

Teaching Science by Experiencing Science:

Biology Research is a Requirement in the General Biology Program

The spark of enthusiasm is impossible to overlook as it travels throughout the poster session. Prancing wildly about, the spark quickly spreads to each of the presenters and guests. At first the room has but one sound, the result of so many conversations taking place at once that it is impossible to individually discern each. Step closer to the posters and you'll start to hear the passionate exchange of discovery and inquiry.

Such is the consequence of a program requiring teachers to do real science.

The best way to teach science is to experience it

"You can't do science without asking the question, and you can't answer the question without doing research," says Jose Araya, a high school teacher from Montachusett Regional Vocational Technical School in Massachusetts.

"Teachers in this program are required to do real biology research. Doing research helps their students think about how to do research," adds Roxane Johnson, a graduate of the program.

Now in its 13th year, the General Biology Program for Teachers (GBP) has evolved into a successful program. More than 200 teachers from all over the U.S. have taken courses to strengthen their science-teaching repertoire; many have earned their Master's of Science degree in General Biology along the way.

"One of the best ways to ensure the quality of undergraduates in the biological sciences is to have them arrive at the university with solid knowledge and skills. For this to happen, students must be taught by teachers who are well informed and up-to-date in their knowledge and teaching methods," says Dr. Lisa Elfring, program director.

The typical GBP student is already employed as a high school teacher and has chosen to take courses and do research in the summer, rather than take a summer job. Many come from outside of Arizona, from as far away as Connecticut, Massachusetts, and Washington DC.

*"I'm
a better teacher, and
a better scientist, because
of this program." –
Garrison Smith*

The program consists of a summer master's degree program with relatively few school-year courses. Over four or more summers, students are expected to accomplish three things – present and defend their research thesis; present a workshop for other teachers; and develop a biology lesson unit.

Participation in the Poster Session during the course of the research is required each summer the teacher is actively doing research.

The Call of the Scientist

Perhaps the greatest appeal of the program is that it's science research-based. "Other programs are humanities-based, but I think it's important to have your master's degree in your subject area" says Garrison Smith, from Kent School in Connecticut. "I need to continue to increase my content knowledge, and I'm actually doing science in this program."

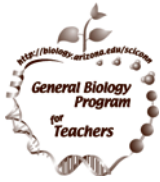
"The idea is to give teachers the opportunity to do actual biology research, an experience most of them didn't have during their education," says Lisa Elfring. "They get a better understanding that science is not just a body of facts, but rather a process of asking questions and figuring out ways to answer them."

For example, Bill Golladay is studying the feeding behavior of crustaceans. Jose Araya is using bioluminescent bacteria to create a low-cost luminometer. Garrison Smith is investigating the intriguing behaviors of burying beetles. Other topics include the discovery of formerly unknown parasites, determining bacterial loads in drinking water wells, and helping to characterize plant-derived vaccine for pneumonic plague.

Flexibility is an important component in the program's success

"I'd never be able to completely focus on research during the school year, so being exposed to a daily dose of real science is being transferred directly back to my students" comments Jose, who spends his summers in Arizona, taking classes and doing research.





Garrison also appreciates the flexibility of the program. "There's more than one session, which accommodates the differences in teacher's summer schedules. And I'm able to continue my research at home, throughout the school year. Since I've

become totally excited about insects, I've been able to design a unit around my research and use my insect collection as part of my class".

Surprises ahead

The end result of Roxane Johnson's experience in the General Biology Program illustrates that the program can produce exciting, unpredictable results.

A few years ago, she was an 8th grade teacher in Tempe, taking science classes at night and during summers to get into the General Biology Program. She was teaching all subjects but felt weakest in science.

Roxane is now the Program Coordinator for The Fulcrum Institute at Tufts University, teaching K-8 teachers, improving their knowledge of physics, and getting them to think more about curriculum and asking inquiry-based questions. Having a Master's of Science degree, as well as the other experiences in the program, "left me in a much better position if I want to go back to teaching."

There's also a chance that students in the GBP will see their research published. "My students will be learning science from a genuine scientist, which might stimulate them to turn on their ability to learn and reason, and increase their knowledge beyond the basic ABCs of science," says Jose.

"The science spark gets re-ignited when I come here, and I take it back with me" says Jose. Adds Garrison: "The program put me back in the mode of doing, thinking, and reading about science." And Roxane "[thought] about science in an entirely new way" once she caught "the science bug."

Participation in the Poster Session offers a quiet bonus. Reflects Jose: "The poster will allow a visual experience to my administrators and students back home."

The collaborative advantage

Each teacher brings a unique perspective to the group, which is comprised of middle school, high



school and AP teachers, and community college teachers from public, private, technical, rural, and inner-city schools. Working together in this program exposes them to a broader view of teaching methods, as well as the breadth of research taking place throughout the University of Arizona. By design, the program compels its students to use their research to teach other teachers.

"We're all learning science and relating that knowledge to each other and our classrooms" says Garrison.

Adds Jose: "It's a great feeling when other teachers get excited about my research. Science advances by interdisciplinary collaboration, and that's exactly what's happening here. Science is a socially charged environment."

Collaboration is also readily available from the UofA community. "Support was just a phone call or an email away," says Roxane. Jose comments: "The UofA has been great about making lab space and time for us, and there's no better way to grasp science than by working in a lab." "I'd recommend it to any science teacher" comments Garrison.

"An on-going challenge is to find ways to provide financial assistance for the teachers in our program, as the cost of a University degree keeps increasing. Grant funding is becoming harder to obtain, and summer students don't qualify for traditional graduate student financial aid provided by the University. Without fundraisers and donations from supporters, the majority of the teachers in our program would not be able to participate." says Lisa Elfring.