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LEHIGH UNIVERSITY

Biological Sciences

Greetings!

Vassie C. Ware, Ph.D.
Professor and Interim Chair

I bring this greeting to you as interim chair of the department of biological sciences while Professor Murray Itzkowitz takes a sabbatical leave. I was thinking about transitions – fall to winter, winter to spring, novice to experienced, active to retired, 20 to 21, student to alumnus – as I prepared this greeting to you. One bittersweet transition included the retirement of Professor Jeffrey Sands last summer and we share some highlights of his career in the newsletter. In the fall we turned our attention to a faculty search for a new assistant professor in physiology. We will look forward to welcoming Dr. Daniel Babcock from the University of Wisconsin – Madison in the fall 2016 semester as we transition from 20 to 21 faculty in the department. The spring has also brought a new interdisciplinary faculty search in computational bioscience & engineering into the mix as the department seeks to add new faculty to our ranks.

Many of you know that among my responsibilities for the last decade has been my role as Co-Director (along with Professor Neal Simon) of Lehigh's Undergraduate Bioscience Program, sponsored by the Howard Hughes Medical Institute (HHMI). Fueled in part by HHMI investments in us, our department has embraced reforms in life science education (now sweeping across the nation) that focus on evidence-based practices in teaching and research to foster the development of a new generation of scientists. Our students, transitioning from the novice to the experienced, continue to be enriched by research opportunities found within courses and within the laboratories of our faculty, often working as part of a team with graduate students in our Ph.D. programs. Here in the newsletter, we highlight the research journeys of several of our undergraduate students and one of our graduate students in the spotlight, and introduce you to our new crop of Langer-Simon Scholars. We hope you will be inspired by their stories, understand how research experiences have helped to shape their futures, and appreciate why expansion of financial support for undergraduate bioscience-related research remains an important goal. You are always invited to help us with this strategic investment.

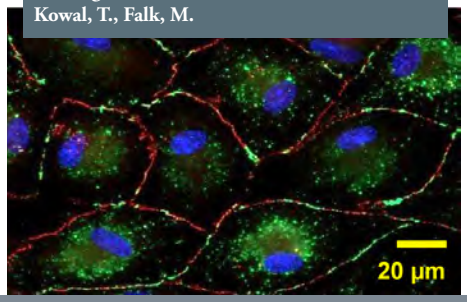
We never tire of hearing from our alumni and learning about the choices you have made since your student days at Lehigh. Let's stay in touch!

Vassie C. Ware, Ph.D.
Interim Chair

2015 - the department at a glance ...

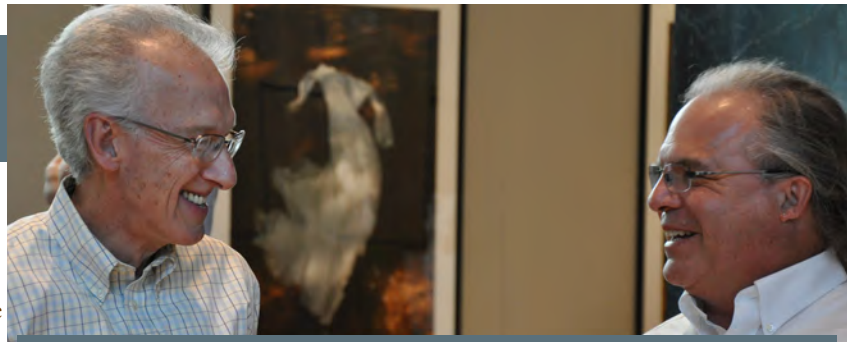
- 20 faculty members
- 5 post-doctoral and research scientists
- 5 technical and 3 administrative staff
- 40 Ph.D.-level graduate students; 25 Master's-level graduate students
- 374 Undergraduate majors:
  - 151 Biology
  - 46 Biochemistry
  - 34 Molecular Biology
  - 143 Behavioral Neuroscience

Primary cilia in HeLa cancer cells detected by Arl13B (green) and gamma-tuzulin (red) staining. Cell nuclei stained with DAPI (blue). Kowal, T., Falk, M.



• Michael Behe • R. Michael Burger • Lynne Cassimeris • David Cundall • Matthias Falk • Julie Haas • M. Kathryn Iovine • • Murray Itzkowitz • Michael Kuchka • Gregory Lang • Michael Layden • Linda Lowe-Krentz • Krystle McLaughlin • • Julie Miwa • Amber Rice • Jill Schneider • Neal Simon • Robert Skibbens • Jennifer Swann • Vassie Ware, Interim Chair •

Sands earns status of Professor Emeritus



Jeff Sands (left) was surprised by his former student, David Auperin, Ph.D. ('80) who attended the "Final Lecture" given by his research adviser.

