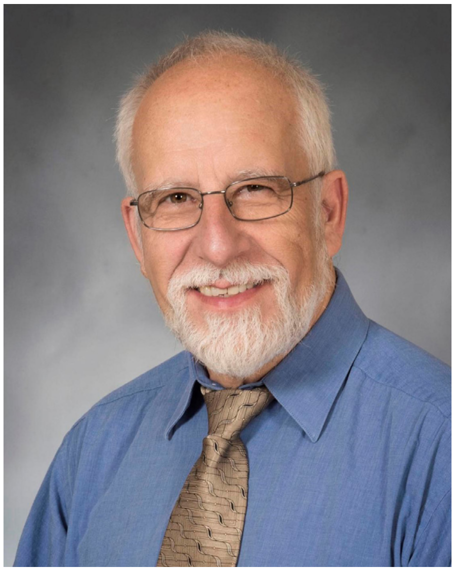
Karl H. Hasenstein



How did my career get started and where did I spend it?

Perhaps not many people trace their career to a formative experience during their school years. I was fortunate to learn from a somewhat quirky but totally dedicated teacher (with a Ph.D. in Biology and a Ph.D. in Chemistry) who just talked, wondered, and explained and demonstrated bioluminescence, the making of rubies, and ion contents in nuclei. The captivation, especially of experimental science, stayed with me, and I was fortunate enough to become a teaching assistant (TA) as an undergraduate student, before working on a Masters (Diplom) and then a PhD with Harald Kaldewey. His meticulous analyses of the bending response of Fritillaria and subsequent auxin transport studies inspired by the classic experiments by Went, led to the characterization of the distribution of (radioactive) auxin after droplet application to sunflower hypocotyls. The fascination of unraveling biological responses based on quantitative differences resulted in the discovery and quantification of 'binding sites' that were later identified as auxin exporters. The time as a graduate student was formative in many ways, from developing a view of the scientific process, to honing my writing skills and becoming acquainted with useful technologies like thin layer chromatography (TLC) and gas chromatography, which led to a better understanding of the formation of auxin metabolites that went beyond the then common description of transportable and immobilized fractions.

Through the support of my PhD advisor and one of my great scientific inspirations, Andreas Sievers, I obtained a fellowship and started a post-doc with David Rayle at San Diego State University. His interest in pH dependencies of auxin transport fit perfectly with my desire to understand auxin transport during tropistic bending of stems and roots. A second post-doc with Mike Evans at Ohio State University resulted in experiments that initially showed conflicting results. Figuring out how these data made sense resulted in a description of the likely pathway of auxin transport and redistribution in root tips. This insight was one of the most rewarding experiences I could ever imagine. The 'inverted fountain' model was soon corroborated by the discovery and distribution of PIN-forming proteins. Mike's knack for the budding computer technology was also instrumental for the development of high-resolution maps of root cell elongation. I was lucky to install soft- and hard-ware in several labs around the world. Visiting other labs, understanding the complex interactions of culture, technology and tradition was more than illuminating; it prepared me well for dealing with my future students from many different backgrounds.

Accepting a faculty position at the University of Louisiana brought not just greater security, but also required getting used to teaching and helping my graduate students rather than working on the bench myself. This transition was tough, but it resulted in many rewarding experiences that will forever stay with me.

What do you consider your most important contributions to plant science?

The result of an invitation by one of my then future graduate students not only opened the door to China, but Yinsheng Wan, with his immense circle of friends and acquaintances, helped with future recruiting efforts. The development of (anti-idiotypic) antibodies provided insights in the ubiquitous presence of ABA perceptive structures – even in brain tissue. When Elison Blancaflor joined the lab, studies of physiological effects on the cytoskeleton took off. His work was exemplary and started

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his own formidable career. Oleg Kuznetzov's almost 10-year tenure in my lab led to space experiments. Peter Scherp's impressive creativity and fascination with microscopy and technology resulted in the development of Solid Phase Gene Extraction that to this day is a great tool to examine transcription at the finest spatial scales. Relying on Chara and its special cellular structure led to many remarkable results, ranging from the measurement of cytoplasmic viscosity, magnetophoretic movement of statoliths, and Qiaojun Jin's incredibly detailed sequence of spermatozoid development and release from antheridial filaments. My wife introduced me to the wondrous world of ecology, which was augmented by tropical excursions that started a small greenhouse plantation of about 50 trees in our Ecology Center and enabled Paul Baker's and Aruna Kilaru's work on self-incompatibility and plant fungal interactions. Jack (Yongyin) Wang's work on hormonal effects on salt stress physiology led to Min Liu's studies on stress responses in protoplasts. Nenggang Zhang tested the effect of auxin and auxin analogs on root architecture and lateral root formation and initiated Yingchun Zhao's characterization of an ethylene antagonist as root growth promoter. The diversity of this list illustrates my fascination with the different but interconnected topics that my students willingly accepted.

Tackling the often debated but not fully understood function of amyloplasts in gravitropism resulted in testing amyloplast movements by gravity and a gravity-independent alternative, namely high-gradient magnetic fields. The common strategy of assessing cellular distributions using static micrographs reduced the chance of observing amyloplast motility. This context provided the basis for experiments to be performed in the absence of effective gravity and resulted in NASA-sponsored space flight experiments. The uncommon approach of using strong permanent magnets to generate magnetic gradients provided a straight-forward but unorthodox experiment that would reveal the nature of the gravisensing process. It took quite some effort to convince the NASA space management that shielding eliminated the risk of strong magnets on sensitive electronics. After typical delays, experiments on the space shuttle and parabolic flights became a reality. Unfortunately, five years of preparation and meticulous engineering were lost during the re-entry accident of the shuttle Columbia (STS-107). Patience and another 11 years finally enabled another experiment on Space-X3, which revealed plant proprioception in a novel light.

I am proud of these various discoveries, such as the transport of auxin in the context of gravitropism, the development of gravitropic sensitivity in seedlings and technological developments, but I view my most important contribution to plant science as shaping of the careers of my students. Their success makes me proud, motivated subsequent students, and expanded our horizon on plant biology.

What advice would you offer young people who are considering a career as a plant scientist?

In my opinion, the most motivating, self-assuring, and meaningful advice for a student is to really find her- or himself among the morass of present-time distractions. The ability to listen to and follow your own compass is essential to develop focus, interest, and eventually success. This advice is probably valid for anyone, regardless of (scientific) discipline. When it comes to plant biology, I can only add that a sense of wonder and appreciation for the beauty of plants, both on the cellular and macroscopic level, is a great foundation for improving our understanding of the living world. Equally important is the realization that any discipline benefits from more than one vantage point. In the past, I promoted physics and chemistry as a strong second leg to stand on. Presently, the willingness to explore computational and analytical processes will be most helpful for a career as scholar and plant biologist.