



The Making of a Biomedical Scientist

BY GARY GOLDENBERG

Sir Richard Doll, the renowned cancer epidemiologist, once noted, “Basic research is not the same as development. A crash course for the latter may be successful; but for the former, it is like trying to make nine women pregnant in the hope of getting a baby in a month’s time.”

Crash courses are no better for the making of a biomedical scientist. Indeed, it takes long years of disciplined study, coupled with hands-on training under the watchful eye of a master craftsman, to transform an inquisitive teenager into a rigorous, abstract, creative, and productive thinker. College included, the process of becoming a researcher can last a decade and a half, longer than just about any other professional preparation.

The true molding of a biomedical scientist begins on the graduate level. At Albert Einstein College of Medicine, this task falls to the Sue Golding Graduate Division of Medical Sciences, one of the nation’s premier incubators of scientific talent. The division consists of two parts. The larger of the two, the PhD program, trains scientists to conduct research in genomics, stem cell biology, cancer

EDUCATION

biology, vaccine development, and other cutting-edge areas relevant to human disease. Founded in 1957, the PhD program is home to about 270 students, about half women.

Another 68 students are enrolled in the 40-year-old Medical Scientist Training Program (MSTP), also known as the MD-PhD program, which prepares physician-scientists to bridge the gap between basic science and clinical research.

Typically, PhD students spend up to six years completing their degrees. At Einstein, they take advanced science classes, pick a research topic, choose a lab, work with a mentor, and write a dissertation. As part of their training, they are expected to publish—the more the better. “We feel very strongly that once you matriculate into the PhD program, you are a student, yes, but on the other hand, you’ve started your scientific career,” says Todd Evans, PhD, professor of developmental and molecular biology and director of the graduate division. “You’re a professional now; you’re contributing to important scientific research.”

It takes even longer to complete the MD-PhD program, seven years or more. In year one, students are immersed in an integrated curriculum of graduate and medical school courses. The second year covers medical studies and preparations for the first phase of the medical licensing exams. In years three through five, students focus exclusively on research, taking a slightly shortened version of the PhD program. After defending their dissertations, students engage in intensive clinical study, including the core clinical clerkships and elective clinical courses.

Each PhD and MD-PhD student attends Einstein tuition-free and is supported by a financial package ranging up to \$60,000 a year, underwritten by a variety of sources, including federal grants and university monies.

It’s a good investment, says Dr. Evans. “Graduate students are a driving force behind lab productivity. And productivity is the key to funding. Student research provides the raw fuel that generates NIH [National Institutes of Health] grants, for example, which could be worth more than a million dollars to a principal investigator. That money goes to pay salaries, for supplies, and for institutional overhead.”

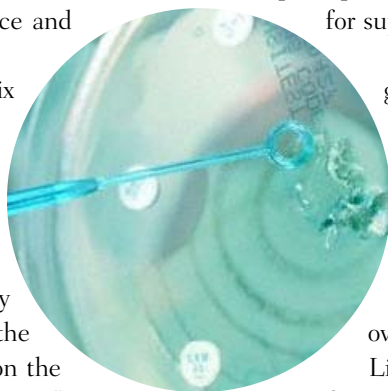
Recently, researchers at Einstein received grants totaling \$53 million toward researching cancer, aging, diabetes, and kidney disease this year.

Einstein was recently ranked sixth in the nation in NIH funding for basic science departments in medical schools, and is consistently ranked in the top 25 institutions for overall NIH funding.

Like other graduate programs, the Golding Graduate Division is composed of 10 such basic science departments as anatomy and structural biology, microbiology and immunology, molecular pharmacology, neuroscience, pathology, and biophysics. However, Einstein is unusual in that this structure is largely administrative. “Here, students can work in any of our ten—soon to be eleven—departments, and often their research will cross many disciplines,” says Dr. Evans. “We don’t just do biochemistry, genetics, or developmental biology. Today, research is done by merging all these fields. We try to instill in students the idea that, by the time they get done with their studies, they will have actually created a new field that didn’t exist before.”

The making of a biomedical scientist doesn’t end there. Eighty-five percent of Einstein’s PhD recipients pursue post-doctoral training.

The newly minted PhD exists in a limbo of sorts, exquisitely educated yet not self-sufficient. “For most careers in science, the PhD is just the entry level,” says Dr. Evans. “If you want to be an effective teacher and communicator, to direct



“You’re a professional now; you’re
contributing
to important scientific research.”

a research lab in a university or a pharmaceutical company, or to get on the tenure-track in academics, then you're going to need some postdoctoral training."

