professor Kamal A. Rashad

About the Presenters

Drew R. Brodeur, Ph.D.

Assistant Teaching Professor, Chemistry and Biochemistry, WPI

I enjoy teaching because it's a fantastic feeling to be able to share knowledge and lead students to that "aha!" moment as they learn the intricacies of our world. Nothing is more satisfying than hearing someone exclaim that they "finally get it!"

Also, teaching is an excellent way to learn more about yourself and the subject you teach, since there are so many individuals involved in the process who all bring their unique perspectives and insight to the table. WPI students are in a league of their own in terms of preparation and desire to learn. It makes a great difference in the classroom experience when the majority of the students WANT to be there.

Joseph "Duff" B. Duffy, Ph.D.

Associate Professor and Department Head, Biology and Biotechnology, WPI

Defining signaling pathways that program cellular diversity is one of the foremost problems in biology and is central to my research interests. In the lab, we use molecular, genetic, and biochemical approaches to characterize the function of these pathways and to gain insight into their role in disease. o date, the lab has focused on the Epidermal Growth Factor Receptor network, a principal therapeutic target for a variety of human cancers. This work involved the characterization of Kekkon1 (Kek1), an archetypal LIG molecule, as a novel feedback inhibitor of the EGFR network. More recently, our work has branched out to neurobiology, adhesion/barrier biology, and lipid metabolism.

At the undergraduate level, I enjoy relating the growing impact of biology in our world through teaching Intro to Biotech, Genetics, and mentoring students in the lab. At the graduate level, I enjoy working with doctoral and master's students in the lab and teaching classes on signal transduction, model experimental systems, and grant writing. Outside of the lab, I enjoy snowshoeing, hiking, photography, and trying to keep up with graduate students on the soccer field.

Robert J. Gegear Ph.D.

Assistant Professor, Biology and Biotechnology, WPI

Our laboratory investigates brain-behavior relationships in pollinating insects, with particular focus on the cognitive processes and brain structures that underlie foraging and the role of such processes in the evolution and maintenance of floral complexity. We address research questions using a wide variety of experimental approaches, including controlled behavioral experiments, genetic analysis, computer modeling, and confocal microscopy.

Arne Gericke, Ph.D.

Professor and Department Head, Chemistry and Biochemistry, WPI

I received my undergraduate and graduate education at the University of Hamburg (Germany). My doctoral thesis was concerned with the development of infrared reflection-absorption spectroscopy for monolayers at the air/water interface. I came to the United States in 1994 as a postdoctoral student to join the research group of Professor Richard Mendelsohn at Rutgers University. During that time, I conducted biomedical research directed at the biophysical characterization of lung surfactant proteins, bone tissue, and lipid/protein interactions.

In 1997, I returned to Germany and became an habilitation candidate at the Max Planck Group for liquid crystal research at the University of Halle. During this time, I initiated my independent research career, which is aimed at the biophysical characterization of lipid-mediated protein functions as well as the development of vibrational spectroscopic imaging for the characterization of human tissue. Before joining WPI in 2011, I spent 11 years at Kent State University as assistant and later associate professor and graduate program coordinator. My research is funded through grants from the National Institutes of Health and the National Science Foundation. I strongly believe in the integration of research and teaching, and throughout my career I have secured several grants aimed at providing undergraduate students with enhanced educational and research experiences.

WPI offers an exceptional environment for inquiry and project-based learning, which is in my opinion the best and most inspiring way of teaching science. Science is taught at WPI in a societal context, which was for me an important aspect in deciding to join WPI.

Dan Mardirosian

Senior Operations Manager

I have more than 20 years of experience in the biomanufacturing industry, including technology transfer and process engineering, as well as clinical cGMP manufacturing management and training. Much of my experience has involved the development and operation of cutting edge, single-use bioreactors and disposable technology applications.

Responsible for the fit-out and start-up of the WPI Biomanufacturing Education and Training Center (BETC) facility, I was instrumental in the selection, installation, and start-up of state-of-the-art bioprocessing equipment, and the design and layout of the lab space. I recruited an impressive pool of knowledgeable instructors and I am also involved in curriculum development, training, and continual process improvement, in addition to having daily oversight of the facility and operations.

I built my experience at notable biotechnology firms including Lonza Biologics, Dow BCMS, Genzyme, Xcellerex, Inc., Collaborative Bioalliance, and Alpha Beta Technologies. I have extensive hands-on experience in all facets of biomanufacturing and I have held increasingly senior positions from technology transfer specialist to project manager, manufacturing engineer and senior process engineer.

Kamal A. Rashad, Ph.D.

Director, Biomanufacturing Education and Training Center and

Research Professor, Biology & Biotechnology

Prior to WPI, I was the Associate Director and Research Professor of Toxicology at Utah State University's Biotechnology Center where I developed and equipped the bioprocess facility at the Center with the most advanced bench top bioreactors and fermenters that are utilized in both research and training programs. My grant work includes a multi-year, multimillion dollar grant from the US Department of Health and Human Services, Biomedical Advanced Research and Development Authority (BARDA) to train employees of vaccine manufacturing facilities from fourteen countries in the latest advances in cell-based vaccine production with emphasis of Influenza vaccines.

