MICHIGAN STATE UNIVERSITY

Testimony of

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Chairman Lipinski, Congressman Ehlers and members of the subcommittee, I am pleased to be part of the panel to discuss the role of graduate education and its centrality to the future success and competitiveness of the United States. My remarks today will cover three interrelated areas: the importance of graduate education as a whole, the importance of graduate education in STEM fields focusing on our work at Michigan State University, and finally I will share some thoughts on policy issues related to the role of graduate education in ensuring our nation's continued competitiveness in the global economy.

National Perspective on Graduate Education

There is a strong link between economic growth and technological innovation. Looking ahead, America's prosperity and security in the 21st century depend upon innovation, scientific discovery and knowledge creation (Council on Competitiveness). In the knowledge-based economy, the clearest path for the country to remain competitive and secure is the production of a highly-trained workforce equipped with advanced and flexible skills, capable of operating at the frontier of knowledge creation. A major part of the responsibility for such a workforce rests on our nation's graduate programs. U.S. graduate schools are the jewel in the crown of our educational system attracting the top domestic and international students by creating dynamic graduate programs that foster research, scholarship and scientific discovery.

Currently, there are 2.3 million students pursuing graduate degrees at the Master's and doctoral levels in arts, humanities, social sciences, business, education, sciences and engineering. Approximately one-fourth of graduate students are enrolled in a doctoral program (Council of Graduate Schools, 2009). In 2007, U.S. graduate schools awarded 61,000 doctoral degrees across all fields, including 41,000 doctorates in STEM fields. At the Master's level, 610,000 degrees were awarded across all fields, including 120,000 masters in STEM fields (S&E Indictors, NSF, 2010).

Today's graduate students are the future knowledge creators, educators, leaders and experts in a variety of fields. We are going to need more of them—particularly to address the grand challenges we face in areas of energy independence, climate change, health care, cyber security and others that we cannot even imagine today. The Bureau of Labor Statistics has estimated that one sixth of the fastest growing occupations from 2006-2016 will require a Master's or Doctoral degree.

As we look to the future, it is clear that every industrialized nation and most developing nations are working to increase their research capability because investing in research and education is a key driver of economic growth in a knowledge economy. Other countries and regions of the world are enhancing their higher education systems and in particular their graduate education systems as part of their economic development strategies. For example, the Australian government has established research and education as a top priority, and backed up its commitment with a 25% increase in government expenditures from 2008 to 2009 (Nature, 2009). China increased its investment in research and development by 36 percent from 2002 to 2007 so that it has almost caught-up to the U.S. in the share of workers engaged in creating knowledge or products (UNESCO). In China between 1985 and 2005 the number of science and engineering doctoral degrees awarded increased by sevenfold, making China third in the world in terms of overall Ph.D. degree production. If trends last recorded in 2006 have continued, it is likely that China has now surpassed the United States in the annual production of doctorates in the natural sciences, mathematics, and engineering (S&E Indictors, NSF, 2010).

Here in the U.S. there is a great deal of discussion on ways to enhance higher education and graduate education in particular. As you know, the financial situation has taken a toll on all sectors of our economy including higher education. State budgets are particularly stressed and states have been disinvesting in graduate education for some time. At the same time, as noted above, leaders in many developing economies across the globe are investing in graduate education and in fellowships for their future STEM leaders. Watching the U.S. over the past 50 years convinced them that graduate education is a key factor in global economic competitiveness and raising their quality of life. This situation is not likely to change in the foreseeable future and creates the need for an enhanced role on the part of the federal government to ensure that the U.S. continues to have a world-class graduate education system.

A Commission on the Future of Graduate Education was formed by the Council of Graduate Schools and Educational Testing Service. The Commission consists of leaders from industry and higher education and is focused on developing an empirical foundation to support the connection between U.S. graduate education and competitiveness and innovation. Among other things, the Commission will examine projected trends for doctoral and master's degree holders, initiatives in other parts of the world focused on enhancing graduate education as part of an economic development strategy and suggest proposed actions to ensure our continued success. The Commission will release its report and recommendations on April 29.

The House Committee on Science and Technology is in the forefront of many efforts to enhance innovation and competitiveness. The upcoming reauthorization of the COMPETES Act is an important policy opportunity to develop and implement policies designed to ensure America will have the brain power we need in the future.

Graduate Education in Science, Technology, Engineering and Mathematics (STEM)

Graduate education is a comprehensive system that is inter-related with undergraduate education and, in STEM, with postdoctoral training, and should be deliberately developed and improved as a system. It is connected to undergraduate education through research experiences for undergraduates and the role of mentoring as well as through teaching experiences in classrooms and laboratories. It is also inextricably linked to the research enterprise by its dependence on faculty mentors and through connections to postdoctoral trainees.

Our successful STEM graduate education enterprise faces some current challenges. One major challenge is recruiting, retaining and developing a diverse cadre of talented students in STEM graduate education. We are now experiencing a brain drain as many students are capable of pursuing science, but turn to other disciplines for a variety of reasons. The "loss of talent" begins at the K-12 level. This is exacerbated by the failure of our educational system to attract STEM professionals into K-12 teaching, with the consequence that there is more emphasis on teaching students facts and vocabulary, than on the fun and fundamental processes of inquiry and discovery. STEM content knowledge and fundamental skills required for graduate education are built on the path from K-12 through undergraduate education, master's degree education, to doctoral education.

The "loss of talent" continues at the undergraduate level creating challenges to the recruitment of qualified graduate students. Engagement with "real-world" problem-solving and the approaches that scientists (broadly defined) use and apply to generate knowledge captivates undergraduates and encourages them to explore graduate education. MSU engages undergraduates in research through the NSF Research Experiences for Undergraduates (REU) program and also through our undergraduate research forum (www.urca.msu.edu.) The opportunity to engage in research at the undergraduate level is one important step in retaining these students, as it provides an opportunity to socialize them into the methods and cultures of a discipline. Students often find these experiences to be the first in which they can use the knowledge gained over years of coursework and apply them to real research problems and witness the impact of their work and practices.

