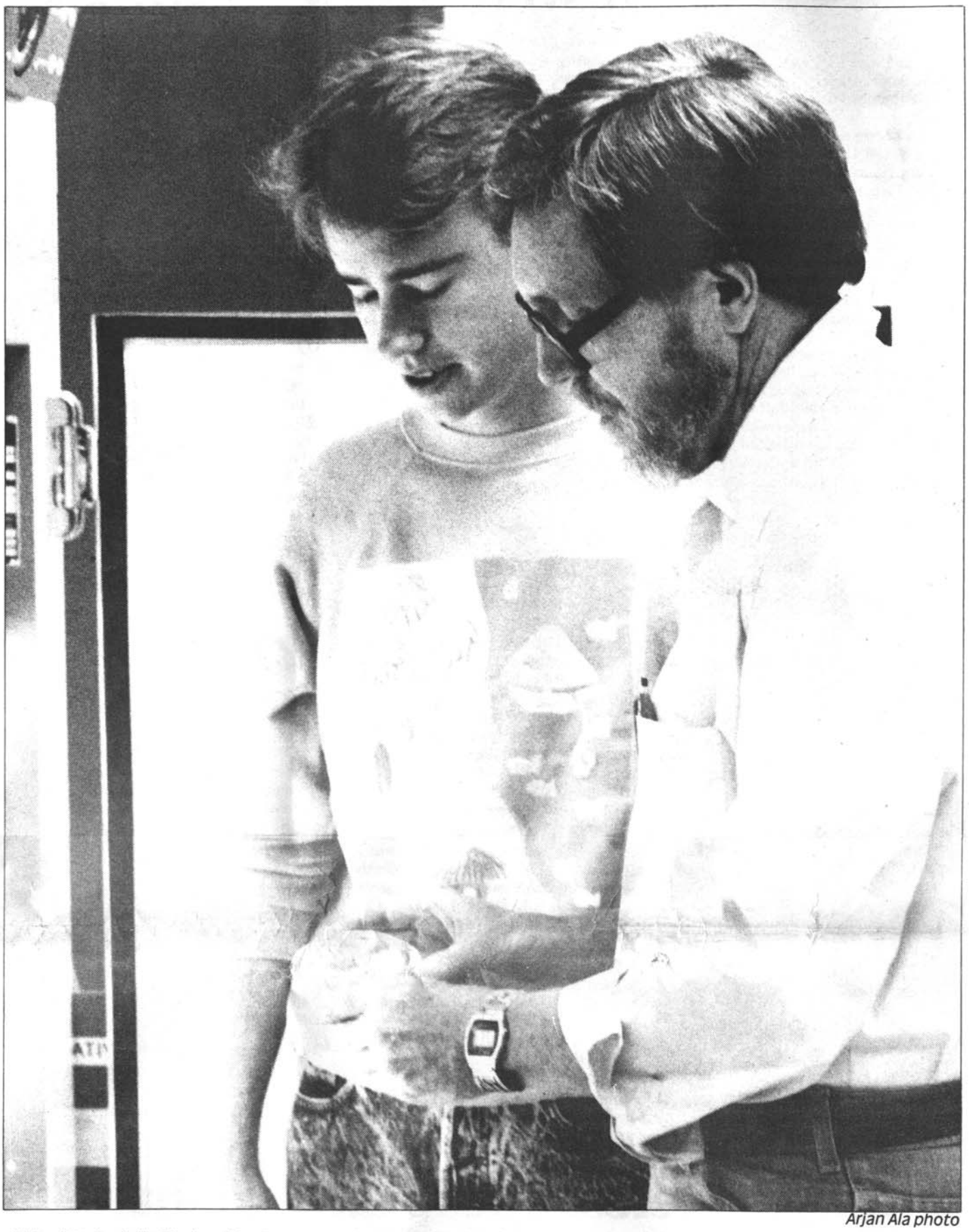
Hornworms inspire excellence

Student works 3 weeks, is able to present data



Arjan Ala photo

Michael Wells, right, Biochemistry Department head, removes cup from incubator in which larvae of the tobacco hornworm, *Manduca sexta*, are raised. Scott Sanders, left, studies the effects of starvation on protein synthesis and on the concentration of fats in the insects' blood in Wells' laboratory.

Scott Sanders thought he wanted to study human cholesterol, but Biochemistry Department Head Michael A. Wells steered him into doing experiments with the larvae of hornworms.

"He made it sound so interesting, so concise and clear," says Sanders, a senior biochemistry major. "I thought I was just going to come into this lab and do research, but he set me up in a one-on-one teaching experience. I learned so much."

There has been a payoff for Sanders: Within three months, he compiled enough data to submit a poster with a postdoctoral fellow at an international symposium on insect sciences.

Sanders says he plans to continue in school for M.D. and Ph.D. degrees. "I wouldn't have even thought about a Ph.D. in biochemistry if I hadn't done this research."

