



Terri Goss Kinzy, PhD,
professor of molecular genetics,
microbiology, and
immunology and assistant
dean for medical scientist
training, with graduate
student Anthony
Esposito

Road Building:

Graduate programs link research to clinical care

“**T**o transform our new scientific knowledge into tangible benefits for people,” the National Institutes of Health (NIH) published the Roadmap in 2003. It called for scientists to develop an “integrated vision to deepen our understanding of biology, stimulate interdisciplinary research teams, and reshape clinical research to accelerate medical discovery and improve people’s health.”

BY KATE O’NEILL • *Portraits by Steve Hockstein*

*Research in a Medical School Environment:
“A Place Where You Feel You’re Making a Difference”*

“Two of our primary missions — to pursue excellence in research and in education — intersect in our graduate programs,” says Terri Goss Kinzy, PhD, professor of molecular genetics, microbiology, and immunology and assistant dean for medical scientist training. In the medical school setting, a third mission, advancing excellence in patient care, interconnects at the graduate level as well. A laboratory may be investigating life at the molecular level, but its work is closely linked to clinically relevant patient outcomes.

By shifting its funding priorities to reinforce the new emphasis on clinical outcomes, the NIH hopes to engage more basic scientists in multi-disciplinary research that focuses on improving human health. In addition, the Roadmap may have heightened the appeal of a medical school setting for scientists — from graduate students to seasoned researchers — who seek gene-based therapies.

“A strong research enterprise is one of the overarching missions that separate an academic medical center from other hospitals,” says Kathleen W. Scotto, PhD, professor of pharmacology, senior associate dean for research, and interim vice president for research at UMDNJ. “It is what gives the clinicians the opportunity to offer the best care to their patients.”

In a variety of settings, basic research faculty members meet and work with a wide spectrum of clinical specialists, creating a two-way flow of information between scientists and clinicians. Ties to the patient are reinforced by basic science faculty members who team-teach medical school courses, such as physiology, in collaboration with the clinical faculty. Moreover, in a medical school, opportunities for translational research abound.

“Basic scientists who feel the lure of clinical research are often drawn to the medical school environment,” says Sunita G. Kramer, PhD, assistant profes-

sor of pathology and laboratory medicine. “It’s a place where you come into contact with the people who will benefit from your work and a place where you feel you’re making a difference.”

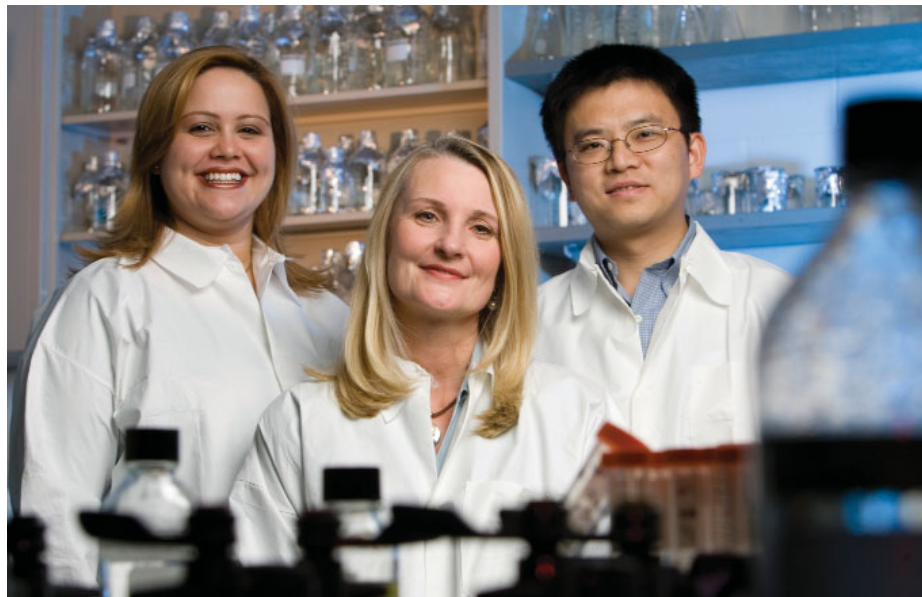
*Collaboration,
Excellence, and Scientific
Diversity Characterize
Graduate Program*

More than 200 doctoral researchers work in laboratories at UMDNJ-Robert Wood Johnson Medical School. Most are enrolled at the UMDNJ-Graduate School of Biomedical Sciences (GSBS) at RWJMS. The GSBS program, in partnership with Rutgers, The State University of New Jersey, offers graduate students an exceptional array of research environments. In addition to wide choices within the academic departments on adjoining campuses, the partnership provides research opportunities

in medical and non-medical settings.

