

Letter to a Young Scientist

*Scientists of the future, whether academic or not,
will increasingly have to collaborate with others.*

By DR. SUSAN W. FISHER

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My research interests are in the general area of environmental toxicology with emphasis on the influence of physical factors on contaminant transfer from sediment into aquatic foodchains. I am also interested in factors which affect trophic transfer and in relating tissue levels of contaminants with the myriad of biological effects that they produce. Although not an insect, alien species such as the zebra mussel, have become a focus of my research with emphasis on control methods as well as their role in contaminant cycling. When not busy in the laboratory, I enjoy sharing my living space with 7 children and a large number of long-eared equines.

I received a PhD in Entomology by studying that very important insect, the White Leghorn hen. Yes, I studied chickens to earn a PhD in Entomology. It's not as outlandish as it sounds: my area of research was insecticide mode of action and environmental fate. For my PhD, I was trying to figure out why certain insecticides caused paralysis in humans and other vertebrates. The most convenient test animal that was a vertebrate and reliably showed the symptoms of interest were chickens. And this turned out to be a very important life lesson as will shortly become apparent.

I received my PhD in 1981 and had the incredibly good fortune to land a job in academia right after graduation. I arrived at The Ohio State University ready to get to work. Shortly after my arrival, the department chair called me into his office and explained that chickens were not insects, an insight for which I am in his debt. As I was in a Department of Entomology, I immediately understood that my chances of getting tenure would require spending some time working on insects which I was happy to do since I hated torturing chickens. But more importantly, my education and chosen field had prepared me to work on different organisms and to address different research questions

because my thesis adviser had allowed me to participate in a variety of projects during my time as a graduate student. This is my first take home lesson: prepare yourself for a career that will change over time, perhaps even radically. Gone are the days when you have the option to study one thing for 50 years. The more flexible you are, the better prepared you will be when the changes inevitably come.

They certainly did in my case. Over my 36 years at OSU, I have studied earthworms, pillbugs (crustacea), midges (blood worms), bacteria, snapping turtles, several species of fish, snails, and zebra mussels to name a few. With each of these projects, I learned new and valuable things but the zebra mussel project stands out as being particularly rich in furthering my education.

The zebra mussel is a nonindigenous species which arrived in the US on ocean-going vessels that originated in Europe. In Europe, commercial vessels take on ballast water which contains living organisms such as zebra mussels. When the European vessels arrive in the US, they expel the ballast water into US water ways. While the mussels are controlled in Europe by a variety of predators and parasites, these controls do not exist in the US. It also turned out that Lake Erie is particularly compatible with zebra mussels. As a result, the zebra mussel populations increased rapidly and started causing huge problems in the Great Lakes. Among these problems, was the fact that the mussels can accumulate in large numbers inside pipes in the water. When that water is used to cool nuclear power plants, and the pipes are blocked by zebra mussels, nuclear meltdown is possible. In fact, the Davis-Bessie plant on Lake Erie was shut down for this reason in 1990.

My training kicked in and our lab became zebra mussel central. We rapidly found a selective way to kill zebra mussels (potassium chloride or KCl) which was harmless to everything else. This was a bizarre finding, so we teamed up with a professor in the School of Veterinary Medicine to find out why harmless potassium would kill zebra mussels. We ended up performing electrocardiograms on the mussels as well

as MRIs in the Medical School. We also did lots of ecological studies to find out how the zebra mussels were impacting the Great Lakes food chain. I could have said no when I was asked by former Senator John Glenn to study zebra mussels. But, I said yes despite my lack of direct experience with mussels. That simple decision was career-changing for me and my students. We secured several million dollars-worth of grants and 12 students earned their degrees studying zebra mussels. This is the value of being broadly trained.

Another thing I learned from studying zebra mussels is that one's mistakes can teach. When we first started working with the mussels to find a toxin that would help control them, I told my students to set up tests by putting the test mussels in beakers containing Standard Reference Water or SRW. SRW can be made to simulate natural water (e.g., Lake Erie water) by starting with distilled water and adding back the necessary salts and minerals to approximate the composition of the desired body of water. USEPA recommends using SRW because all aquatic life thrives in SRW—except zebra mussels. Zebra mussels were killed instantly in SRW. I was sure that we had a contaminated reagent or a student didn't know how to calculate the correct amount of each chemical. So we checked all of this 17 or 18 times. Finally, I told the students to put zebra mussels in distilled water and then add back each chemical individually. That is how we discovered that KCl is toxic to zebra mussels. What started out as a putative error, turned into an experimental success.

Scientists of the future, whether academic or not, will increasingly have to collaborate with others. Your ability to do creative research and make consequential contributions will be magnified by these collaborations. In addition to the collaborations referenced above, I have had great joy from collaborating with all sorts of creative people—particularly when trying to figure out new ways to teach basic concepts in biology to students in Biology 101. I collaborated with the Department of Dance to illustrate the finer points of mitosis. I worked with animation specialists to make a video of the OSU Marching Band marching the Krebs's Cycle. I engaged the football coach to explain photosynthesis. I hired a composer to write music based on the nucleotide sequence of a specific gene and, with a whole bunch of talented people, we converted an entire lecture on DNA replication and protein synthesis into a rock opera. I am still looking for a word that rhymes with totipotent! In the meantime,

my long suffering Biology 101 students experienced a class some of them say they will never forget.

My wish for any young scientist who is contemplating a career is to remember, if things go well, you will be a member of your organization for a long time, perhaps 30 or 40 years. If you are in academia, a system that operates on the principle of shared governance, it is essential that you pull your load in this area. Shared governance doesn't work if the governed don't participate. If you want to have an impact on policy or maybe just keep high-level administrators from enacting bad policies, you have an obligation to be informed and to present your ideas. Looking back, I would say that one of the most rewarding things I have done in my 36 years was to participate in the University Senate, the venue in which policy is made and discussed with representatives across the university.

Finally, I realize that my message thus far has been to advise you to work, work, work. In the academic world where I have spent my entire career, one learns early that it is impossible to publish too many papers or get too many grants or advise too many students. Productivity is rewarded. It is important to be active and to grow as long as you are privileged to hold a job. However, you are also entitled to a personal life. Academia is not the priesthood. If you want to have a family, it is your right. Don't become so consumed by your job that you neglect what it means to be human. If you do, your work will suffer. So, for your own sake as well as that of your loved ones, figure out a balance between work and life and stick to it even when it is inconvenient. Above all be creative and enjoy your job. You are about to embark on a glorious odyssey. May you enjoy every moment!