At Einstein, 350 "postdocs" train under the direction of an internationally recognized researcher. "At this level," says Dr. Evans, "you care less about the school, or even about the program (although these are important for providing a productive environment); you care most about the specific lab. You want to be identified with a particular researcher who has a project that will be a stepping-stone to the rest of your career."

Most postdocs spend four or five years in this stage of training. It's a highly productive period, though fraught with problems and challenges. Postdocs earn very modest salaries; in many institutions they get few of the benefits of fulltime employees and faculty members. And each year the job market gets tighter, forcing some postdocs to complete a series of fellowships—a career holding-pattern that can last for years until the right opportunity comes along.

In 1978, Einstein established the Belfer Institute for Advanced Biomedical Studies, becoming one of the first medical schools to formally address the needs of postdocs. Eight years later, the Institute's mandate was expanded to include quality-of-life issues, from housing to health insurance to job opportunities. That same year, two postdocs formed the Einstein Postdoctoral Association, providing another forum for those trainees.

After a decade or more of training, most Einstein postdocs go on to careers in academia or industry, although a growing handful find alternative outlets for their skills, for example, at medical publishers, foundations, nonprofit organizations, and nongovernmental and governmental policy-making agencies. And most are glad they made the long journey.

A crash course it is not.

Joy of Neuroscience

Joy Walter

PhD Candidate

"This is what scares you when you first come to graduate school at Einstein," says second-year doctoral candidate Joy Walter, holding up her ID badge. "It says 'Class of 2008.' I don't want to be here for six years!"

Indeed, the prospect of that many years of all-consuming study is daunting, all the more so when you're 20-something



RESEARCH:

Enriching the Medical School Experience

Einstein has a long tradition of encouraging students to participate in research at the college and at leading research centers worldwide. According to Albert S. Kuperman, PhD, associate dean for educational affairs, "continuing advances in the scientific basis of clinical medicine and the magnitude of its knowledge base requires physicians to develop superb skills in accessing that knowledge base efficiently and critically." Dr. Kuperman says students develop the skills through research, and, as a result, are more likely to consider careers as investigators. Indeed, says Dr. Kuperman, "many research stars on our own faculty today got their start during research projects while students at Einstein." In this respect, he continues, "Einstein ranks with the best medical schools in the nation."

Fellowship-supported research opportunities for Einstein students range from two-month summer projects to yearlong ventures, with such undertakings leading to a diploma with distinction in research. Some students, says Dr. Kuperman, develop such a strong interest in research that they join the MD-PhD program. Others become interested in Einstein's new graduate program in Clinical Research Methods, which requires a fifth year of study and mentor-guided clinical research leading to an MS degree.

Beyond qualifying for fellowships funded by Einstein, Dr. Kuperman says "the college's medical students do very well in the national competition for prestigious fellowships such as those awarded by the Howard Hughes Medical Institute."

“You use your best judgment,
and sometimes you are lucky, other times not.
Other people find it frustrating
but I love to **battle it out.**”

and newly married, with plans to raise a family and hopes for some semblance of a social life. But it’s hard to imagine that Ms. Walter won’t stay the course. Anyone who brings her notebook to a party—as she did recently—so she could work on a nagging lab problem is clearly committed to a career in science; in her case, neuroscience.

With her formal coursework largely completed, Ms. Walter spends most of her waking hours in the laboratory of Kamran Khodakhah, PhD, associate professor of neuroscience, a noted authority on the cerebellum, the corner of the brain that coordinates movement.

It’s obvious that Ms. Walter really does want to be at Einstein, even if it takes a half dozen years to get her degree. When asked about her research—on the electrophysiology of Purkinje cells, which are responsible for integrating all signals that stream into the cerebellum—she muses on and on about parallel fibers, decay rates, and ion channels the way others chat about the Yankees over a cold glass of beer. “Sorry,” she says, realizing she lost her interviewer five minutes ago, “I just like to talk about it.”

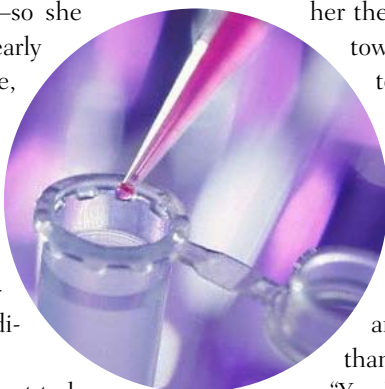
A biochemistry and math major in college (and a Division I softball player), Ms. Walter once considered going to medical school. But a short stint in a neuroscience research lab during her senior year shifted her focus. “I enjoyed the hands-on work in the lab,” she says. “In neuroscience, I use everything that I’ve learned—physics, mathematics, biochemistry, biology. It’s a different kind of thinking. Every day, you’re trying to figure out new things. It’s exciting.”