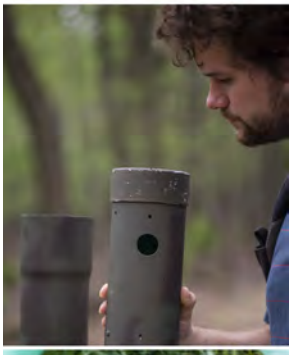
After 42 years of serving Lehigh University, Professor Jeffrey Sands retired in the summer of 2015. Over the years, students in the physics, biology, molecular biology and biological sciences departments were the beneficiaries of Dr. Sands's teaching. Dr. Sands was instrumental in creating the department of biological sciences, and served a term as chair of each of the biology-related departments.

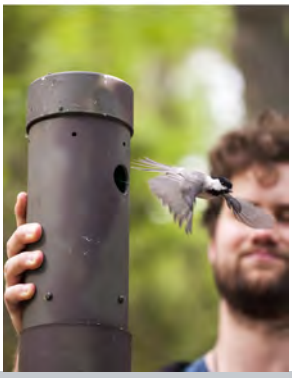
Sands received his bachelor's degree (Physics, University of Delaware) in 1969 and his Ph.D. (Biophysics, Pennsylvania State University) in 1973. Jeff was initially hired as an assistant professor (1973) in physics. Over his career, he served as mentor and research adviser for 15 Ph.D. graduate students, as well as countless undergraduate students. While in biological sciences, Sands taught Cell & Molecular Biology, Genetics, Molecular Genetics, Virology and a variety of writing intensive classes. His research areas included virus origins, evolutionary genetics, and integration of physics into biology education.

Dr. Sands received the Lindback Award for Distinguished Teaching in 1999 and the Stabler Award in 1983. He served on several committees throughout his career and was chair of the College of Arts and Sciences Tenure Committee and the Faculty Personnel Committee.

Graduate Student Spotlight

Michael McQuillan, Integrative Biology





Michael started his undergraduate career as a jazz saxophone performance major at the University of the Arts, in Philadelphia. After a year of music school, he decided that a career in music was not for him, and he transferred to Temple University to pursue another passion, biology. It was at Temple that Michael discovered an interest in studying ecology. At Temple, Michael conducted research in a community ecology lab, where he examined invasive species dynamics in marine environments. This initial interest in research eventually blossomed into a research path that combines the fields of ecology and evolution, which he has pursued since joining Dr. Amber Rice's lab at Lehigh in 2012.

At Lehigh, Michael's research interests focus on speciation, which is the process by which new species arise in nature. Understanding this process is of upmost importance for evolutionary biologists, because it is the same process that ultimately leads to the incredible amount of biodiversity we see in the world around us. To study this process, Michael studies natural hybridization, a natural phenomenon where two different species come into contact and mate with each other, producing hybrid offspring. This relatively common process is important to understand because it can tell us why species ultimately do or do not remain distinct from one another. Oftentimes, hybrid offspring are produced that are unfit, or unlikely to survive and reproduce, and understanding why hybrids are unfit can tell us a lot about how species remain distinct. One of Michael's current research projects examines why hybrids may be selected against in nature.

To answer this question, Michael studies two different species of songbird that are hybridizing locally, the Black-capped and Carolina chickadee. These birds are prodigious 'scatter hoarders,' meaning they cache (store) food items in hundreds of different locations in the environment, and they must rely on their spatial memory in order to accurately retrieve those caches. This behavior is important for surviving harsh winter conditions, and birds that inhabit harsh environments have enhanced spatial memory ability compared to birds from milder environments. This ability has also been shown to be heritable, or under genetic control, and natural selection has likely favored enhanced spatial memory ability in harsh or unpredictable environments. Michael's hypothesis is that hybrid chickadees may be cognitively deficient in terms of their spatial memory ability, compared to pure-species black-capped and Carolina chickadees. If so, hybrids may be less likely to survive the winter, and this could be a source of selection acting to keep the two species distinct from one another. To test this hypothesis, he uses behavioral experiments designed to compare the spatial memory ability of wild-caught pure and hybrid chickadees. Michael recently received a Sigma Xi grant to help fund his research project. In the future, he plans also to compare the general learning ability and problem-solving abilities of pure species and hybrids. In general, Michael's research includes behavioral tests, genetic analyses, as well as climate modeling approaches to understand the ecological and evolutionary causes and consequences of hybridization in these species.

In his free time, Michael enjoys hiking, listening to/playing music, and hanging out with his pet cat.

Can you provide support for a graduate student travel to a professional meeting?

Seizing Opportunities, Opening Doors

article by Kelly Hochbein, University Communications
photos courtesy of Christa Neu, University Communications

"You really never know when a new passion might be unearthed," says Emily Heckman '16. "That's sort of what happened to me in research." Heckman, a molecular biology major, unearthed her passion by taking full advantage of the wealth of research opportunities that Lehigh offers its undergraduates.

"I tried something new and now want to make a career out of it," says Heckman. "There are so many opportunities around campus to get plugged in or involved one way or another, and just taking that first step is what can really change things."

