# bedside to bench

New PhD Program's Audacious Goal: Build a Better Biomedical Scientist

Traditionally, medical schools have trained PhD students from the ground up. They'd begin with biochemistry and a thorough introduction to wet bench laboratory science. Upon that base, they'd build upward, systematically, to the physiology of living organisms. Eventually, students might get some exposure to clinicians and patients with conditions related to their chosen areas of research.

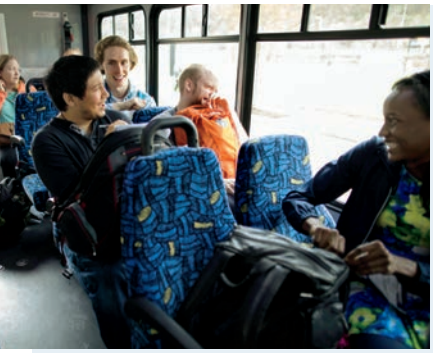
But science has changed dramatically in recent years, and the education of scientists must follow suit. Institutions around the world now understand that the scientists of the future will be thoroughly versed in biomedical informatics and computational biology. At the same time, they should feel empowered to explore the clinical realm—yes, even laboratory scientists must interact with clinicians and patients if they hope to understand and help cure human disease.

For a prospective PhD student, this may sound like a lot to ask of a single program, but faculty in Pitt's School of Medicine have prepared a long time for this. They've developed an approach that they believe is nothing less than a culture change in the education of biomedical scientists—the new Integrative Systems Biology graduate program.

Systems biology acknowledges that biological entities can't be reduced to linear representations of how their parts function. To study dynamic, complex living systems, systems biologists use technologies like genomics, bioinformatics, and proteomics, plus mathematical and computational models to describe and predict dynamic behavior.

First-year PhD students are introduced to biomedical science through extensive clinical coursework alongside Pitt physician-scientists.

The new Integrative Systems Biology program represents a culture change in how medical schools educate, train, and cultivate biomedical scientists.



"My undergrad advisor was in bioinformatics and he always said, 'That's the future of science. The future of science will be an amalgamation of computational skills and wet lab research.'"
—ISB student Alex Swain


## COMPUTATIONAL BIOLOGY FOR LAB SCIENTISTS

Students in Pitt's Integrative Systems Biology program are immersed in biomedical informatics and computational biology as soon as they arrive on campus—no prior experience required.

The program director of the ISB program, Neil Hukriede, PhD, associate professor and vice chair of developmental biology, says, "Bench scientists like myself, we struggle with the computation side because we weren't trained as computational biologists. What we're trying to do is to generate students who can do both."

"That's the thing that hooked me the most, I think," says ISB student Ricardo DeMoya, "because I arrived with no computational background. In just one bioinformatics class, my knowledge has expanded beyond belief."

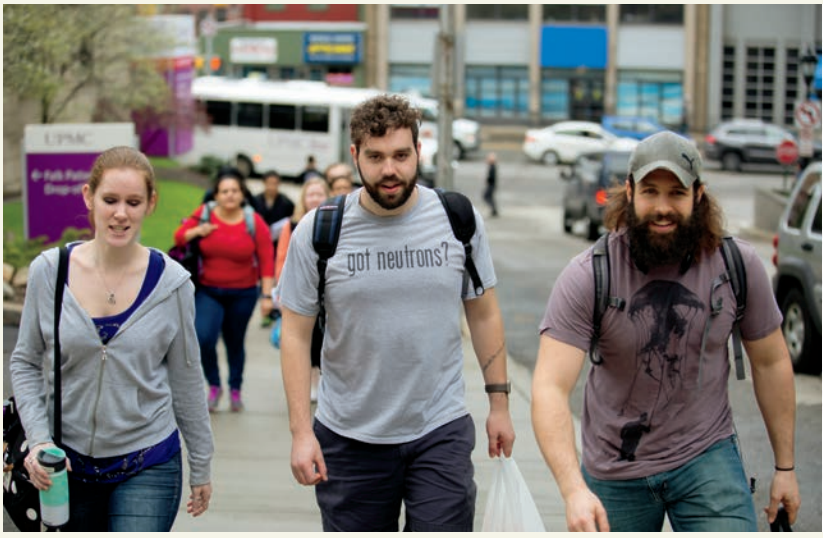

## CLINICAL BLOCKS FOR PHD STUDENTS

First-year ISB students are quickly placed in a clinic-focused course that is at the heart of the culture change that the program represents. "Bedside to Bench" is led by Gary Thomas, PhD, professor of microbiology and molecular genetics. Working closely with physician-scientists like Thomas Kleyman, MD, Pitt's Sheldon Adler Professor of Nephrology Research and chief of the Renal-Electrolyte Division, Thomas created a course that puts PhD students in the clinical environment to foster deep understanding of human physiology and diseases that they might eventually help cure.

