MBIM NEWSLETTER MAY 2015

Let us hear from you:

We love to hear from our alumni! Let us know what you are doing and anything else we can share with your fellow Microbiology and Immunology students.

Please contact:
Parvin Bolourani
parvin@mail.ubc.ca
MBIM Alumni Coordinator

Please join us for...

GRADUATION TEA

MONDAY, MAY 25, 2015
12:30 - 2:30 at the Life Science Centre
LIGHT SNACKS & BEVERAGES will be served

RSVP TO: CRAIG.KORNAK@UBC.CA

CONTACT US:

604.822.1689
craig.kornak@ubc.ca

Life Science Centre
2350 Health Science Mall
Vancouver, BC V6T 1Z3

IN THIS ISSUE:

- A Message From the Head
- MISA - Micro Student Association
- The Thompson Lab
- The Beatty Group's Solar Energy Project

FROM THE DEPARTMENT HEAD
BY: MIKE GOLD

When I first heard UBC's fundraising catchphrase "Start an Evolution", I thought this was a bit silly because in biology most evolutionary changes take a very long time, although there are certainly examples to the contrary. But then I started thinking about the evolution of organizations, like universities or departments, where the time scale should be much shorter and "intelligent design" is essential. So I started thinking about how our department is evolving and I'm pleased to report that the process seems to be going very well!

Within the next 6-8 months we will have two new faculty members, Lisa Osborne and Cara Haney. Both Lisa and Cara work on host-microbiome-pathogen interactions, an extremely timely topic. Lisa will focus on the gut microbiome, which controls everything, and will use genetically engineered mouse strains to gain new insights into these complex multi-kingdom (mammalian host, bacteria, viruses, protozoa, worms, fungi) interactions. In contrast, Cara will study some of the same concepts in the context of plant roots, which she quipped as being like the gut microbiome, except with the microbes on the outside. Just like the human gut microbiome affects distant immune processes involved in asthma in the lung, the plant root microbiome regulates that plant's innate immune responses in the leaves that protect them from pathogenic bacteria and chewing insects. We are looking forward to Lisa and Cara joining us at UBC and creating research synergies that will "evolve" our understanding of the critical role of host-microbiome interactions in controlling multiple physiological processes.

It's also great to see that our younger faculty members are "differentiating" into stars, as we knew that they would. Martin Hirst has established himself as a leader in the field of epigenetics, which has completely changed our view of how gene expression is regulated during development, in the context of cell fate decisions, and in the transformation of normal cells into malignant cells. Martin was part of the large-scale NIH Epigenomics Roadmap project and was an author on four Nature Press papers that all came out on the same day. Quite an achievement! Sean Crowe, who has brought geomicrobiology to our department, has combined precise chemical measurements with microbial community analysis of core samples to reveal how bacteria transformed the earth's physical environment and contributed to the initial oxygenation of the oceans and the atmosphere 2.4 billion years ago. This has resulted in papers in Nature and Science that have received a great deal of attention. In addition to having established herself as a fabulous instructor, Georgia Perona-Wright is unraveling the complexities of how cytokines and their receptors mediate both local and public conversations between lymphocytes in order to coordinate immune responses in the context of infections and co-infections with multiple pathogens. Because many people in the world are chronically infected with parasites, understanding how this modulates their immune responses to other pathogens and to vaccines is critical. Our new instructor, Dave Oliver, is using his industry experience to direct the evolution of our MICB 421 and MICB 447 lab courses by emphasizing modern approaches in project management and communication. In these courses, and others, major projects now involve producing effective and informative videos. This is part of how we are "evolving" our teaching approaches, with M&I being leaders in introducing active learning approaches into our courses and placing strong emphasis on developing transferrable skills (communication skills, experience working as a team, project management, leadership skills, etc.) in both our undergraduate and graduate programs.

Continued below...

MISA - MICRO STUDENT ASSOCIATION
BY: IDO REFAELI

Well, it has been a big year for MISA. Our executive board went into September with a single objective in mind: to further the lives of our peers both academically and socially. Since then, we have worked tirelessly to deliver events that facilitated the creation of long-lasting relationships and enhanced student learning outside of the classroom.