Lehigh's department of biological sciences encourages students to take that first step. As a result, Heckman and fellow undergraduate researchers Kyra Feuer '16, Michelle Juarez '16, Jasmine Singh '16 and Rachel Sternberg '16 arrived at Lehigh and jumped right in. So far they've learned not only a great deal about research, but also quite a bit about themselves and their potential beyond Lehigh.

Enhancing science education

Lehigh's department of biological sciences includes the university's largest number of students involved in independent study and honors research with faculty. The department also has the largest number of science majors at the university, of which over 60 percent are women. The department's dedication to innovation in life science education and student growth has earned it multiple grants from the Howard Hughes Medical Institute (HHMI), whose mission is to "advance biomedical research and science education for the benefit of humanity." In the three most recent competitions (2006, 2010 and 2014) among major research universities, HHMI awarded Lehigh more than $5 million to support interdisciplinary curriculum development, course-based research experiences, expanded research-intensive opportunities for undergraduates, and programs designed to increase success rates in Science, Technology, Engineering, and Mathematics among members of under-represented and at-risk students.

Among Lehigh's HHMI programs is SEA-PHAGES (The Science Education Alliance's Phage Hunters Advancing Genomics and Evolutionary Science), a two-semester course that immerses students in authentic research experiences. During the course, which starts in the spring of the first year, students isolate, name, sequence and analyze newly discovered mycobacteriophages, which are viruses that infect mycobacteria, some of which cause tuberculosis. Undergraduates learn to work and think as scientists and acquire a variety of techniques that span disciplines including microbiology, molecular biology, genomics and bioinformatics.

Heckman, Juarez and Sternberg were interested in the biological sciences as first-year students and signed up for the SEA-PHAGES course with Vassie Ware, professor of molecular biology, during their second semester. Feuer signed on at the start of her sophomore year.

"I think it's phenomenal," says Juarez, who is majoring in behavioral neuroscience, of SEA-PHAGES. "Every experiment I ran, I knew was for a purpose. The experiments I had to conduct were never pre-determined by someone else for me. I had to determine the next experimental steps based on what I had learned from my own research. "

"I was just blown away by how much I loved it," says Feuer, a behavioral neuroscience and psychology major. "[SEA-PHAGES] was the first time I got to do research. There weren't any answers yet to the questions we were asking. I absolutely loved it and didn't want to stop."

For these students, SEA-PHAGES provided an invaluable gateway into research. Each student has since pursued independent research-for-credit opportunities during the academic year, and all have extended their experience with summer research opportunities both on- and off-campus.

Undergraduate researcher Emily Heckman, '16

'The questions really never end.'

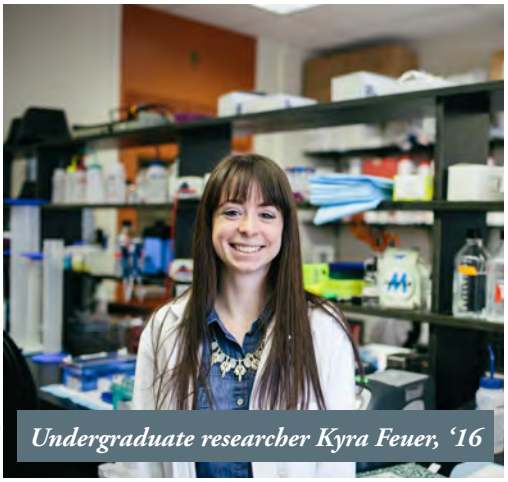
"I'd never worked in a lab before," says Emily Heckman of SEA-PHAGES. "One thing I learned in going through [the course] was that the questions really never end. You answer one question and it leads to new questions. It's really a cycle that self-perpetuates. I really loved it."

Heckman also participated in Lehigh's innovative Mountaintop initiative last summer, which, she says, "solidified everything." The project integrated molecular biology and bioengineering principles to combat pathogenic bacteria. Heckman and her team sought to identify the functions of genes from viruses and bacteriophages and aimed to use them as a therapy to degrade pathogen-causing bacteria that cause diseases such as tuberculosis and listeriosis.

"It was a really cool undertaking getting to work with bioengineering and materials scientists and learning their perspectives on the same problem," says Heckman, who hopes to eventually complete a Ph.D. program and lead her own research lab. "It really gave me an appreciation for the importance of an interdisciplinary approach to complex problems in life science. You have to have people who specialize in other areas to open your eyes to different perspectives and analytical methods."

'My own seat at the bench'

While still in the SEA-PHAGES class as a sophomore, Kyra Feuer, already hooked, reached out to faculty members for additional research opportunities. Greg Lang, assistant professor of molecular biology, hired Feuer as a work-study student in his lab, where she studied yeast evolution. "I got my own seat at the bench, which was really cool," says Feuer. In addition to her work with Lang, Feuer chose to continue with her phage research and registered for supervised research in the Ware Lab.



