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In memoriam

In memoriam – Sharon B. Gray

Biographic Introduction



Sharon B. Gray was born on 25th November 1985 to Thomas and Pamela Gray in Carbondale, Illinois. She had three brothers and two sisters. Many of her formative years were spent in Lindenhurst, IL where she attended Antioch High School, excelling academically and participating in gymnastics and charitable activities. Sharon credited her parents with instilling strong environmental awareness and scientific interest in her as child. In particular, family camping and hiking trips were formative experiences. These activities were a lifelong passion for Sharon that only grew further through her relationship with husband, Robert Cody Markelz, on trips across the U.S. as well as to Australia. They also informed her personal and professional philosophy. In one

fellowship application, Sharon wrote, “I feel that when the human race acquired the technology and evolved the intelligence necessary to build an industrial society, it also acquired the moral obligation to understand and monitor its impact on the rest of the world.” This belief led her to study the response of plants to global environmental change. She did so with a particular passion for integrating across disciplines, including plant physiology, molecular biology, development and ecology, with the result that at the time of her death she was uniquely poised to lead her own group and to make important contributions to understanding and improving plant stress tolerance in a changing environment.

Undergraduate accomplishments

Sharon earned her B.S. in Integrative Biology, with distinction, from the University of Illinois at Urbana-Champaign (UIUC) in 2006. She began her research career during her sophomore year, through an independent study with Dr. Evan DeLucia. Foreseeing many current explorations into high-throughput phenotyping, Sharon demonstrated that rapid measurements of canopy reflectance spectra reflected structural and physiological effects of changing tropospheric chemistry on soybean growing in a field setting. Sharon published her undergraduate research project in the *Journal of Experimental Botany*. She then made the strategic decision to gain more research experience before starting graduate school, and won a Global Change Education Program (GCEP) fellowship from the U.S. Department of Energy (DOE) to work with Dr. Aimee Classen at Oak Ridge National Laboratory. There Sharon studied the effects of global environmental change on the soil microbial community and soil respiration. Sharon continued this research with a second GCEP fellowship to work with Dr. Michael Miller at Argonne National Laboratory, and published her findings in the *Soil Science Society of America Journal*. Before beginning graduate school, Sharon was the first author on two publications, and was demonstrating her skill and commitment as a mentor by working with other undergraduate fellows in the research groups.

Ph.D. accomplishments

In 2008, Sharon returned to UIUC to begin graduate studies in the research group of Dr. Andrew Leakey. Her research was based at the Soybean Free-Air CO₂ Enrichment (SoyFACE) facility and supported by a Graduate Research on the Environment Fellowship from DOE. Sharon assembled a very substantial and multi-faceted

8-year dataset combining her own observations with those of collaborators. It revealed that the expected stimulation of soybean yield at elevated CO₂ was lost as drought intensified. This new evidence from a field study in the primary area of soybean production contrasted strongly with the prevailing view in the literature, where elevated CO₂ in the future was expected to ameliorate drought stress. And, significantly, she identified three mechanisms which combined to drive the observed yield response. This involved analyses of root-to-shoot hormone signals, metabolic fluxes, root and nodule distributions, tissue composition, canopy dynamics and micrometeorology. This demonstrated Sharon's exceptional ability to integrate across biological levels and to collaborate. She led teams of up to 12 undergraduates, graduate students, post-docs and faculty members on large field sampling campaigns. She also had to coordinate data exchanges with nine co-authors for her analysis. The novelty and significance of her findings resulted in her leading papers that were published in *Nature Plants* and *Functional Plant Biology*. In addition, Sharon won the Govindjee Award for Excellence in the Biological Sciences at UIUC, the Robert Emerson Award for most meritorious thesis in Integrative Biology at UIUC, and was invited to present her work at a Keystone Symposia.

Sharon's contributions as a p.h.d. student went well beyond her academic and research successes. She used her warm and engaging personality to great effect as an award-winning teacher in formal university settings, and also in numerous outreach activities to diverse audiences. Sharon was part of the graduate student team that conceived and initiated the Plants iView project as a new outreach program on plant biology for middle school students, with funding from the ASPB Education Foundation and UIUC. The program is still active and student-led five years later. Within the Leakey research group, Sharon achieved her own research goals while also making the time to mentor eight undergraduate students doing independent research projects, many of whom went on to their own graduate careers at UIUC, Penn State, and the University of Minnesota. But, Sharon's ability to relate and connect with people from all backgrounds was perhaps best on display through the friendship she forged with Jo Pride. Jo was part of the inaugural class of senior citizens that regularly visited the Institute for Genomic Biology at UIUC from the Osher Lifelong Learning Institute. Over several years, Sharon and Jo teamed up to perform experiments, as well as to discuss the relationship between cutting-edge scientific research and the grand challenges facing society today. Their technical and philosophical conversations often slipped into conversations about the plans for Sharon's upcoming wedding or Jo's family history, and embody the way that science and life are inseparably intertwined. The memory of Sharon as an exemplary academic researcher, teacher and mentor who enriched the lives of all that encountered her - from one-time encounters at conferences, to many long-term professional relationships and friendships - will remain strong and positive. Just like Sharon herself.