I was a faculty member in the Department of Biochemistry and Molecular Biology at Pennsylvania State University where I conducted research on the impact of environmental pollutants on human health. I also developed and taught biotechnology undergraduate courses, biotechnology training programs, directed the Summer Symposium in Molecular Biology and was the key faculty in the development of the biotechnology undergraduate degree and the course curriculum.

I have delivered numerous lectures and training programs in several countries, including Canada, China, Dominican Republic, Egypt, Indonesia, Iraq, Korea, Malaysia, Philippines, Puerto Rico, Vietnam, Thailand, Taiwan, Turkey, Singapore and the US. I received a national Faculty Service Award in 1997 from the US University Continuing Education Association for meritorious service to Penn State University.

Elizabeth "Liz" F. Ryder, Ph.D.

Associate Professor, Biology and Biotechnology, WPI

Neurobiology and genetics are my two favorite scientific subjects, and my goal at WPI is to help students discover for themselves how exciting it is to work in these areas. In the classroom, I try to introduce students not only to necessary background knowledge, but also to some of the cutting-edge research going on in these rapidly changing fields. I hope to show students that biology is not about memorizing facts, but rather about asking questions, generating hypotheses, interpreting data, and coming up with exciting new models that can help to explain whatever biological system interests them.

In my laboratory, we study how neurons navigate during development to reach appropriate locations and make the correct connections to set up a functioning nervous system. I am also interested in using computational tools to understand how genes are turned on and off in particular types of cells, and to model cellular interactions in the worm. One exciting aspect of working in a model system is that because of their simplicity, they often lead the way to new understanding of complex biological questions.

One of the reasons I came to WPI is that the university puts so much emphasis on students learning to carry out real research through their MQP work. In the research lab, I really enjoy helping students develop, from novices who simply carry out my instructions, to proficient scientists who can design their own experiments, interpret their results, and put their work in the context of other research in the field. Students used to lab classes that (usually) work are often surprised by how much thought and persistence it can take to get experiments to work in the research lab! When a series of experiments gives us a result that allows us to add to our understanding of the nervous system, it is truly an exhilarating feeling.

Jagan Srinivasan, Ph.D.

Assistant Professor, Biology and Biotechnology, WPI

It has been my lifelong dream to become a professor in the field of Biology. Being a faculty member provides a great opportunity to teach and interact with students. Students by nature are highly inquisitive and motivated, and as teachers, we have the responsibility to guide our students to explore and think in new ways. I believe that teaching is a two-way interaction between teachers and students. I come from India and my parents, both of whom were teachers, taught me to strive for excellence in my scholarly pursuits. Science bears no geographical barriers and my academic training has taken me across three different continents (Asia, Europe and America). This experience has helped me to understand and appreciate the academic curricula of these continents.

My current research at WPI is highly inter-disciplinary and encompasses areas such as neurobiology, molecular genetics, and chemical biology. I will be teaching courses at both the undergraduate and graduate levels. My philosophy for the courses I will teach at WPI will be to emphasize the importance of hypothesis-driven research and the need to carefully design biological experiments to test them. I feel this approach will allow students to develop their curiosity for a scientific problem and strongly encourage critical and independent thinking. It also represents an opportunity for students bring in fresh ideas on topics that are not directly related with their research and curriculum. I have experienced that it is quite easy to excite a young student about a scientific problem but very difficult to maintain their enthusiasm. Therefore, I believe in a 'hands on' approach to teaching as being 'hands on' allows me to constantly keep track of my students' progress. It also provides an environment for discussing problems and pitfalls of an experiment/concept. I have applied this approach very productively, as one of my undergraduate students, Omer Durak, has co-authored a paper with me in a peer-reviewed journal BMC Biology. Many of the undergraduates that I have mentored have gone on to pursue graduate programs in several universities around the world. These success stories give me the confidence that as a teacher at WPI, I can reach shape the ideas and thoughts of many younger, keen minds.

A goal, which I aspire as an academic researcher and teacher, is to uncover and share the practical implications of my research. I believe that this is absolutely attainable on a daily basis through a conscious dedication to the practice of sound academic research and teaching. I believe that a perfect platform will not only share the practical knowledge with others, but also challenge my students, colleagues and members of the civic community at large to contribute into this endeavor.

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About Worcester Polytechnic Institute

Founded in 1865 in Worcester, Mass., WPI is one of the nation's first engineering and technology universities. Its 14 academic departments offer more than 50 undergraduate and graduate degree programs in science, engineering, technology, business, the social sciences, and the humanities and arts, leading to bachelor's, master's and doctoral degrees. WPI's talented faculty work with students on interdisciplinary research that seeks solutions to important and socially relevant problems in fields as diverse as the life sciences and bioengineering, energy, information security, materials processing, and robotics. Students also have the opportunity to make a difference to communities and organizations around the world through the university's innovative Global Perspective Program. There are more than 35 WPI project centers throughout North America and Central America, Africa, Australia, Asia, and Europe.