Graduate students have access to the multi-disciplinary expertise of more than 500 faculty researchers at RWJMS and Rutgers. Among them are five Investigators, Howard Hughes Medical Institute, all of whom open their labs to PhD candidates in the program. Many faculty hold joint appointments at RWJMS and Rutgers, and several of the 15 major institutes and multi-disciplinary centers on the two campuses are affiliations between the schools.

“To retain faculty, a university must have a vigorous graduate program,” says Thomas E. Shenk, PhD, James A. Elkins, Jr., Professor in the Life Sciences and past chair, Department of Molecular Biology, Princeton University. Dr. Shenk, a virologist, was one of the earliest graduate students at RWJMS (then Rutgers Medical School). He completed his doctoral work in 1973, mentored by Victor Stollar, MD, professor of molecular genetics, microbiology, and immunology, who was then an associate professor of microbiology. “Graduate students not only fuel the research program,” says Dr. Shenk, “they keep your scientific life exciting.” Last year, the



Left to right: Rebecca Baerga, graduate student in pharmacology and doctoral candidate in the GSBS program in cellular and molecular biology; Kathleen W. Scotto, PhD, professor of pharmacology, senior associate dean for research, and interim vice president for research at UMDNJ; and Victor Jin, PhD, assistant professor of pharmacology, RWJMS

Department of Molecular Biology at Princeton became the newest partner in the RWJMS MD/PhD program. In the summer of 2005, Dr. Shenk inaugurated the program at Princeton by hosting MD/PhD candidate Sean Liu during a pre-doctoral lab rotation. “Sean was terrific, tremendously enthusiastic,” Dr. Shenk says. “He interacted well in the lab and had an excellent background in science.”

Along with faculty and post-doctoral fellows, graduate students have access to staff expertise and state-of-the-art technology in the schools’ state-of-the-art centers and institutes, says Michael J. Leibowitz, MD, PhD, professor of molecular genetics, microbiology, and immunology and associate dean, GSBS. In September, RWJMS dedicated the Child Health Institute of New Jersey (CHINJ), reinforcing the school’s strong developmental biology program. Like the new labs in the RWJMS Research Building and The Cancer Institute of New Jersey (CINJ), the juxtaposed, virtually wall-free labs at CHINJ encourage people to interconnect freely, sharing information, techniques, and discoveries.

The Center for Advanced Biotechnology and Medicine (CABM), located on the

Piscataway campus, offers extraordinary opportunities for researchers at all levels. CABM, a collaboration between UMDNJ and Rutgers, works with researchers in industry as well, seeking fundamental knowledge that will improve human health. Geneticist James H. Millonig, PhD, assistant professor of neuroscience and cell biology and resident member, CABM, is mentoring five PhD candidates and one post-doctoral fellow in projects related to autism. “The scientific diversity at CABM makes it a good environment for research,” says Dr. Millonig. “People in our lab make friends in neighboring labs. In this year’s CABM retreat, they learned about topics ranging from crystallography to cancer to developmental biology. They see how hard we work and what it takes to succeed.”

The Route to a PhD: Hypothesis, Thesis, Conclusion

Graduate school faculty members seek candidates in a variety of professional venues — among participants at professional meetings and during visits to undergraduate campuses. The graduate program has excellent exposure

at Rutgers, where undergraduates may first develop familiarity with the schools’ research labs. In addition, GSBS and RWJMS recently received three renewals of NIH awards to support ongoing training of talented doctoral students from groups under-represented in medicine and science.