Undergraduate researcher Kyra Feuer, '16

Seeking even more variety, Feuer applied and was accepted to the Biosystems Dynamic Summer Institute (BDSI), one of the HHMI-funded initiatives at Lehigh. Assigned to the team led by Julie Miwa, assistant professor of neuroscience, and Amber Rice, assistant professor of evolutionary biology, Feuer worked in the lab full time, studying a family of genes known as lynx, which influence learning and anxiety. She has continued her research on lynx during the academic year and through a Mountaintop project in the summer of 2015.

"I had been doing research during the school year, but there's a big difference between going to the lab a few hours a week between classes and actually spending 40 hours a week working on it full time," says Feuer. "I absolutely loved it. I knew for sure I wanted to go to grad school and do research for life." Feuer, who is interested in the genetics of abnormal behavior, chose to continue her work with the lynx gene beyond the summer program. She currently studies lynx1, the gene that can cause differences in learning potential in different people. "We're trying to understand why some people learn more effectively than others."

"I'm the type of person that really needs a problem to solve," says Feuer. "It's so much more exciting when you're actually using [knowledge] in real life to solve problems that no one knows the answer to."

Undergraduate researcher Michelle Juarez, '16

'Immerse yourself as much as you can'

SEA-PHAGES had a particularly significant impact on Michelle Juarez: "I am so glad I did it because, to be honest, I don't know if I'd even be doing research if I'd never done that program." Following the course, Juarez has continued during the academic year to work with Ware, studying gene functions that are unknown in certain classes of mycobacteriophages. She is attempting to discover the function of gene gp57 (which is found in only one group of related bacteriophages) in order to determine how this gene affects bacteriophage infection and killing of its host.

After completing the SEA-PHAGES course, Juarez was also nominated for and accepted by the HHMI Exceptional Research Opportunities Program (EXROP) fellowship, which provides summer research experiences to undergraduate students who are from disadvantaged backgrounds or from groups traditionally underrepresented in the sciences. Through EXROP, Juarez spent ten weeks for the past two summers studying the retina in the lab of Constance Cepko, professor of genetics at Harvard Medical School. Juarez plans to attend an M.D./Ph.D. program and eventually work in global medicine and policy development. She advises other students to take advantage of the opportunities available to them. "Immerse yourself as much as you can," says Juarez. "If you know what you want to do, try and get involved. You have to be proactive. I knew I wanted to do research, so I got involved right away in whatever way I could."

'Masters of the topic we're researching'

SEA-PHAGES allowed Rachel Sternberg to "really get my hands wet and try different things. I really loved it and I've been [in the lab] ever since." Today, Sternberg works with yeast in the lab of Robert Skibbens, professor of cell biology. She focuses on Eco1, a cell cycle gene required for cohesion around sister chromatids. Mutations in Eco1 produce cells that are a hallmark of cancer progression. Sternberg is studying the regulation of cohesion factors that respond to DNA damage that, if left unrepaired, would result in new mutations. "We are really getting that full research experience," says Sternberg, who plans to attend medical school and become a pediatrician. "We're not just following a grad student—we're the ones who are the masters of the topic we're researching. That's amazing."

Undergraduate researcher Rachel Sternberg, '16

Sternberg's passion for her work is just as evident when things don't go according to plan as when they do. "Two semesters ago I started doing one project, went down one path and realized it was not working the way we had expected. I backtracked a step, found a solution, and now I'm still following that same path," says Sternberg. "I think that's part of research. I think you learn as much just from a dead end that you do from a positive experiment."

Interested in supporting undergraduate research? Visit giving.lehigh.edu to make your gift

'Different ways to move toward the same goal'

Jasmine Singh, a biochemistry major, did not take the SEA-PHAGES course. Instead, she chose a lab course based on the work she'd eventually do in the developmental biology lab of Kathy Iovine, associate professor of microbiology. Singh's current independent research in the Iovine Lab has her studying the effects of the extracellular matrix on cell proliferation and differentiation using AB9 cells, an immortalized fibroblast cell line derived from the zebrafish regenerating fin. "There's a mixture of undergrads and grads in the lab and everyone is really friendly," says Singh, who takes advantage of the knowledge and experience of graduate students whenever she can. "[They're] so helpful when I ask questions about what they're working on or a procedure."

Undergraduate researcher Jasmine Singh, '16

Like Feuer, Singh participated in the BDSI program, which allowed her to continue in the Iovine Lab last summer. During BDSI, Singh worked in collaboration with the bioengineering-focused Berger Lab on a project related to her independent research. "It was really cool to see how the two fields of bioengineering and developmental biology overlapped. It was really enriching." "I've been exposed to so many different ways to approach the same problem," says Singh, who plans to study medicine. "You can read in a textbook that there are multiple ways to move toward the same goal, but actually seeing different strategies at work in the lab has had an impact on my perspective."