We kicked off the year with a welcome back BBQ and our annual MISA Icebreaker. After getting settled into school life again, we launched our Mentorship Program. In this program, second and third year students were paired up with more seasoned fourth and fifth year students who advise them on how to succeed in MBIM and how to approach professors to find the research experiences that interested them most.

In keeping with the Virology theme of MICB 306 we held our departmental vaccine initiative in November, where faculty members and students were vaccinated against the flu. That same month, our Undergraduate Research Conference received very positive reviews from the student community. In collaboration with the Undergraduate Research Organization (URO), Biology Student Society (BIOSOC), Biochemistry, Pharmacy and Pharmacology Club (BPP), and Science Undergraduate Society (SUS) we put on this event to provide undergraduate students in the Faculty of Science with the tools to get into research. There were multiple workshops, including sessions on how to approach research professors, how to write a resume, how to design a poster presentation, informational workshops on all the scholarships available to students, and a session about grad school and what it takes to be a successful grad student.

In February we put on "NERDLOVE", a Valentines Day-themed event that connected MBIM students with the greater Faculty of Science student community. To finish off the year, we collaborated with UBC's brewing club – BruBC – to bring our MBIM students MISA's first-ever brewing event. This was a month-long brewing project where student teams brew a beer of their choice and then participate in a tasting competition. This was truly a fun time as well as a great educational experience – we were finally able to apply the concepts of fermentation biology to something we were quite passionate about!

But while all of these amazing events were going on, we also made sure to take the time to organize some casual pub nights for our students to unwind during exam time. Over the course of this year it was amazing to see how our student community evolved into a tight-knit bunch that really cared for each other. We are so happy to have been involved in this incredible experience and to have made long-lasting friendships with some of the brightest, most interesting, funny, hardworking and caring people here at UBC.

So yes, it has been a great year for MISA, and we hope that next year will only be greater!

Cheers,

Your 2014/15 MISA Executives.

THE THOMPSON LABORATORY
BY: CHARLES THOMPSON

Development of new drug combinations to treat Mycobacterial diseases

While hundreds of drugs are available for treating most bacterial diseases in Western countries, few are active for treatment of Mycobacterial diseases that are common in developing countries. These include tuberculosis, caused by *Mycobacterium tuberculosis*, or Buruli Ulcer, caused by *Mycobacterium ulcerans*.

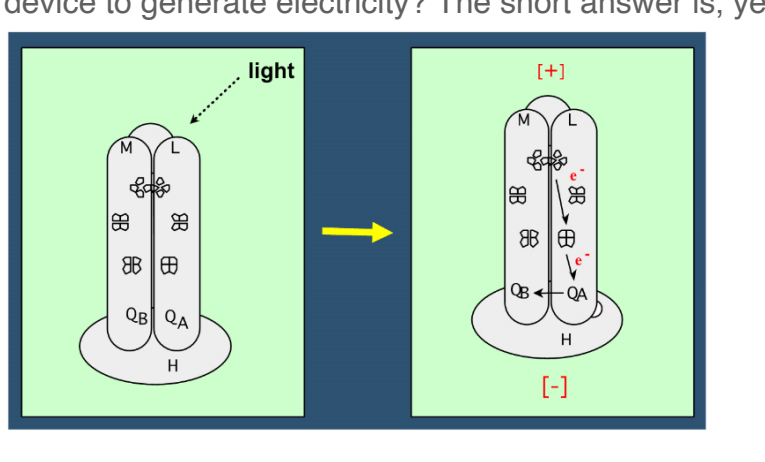
New drugs can take up to 14 years and $800 million to bring to market, an investment not commercially feasible for diseases affecting major populations in underdeveloped parts of the world.

Our lab developed new technologies to study how currently available, FDA approved drugs might work alone, or in synergy to kill Mycobacterial pathogens. We screened 4,000 different FDA approved compounds, including 500 antibiotics, and were surprised to find that many were synergistically active against *M. tuberculosis* or *M. ulcerans*. Working with the Centre for Drug Research and Development at UBC, GlaxoSmithKline in Spain, The University of Colorado, and The Swiss Tropical and Public Health Institute, we are further developing these repurposed drugs and drug combinations. Our results have attracted the interest of doctors at a leading clinic in South Africa who want to test new drug combinations on MDR-TB and XDR-TB patients. Since these drugs have already been approved, the cost and time it takes to translate research from bench to bedside could be greatly reduced. We have the potential to get new drug combinations to patients at a fraction of the cost in time and money. The high proportion of synergistic interactions also illustrates the need for this type of screening for all bacterial pathogens that have become multidrug resistant.