Summer programs at RWJMS and Rutgers introduce undergraduates to the exceptional research opportunities in the GSBS program. Research in Science and Engineering (RISE), a highly competitive summer program jointly sponsored by Rutgers and GSBS, has the primary aim of providing students from groups under-represented in the sciences with an introduction to the excitement of research. Some outstanding RISE participants have returned to continue their work with GSBS faculty.

As an undergraduate at the Pontifical Catholic University of Puerto Rico, Rebecca Baerga was selected for RISE. She worked with Federico Sesti, PhD, assistant professor of physiology and biophysics, studying the function of ion channels in regulating cardiac activity. Now a doctoral candidate in the GSBS Program in Cellular and Molecular Biology, Ms. Baerga is mentored by Shengkan (Victor) Jin, PhD, assistant professor of pharmacology.

The Department of Neuroscience and Cell Biology offers a separate summer program for outstanding college students from New Jersey, introducing them to the department’s resources — human and technological — “and teaching them how much fun science can be,” says the program’s director, Cheryl F. Dreyfus, PhD, professor of neuroscience and cell biology. “We have helped recruit medical students with a strong interest in research and some MD/PhD candidates as well.”

Michael J. Leibowitz, MD, PhD, professor of molecular genetics, microbiology, and immunology and associate dean, GSBS (left), and Karl E. Milette-González, PhD, instructor of obstetrics, gynecology, and reproductive sciences





Cheryl F. Dreyfus, PhD, professor of neuroscience and cell biology and director of the department's summer program for outstanding college students from New Jersey, with Denise Livingston '08, a student in the MD/PhD program at RWJMS

As a college student, Denise Livingston '08 participated in the neuroscience summer program. She subsequently was accepted by the MD/PhD program at RWJMS, where Dr. Dreyfus has served as her mentor. In 2006, after defending her thesis on the effects of the estrogenic hormone estradiol on astrocytes, Ms. Livingston will begin clinical rotations as she resumes her medical school studies. She will continue to use her research skills by applying translational research to tackling problems encountered in a clinical setting. "A background in research provides a deeper way of helping patients," she says.

Most graduate students at GSBS do their research under the umbrella of the graduate programs in molecular biosciences, working with a multi-disciplinary faculty from RWJMS and Rutgers. Others are mentored by RWJMS faculty in the graduate programs of biomedical engineering and environmental science. In addition, the RWJMS Department of Neuroscience and Cell Biology runs a highly successful graduate program in collaboration with GSBS. Recent graduates of the neuroscience graduate program include Carmine Guirland, PhD, whose adviser was James Q. Zheng, PhD, associate professor of neuroscience and cell biology

and member, CABM. Dr. Guirland was first author on two papers published with Dr. Zheng, one in the *Journal of Neuroscience* and one in *Neuron*.

Graduate students regularly present their work not only within their departments, but at major scientific meetings. "Our graduate students tend to be highly motivated to develop scientific insights into their own projects," says Dr. Leibowitz. "This approach is particularly apt today, when doctoral students learn not by watching but by doing and are no longer expected to 'learn at the foot of the master.'"

From start to finish, the goal of the doctoral process is to learn to think and work like a scientist, says Dr. Dreyfus. Typically, graduate students are mentored to sharpen their research skills, while gaining knowledge, experience, leadership, and, ultimately, independence. And since most of their financial support comes from their mentors' awards, they also learn how to apply for their own grants.

After graduation, most PhDs continue their research in academia or industry. Others become writers, or serve in science-related government posts. Beth-Anne Sieber, PhD, chief, Developmental Neurobiology Program, National Institute for Mental Health, spent five post-doctoral

years at the Karolinska Institute, in Stockholm, Sweden. At RWJMS, her co-mentors were Dr. Dreyfus and the late Ira B. Black, MD, professor and chair, Department of Neuroscience and Cell Biology, and founding director, Stem Cell Institute of New Jersey. "My scientific training was integral to my obtaining my current position and has provided excellent preparation for counseling NIH grant applicants," Dr. Sieber says. "Above all, it allowed me to relate my findings to clinical disorders, including Parkinson's disease and schizophrenia, and trained me to think about basic research as it relates to human lives."

Mentor! Mentor!