A firm grounding

In offering these unique research experiences, Lehigh has provided a world of possibility for each of these students. "I'm really glad I ended up [at Lehigh] because I feel like I've gotten so much more out of my college experience than I would have anywhere else," says Singh. "I didn't expect to be doing research. I didn't expect to be finding out anything. To be able to do it is rewarding."

"All my experiences at Lehigh have built me into a confident scientist who can function independently in a lab," says Heckman. "It's groomed me for what's to come. I'm definitely not done growing, but I think I have a solid foundation now because of the education I've received at Lehigh." "There are so many doors that have been opened for me instead of just coming here and going to class and leaving class," says Sternberg. "The opportunities are endless."

We get letters!

Hello Dr. Cassimeris,

It has been quite some time (15+ years?!), but there may be a chance that you remember me from my undergraduate experience at Lehigh. I just wanted to send a short note to thank you for teaching Cell Biology at Lehigh. Although I never did a research project in your lab, your teaching and passion about scientific research had a major impact on me that I have relied upon throughout my career thus far.

After graduating from Lehigh in '01, I ended up getting a Ph.D. in Immunology and Molecular Pathogenesis at Emory University. When I graduated in 2007 I took a few years off to raise two little ones and then got a great position as an assistant professor at Frostburg State University in western Maryland.

Rebekah (Tuthill) Taylor ('01)(left) sent this wonderful letter to her former professor, Lynne Cassimeris (right). We enjoy reading about our students' successes. Thanks, Rebekah for taking the time to write!

The reason I am writing is not about me, but about you! Today I gave my last lecture teaching Cell Biology for the first time. As I prepared lecture after lecture, night after night, I was surprised at how easily all of the material came back to me and how so many nuances, stories, and practical links I remembered from your lectures. I remember your funny story about "keen-o-chores" and your amazing passion for all things microtubule. It's no accident that I spent quite a bit of time covering cell motility, vesicular trafficking, and protein packaging. I also remember that you taught a special course during my fifth year on pathogenesis, which was a major contributor to my decision to follow that route of study in grad school. I eventually became very handy at confocal microscopy and immunofluorescence, which I know are also great interests of yours.

So thank you, again, for all of your efforts at Lehigh. You are a great instructor and scientist and I was glad to see that you are still there, making a difference in students' lives.

Rebekah (Tuthill) Taylor, Ph.D.

2015 Research Publications

Bold = Faculty
Bold+Italics = Graduate Student
Italics = Undergraduate Student
* = Former Student

V.C. Silva*, *M. Plooster*, ***J.C. Leung*** and **L. Cassimeris**. 2015. A delay prior to mitotic entry triggers caspase 8-dependent cell death in p53-deficient HeLa and HCT-116 cells. Cell Cycle. 14: 1070-1081.

Kowal, T.J., and **Falk, M.M.** 2015. Primary cilia found on HeLa and other cancer cells. Cell Biology International 39:1341-1347.

Haas, J.S. 2015. A new measure for the strength of electrical synapses. Front. Cell. Neurosci.

Bhadra, J.* and **Iovine, M.K.** Hsp47 mediates Cx43-dependent skeletal growth and patterning in the regenerating fin. Mechanisms of Development. doi: 10.1016/j.mod.2015.06.004. 2015.

Bloch A., Paciorek, T., **Richter, M.** & **Itzkowitz, M.** 2015 Do Males measure Body Sizes of Males and Females Similarly? A test in the beaugregory damselfish, Stegastes leucostictus. Ecology, Ethology and Evolution. 10.1080/03949370.2015.110068

Frenkel E.M., McDonald M.J., Van Dyken J.D., Kosheleva K., **Lang G.I.**, and Desai M.M. 2015. Crowded growth leads to the spontaneous evolution of semistable coexistence in laboratory yeast populations. Proc Natl Acad Sci U S A Aug 3. pii: 201506184

McQuillan, M. A. and **Rice, A. M.** 2015. Differential effects of climate and species interactions on range limits at a hybrid zone: Potential direct and indirect impacts of climate change. Ecology and Evolution 21: 5120-5137.

Kevin Tong* and **Robert V. Skibbens.** 2015. Pds5 regulators segregate cohesion and condensation pathways in Saccharomyces cerevisiae. PNAS 112(22):7021-7026

Cresawn SG, Pope WH, Jacobs-Sera D, Bowman CA, Russell DA, (**Ware, VC**), et al. 2015. Comparative Genomics of Cluster O Mycobacteriophages. PLoS ONE 10(3): e0118725doi:10.1371/journal.pone.011872

Coleman, W.L. and Burger, R.M. Extracellular Recording and Neuropharmacological Methods. In: Basics in Electrophysiology. Eds. Covey, E. and Carter, M. Osford University Press. March 2015. ISBN: 9780199939800. Cover image

Pope WH, Bowman CA, Russell DA, Jacobs-Sera D, Asai DJ, et al. 2015. Whole genome comparison of a large collection of mycobacteriophages reveals a continuum of phage genetic diversity. eLife 2015;4:e06416. (*Student publication from SEA-PHAGES Class (Vassie Ware, Ph.D. and Margaret Kenna, Ph.D., Instructors*)

2015-2016 Langer-Simon Scholars

The department of biological sciences announced the following students were this year's recipients of the Langer-Simon Endowed Fund for Bioscience Research. Each student has been awarded support for travel to a professional meeting and for research supplies.

