

NIMBioS Research Collaboration Workshop for Women in Mathematical Biology

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On June 22, 2015, four research teams composed of 24 women in mathematics and biology converged at the National Institute for Mathematics and Biological Synthesis (NIMBioS) in Knoxville, Tennessee to participate in a Research Collaboration Workshop for Women in Mathematical Biology. The goal of the workshop was to kick-start multidisciplinary research projects and form lifetime connections to other women in STEM fields. This workshop was inspired by the highly successful 2013 Institute for Mathematics and its Applications (IMA) Special Workshop: WhAM! A Research Collaboration Workshop for Women in Applied Mathematics: Dynamical Systems with Applications to Biology and Medicine.

NIMBioS was an excellent venue to host this multidisciplinary workshop. Consistent with the institute's mission to trigger research in quantitative modeling and analysis in the life sciences, the research teams consisted of women who are trained and working in both biology and mathematics departments. Each group consisted of a senior faculty member and a junior faculty member from the fields of mathematics, engineering, and the life sciences. These teams each mentored four junior women who ranged from graduate students to assistant professors. Anita Layton (Duke University) organized

the workshop and did an outstanding job of attracting and recruiting some of the most interdisciplinary women in the field of mathematical biology. Suzanne Lenhart (University of Tennessee, Knoxville) was the local organizer and did a fantastic job communicating all of the opportunities for continued research at NIMBioS.

On the first day of the meeting, each research group gave a brief overview of their proposed project. Laura Miller (University of North Carolina at Chapel Hill) and Lydia Bourouiba (Massachusetts Institute of Technology) outlined a project that combines numerical analysis and fluid dynamics to understand how spiders are transported potentially thousands of miles by the wind. Anita Layton and Aurélie Edwards (CNRS, Paris) summarized a highly interdisciplinary and relevant medical project on blood flow autoregulation in the kidney. Their objective was to build upon a published model of calcium dynamics of the afferent arteriole to better understand vasodilative and vasoconstrictive responses. Victoria Booth (University of Michigan) and Megan Hastings Hagenauer (University of Michigan) described the bidirectional relationship between sleep and pain and its significance to the treatment of diseases. The goal of their group was to develop a mathematical model of the interactions between sleep, circadian rhythms and pain sensitivity. Finally, Suzanne Lenhart and Cristina Lanzas (North Carolina State University) described mathematical models that account for the interactions between gut microbiota and *C. difficile*, and the perturbation that antimicrobial therapy causes on the gut microbiota.

After the introductions to the projects, all of the participants broke out into individual working groups.

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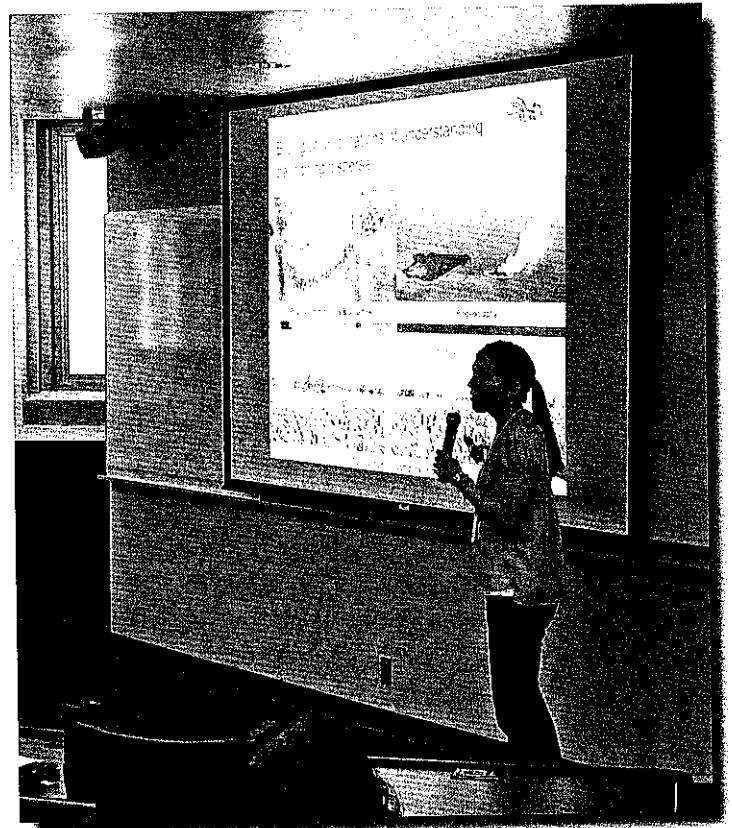
*Participants in the 2015 Research Collaboration Workshop
for Women in Mathematical Biology at NIMBioS at the University of Tennessee*

What quickly became obvious as each group delved into its research projects was how quickly one can make substantial progress in a very short amount of time. In fact, the pace of the entire meeting underscored how much work a group of motivated women can get done if given a supportive environment and few interruptions. After an intense afternoon of work, the group headed into Knoxville for some wonderful southern food at Tupelo Honey Cafe. Unfortunately, Lou Gross (University of Tennessee, Knoxville) was not available to advise the group on Knoxville's famous bluegrass music, but a few workshop members did make their way to some local music venues.