Students rotate through clinical blocks like endocrinology, cardiology, pulmonology, and infectious diseases. They meet patients who've survived breast cancer, undergone cardiac procedures, or live with diabetes. After each clinical block, they take part in a journal club in which they discuss recent research findings with clinicians.

Thomas says this is the only such program in the nation introducing PhD students to biomedicine through extensive rotations through clinical areas. In their second year, students continue the course with six more blocks, ultimately covering 10 divisions of the Department of Medicine and two clinical departments.

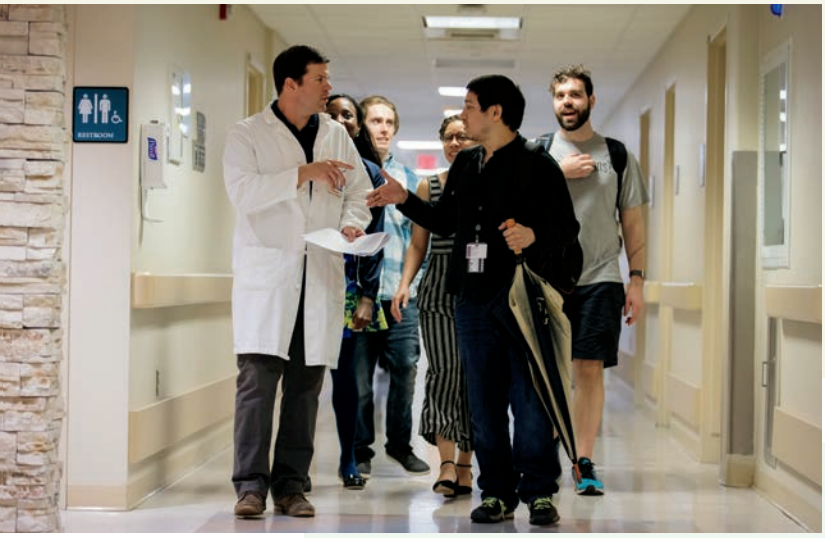
Watching the students develop over the course of the year is incredible," says Thomas. "By the middle of the course, they are becoming very savvy when it comes to understanding biology. The knowledge of a typical first-year grad student is usually narrow and shallow. This course gives them a much deeper and broader exposure to human physiology so that they can better understand the complex molecular pathways that drive disease."




"The clinical perspective we get in this program—having the rotations and being in journal club with physician-scientists—is something that I don't think I would be getting in any other program."
—Sarah Munyoki

A DAY IN THE LIFE OF AN ISB STUDENT includes journal club at Bridgeside Point and a shuttle ride back to the heart of Pitt's campus, where students rotate through a dialysis clinic with faculty physicians from the Department of Medicine. The day concludes with a class that encourages them to apply what they've learned in clinic to basic research in the lab.

With extensive input from Pitt clinician–scientists Roderick Tan, MD, PhD, and Nate Weathington, MD, PhD, who are both assistant professors of medicine, this is the only program in the nation introducing PhD students to biomedicine through comprehensive clinical rotations.



## ISB STUDENTS: IN THEIR OWN WORDS

"The most interesting part is the clinical blocks. In the endocrinology block, we met a person with diabetes. The experience really expanded my knowledge. For example, I thought that with type I diabetes, you only need to take insulin once or twice a day. But it's much more complex than that. Oftentimes, if you are diabetic you're on multiple other medications because you have complications like kidney failure and nerve loss. I thought it was kind of simple—now we have insulin, and it's very easy to manage. A patient being on 20 different medications a day is something I didn't think about before." — Sarah Munyoki

"I chose this program because I wanted to work with both clinical data and genetic data. I think it's really great that this graduate program is in a medical school and at a big medical center. My lab is in Children's Hospital, and we have exomes from around 500 patients. We can follow these patients very closely at the hospital, and that's a very useful resource to have as a graduate student. I can work with all of this data from a large population of patients, and that's what I want to do as a scientist." — Kylia Williams

## RE-IMAGINE GRADUATE BIOMEDICAL EDUCATION

"We're really trying to change how graduate education is implemented. For example, we expect a student in the last year to have an externship experience. So, if your experiments are very much wet lab, you might spend three to six months in a lab that does more computation. It could also be off campus. We've made arrangements with venture capital firms, so a student could spend three to six months working in venture capital. We also have arrangements with the Beijing Genomics Institute in China, so a student could go there and do computational work on a different level. If your project has a clinical/translational bent, you might spend it in the clinical realm, where you have patient recruitment samples being obtained from patients. Or a student can do an externship experience with Pitt's Innovation Institute and learn about intellectual property. A student might learn what it takes to launch a successful company. We want to broaden students' horizons in terms of career choices so that it's not just 'one size fits all.'" — Cecilia Lo, PhD, F. Sargent Cheever Professor and chair of developmental biology; executive director, ISB program