(l to r) Katelyn Latuska, Siraj Pursnani, Amanda Sidwell, Rachel Margraf

Katelyn Latuska ('17) is an undergraduate researcher in the Lowe-Krentz Lab and is investigating how reactive oxygen species influence the development of vascular disease such as atherosclerosis. She is doing this by measuring the levels of p-JNK, a stress-activated kinase bound to a phosphate and other similar stress-activated molecules known to be triggered during pro-inflammatory responses in endothelial cells. Katelyn is majoring in biology.

Rachel Margraf ('18), a molecular biology major, is a member of the Falk Lab and studies gap junctions, transmembrane protein complexes which permit passage of ions and small molecules between cells. Rachel's work uses immunofluorescence microscopy to determine the cellular location of different modified (phosphorylated) forms of the gap junction protein Connexin 43. These modifications are important for understanding the pathway of gap junction internalization, which removes old gap junctions from the membrane, and may ultimately have implications in heart and skeletal development diseases.

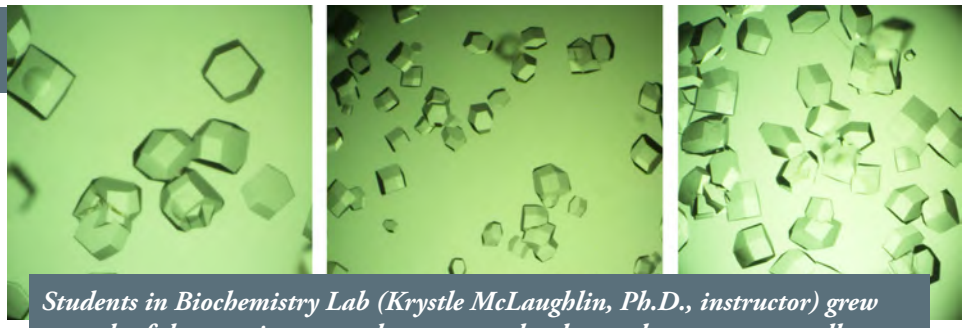
Siraj Pursnani ('17) is majoring in molecular biology and minoring in health, medicine, and society. His undergraduate research experience has been in the Layden Lab where they seek to understand how neurons differentiate from naïve proliferative cells. Notch-Delta signaling is a well-known and a highly conserved signaling pathway that regulates cellular differentiation in animals. Suraj's research focuses on Delta signaling and how that Delta plays an active role in promoting cellular differentiation.

Amanda Sidwell ('17), a member of the Simon Lab and a behavioral neuroscience major, is examining the interaction between traumatic brain injury (TBI) and the vasopressin system. Vasopressin is a neuropeptide that is released in the brain after a TBI. She is helping to test astrocytic cell lines for the presence of vasopressin 1a receptors (V1aR) using binding assays and Western blot analysis. The lab uses these cell lines as an in vitro model for investigating the signaling cascades that occur after a TBI and causes the secondary swelling of the brain.

Robert & Laura Langer established the Langer-Simon Endowed Fund for Bioscience Research through a generous gift in 2012. The purpose is to support research experiences for undergraduate students in the biological sciences. The fund supports student research projects with an emphasis on lab activities that integrate multiple displines and perspectives.

Won't you help invest in our undergraduate research efforts?

Alumni Updates



Students in Biochemistry Lab (Krystle McLaughlin, Ph.D., instructor) grew crystals of the protein enzyme lysozyme as they learn about x-ray crystallography, the most widely used method for determining the structure of proteins.

Abraham Eastwood (Ph.D., 1971) was a postdoctoral fellow at the College of Physicians and Surgeons of Columbia Universtiy. Then he was a member of the Anatomy and Neurology at Columbia P&S for seven years. "My research interests were muscle structure and muscle disease and I ran a laboratory with an intermediate voltage (200 kV) electron microscope. After that I was a research grant administrator for the MDA. I then took a position as grant administrator for the National Multiple Sclerosis Society. And finally, I ran the NMSS web site for five years before my retirement in 2005."

Brett Kreitman (B.A. Bio, 1978) earned his DMD degree and has 27 years of teaching experience and 33 years in private practice.

Cynthia Macri, M.D. (B.S. Bio, 1979) just retired after 35 years as a commissioned officer in the US Navy, serving mostly as a physician, but towards the end as a diversity advisor for the Chief of Naval Operations. "The ties to Lehigh are definitely deep. I am thankful that the education I received in the biology department prepared me well for both my career as a Navy doctor, but also for passing the torch to the next generation."

