

NOVEMBER 17, 2009

The 2010 Med into Grad Grantees

Baylor College of Medicine* Since 2005, Baylor College of Medicine has been working towards an ambitious goal: Train a new generation of leaders in translational research who are capable of bringing together investigations at the lab bench with clinical research and medicine. With HHMI support, Baylor launched the Translational Biology and Molecular Medicine graduate program, which has grown from nine to 51 students in four years. The graduate students follow a cutting-edge curriculum built on a foundation of basic science and clinical medicine courses. Guided by two mentors, a basic scientist and a clinician, students supplement their classroom studies by working side-by-side on interdisciplinary research projects with medical teams. These interactions can bring the necessary perspective to help students pursue research projects that have the greatest impact on human health. A secondary benefit of the program is that student mentoring has fostered new research collaborations between basic science and clinical faculty at Baylor.

Cleveland Clinic Lerner College of Medicine/Case Western Reserve University* When HHMI launched the Med into Grad program in 2004, the Cleveland Clinic and Case Western Reserve University were in the final phase of designing an entirely new Ph.D. program that would teach graduate students to translate basic science discoveries into enhanced treatments and diagnostics for patients. The Molecular Medicine Ph.D. Program features an entirely new core curriculum designed to integrate human biology into small interactive courses in the basic sciences. A clinical mentor is assigned to each student and helps that student design an individually-tailored opportunity to observe and learn from doctors and their patients. Students can choose from a range of clinical specialties that complement their research interests. The program's directors are confident that their students will develop long-term relationships with physicians and scientists that will prepare them to work in multidisciplinary teams to address critical topics in research related to human health and disease.

Columbia University College of Physicians and Surgeons Columbia University wants to prepare its science graduate students to collaborate effectively with physicians working on a range of medical problems. Students entering the school's graduate programs in Molecular Basis of Health and Disease will receive a broad exposure to disease-related concepts, as well as basic cellular and molecular biology. Columbia students from these programs will start with a year of coursework, which provides a solid foundation in medical concepts. In the core course, entitled "Mechanisms of Human

Disease,” students will learn about the organ systems in the human body and focus on one disease associated with each organ. After the first year, five outstanding students are selected to move into a specialized course of study that they will follow during the rest of their graduate career. Students in this program will follow a curriculum focused on the diagnosis and treatment of patients. Columbia faculty expect that their program will provide students with a deeper understanding of disease-related concepts that will enable them to see new opportunities to improve clinical treatments and diagnostics.

Cornell University Cornell University in Ithaca, N.Y., and its affiliated Weill Cornell Medical College in New York City are collaborating to train biomedical engineering graduate students who will have the capacity to tackle problems in clinical medicine using newly developed tools in imaging, computing, microfabrication, and nanoscience. Beginning graduate students will take an innovative, new course on the mechanisms of disease taught jointly by Ithaca and Weill Cornell faculty. Students will then spend a summer at Weill Cornell shadowing clinicians as they treat patients and working on a research project with a clinical mentor. The opportunity to work with hospital-based physicians is a key part of the program because it will allow students to see the strengths and weaknesses of existing technologies. Students who choose to collaborate with a Weill Cornell faculty member on their thesis can apply for a year-long research fellowship under the guidance of both engineering and clinical faculty. The program’s directors say these experiences will equip students with the personal and professional skills necessary to conduct research at the interface between engineering and medicine.

Emory University Until recently, Ph.D. students in the biomedical sciences at three schools that form the Atlanta Clinical and Translational Science Institute—Emory University, the Morehouse School of Medicine, and the Georgia Institute of Technology—have had limited opportunities for training in translational or clinically focused research. In a recent survey of science graduate students conducted by the schools, 85 percent of students reported that they wanted more clinical and translational research training. These institutions have responded by creating a program that will teach biomedical science and engineering graduate students how the basic sciences can contribute to better treatments or diagnostics. The new curriculum will teach students by example: Some courses will emphasize the pitfalls inherent in translational research and what can be done to overcome those obstacles. For example, lack of research funding is often cited as a roadblock to the efficient translation of basic discoveries into new therapies, so students in the new program will take classes on grant-writing. The program will provide students opportunities to better understand the importance of translating basic science discoveries into improvements in the practice of medicine through a semester-long exposure to clinical medicine and researchers doing translational or clinical research at sites throughout Atlanta. Each student will be mentored by a multidisciplinary team including a basic scientist, a translational scientist, and a clinical mentor.