She ultimately applied to graduate programs in math and science, but opted for the latter after visiting the Department of Neuroscience at Einstein. “I immediately felt comfortable here,” says the waif-like Ms. Walter, who looks more like a high school student than an academic scientist. “It was

very friendly. There was no intimidation.”

In truth, Ms. Walter is not all that concerned about far-off dates like 2008. She’s more focused on defining the scope of her thesis project, one of the most significant steps toward her PhD. Worries about how to conduct top-flight research and raise a family—a feat that relatively few women manage to pull off—are for another day. (“It is indeed a huge challenge, but it can be done,” notes Dr. Evans. “There are good role models for women at AECOM—professors Pamela Stanley, Susan Horwitz, Nancy Carrasco, and many others—more so, in my opinion, than at many other institutions.”)

“You have to be patient—I’m finding that out late-ly,” says Ms. Walter, referring to her research and, perhaps, to her long-term goals. “Things go wrong sometimes, and you have to step back and take a deep breath.”



A Tale of Two Degrees

Francine Garrett

MD-PhD Candidate

Perhaps the most challenging graduate program in all of academia is the combined MD-PhD degree, education’s equivalent of the decathlon. Candidates for the joint degree, which can take up to 10 years to complete, must be bright, versatile, indefatigable, independent, patient, and resilient, to name just a few prerequisites. In short, they must be something like Francine Garrett.

Ms. Garrett is more than halfway through Einstein’s MD-PhD program, having completed her first two years of medical school and five years of graduate studies in cell biology. Soon, she will defend her doctoral thesis and enter the final phase of the medical curriculum, the clinical rotations. If all

Francine Garrett, in Einstein's MD-PhD program, has spent seven years working toward her joint degree. She has at least another two to go.

goes according to plan, she expects to wrap up her studies by 2005, for a total of nine years of advanced schooling. Then she will have to decide whether to pursue a residency in a medical specialty or postdoctoral training in research—or both. It's exhausting just thinking about it.

Ms. Garrett was born in the United States but spent most of her formative years in Israel, where she attended high school and served in the Israel Defense Force. An athletic scholarship brought her to California State University in Fullerton, where she studied biochemistry and competed in gymnastics, until that career was cut short by injury.

Before long, she was back in Israel for a summer term abroad. This brief interlude, during which she worked in a cancer center with

a team of basic researchers and clinicians, would change her life. "It was the first time that I had seen how powerful the combination of science and medicine can be," she recalls.

The next step was Einstein. Ms. Garrett enjoyed the initial phase of the MD-PhD program (19 months of preclinical medical studies), but she could hardly wait to enter the world of test tubes and centrifuges. An exhaustive search for the right lab and the right mentor led her in 1999 to Barbara Birshtein, PhD, professor of cell biology. Ever since, Ms. Garrett has been studying the genes behind B-cells, the immune cells that make antibodies, with a special focus on the role of chromatin (the structure that allows more than a yard of DNA to fit inside the microscopic nucleus) and histones (the most abundant of the chromatin proteins, implicated in



the spatial organization of DNA).

Little is known about chromatin in B-cells, and this suits Ms. Garrett very well. "Every day is different—trial and error," she says. "You use your best judgment, and sometimes you are lucky, other times not. Other people find it frustrating, but I love to battle it out."

In her spare time, Ms. Garrett volunteers for the Student National Medical Association, the oldest and largest medical student organization dedicated to people of color and underserved communities. She has been member of the board of directors for six years and served as chair for one year.

In addition, she was involved in initiating one of Einstein's most popular electives, "Social Medicine," which addresses societal influences on the health of individuals and popula-

EDUCATION

tions and encourages students to accept the responsibility of promoting social change as an integral part of their education and practice.

“The school has supported me the whole way,” she says. “I cannot imagine having held all these positions in a different institution.”

Nearing the end of her stay at Einstein, Ms. Garrett is beginning to ponder life beyond its Bronx campus. “I’ve been contemplating fields that can entertain both trainings, such as aerospace,” she says.

Seven years down, two to go—more if you count the residency or postdoc training. “If you love it, time doesn’t matter,” she insists.

