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# Bioinformatics: New Frontier Calls Young Scientists

Not many people who make their living as specialists in bioinformatics planned it just that way. James Ostell, for example, was studying invertebrate development. James Fickett wasn't even in biology: He got his Ph.D. in math, where he says he enjoyed the "abstract beauty" of the discipline. Nevertheless, today both of them are specialists in the rapidly growing discipline that exists to organize the huge mass of information being generated by today's molecular biology.

This is the fourth in a series of seven pages in *Science* linked to features on *Science*'s Next Wave, the new AAAS/*Science* World Wide Web project for young scientists (http://sci.aaas.org/nextwave). This story focuses on people who have entered the new and rapidly growing field of bioinformatics.

Bioinformatics is a young field, its exponential growth fueled by progress on the Human Genome Project. It comes with all the attractions—and difficulties—of a young area. Until recently there were few training programs in this nascent discipline. And although bioinformatics is so broad that it attracts researchers with backgrounds ranging from biology to physics to computer science, the transition can be difficult. Yet the payoffs, both intellectual and financial, can also be large: The field is far from overpopulated, and the number of jobs is growing rapidly.

Because the field is so new, almost everyone now in it started out to be something else. Sometimes they reached bioinformatics via a side interest—in software, for example. Ostell, now information engineering branch chief at the National Center for Biotechnology Information (NCBI), part of the National Library of Medicine in Bethesda, Maryland, was interested in gene expression, and so he entered Harvard University in 1979 to get a Ph.D. in that subject. Realizing that he needed a way to analyze the sequences of the genes he was cloning, Ostell set out, with only a semester of Fortran under his belt, to write software for his own use.

The software worked so well that Ostell was encouraged by his labmates to write a paper about it for a special issue of *Nucleic Acids Research* devoted to computers. After that, "I was deluged by requests for the software," he says. Slowly but surely, developing and supporting his software began to take all of his time; his genetic research slowed perceptibly. Collaborating with a company called International Biotechnology Inc. (which is now part of Kodak Scientific Imaging Systems), Ostell turned his program into a commercial tool that is now available under the name MacVector. Although the work on his thesis was slowed by his emerging focus on bioinformatics, in 1987 he did finish his dissertation, and in 1988 he was contacted by David Lipman, director of the fledgling NCBI, to become the information engineering branch chief.

Ostell was a biologist who picked up programming, but others enter bioinformatics via the reverse route. Mathematician Fickett, now a member of the bioinformatics group at SmithKline Beecham, calls himself a "self-taught" biologist. After getting his Ph.D. in math in 1979 from the University of Colorado and a brief stint as an assistant professor at Texas A & M University, Fickett went to work at Los Alamos National Laboratory, where he eventually became the section leader for genome informatics in the theoretical biology and biophysics group. After 16 years at Los Alamos, Fickett began looking for another opportunity in bioinformatics. A few months ago, he joined SmithKline Beecham as a senior computational biologist. Fickett says that his career shift from pure mathematics to working for a large pharmaceutical company, although challenging, was a natural. "I enjoy the abstract beauty of mathematics," he says, "but I needed to do something closer to a real-world application."

Because bioinformatics is a hot field and can accommodate people from a wide variety of backgrounds, you might expect that the number of qualified applicants would far outnumber the available positions. Not so. Lou DeGennaro, director of molecular genetics at Wyeth Ayerst, says "One of the problems with building a bioinformatics group is that there aren't very many experienced people in bioinformatics." And if companies in the United States are struggling to find qualified people, the problem is worse in some other countries, including the United Kingdom. The reason? "We are suffering from a brain drain," says Steve Gardner, senior product manager of the bioinformatics division at Oxford Molecular in Oxford, England. "Many of our qualified people," says Gardner, "are lured to the U.S. by the promise of a better salary."

Although most company representatives agree that there is a shortage of qualified people in bioinformatics, opinions vary when it comes to deciding just how much programming experience is needed for people to make the transition to this new field. "Professional programming experience is extremely important," says Joseph King, who has a Ph.D. in genetics and is a programmer for the Genetics Computer Group, a small company in Wisconsin specializing in the development and support of sequence-analysis software. King adds that, for success in bioinformatics, programming must be "more than a hobby." But Ian Williams, group director of molecular science at Pfizer, disagrees: "There is a place in bioinformatics today for people with Ph.D.s in molecular biology." And for this group, in Williams's view, "professional programming experience is not necessary."

This disparity of opinions reveals just how young a field bioinformatics is. Within a few years the profession will no doubt have matured considerably. The emergence of formal training programs in bioinformatics will no doubt impose a greater degree of uniformity on the issue of appropriate qualifications. And the exponential growth of the field probably can't be sustained for many more years. But for the moment, this is a field that is wide open to those who have, or can acquire, knowledge of biology and computing. With traditional scientific job markets shrinking, this kind of thing may be just the opportunity many young scientists are looking for.

**–Nicole Ruediger**

*Nicole Ruediger is a young biologist living in Florida. Like many of her peers, she is considering a variety of career options.*

**For more information on making the transition to a career in bioinformatics, please go to *Science*'s Next Wave, on the World Wide Web at <http://sci.aaas.org/nextwave>, and look under the "New Niches" heading on the home page. There you will find the stories of the "Role Models" who have already made this transition, along with "Resources" that will help you make it yourself.**