Harvard Medical School* In less than four years, the Leder Human Biology and Translational Medicine Program has attracted the interest of so many students that it has increased the entering class size, from nine to 20. Accepted students take courses on human biology and disease designed to give them the context for human biology and disease, most of which are also open to graduate students outside of the program as well as undergraduate students. The program, begun with support from HHMI, also pairs graduate students with physicians and patients—one option even allows students to follow a single patient over the course of several months. Students report that their experience in the clinic makes their lab research more meaningful and motivates them to work harder. The program's directors say their students feel more comfortable being around doctors and patients and more confident that they can make clinical and research collaborations successful.

Memorial Sloan-Kettering Cancer Center New technologies are leading to important advances in the diagnosis, treatment, and prevention of cancer. Memorial Sloan-Kettering Cancer Center has created a graduate program that focuses on training scientists who can help develop the next generation of cancer treatments and diagnostics. During their first year, students in the Cancer Biology Graduate Program learn about the biology, treatments, and existing model systems used by cancer researchers, with an emphasis on key metabolic pathways that malfunction to cause cancer. The clinical section of the program will give students a chance to observe physicians as they treat cancer patients. In the clinic, students will see how physicians and health care workers rely on a variety of technologies to identify and classify cancers. The students will also choose a clinical mentor, whom they will follow on grand rounds and in clinical consultations with patients and their families.

The Ohio State University The College of Medicine at The Ohio State University recently merged many of its graduate programs into a single Integrated Biomedical Science Graduate Program (IBGP) to encourage faculty and students to use interdisciplinary approaches to understand human diseases. The University's new HHMI-supported Med into Grad program will take advantage of that by pulling students from six basic science graduate areas—genetics, microbial pathogenesis, neurosciences, mathematical biology and biomedical informatics, RNA biology, and biomedical engineering—from the colleges of Medicine, Engineering, and Mathematics and Applied Sciences. These students will start with the IBGP curriculum, which will help integrate their studies with parts of the medical curriculum. By training these students in a single program, the university hopes they will develop new ways to understand, prevent, diagnose, and treat human diseases. The students will study human development, translational research and ethics, and observe doctors and patients in clinical settings. Graduate students in the program will participate in some of the same courses as medical students – providing another opportunity for both groups of students to understand how scientists and clinicians tackle medical problems from different perspectives.

Rice University* Technology can play an important role in improving survival rates for cancer patients. But the bioengineers and biophysicists who help to develop imaging techniques, radiation treatments, and other technologies rarely receive specialized training in cancer biology. In 2006, Rice University and the University of Texas M. D. Anderson Cancer Center—which are located 10 minutes from each other in Houston—used HHMI funding to develop a new science graduate program to train bioengineers to develop new diagnostics and treatments for cancer. Twenty-three students are enrolled in the program, which features courses in cancer biology, cancer therapies, and clinical medicine, supplemented by clinical internships and individual mentoring by basic scientists and clinicians. Now the program is being expanded to include physics graduate students from M.D. Anderson who are interested in medicine. Students from both M.D. Anderson and Rice will be able to participate in a summer clinical internship at the Texas Medical Center, the largest medical center in the world. The internship includes short courses and clinical rotations to familiarize students with medical concepts and practices.

Tufts University School of Medicine One need look no further than current news headlines to see the impact that infectious diseases are having on today's world. Tufts University's new graduate program, Medically-oriented Research in Graduate Education-Infectious Disease (MERGE-ID), seeks to develop a new crop of scientists who have the knowledge, training, ambition, and desire to develop new diagnostics and treatments for devastating human pathogens that affect millions, such as malaria, AIDS, and cholera. Students will receive training in the basic microbiology and immunology of pathogenic organisms. Their coursework and clinical studies will also provide in-depth knowledge of the pathogenesis, diagnosis, prevention, treatment, and epidemiology of infectious diseases. This program integrates clinical studies and patient contact throughout the training period. Students will be expected to choose a medically relevant topic for their thesis research, which will be carried out under the guidance of a basic scientist and a physician-scientist. Students also select a clinical project in the United States or abroad that complements their thesis work, which will allow them to observe doctors at work. With this training, the program's directors hope that students will be well prepared to help solve some of the major infectious disease problems worldwide.

University of Alabama at Birmingham* Modern biological research is increasingly collaborative and team-centered, but many scientists and physicians don't speak the same language. The Hughes Med-Grad Fellowship Program at the University of Alabama at Birmingham (UAB) is training scientists who can communicate and collaborate successfully across disciplines. Since 2006, students selected from the university's eight interdisciplinary graduate programs have been paired with a faculty mentor who specializes in disease-based research. That mentor guides the student's thesis and helps him or her develop a customized curriculum. In addition, the Med-Grad students take five courses that expose them to patient-oriented research topics, such as animal models of human disease and the varying

manifestations of diseases in patients. Many students also do an internship in drug discovery at Southern Research Institute, a nonprofit research center in Birmingham. The internship is an important part of the program because students learn valuable lessons about drug development, including how to recognize and head off potential problems that could keep new treatments and diagnostics from reaching the marketplace.