THE BEATTY GROUP
BY: TOM BEATTY

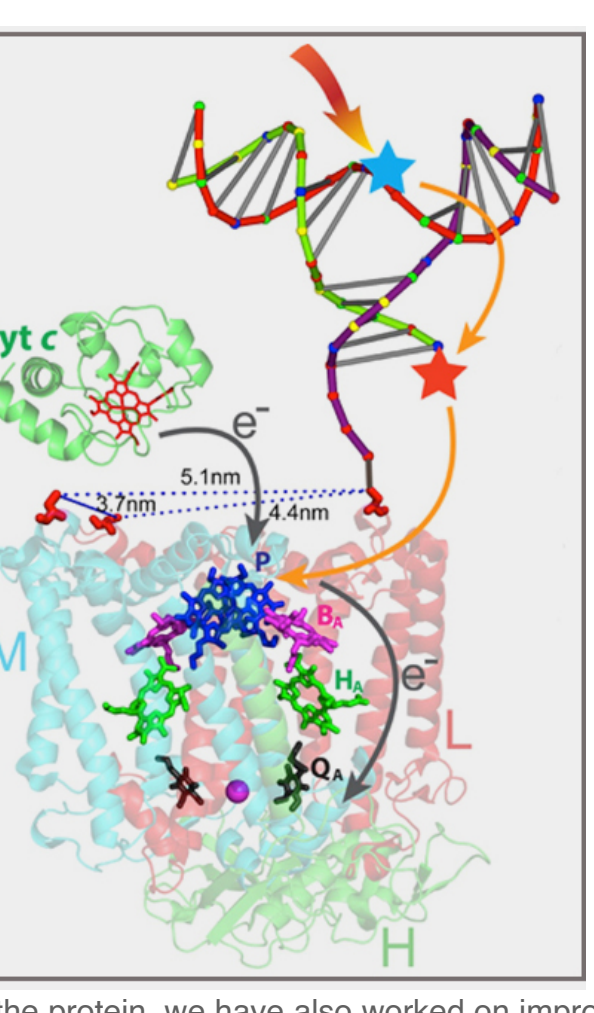
The Beatty Group's Solar Energy Project

It was about ten years ago that M&I's Tom Beatty called the UBC electrical engineer John Madden to ask for help on what appeared to be a far-fetched idea: can we benefit from nature's methods, as in plants and photosynthetic bacteria, to harvest light energy and effectively convert photons to electrons -- and use the electrons in a device to generate electricity? The short answer is, yes!



The Beatty and Madden groups have come together to use genetic engineering and biochemical separation techniques developed in the Beatty lab, along with device modeling and fabrication techniques employed in Madden's group, to create several types of small-scale devices that convert light energy to electricity. This work utilizes photosynthetic proteins that naturally harvest light energy and convert this energy to a flow of electrons. In photosynthesis, this electron flow is immediately tapped in chemical reactions by other proteins in a living cell. In our work we remove the proteins from the bacterial cell and divert the light-driven electron flow to a fabricated electrode, where electrons enter an electrical circuit to power devices. Work by others had shown the feasibility of this approach but currents and voltages were much smaller than is theoretically possible. In our approach the efficient transfer of electrons from the protein to the electrode is enhanced by using genetically engineered proteins, whose properties are changed in geometrically and chemically precise ways, along with new methods for construction of solar cells. The net result of using these altered proteins and new cell configurations is much a much more efficient connection of the electron donor (the protein) to the acceptor (the electrode), and hence greatly improved electrical current.

The photosynthetic reaction center can be functionalized by substituting cysteine for a native residue, three of which and the distance between them are shown. One of these cysteins was used to bind a synthetic strand of DNA through a disulfide bond. A second DNA strand modified by adding a red dye forms a double helix with part of the first strand, and a third DNA strand containing a blue dye, forms a mixed double helix with the first two strands, Because these dyes absorb unnatural light wavelengths, and can transfer this energy to the special pair to initiate electron transfer, we have created a sensor that initiates electrical current in response to any wavelength for which a dye can be made. Alternatively, this may be viewed as creating a more efficient reaction center, now capable of using a broader range of the solar spectrum.