The pre-eminent role of the mentor distinguishes the graduate student's odyssey from other academic processes. Connecting and collaborating with a skilled, compatible mentor, who has a suitable lab opening, is a leading concern for doctoral candidates.

The matching process begins with visits to the campus, as applicants tour the facilities, dine with current graduate students, talk with faculty members, and, ideally, meet each member of the admissions committee. In the first year of the graduate program, students



Graduate student Edgardo Santiago-Martinez, and his mentor, Sunita G. Kramer, PhD, assistant professor of pathology and laboratory medicine

complete a core curriculum and a minimum of three lab rotations. The lab rotation process provides the opportunity for graduate students and faculty researchers to meet and work together. By the end of the year, the graduate students will have gone from initial immersion into a pool of more than 200 labs to the most important step of their doctoral career: selecting — and being accepted by — a mentor.

“Graduate students are the lifeblood of a lab,” says Dr. Scotto. “When a new PhD candidate joins the team, you can feel the lab dynamics change. They bring brightness, inquisitiveness, and tremendous enthusiasm that makes us all relive the promise of research that got us started down this road.”

“You have to measure the decision carefully,” says Karl E. Miletti-González, PhD, instructor of obstetrics, gynecology, and reproductive sciences. “The choice of a mentor can be more important than the scientific focus of the lab. You have to have a good relationship with your mentor, and you have to like the dynamics of the lab.” Dr. Miletti-González originally planned to do doctoral research on HIV/AIDS. But he willingly changed his plans so that he could work with Dr. Leibowitz, using yeast models to study group I intron ribozymes as potential

chemotherapeutic targets. Two years after post-doctoral research training with Lorna Rodríguez-Rodríguez, MD, PhD, associate professor of obstetrics, gynecology, and reproductive sciences and chief, gynecologic oncology, CINJ, Dr. Miletti-González was offered a faculty position on Dr. Rodríguez-Rodríguez’s multi-disciplinary research team, doing research on CD44 in ovarian cancer.

Among faculty members, the competition is lively too, as they seek to attract graduate students who are not just the cream of the intellectual crop, but also able to work well with research colleagues. Dr. Kramer says she looks for enthusiasm and independence in her advisees. “How they deal with failure, not success, is very important to me. As scientists, a high failure rate is a normal part of bench work. With experience, though, our advisees learn that it’s the unexpected that takes us forward.”

During his first year in the GSBS program, Edgardo Santiago-Martinez met Dr. Kramer at a poster presentation on her use of *Drosophila* to study vascular tissue formation. Their conversation led to a lab rotation and then to Dr. Kramer’s decision to become his mentor. In 1998, as a graduate student, Dr. Kramer won the Best Poster Award at the Northeastern Developmental Biology Confer-

ence in Woods Hole, Massachusetts. She was proud to see her advisee awarded the same honor at Woods Hole last summer.

Before first-year graduate students start a rotation in his lab, Kiran E. Madura, PhD, associate professor of biochemistry, meets with them for an hour. The preliminary session has value on both sides. “It’s important for them to see how we interact, because dynamics determine the productivity of the lab,” says Dr. Madura. His advisees can expect to work closely with him during the “exploratory” first year. Then he will assign them to ongoing projects with other members of the lab team.

By the time they earn their PhD, most GSBS students have spearheaded projects, presented their work, and published papers, often in major journals as co-authors with their mentor, frequently as first author. During 2004, says Dr. Leibowitz, GSBS students on the Piscataway campus published 85 peer-reviewed articles on their research, including many in the most highly visible scientific journals.

Building on Tradition

The RWJMS tradition of excellence in research began with the original faculty. The core of outstanding scientists who taught and conducted research in the school’s first labs included many physician-scientists who brought their focus on the patient-centered research to the school. When Dr. Stollar mentored the young Tom Shenk, he became a pioneer, helping to train future leaders in their fields of study. In turn, Dr. Shenk and his peers made important discoveries and educated a new generation of inquisitive young scientists and teachers. Today, with similar drive, imagination, and care, Edgardo Santiago-Martinez and his fellow graduate students are working to develop new solutions that may change the world, whether by eradicating a disease, healing a population, or improving life for a single patient. **M**