Sanders says he finds the enjoyment in research comes from "seeing the results. Each time, you learn something new. It's the excitement that nobody knows the answer yet, until I find it. It's a very good supplement to class work because you get a more in-depth look at things you learn in class."

Every experiment "answers one question and generates a dozen others," Wells says, adding that "doing something no one has ever done before is a real ego trip. In fact, my doing undergraduate research had a direct effect on my going on for a Ph.D."

Wells stresses that engaging undergraduates in research can help students decide on their careers in three ways:

•They may find out they hate research and that a Ph.D. is something they would rather not pursue.

•They may find that they enjoy research but may not want to go on to graduate school. "There are lots of jobs as technicians that can satisfy their desire to do research without putting them under the stress of being a faculty member," Wells says.

•They may really love it, and it may turn them on to going to graduate school and getting a Ph.D.

Wells says "that's very important because we face a critical shortage of biology faculty in the next 20 years or so.

"Estimates are that in biochemistry maybe a third of the faculty will be retiring in the next 20 years. Other estimates are that we are training only about half the number of people we need to fill those positions. So there are a lot of opportunities for current undergraduates by the time they finish graduate school and are ready to enter a faculty position."

Wells estimates that the number of students in the biological sciences at The University of Arizona who have applied to graduate school has increased fivefold since he secured funding to begin an undergraduate research program in 1988.

"Last summer, we supported about 55 students; Scott Sanders was one of them," says Wells. "There wasn't a penny of state money that went into that effort. It cost approximately $125,000 to pay the student stipends, which came in part from a Howard Hughes Medical Institute grant, from a National Science Foundation grant that we got for undergraduate biochemistry research, from the faculty's research grants and from biochemistry overhead recovery, which is money that comes back to the department from the University in proportion to the amount of research grant money that it generates."

Additional money to pay for supplies and equipment came from the faculty's research grants, Wells says. "That amounted to about $125,000, so we invested roughly a quarter million dollars in undergraduate research, and the state didn't put up any of the money for the students."

Wells says the program is intensive in terms of faculty time, but it's proving to be "the best thing we've ever done. The response from the faculty has been as positive as the response from the students. I think the fact that the faculty are willing to put money out of their research grants to support this program is another indication of their level of enthusiasm. Several faculty have said this is the most satisfying educational experience they've had."

Wells points out that it takes a lot of time to teach people how to do science. "A conservative estimate is that there were 7,000 contact hours with faculty for the 55 students last summer. That's equivalent to the time the faculty would spend lecturing in 100 courses if they met three times a week.

"It amounts to one student per faculty for three hours a week instead of 1,000 students in a big lecture hall. The impact in terms of the number of students is obviously much smaller, but it's a major commitment in faculty time, which in terms of the number of papers published is not a high-yield activity. But I would suspect that you would find very few faculty who would be willing to give up that time."

Wells predicts that these students will have a big advantage in graduate school because of the maturity and self confidence they gain by doing research. "It's a pretty scary step to go from a classroom into a laboratory," he says. "It was for me."

A bonus is that about a third of the students will probably generate enough data for papers, Wells says, "but I don't think it's necessary that they publish a paper to get the most out of the program.

"In my opinion, this is an educational program first and foremost, and it's intimately related to the fact that we do have a high quality research faculty at this university. Without a research-active faculty, we wouldn't have laboratories for the students to work in, and we wouldn't have the money to fund the program from grants like the Hughes fund and NSF."

But the real key to the success of the program, he says, is that the students are taken under the wing of research teams. "We told the students, 'You're accepted into the program, and we'll pay you. Now you go find the faculty and talk to them. Find where your interest is and where the faculty interest is.'

"It forced students to talk to faculty, which they may never have done before; and it made faculty talk to students about their research, which they may never have done before. Obviously, some spark was lit in each case."

Teaching-research synergy pulls faculty out of 'details'

An unknown sage has described science as a history of superseded theories. Sam Ward thinks undergraduate researchers contribute to the process of superseding.

"One of the things I've always liked about undergraduate students is that it's valuable to have people in the lab who don't know all the things they can't do," says Ward, who heads the UA's Department of Molecular and Cellular Biology. "Students ask refreshingly naive questions that force you to think about why you're doing all this."

Undergraduates often are willing to tackle unusual questions or procedures "that some of us who are more experienced might say aren't worth doing," Ward says. "Sometimes they'll find new results, so there is some benefit to approaching a problem with a level of naivete."

He says the trouble with day-to-day research is that it tends to bury faculty in details. "Teaching contributes a lot to research because it forces you to reduce things to the level of the student and to get beyond the details. It also forces you to look at things from a larger perspective, and that can be really valuable."

Ward says he has noticed that when he consults in private industry where there are no students around, "people tend to become very set in their ways. I think one of the vitalities of research at a university is that the steady stream of people coming in brings new ideas and challenges the ones we have."