On the second day of the workshop, each group moved quickly from breakfast to an intense morning session to delve even deeper into their projects. Coffee and lunch breaks were buzzing with research ideas and networking. By midafternoon, the entire group reconvened to discuss their progress. It was absolutely astonishing to hear how much each team had accomplished in a mere 36 hours. After the group updates, the women scientists and mathematicians met with the NIMBioS postdoctoral fellows and some of the undergraduate students working at the institute through a summer REU program. The degree to which NIMBioS encourages networking and how well they advocate for their postdoctoral fellows is impressive. At the end of the day, some of the participants visited Icon, the restaurant within the World's Fair Park Sunsphere. This was a fabulous location to see the sunset in Knoxville and enjoy the food prepared by their award winning chef, Bruce Bogartz.



Sanjukta Hota presents the results from the Sleep, Circadian Rhythms and Pain group



Kimberly Sheldon describes the importance of dispersal for the population dynamics of spiders

On Wednesday, all of the groups got straight to work preparing for their final presentations and making plans for future research. In between work sessions, NIMBioS provided excellent snacks and meals for the hard-working women with ample time for networking and brainstorming across the research groups. Wednesday concluded with an excellent dinner served at NIMBioS, and many of the groups returned to the hotel to continue working on their talks into the wee hours of the morning.

Thursday morning began with breakfast followed by presentations of the results of three days of hard work. The junior scientists gave the presentations, with the group leaders stepping aside. All of the participants were amazed by the amount of work that been accomplished since the updates on Tuesday afternoon. The spider group had submitted large-scale simulations to a remote cluster at University of North Carolina at Chapel Hill which showed that the spider's silk dragline flaps violently immediately before take-off. The blood flow autoregulation group explored a detailed model consisting of a system of coupled differential equations to accurately capture the dynamics of vasodilation and vasoconstriction. The sleep, circadian rhythms, and pain

group showed just how devastating the combined effects of pain and lack of sleep can be. The antimicrobial therapy group created a model that showed that antibiotic-induced alterations in microbial bile acid metabolism in the gut decreases colonization resistance against *C. difficile*.

During the final lunch, many of the women remarked on how wonderful it was to conduct research with a group of women. In addition to the level of comfort provided, it was great opportunity for junior women to meet senior professors in their field. The meeting format also gave young students the opportunity to hone their presentation skills in a welcoming and safe environment. The interdisciplinary makeup of the workshop allowed mathematicians and biologists to discuss and discover some of the intellectual as well as cultural differences between the two fields.

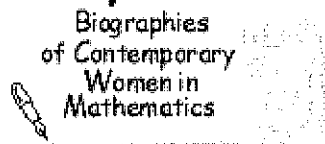
An excellent outcome of the multidisciplinary working groups was the synergy brought through different perspectives. Mathematicians were able to bring modeling approaches, analytical skills, and computational methods to address biological questions. Life scientists were able to bring their knowledge of the application as well as existing data and the potential to collect new data to validate

models. Just as important as networking with women in one's own field was the opportunity to connect to women in another field who may become long-term collaborators and mentors. Many of the participants also learned about a variety of technologies available to enhance collaboration such as GitHub, ShareLaTeX and Basecamp.

Even though the workshop has ended, there is still much more work to be done. Anita Layton and Laura Miller have offered to co-edit a volume in Springer's Association for Women in Mathematics Series that focuses on the research initiated at this workshop. The goal is for each group to write two papers. The first paper will focus on an introduction to the application to be addressed. The second paper will cover the new research that was conducted during the workshop and in the subsequent collaborations. All groups are also strongly encouraged to continue the research for submission to appropriate peer-reviewed journals in the relevant disciplinary fields.

If you are a math or life science faculty member, please consider organizing a similar event at your university or at one of the national mathematics or life science institutes.

Essay Contest



To increase awareness of women's ongoing contributions to the mathematical sciences, the Association for Women in Mathematics holds an annual essay contest for biographies of contemporary women mathematicians and statisticians in academic, industrial, and government careers. AWM is pleased to announce that the 2016 contest is sponsored by Math for America, www.mathforamerica.org.

The essays will be based primarily on an interview with a woman currently working in a mathematical career. The AWM Essay Contest is open to students in the following categories: **grades 6–8**, **grades 9–12**, and **undergraduate**. At least one winning entry will be chosen from each category. Winners will receive a prize, and their essays will be published online at the AWM website. Additionally, a grand prize winner will have his or her entry published in the *AWM Newsletter*. For more information, contact Dr. Heather Lewis (the contest organizer) at hlewis5@naz.edu or see the contest web page: www.awmmath.org/biographies/contest.html. The deadline for electronic receipt of entries is **January 31, 2016**. (To volunteer as an interview subject, contact Heather Lewis at the email address given.)



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