Rebekah Taylor (B.A. Mol. Bio., '01) graduated from Emory University with a Ph.D. in Immunology and Molecular Pathogenesis in 2007. "I am currently an assistant professor in the department of biology at Frostburg State University in Maryland. My research focuses on two lines of work: (1) microscopic lymphoid tissues in the murine small intestine and (2) the detection and prevalence of Lyme disease in western Maryland."

Alexandra Ganim (B.S. Biology, '07) completed a masters in public health from George Washington University. She worked for the US Centers for Disease Control and Prevention while studying for her masters, and then became a Quarantine Public Health Advisor at a major international airport. Subsequently she worked for the US Dept. of Health & Human Services on global health policy and focused on emerging disease threats and pandemic preparedness, working in close partnership with WHO. "My work at CDC is focused on building the global capacities to prevent, detect and respond to emerging disease threats. A shout out to Murray Itzkowitz – my favorite advisor/mentor!"

Burton Tabaac (B.S. BNS, '09) has completed his internal medicine internship at Abington Memorial Hospital in Abington, PA and has matriculated into the George Washington University Hospital neurology residency program in Washington, DC.

Caitlin (Katrinic) Brown (B.S. Bio, '10) finished the didactic portion of the physician assistant program at Louisiana State University. She has started clinical rotations and will graduate this coming August.

Tiauna Howard (B.S. Biochem, '12) completed her M.S. in Chemistry and has entered the Ph.D. program at Seton Hall University.

Cassandra Tuttman (B.S. Biochem, '12; M.S. Mol Bio '13) is completing her third year as a student at the University of Pennsylvania School of Veterinary Medicine.

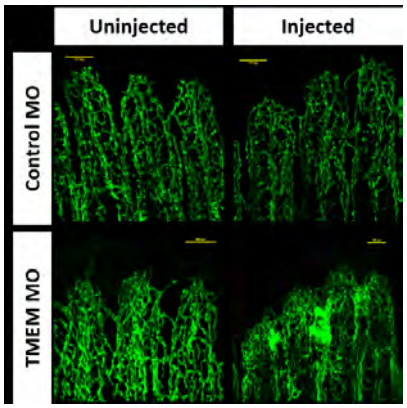
Brandon Bensel (B.S. Mol. Bio, '13) is a graduate student in the Ph.D. program at Rennselaer Polytechnic Institute. "This past spring I passed my candidacy exam and have become an official Ph.D. Candidate."

Kasarah Ackerman (B.S. Bio, '14) is a medical student at Rowan SOM. "I am enjoying every minute of it!"

Aislinn Rowan (B.S. Bio, '14) is a second year Ph.D. student in the Pathobiology program at Brown University.

Christopher Zappile (B.S. Mol. Bio, '14) is working at Celgene Cellular Therapeutics as a lab technician.

Check out our re-designed website: www.lehigh.edu/~inbios



Morpholino-mediated heparin receptor knockdown results in a disorganized, hypervascularized phenotype. Fli1:eGFP transgenic fish fins were amputated at a distance half way between the tip of the fin and the body and allowed to regenerate. Three days post amputation, half of the fin was injected with either a non-targeting standard control morpholino or a targeting morpholino to TMEM184A, the heparin receptor. The other half of the fin was uninjected. One day post injection, regenerated fins were harvested. Whole fins were mounted and imaged using fluorescence microscopy. Vascular "nodes" observed in the injected side of the TMEM184A knockdown fin compared to controls. Scale bars = 100 uM.
Farwell, S.N. Lowe-Krentz Lab

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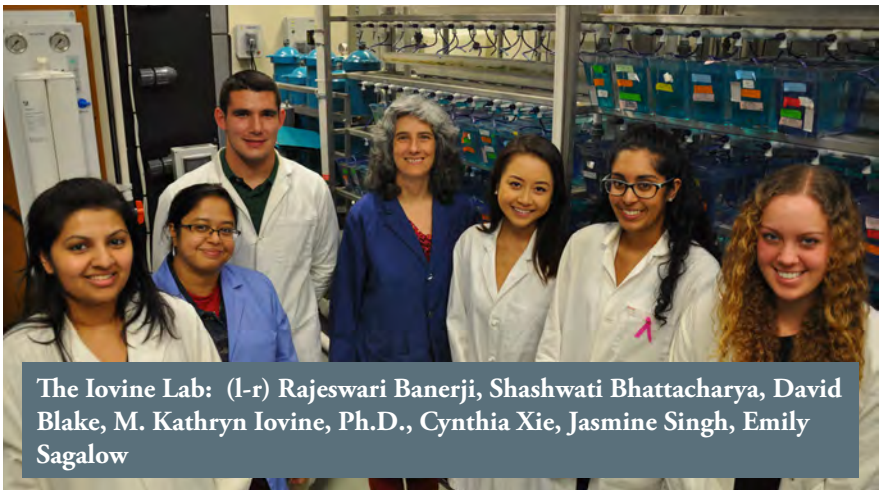
111 Research Dr., B217
Bethlehem, PA 18015

The Iovine Lab - Working their fingers to the bone!

