



Courtesy of Mandana Sassanfar,
Manager of the MIT Summer
Research Program in Biology

Career Advice

Making Your Summer Research Internship a Good One

Howard University biology student Chinweike Okegbe spent this past summer at the Massachusetts Institute of Technology in Cambridge investigating how bacteria

communicate as part of the **MIT Summer Research Program in the Biological Sciences and Related Fields**

(http://mit.edu/biology/www/outreach/summer_research/undergraduates.html). According to Lars Dietrich, the MIT postdoc who supervised him, Okegbe's first 2 weeks were a struggle. A lot of experiments didn't work and "at the very beginning he was very frustrated about it." But "then it clicked. He really understood how to do research."

Most first-time researchers encounter a gap between the work they're doing and what they learned in their courses.

Getting past the frustration--and in the process learning how real research differs from science learned in the classroom--is what undergraduate research internships are all about. Yet despite the focus on real research, real progress in most programs is regarded as a bonus and not the main objective. Okegbe went on to produce some interesting results and to contribute intellectually to a research paper Dietrich plans to publish. "What I really wanted him to understand is that this is how science works," Dietrich says.

What's expected during an internship

At the core of most summer research internships is a research project of your own. While working on it, you learn new scientific techniques and how to design experiments, analyze results, formulate hypotheses, and keep a lab notebook. In the best cases (but not always), you work closely with a supervisor who guides and inspires you.

Undergraduate interns are expected to work hard to learn the field well enough to understand the key questions and motivations. They "need to learn about background literature and understand what's going on and why they are doing things," says Omar Janneh, a lecturer in pharmacology at the **University of Ulster** (<http://www.ulster.ac.uk/>) in Coleraine, U.K. They must be "able to ask questions and understand why they are doing things and not just following protocols."

Interns are expected to attend lab meetings, symposia, and sometimes classroom lectures. And don't expect that you'll be sitting in the back row every week: Sometimes you'll be demonstrating your own scientific insight and developing your science communication skills.



Jonathan Williams

Jonathan Williams

Obtaining interesting scientific results in just a few weeks--most summer internships last for 10 or 12 weeks maximum--isn't likely, and it's usually not the point, Dietrich says. It "is more about experience than output, and we don't expect the students to produce papers for a journal within 10 weeks," says Jonathan Williams, an associate professor at the **Institute for Astronomy** (<http://www.ifa.hawaii.edu/>) at the University of Hawaii, Honolulu, who runs the **Research Experiences for Undergraduates** (http://www.nsf.gov/crssprgm/reu/reu_search.cfm) program there.

Perhaps the most important thing an intern can do is attack scientific challenges with enthusiasm and seriousness. A good summer intern is "absolutely keen on the job and is a good listener and is ready to learn and contribute to whatever is going on in the lab," Janneh says. He or she is also "somebody who is able to work with a team but also be an individual contributor."

Real Research

A first difficulty for some interns is revising their expectations about the kind of work they'll be doing. "Some summer students come here with a much purer view of what research is than what it actually turns out to be. Much of what people do here is really very dirty work like getting down on your knees, pulling cables, ... working long hours, just sitting around waiting for the beam to come back on," says Michael Doser, a physicist at the European Organization for Nuclear Research near Geneva, Switzerland, who helps run a Summer Student Programme there. Some undergrads also expect to spend most of their time using the lab's expensive equipment, when in fact, in a field such as astronomy, "the data is so complex that one or two nights of data will keep them busy for the entire summer," Williams says.

Most first-time researchers encounter a gap between the work they're doing and what they learned in their courses. Although most class assignments often require you to find predefined answers, research questions are open-ended. Interns should be prepared to see many of their experiments fail--and to learn from each failure.



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Okegbe with Lars Dietrich

Another expectation summer researchers may have to revise is how much time supervisors will spend with them. Some students "think they are going to see the mentors every day." But "mentors are pretty busy people, and they will give them a few hours a week," Williams says. So interns must learn to work independently.

Doing well

Trust is paramount in science, so you need to approach your work with rigor and integrity. Think through your approach and carefully consider every step. "You want to think about doing your experiments and making them fail-proof and really present some convincing evidence that what you are saying is actually true," Okegbe says. "You have to maintain a clear mind and look at data and look at questions objectively and try to solve them without being biased toward any particular solution."

Once the data start coming in, make sure you keep a good lab notebook, because a reliable scientific record is another cornerstone of science. In any laboratory, a good lab notebook makes the data completely clear and provides enough information about your experimental technique to allow another trained scientist to reproduce your work, even years from now. It's important to understand the system of documentation your lab uses, because every system has idiosyncrasies. One big surprise that some interns encounter is that some labs don't have a good system of keeping records. If you find yourself in such a laboratory, raise the standard.

Ask questions, and lots of them--but start by asking them of yourself. Get used to finding your own answers, from books, scientific journal articles, and laboratory colleagues. "The best students ... will be told how to do something, and they will go away and do it, and they'll come back and show you their results," Williams says. "If there is an unexpected problem, they

try to figure out what's going wrong themselves before immediately going to someone to get the answer," he adds. "If they really are stuck, then they go for help."

One great advantage of seeking your own answers is that sometimes the answers you come up with are new. "If I give different students a problem, some of them will solve it in a very straightforward manner to my complete satisfaction, ... but it will be what I expected," Doser says. "And then occasionally somebody will ... come up with an idea that I've never heard of ... and will give a new development to a certain problem," he adds. "Don't only do what your adviser tells you but also use your own creativity and your own mind," Dietrich says.

It's one thing to be asked to work independently; it's another to spend the whole summer at the sink washing glassware or floundering at the bench without insight or guidance. A summer internship is--or should be--an educational experience, so interns have a right to expect face time with advisers and a legitimate scientific challenge. If you have a problem, "try to talk to the supervisor," Dietrich says. If that doesn't work, "I would advise to switch the project or ask if you could work with another supervisor." And if that doesn't work, Dietrich says, just try to find someone in the lab who can help you.



Michael Doser

Michael Doser

Also a social experience

A good way to enhance your learning experience is to interact with people other than your supervisor. But don't limit your interactions to the laboratory. In many labs, planned and spontaneous social events are common. Undergraduates should participate in these events because "it gives you a better feel [for] how the people are in science, what you can do beyond the research," Dietrich advises.

A summer internship should be a rich experience, in and out of the lab. Williams wants his summer students to enjoy Hawaii. "We expect them to go swimming, dive, travel to the other islands, climb, go hiking, ... but we also expect them to work hard when they're here. There's a time to work and there's a time to play, and they have to keep that balance."

A summer internship can help you decide whether graduate school is right for you, and it can lead to important professional connections that can help you later. "Get to know your peers and those slightly ahead of you. ... Make friends and keep in touch," Williams says. The road to a Ph.D., he adds, often begins with an internship, and "it's a long and sometimes lonely journey. But it's also exciting, and following different people at different stages of their career can be inspiring."

Photos. Top and Middle: Courtesy, Mandana Sassanfar, Manager of the MIT Summer Research Program in Biology. Middle: Courtesy, Jonathan Williams. Bottom: Courtesy, Michael Doser.

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