



PERFECT TOGETHER:

NEW JERSEY, PHARMACEUTICALS AND NJIT

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TO RECYCLE A PHRASE FROM THE TOURISM campaign of a few years ago, New Jersey, the pharmaceutical industry and NJIT are perfect together. Lisa Pantano '96, MS '04 agrees. Pantano says that when she completed her BS in chemical engineering in 1996, two industries offered the best prospects for someone in her field who wished to work in New Jersey: petroleum and pharmaceuticals. For Pantano, pharmaceuticals won out, and today she is a principal engineer at Sanofi-Aventis. Pharmaceutical engineers like Pantano play a vital role in the design, scale-up and operation of facilities where drugs are developed and manufactured under very stringent conditions.

Providing critical expertise

New Jersey is home to the headquarters of more pharmaceutical companies than any other state. Given NJIT's academic stature, it's not surprising that the pharmaceutical industry looks to the university for expertise critical to meeting the challenges of innovation, quality and competition. Today, the focus of NJIT's partnership with the industry is the master of science program in pharmaceutical engineering, introduced in January 2002 under the direction of Piero Armenante, distinguished professor of chemical engineering.

NJIT's program is among just a few in the nation. Although chemical engineers have long worked in

the pharmaceutical industry, success has required learning more on the job than is typical in other industries. Enterprises that draw upon the skills of chemical engineers, Pantano says, generally depend on continuous production processes — refining petroleum, for example.

"However, batch processing is the norm at pharmaceutical companies, a technology that has not received the same emphasis in most chemical engineering programs," says Pantano. "In the pharmaceutical industry, engineers are not called on to design large distillation columns, but rather to develop smaller-scale operations for manufacturing solid and liquid products." This requires understanding and implementing a wide range of especially complex processes, such as mixing fine and ultra-fine powders, granulation, encapsulation, and tablet compression and coating.

Another 2004 recipient of the MS in pharmaceutical engineering, Curtis Porcello, echoes this perspective. Porcello helps to design processes for manufacturing drugs in various dosage forms at Sanofi-Aventis. "Just taking a casual look at the catalog for a typical graduate degree in chemical engineering shows how much the core courses differ from the specialized knowledge needed by pharmaceutical engineers," Porcello says. Unlike classic chemical engineering curricula, the NJIT pharmaceutical program introduces students to

many topics with aspects unique to the industry, including pharmaceutical unit operations and facility design, pharmaceutical synthesis and separation processes, quality control, regulatory issues and packaging technology.

Two main tracks

NJIT's 30-credit pharmaceutical program has two main study tracks. One focuses on the engineering aspects of chemical reaction and separation processes required for manufacturing active pharmaceutical ingredients. The other track is dedicated to engineering for the manufacture of final drug products that deliver the active ingredients.

Although many engineers in the pharmaceutical industry are not directly involved in the pharmacological aspect of drug development, they do work alongside pharmacists and other life-science professionals. Accordingly, NJIT's program includes courses that familiarize students with pharmacological concepts, such as drug delivery and pharmacokinetics, that determine the final formulation of products and their physiological effects. There is also the opportunity to work one-on-one with faculty carrying out pharmaceutically relevant research.

Personal connections

The NJIT pharmaceutical program is also exceptional for the degree of involvement by industry professionals and companies. The program has benefited from guidance, funding and other support provided by companies that include P.F. Laboratories, Novartis, Torcon, Bristol-Myers Squibb, Johnson & Johnson, and especially Schering-Plough.

Industry participation is also very personal at NJIT, with alumni sharing invaluable real-world perspectives. Among these is Colin Walters '94, MS '00, who has degrees in chemical engineering and works at Schering-Plough. "The development and manufacturing of pharmaceuticals differ markedly from virtually all other industries in terms of the focus on quality," Walters says. "Pharmaceutical engineers play a strategic role in meeting the demands of an increasingly competitive marketplace while complying with very stringent regulatory standards."

Joseph Manfredi '74 is even more involved. The founder and president of GMP Systems, which provides advanced processing equipment for the pharmaceutical industry, Manfredi chairs the advisory board for the MS program and teaches a core

course in pharmaceutical manufacturing technology.

"Joe was a driving force behind establishment of the program. He also exemplifies the personal and industry support that continues to make our master's program so successful, with more students applying than we anticipated," says Armenante. "We're working with the industry to develop the cadre of professionals that companies need as they're compelled to pay greater attention to the engineering aspects of pharmaceutical development and production, from formulation all the way up to large-scale processing and manufacturing."

Armenante and his NJIT colleagues are also taking a longer-term view of pharmaceutical engineering education. "Our goal is to give students the most options when it comes to their career paths. That's one reason we first chose to introduce the MS, as opposed to an undergraduate major. We feel that



Professor Piero Armenante (center) with PhD student Marc Steinman (left) and Colin Walters '94, MS '00 at a Schering-Plough facility in New Jersey. Industry professionals like Steinman and Walters, who work for Schering-Plough, provided input valuable for designing the curriculum leading to the MS in pharmaceutical engineering.

this provides the greatest flexibility and benefits for professionals who have degrees in related disciplines, such as chemical engineering, and are already working in the industry.

"But we're looking at a lot of possibilities, from enhancing the MS with a track in biological processing to offering undergraduate courses and perhaps a PhD. It's a work in progress, as all good educational programs must be." ■

Pharmaceutical engineering at NJIT:

<http://chemicaleng.njit.edu/academics/ms/pharm.php>