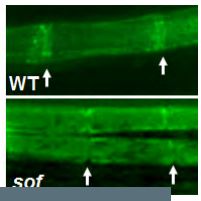
KEY
Connexin43=gap junction protein
connexin43=zebrafish gene
CONNEXIN43=human gene

Research in the Iovine lab focuses on how the bones of the skeleton achieve the appropriate size and shape. There are 206 bones in the adult human skeleton, and each must be made correctly for the proper final form. The skeleton also provides important functions such as strength, flexibility, and protection of vital organs, including the brain. Hereditary mutations in skeletal genes may disturb the form and/or function of the human skeleton.

We use the regenerating zebrafish fin skeleton to address questions of how bones achieve the correct size and shape. Our research has focused on the *short fin (sof)* mutant, which has short fins due to defects in both skeletal growth (cell proliferation) and patterning (placement of joints).

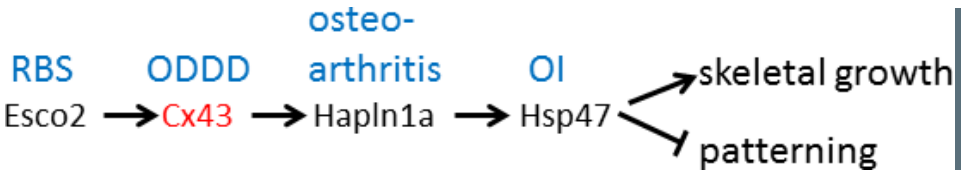


The Iovine Lab: (l-r) Rajeswari Banerji, Shashwati Bhattacharya, David Blake, M. Kathryn Iovine, Ph.D., Cynthia Xie, Jasmine Singh, Emily Sagalow



The *short fin* (*sof*) mutant has fins half the length of wild-type (WT) and short bony fin ray segments (right).

Mutations in a gene named *connexin43* cause the *short fin* phenotypes, suggesting that the function of Connexin43 is required for normal skeletal form. It is not clear exactly how Connexin43 controls bone growth. However, because mutations in human CONNEXIN43 also lead to a skeletal disease in humans (i.e. oculodentodigital dysplasia, ODDD), we believe that our findings on the role of zebrafish Connexin43 in the regenerating fin will be applicable to the human skeleton. Remarkably, our research has uncovered a molecular pathway that connects Connexin43 to genes responsible for additional human skeletal diseases:



A pathway for Connexin43 (Cx43) that coordinates skeletal growth (proliferation) with patterning (joint formation) was discovered in the Iovine lab. Several genes that function as part of this pathway are associated with skeletal diseases in humans.

In people, mutations in ESCO2 cause Roberts syndrome (RBS). RBS is characterized by shortened limbs and craniofacial defects. The skeletal defects in RBS are similar to those observed in ODDD (caused by mutations in *CONNEXIN43*). Moreover, variations in human Hapln1 are associated with spinal osteoarthritis, and mutations in the gene coding Hsp47 causes osteogenesis imperfecta (i.e. OI or brittle bone disease).

Ongoing research in the Iovine lab will continue to define the relationships between the genes of the Connexin43 pathway, as well as how this pathway influences skeletal growth and patterning. It is remarkable that several genes acting in the pathway have such clear connections to human skeletal disease. Therefore, our research is likely to make discoveries regarding the growth and patterning of the skeleton that are relevant to human health.

We're proud of our accomplishments!

Below is just a sampling of the recognitions of the great work of our faculty and students.

Celia Fung and **Carlie Skellington** (both B.S. Biology, '15) were awarded U.S. Student Fulbright Fellowships. Celia is doing research in Swaziland and Carlie is teaching in Indonesia.

Tia Kowal, a Ph.D. Candidate in the lab of Matthias Falk, was a winner in the 2015 ATCC microscopy image contest.

Andrew Black, Ph.D. ('15) was awarded the Stout Dissertation Award which is given to Ph.D. level graduate students whose research will have an important impact on their field of study. Andrew studied in the lab of Professor Murray Itzkowitz.

Assistant Professor **Julie Haas** was named a Haddie Investigator by the Brain & Behavior Foundation

Professor **Vassie Ware** was awarded the Lindback Award for Distinguished Teaching by the university, and the Dean's Award for Teaching. Both are a testimony to Dr. Ware's commitment to educating Lehigh's students.

Professor **Linda Lowe-Krentz** was awarded the Dean's Award for Service. Dr. Lowe-Krentz serves on committees and is passionate about making Lehigh a better place for all.