University of California, Davis* Biomedical science is becoming increasingly collaborative and interdisciplinary, as reliant on the physical and computational sciences as on biology. But how are the biomedical investigators of the future going to learn to work effectively across disciplinary lines? The University of California, Davis believes teamwork is such an essential skill that it has built its HHMI-funded Integrating Medicine into Basic Sciences program around a series of collaborative experiences and team projects. Before students begin the formal program, they complete an intensive five-week summer curriculum that brings them up to speed on the language, culture, and technology they will encounter in a clinical setting. In the fall, students are assigned to a team-based, clinical research project in one of three areas—cancer, neurological disease, or cardiovascular disease. Their exposure to clinical research and patient care continues when each student embarks on a required year-long internship in a health clinic, where they shadow a doctor and his or her patients. And after students choose their thesis topic, they receive mentoring from a team that includes physician-scientists and basic scientists. Along the way, students are also mentored in writing a grant proposal for a patient-oriented research project. All of these experiential experiences are designed to help develop a different scientist in the future, ready to successfully engage diverse collaborators in a variety of settings.

University of California, San Diego, School of Medicine* When it comes to medicine, there is only so much one can learn from textbooks and research articles, say graduate students in the University of California, San Diego School of Medicine's Med into Grad program. There is much to be learned outside the classroom – and that's why UCSD's program emphasizes firsthand experience with patients. In their first year of the program, graduate students select a physician mentor from one of 12 clinical subspecialties. Students shadow the doctors day and night – whether they are working in the hospital or outpatient clinic or presenting a medical case history. This total immersion in medicine gives the UCSD students a unique perspective that energizes and inspires their own research. And the graduate students are giving back to the San Diego medical community in their own way, by sharing their expertise as “molecular consultants” within teams of medical students, residents, and clinical fellows.

University of California, San Francisco The University of California, San Francisco wants to train students who are prepared to apply their scientific knowledge to tough problems in human health. UCSF's Med into Grad program begins with transmitting essential knowledge in anatomy, physiology, pathology, and immunology. They then get the chance to

experience these different areas through rotations in various clinical labs and classes that focus on designing clinical research projects and understanding specific clinical disciplines, such as oncology. These activities prepare students to work under the guidance of both a basic science and a clinical faculty mentor, especially those who incorporate clinical research into their thesis projects. The program's directors hope to improve the medical literacy of all UCSF graduate students with lectures that pair a basic scientist and a clinician to discuss an important medical problem.

University of Chicago The goal of the University of Chicago's new Translational Training Program is to prepare graduate students in both basic and clinical research so they can identify scientific discoveries have the potential to impact new treatments or diagnostics. They will combine courses with a team-based translational research project to provide students with a thorough grounding in the biology of human diseases and disease. Students are required to work with colleagues from relevant scientific disciplines to propose, develop, and design prototype devices or solutions to current health problems. In the first year in the program, the teams of students identify a research problem—for example, developing a new type of insulin delivery system for diabetics—and develop a plan to solve their chosen problem. During the following summer they carry out the necessary experiments to move their proposal toward clinical testing. The program's emphasis on multidisciplinary research will prepare graduates to seek innovative solutions to major clinical problems.

University of North Carolina at Chapel Hill* During the past three years, 16 graduate students at the University of North Carolina at Chapel Hill have pursued patient-oriented research projects. While most graduate students are lucky to find a single mentor, these students each had two: a basic scientist and a clinician. That individualized approach has heightened interest in the HHMI-funded translational medicine program with 35 percent of the incoming class of 121 students indicating they would like similar training. Graduate students in the program take a yearlong course on the molecular and cellular basis of human diseases, including a hands-on lab. In addition, each student is assigned a physician mentor who specializes in a disease the student is interested in researching. By shadowing the mentor, the student learns about many aspects of medical care, ranging from directly treating patients to working on clinical trials. In the coming years, the program's directors want to add a summer workshop called "Working with Clinicians" that will orient students about clinical practice and research.

University of Pennsylvania* Graduate students in the University of Pennsylvania's Med into Grad program have the opportunity to see science through the eyes of both doctors and patients. The program aims to promote clinically-relevant research and foster better communication between basic and clinical scientists by producing basic scientists who have a clearer understanding of human biology and pathology. After graduate students enter the program, they select a physician mentor who is studying a disease or syndrome that interests them. The students shadow their mentors in the clinic

for a summer semester. This clinical clerkship is so popular among students and faculty that it is now being expanded to 10 students per year – up from six students when the program originated in 2006. In addition to physiology courses, Penn Med into Grad students also have the opportunity to take a “Bench to Bedside” course that reinforces the relationship between clinical and basic research by exploring current developments in translational research. They also attend a monthly seminar series, where translational scientists at Penn discuss their research with the Med into Grad students.