Postdoctoral accomplishments

At the completion of her PhD, Sharon knew that she wanted to expand her skill set in two fields of research - developmental biology and molecular biology. A central result of her PhD research was that root system architecture in soybean had changed in response to drought and elevated CO₂ in unexpected ways. Sharon wanted to further understand the underlying mechanistic events that could give rise to these changes. Sharon interviewed for a postdoctoral position at UC Davis in 2012 and presented an inspiring seminar. She answered very critical and probing questions with patience and determination. She very clearly expressed the

skills she wished to learn and her desire to obtain an academic position in the future. At this moment it was clear to all in the room that Sharon was going to fill a strategic and important niche in the field of plant biology - a nexus between physiology and molecular developmental biology. In order to pursue this avenue of research she successfully wrote and received one of the first NSF Plant Genome Research Program Postdoctoral Fellowships. This cohort of postdoctoral fellows remains active and Sharon was a central figure in this tight-knit group.

According to Sharon, her first months of postdoctoral research were challenging - and the learning curve steep. However, those around her would not have known that she ever struggled. She embraced every possible opportunity available to her - and even created others. She learned how to prep RNAseq libraries in parallel, how to carry out immunoprecipitations, and read literature about all the central genes and hormones involved in plant root and vascular development. She learned how to perform cross-sections of roots in VERY high-throughput, she could name the different cell types of a root and draw them out on command. We experimented with dyes to stain for suberin and lignin and she trained a cohort of undergraduates while giving them each unique research projects that both assisted her and developed their research skills in such a way to help them fulfill their future aspirations. One undergraduate recently shared with me that she couldn't wait to finish her PhD and postdoc with Sharon. She participated in hackathons and R club, she went to Germany for a month to learn metabolite profiling (and embrace gluwain and Christmas markets). She was continually trying to better herself, to prepare for an independent academic position, to balance work and family and endeavoured to spend time skiing and exploring all that California offered with her husband and best friend. Through all this, we learned of her enormous beloved family, her nieces and nephews, her chemist father and mother who managed to homeschool a bevy of six spirited children. She had self-confidence, poise and even managed to count an NSF program director as an important mentor.

The opportunity to write the review in this special issue of *Developmental Biology* came at a critical transition point in her career. She was so excited and determined to obtain an independent academic position. She lived in this gray area between plant physiology, climate change and developmental biology and understood all the questions that remained to be answered. This review was intended to clearly lay out all these unanswered questions and to provide a framework for her future grant proposals. In parallel to completing her NSF PGRP-funded project, she was coordinating a field experiment in the summer of 2016 (both in her home garden and in UC Davis fields) to test how molecular signatures in individual cell types changed in the field relative to the greenhouse. In the presumed last year of her postdoc I appointed her as the key scientist in an exciting project to study the influence of microbes on the parasitism of Sorghum by Striga. Above all else, Sharon was inspired to perform research to facilitate change - both global and local. The experiments to be performed in Ethiopia directly drew on the tools and skills she had developed in her NSF PGRP project. This project was a perfect fit for her - it involved extensive organization, mentorship with a diverse group of scientists, and most importantly, the ability to transition into a role of leadership. Within the first 24 h of our time in Ethiopia, the group of researchers who had never met her loved her. She cracked jokes, was consulted for her research expertise, and managed to always be the first to spot exotic animals. She had an extraordinarily bright career ahead of her. She was sure to be a leader and a beloved mentor to her future research group.

A particularly difficult moment for Sharon during our time in Ethiopia was when she realized the challenges facing Ethiopian scientists, and in particular, the very small (but growing) number

of female scientists. A fund has been developed in her honor to promote women at an early career stage in science, with hopes to train Ethiopian scientists in skills that they are unable to learn given the current infrastructure (<https://www.gofundme.com/sharonbethgray>). Sharon will be deeply missed by many – her light, her determination, her knowledge, her laughter and friendship. It is a great honor to have this issue be dedicated to Sharon Gray. Those of us who knew her are dedicated to honoring her

memory, to completing her work and will strive to meet each challenge as she did – with patience, empathy, creativity, diligence, enthusiasm and respect.

Andrew D.B. Leakey, Siobhan M. Brady, Robert Cody J. Markelz