From Postdoc to Professor

Paula Cohen, PhD

Assistant Professor of Molecular Genetics

Growing up in England, Paula Cohen dreamed of becoming the next “Quincy,” the TV forensic pathologist who nabbed criminals from the late ’70s through the early ’80s.

However, when the time came, she couldn’t muster the courage to apply to medical school (an undergraduate program in Britain). “I was only sixteen or seventeen, and I realized that I would be graduating very young as a doctor. It was too frightening,” she recalls.

Against the advice of her counselors, she decided to study science instead. “In England, science has little prestige, and it’s certainly not a career track that is widely publicized,” she explains. “It’s a hard career there.”

It turned out to be one of the best decisions she’s ever

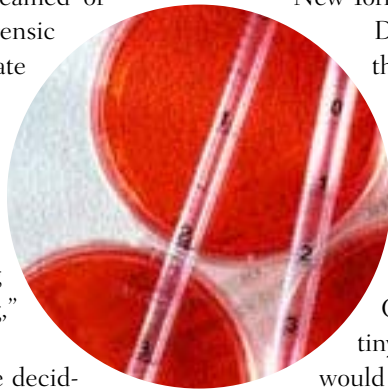
made. “By my second year, I realized that (A) I was passionate about science and (B) I would be the lousiest doctor on the whole planet—I have no patience for people who are ill. If only an astute career adviser had seen that, it would have saved me a lot of pain and heartache.”

Dr. Cohen gravitated toward the study of endocrinology and developmental biology, focusing on the signals that an embryo sends to the mother upon implantation, an interaction that is still poorly understood. “My mother had eight miscarriages, so it was a meaningful area of research to me,” she says.

PhD in hand, Dr. Cohen came to Einstein in the early 1990s to pursue a postdoctoral fellowship in the laboratory of Jeffrey Pollard, PhD, professor of developmental and molecular biology and of obstetrics and gynecology and women’s health. “I was tired of London and wanted to go to a small place, but Jeff Pollard’s work was the most exciting to me. He responded to my inquiries with a project that was just overwhelming. I couldn’t turn it down. I said, ‘I can deal with New York for two years.’”

Dr. Cohen fell in love with both the city and the Einstein community. “I had this great project and all these amazing facilities open to me,” she says. “As a postdoc from England, I was like the proverbial kid in the candy store.”

After two years, she made preparations to return home, even landing a faculty slot at Oxford. “Oxford said they would give me a tiny lab space and a little money, but that I would have to narrow my focus to achieve anything meaningful with the restricted funding available over there. Meanwhile, Jeff was saying, the whole world is yours, you can do all this research here. The difference was night and day.” Not surprisingly, she stayed at Einstein.



“I had this great project and all these
amazing facilities
open to me.”



**A former Einstein “postdoc,”
Dr. Cohen now directs her own
laboratory and supervises
young scientists.**

With Dr. Pollard’s encouragement, she started working with researchers in the department of molecular genetics who had made a mouse model for studying colon cancer. “They predicted from yeast data that the mouse mutants might be sterile, so they asked me to help out with the analysis,” she says. “Einstein is unique in promoting these types of collaborations.”

In 2000, Dr. Cohen joined the faculty with a primary appointment in molecular genetics. “Somebody told me that if I stayed at the same institution as a faculty member, I would always be seen as a postdoc,” she adds. “But that is not at all the case, here at Einstein at least. People have been very supportive and nurturing.”

Now, as the director of her own laboratory and a supervisor of young sci-

In Dr. Pollard, Dr. Cohen found the mentor she had never had. But others were not so lucky, and this prompted her and another postdoc, Fiona Pixley, to form the Einstein Postdoctoral Association in 1996. “We saw that some faculty, not necessarily here, were not treating their postdocs particularly well,” she says. “Also, people were staying in postdoc positions much longer—five, six, seven years—because it was getting harder to get faculty positions. In some instances, they were going without health benefits and other necessities. At that time, Einstein was a frontrunner in national efforts to standardize and improve postdoctoral working conditions, and continues to be so to this day.”

entists, Dr. Cohen is seeing the other side of the mentor-student relationship. “It is bloody scary,” she says. “I look at them and say, my goodness, these people aren’t much younger than I am. I don’t know whether I’m doing the right thing all the time, but the student advisory committee structure at Einstein helps you with that, and there are always senior faculty to turn to for advice.”

After all this time working in the US, Dr. Cohen can’t imagine going back home. “Don’t tell my mother,” she says. “The scientists and the scientific training in England are amazing, but who would want to struggle that much? It’s hard enough to do science here.” ■