In addition to diverting electrons from the protein, we have also worked on improving the wavelength range of photons that are harvested by the protein to initiate electron transfer reactions. This work has been done in collaboration with Neal Woodbury's group and colleagues at the Arizona State University. Commercially available solar panels absorb a limited range of the solar spectrum, defined by the physical properties of the light-harvesting substance employed. Our research was to modify our photosynthetic chlorophyll-binding proteins that naturally harvest light and produce electrical voltage.Bacterial proteins were genetically engineered to increase the range of solar spectrum absorption by incorporating synthetic light-harvesting dyes. A novel combination of natural protein chlorophylls, DNA linkers and synthetic dyes was used to greatly expand the range of the solar spectrum that can be used to produce electrical voltage.

Our work is one step leading to the demonstration of photosynthetic proteins as inexpensive, efficient and environmentally sustainable components of solar panels, which could be developed in commercial applications. We have several patents in progress, although the curiosity that drives the fundamental side of our research and resultant new knowledge has been the most important factor in our success.
Accounts of our work can be found by clicking on the following links:

http://news.ubc.ca/2015/02/19/a-place-in-the-sun/
http://engineering.ubc.ca/apsc-eng/spotlight/bio-solar-cells-photosynthesis-
http://ubyssey.ca/news/cheaper-efficient-solar-cells-inspired-photosynthesis-works-
http://marketbusinessnews.com/using-photosynthesis-create-biological-solar-panel-
http://customstoday.com.pk/university-of-british-columbia-researchers-want-to-use-
http://www.microbiology.ubc.ca/Beatty

MIKE GOLD Continued...

The success of our department members requires the continual evolution of their research programs and is reflected in the many awards that they received in the past year. This includes Brett Finlay being awarded the 2014 Prix Galien Canada for his contributions to pharmaceutical research and innovation, Steven Hallam begin elected a Fellow of the American Association for the Advancement of Science as well as a Stanford Woods Institute for the Environment Leopold Leadership Fellow, Lindsay Eltis being named a Tier 1 Canada Research Chair in Microbial Catabolism and Biocatalysis, Bob Hancock being renewed as a Tier 1 Canada Research Chair in New Anti-Infective Strategies, Georgia Perona-Wright receiving a Michael Smith Foundation for Health Research Scholar Award, and Sean Crowe being elected as a Peter Wall Institute Scholar.

An important part of both our personal evolution, and our evolution as a department, is transitioning from looking inward to increasingly looking outward in terms of our contributions to society. Our most important contribution to society is of course the students who graduate from our programs and go on to make important contributions in many venues. We are reminded of this in many ways, some of them a bit awkward, such as when the physician who was to perform a colonoscopy on me revealed that he had had me as instructor in MICB 202. In any case, it is most gratifying to hear from our former students about how the training they received in our programs gave them the opportunities and the tools to make a difference and to contribute to their community.

In this regard, we are very proud of our community engagement events and outreach events such as World TB Day and Day of Immunology. Many of our department members are involved in initiatives aimed at informing the public about the importance of microbiology and immunology in their lives, and in broadening the horizons of young students so that they think that they too can be scientists. I want to highlight the efforts of Nicolette Fonseca, a graduate student in Georgia Perona-Wright's lab. Nicolette established an eMentoring program that links graduate students at UBC with senior undergraduates at St. Xavier's College in Goa, India. Her goal is to increase the students' awareness of the research possibilities available globally, and to build confidence and a sense of opportunity among science students in Goa. She conceived the idea, selected and trained the UBC mentors and worked with faculty at St. Xavier's to make connections to students in Goa. For establishing this international mentoring program, Nicolette was awarded a Faculty of Science Service Achievement Award.

So both as individuals and a department, the question now is: How are we going to evolve ourselves in the next year so that we take on new challenges and position ourselves to make positive impacts locally and globally? Based on the track record, I predict that current and past M&I members will come up with many highly creative and highly successful answers to this question.

Mike