Statement on Research

Eric M. Kramer

My graduate degree is in theoretical and computational physics (PhD University of Chicago, 1996). I subsequently did a postdoc in biochemistry at Brandeis University. During that time, my long-term goal was to work at the interface of biology, chemistry, and physics.

My initial entry into plant biology came about through an interest in wood grain pattern formation. I have since written several papers that develop and analyze a mathematical model of cell orientation in the vascular cambium – the meristematic tissue that produces new wood and in which the grain pattern is established. In 2003 I received a grant from the US Department of Agriculture to do experiments to test the model. The project attracted funding in part because a better understanding of wood grain could yield practical improvements in commercial lumber. There is also an expectation that the model and experiments will have significant overlap with the nascent field of *Populus* genomics. Each June for the last three years I have conducted experiments on a stand of quaking aspen trees in Hopkins Forest, Williamstown, MA. Samples of cambial tissue are chiseled out, frozen in liquid nitrogen, and delivered to project collaborator Jennifer Normanly (Biochemistry and Molecular Biology, University of Massachusetts at Amherst) for analysis. Jennifer uses GC-MS techniques to quantify the mass of the plant hormone auxin in the samples. The term of the grant ends in 2006, but Jennifer and I plan to reapply for a larger-scale project.

In the last few years I have developed a second research focus – cell-scale models of hormone transport and action in Arabidopsis roots. The first paper on this research appeared in *Trends in Plant Science* in 2004. The *TIPS* paper described a computer model of auxin transport that incorporated many recent advances in plant cell and molecular biology, including the AUX/LAX family of auxin influx facilitator proteins. While writing the paper I began a correspondence with Malcolm Bennett (Biosciences, University of Nottingham), expert in the AUX/LAX gene family. Malcolm and I have subsequently developed a strong collaboration that combines his expertise in plant molecular biology with my own background in biophysics and computation. Our first joint paper, on the role of auxin as a gravitropic signal in the Arabidopsis root apex, has been accepted for publication in *Nature Cell Biology*.

In addition to our current collaborations, Malcolm and I are part of a grant proposal to establish a British center for integrative plant biology (informally called the "Virtual Root") at the University of Nottingham. The Virtual Root project will combine a variety of molecular and cell biology approaches with computer modeling and image analysis to achieve a high-resolution model of root physiology. The proposal includes plans for me to be a permanent part of the Virtual Root collaboration, spending several weeks each year in Nottingham.

My belief is that the integration of recent advances in cell and molecular biology into a coherent picture of organismal function is one of the great challenges in modern science, and that further advances will require collaborations that cross traditional disciplinary boundaries to include biologists, mathematicians, and physicists.

Statement on Teaching

Eric M. Kramer

In 1998, I took a position as Visiting Assistant Professor at Williams College. Williams is a selective liberal arts college where the first priority of faculty is teaching rather than research. I discovered that I enjoyed teaching very much. In addition, a position at a liberal arts college gave me the flexibility to pursue my interdisciplinary research interests - to essentially enter a new field from scratch - with fewer of the traditional demands than a university post. I subsequently took a position at Simons' Rock College in Great Barrington, MA, where I have spent the last six years.

I have been happy teaching at Simon's Rock. Although the teaching load of three courses per semester sounds grueling, class sizes are small (5 to 15 students) and the students are highly motivated. I usually teach the calculus-based Physics 100 course in the fall semester and a range of advanced physics courses in the spring. These later have included relativity, classical mechanics, and statistical thermodynamics. Of particular relevance for the current application: I developed a course on computer methods in science based on the textbook *Numerical Recipes* by Press et al., and a course on biophysics based on the textbook *Biological Physics* by Philip Nelson.

At Simon's Rock I earned a reputation as an enthusiastic teacher with high expectations for student performance. Course evaluation forms that ask students to rank my effectiveness on a scale of 1 to 5 generally have an average score around 4. While Simon's Rock doesn't grant tenure, in 2005 I received a 10-year contract and was appointed Associate Professor.

The administration at Simon's Rock has been very supportive of my research, including the provision of startup funds when I was first hired and some cost-sharing on research grants. However, the annual teaching load is quite high, and there is a shortage of qualified students to work in my lab. In addition, as detailed in my Statement on Research, my research commitments have grown steadily for the last several years. Continuing my research at the proper pace will require more time and attention than a teaching post at a liberal arts college could reasonably accommodate.