University of Rochester With cardiovascular disease considered the leading cause of death worldwide, the University of Rochester is focused on training a generation of researchers to develop new treatments and diagnostic procedures through its Cardiovascular Sciences Graduate Program. Participating basic science and clinical faculty are working together to create courses that will teach students about the science underlying cardiovascular physiology and disease. Students will also follow cardiologists in the clinic during the first two years of this Ph.D. program. The clinical portion of the program will teach students how to interact with and learn from patients – and will provide a firsthand look at the challenges facing cardiologists and other heart specialists. Students will also take a biomedical engineering laboratory course that will teach them about different diagnostic and therapeutic approaches to cardiovascular diseases. And the school plans to invite prominent scientists to present seminars that give students a front-row view of today’s best tools for fighting heart disease.

University of Texas Southwestern Medical Center In 2008, the University of Texas Southwestern Medical Center launched a pilot program to combine training in basic and clinical sciences. Only four graduate students participated in the program, but the feedback from that small “pioneer” group was so positive that the university decided to expand the effort. Faculty were enthusiastic, in part, because the students reported that interacting with patients and working alongside clinicians improved their approach to their own research. Moreover, students added tremendously to their understanding of the biology of human diseases. Now, with support from HHMI, University of Texas Southwestern will expand its program, giving more graduate students the chance to learn about clinical and translational research. Students on a Ph.D. track will take a year-long curriculum—including shadowing doctors in a hospital and in a patient-oriented research setting—then begin doing their dissertation research on a medically-relevant topic. Students in a new combined Ph.D./Master’s in Clinical Science track will take more clinical science classes and conduct clinical translational research.

The University of Utah When faculty at the University of Utah were putting together their proposal for the HHMI Med into Grad Program, they knew right away where resources were needed. The school already had a successful program that taught medical students how to apply science to their work in the clinic. But no such program existed to teach graduate science students about medicine. Many of these graduate students will work on disease-related research at some point in their careers. With the creation of the new

Molecular Medicine into Grad Program, the university is hoping to transform its teaching of graduate science students and better prepare them to make discoveries that can be translated into improvements in human health. Students will get an introduction to basic medical education by taking courses, such as human physiology, pathology, and therapeutics. The program also emphasizes collaboration between medical faculty, graduate science and medical students. And collaborations with students and faculty at other professional schools on campus – such as business and law – will also be an important part of the program. Projects with students and faculty in the law and business schools will help the graduate students understand the intellectual property and commercialization issues that often stop important scientific developments from making their way to doctors and patients.

University of Washington* Graduate students in the University of Washington's (UW) Molecular Medicine Training Program are as enthusiastic as medical students and residents when it comes to going on medical rotations, the program's directors say. These rotations help the graduate students understand their medical colleagues and maintain their dedication to translational research once they return to their basic science labs. So far, more than 300 students in 14 departments have taken specially-designed courses in molecular medicine, which have been developed with support from HHMI. Thus far, students have participated in Molecular Medicine courses as a supplement to their regular graduate school requirements, and have pursued thesis research under the guidance of faculty members from both the basic and clinical sciences. The UW hopes to foster the evolution of a dedicated Ph.D. program in Molecular Medicine, which will attract the many students drawn to this emerging interdisciplinary area.

Vanderbilt University The directors of Vanderbilt University's new certificate program in Molecular Medicine believe that training for health science researchers requires a three-pronged approach: instruction in basic science, knowledge of clinical medicine, and experience working with doctors. But graduate students in the basic biomedical sciences at Vanderbilt have historically had limited opportunities to work with physicians. Vanderbilt recognized that the lack of contact with clinicians might hinder the students' understanding of what new insights might be needed to improve patient care, so the university built a new program to address that need. The new program is flexible – allowing students to pursue their own research interests and receive a solid foundation in biomedical research and human disease. Outside the classroom, each student will work with a clinical mentor who will introduce them to medical practice and patients, and at the same time help guide their thesis project.

Yale University* For the last three years, graduate students in Yale University's HHMI-funded Medical Research Scholars Program have had a chance to see what their future careers might be like. Students work with physicians and interact with patients in an intense, two-year mentorship program. Yale created this program in the hope that these students will be inspired to work closely with physicians and physician-scientists when they

embark on their own careers in research. The students in the program report they are better able to set goals for their own research projects after seeing firsthand a disease's symptoms, treatment options, and the limitations of current therapies. In addition to their clinical mentoring, the graduate students attend classes on human physiology and disease, as well as drug discovery and clinical trials. Additional HHMI funding will permit Yale to create new courses – built around statistics and the biology of human disease -- that will help students better understand clinical medicine.

* 2006 grantees