The ultimate goal of graduate education is the metamorphosis from an undergraduate student who is the recipient of knowledge ("learning about" –Brown and Duguid, *The Social Life of Information*, 2000) to a STEM professional ("learning to be" IBID) who generates new knowledge. This is accomplished by defining and focusing on problems that need to be solved and guiding the graduate student in finding solutions independently. Quality mentoring is crucial. Research-active faculty members know the content areas important to their disciplines and share that content by engaging students through active learning in classrooms to the much more focused effort that is required for a dissertation—a substantial contribution to new knowledge.

Over the past decade, many national efforts have focused resources and time on the improvement of graduate education. For example, the Ph.D. Completion Project directed by the Council of Graduate Schools is examining barriers to completion of the doctoral degree and developing plans and strategies to increase doctoral degree completion in partnership with a number of leading universities across the country. Graduate education leaders have recognized that one of the most important issues to focus on is simply increasing degree completion.

At the Master's level, the Professional Science Master's (PSM) represents the development of an innovative new Master's degree designed to prepare future science professionals for careers in government, business or the non-profit sector. PSM degrees are designed in collaboration with employers and intended to be responsive to regional and local workforce needs.

A PSM initiative at NSF was authorized in the COMPETES Act and funds for it were included in the American Recovery and Reinvestment Act.

One of the most effective national initiatives for improving doctoral education was the Carnegie Initiative on the Doctorate (http://gallery.carnegiefoundation.org/cid/.) No outside funding was provided, yet Michigan State University and a host of other institutions engaged faculty and graduate students in the improvement of their own programs. Two of the lessons learned in this endeavor were that: successful lifelong learners "have a keen sense of how they learn" (Walker, et al, 2008, *The Formation of Scholars: Rethinking Doctoral Education in the 21st Century*, page 85) and that faculty and students need to work together as partners in order to foster change (ibid).

Graduate Education at Michigan State University

Michigan State University enrolls approximately 10,000 graduate and graduate professional students annually. This academic year, 2,185 of these students are in the STEM disciplines that cross 6 colleges (Natural Science, Engineering, Agriculture and Natural Resources, Human Medicine, Osteopathic Medicine, and Veterinary Medicine). In the 2008-2009 academic year, MSU granted 501 graduate degrees in the STEM fields. MSU also has a living-learning environment in our Lyman Briggs College, a residential college focused on STEM undergraduate education that deliberately links the fundamental scientific and mathematical context of their individual disciplines with the societal context of science. Faculty members use the research-validated pedagogical techniques and technologies; students are active participants in the classroom. Students learn to analyze the way scientists think about research questions and also how scholars in other fields evaluate the methods and conclusions of scientists. This College is the longest running such entity on a research-extensive university campus and participates as a partner with the Graduate School to expose graduate students to teaching practices.

MSU is the only university in the U.S. with three medical schools on campus (Human Medicine (MD), Osteopathic Medicine (DO), Veterinary Medicine (DVM) that are connected to the basic life sciences and research (College of Natural Science) via jointly appointed faculty. Many of our College of Natural Science faculty members are also connected to the College of Agriculture and Natural Resources through joint appointments. This model, built on our land-grant tradition, contributes to our success in preparing a competent STEM workforce for the 21st century

Preparing Graduate Students for 21st Century Careers

While many graduate students desire a career in academia and/or research, others pursue opportunities in government, large and small corporations, or the non-profit sector. At MSU, we developed an approach to professional development that both complements the academic program of the students and provides faculty with the tools to adopt and adapt our approach to provide this "parallel" mentoring in close connection to their program curriculum. This professional development equips students with the knowledge and skills to be effective leaders across employment sectors for the global economy.

The Graduate School at MSU defines six broad areas of essential skills for graduate students and postdoctoral trainees (the Graduate School houses the MSU Postdoc Office—an indication of the importance of viewing STEM workforce development as a system) . These are particularly important for the STEM workforce of the 21st century across all employment sectors:

1) **research, scholarship and creative activities** (synthesizing and integrating research, using relevant resources effectively, independent critical thinking, managing to completion, sustaining passion for the activity, being a steward of the discipline)

2) **leadership** (not administrators or titles, but rather idea and content leaders with influence, purposefully building learning communities, implement and evaluate solutions, manage people and resources effectively, encourage and support international connections)

3) **ethics and integrity** (including responsible conduct of research and scholarship, confidentiality where appropriate, adherence to professional principles)

4) **collaboration** (with other STEM researchers and with global communities in which research will be applied to solve problems, give and receive constructive feedback, partner with diverse groups, build and sustain networks)

5) **communication** (written and oral and for multiple audiences, apply principles of active and cooperative learning to diverse audiences, share your enthusiasm, practice active listening), and

6) **balance and resilience** (set goals, understand the multiple missions and expectations of your employer, understand your own expectations, negotiate and resolve conflicts effectively, take care of yourself).

Some of these, in fact, were explicitly defined as key skills by industrial boards of advisors for our Professional Science Master's degree programs, and apply equally well to doctoral programs. MSU was an early adopter of the PSMs, and was the first member of the Association of American Universities to develop a number of these programs. Others are defined by our faculty themselves when searching for new colleagues.

The Graduate School at MSU offers a variety of pathways for master's and doctoral students to gain and hone these skills, while simultaneously gaining expanded content knowledge in their respective disciplines and preparation to become effective researchers. The CAFFE (an NSF-funded initiative described in a later section) model now in development at MSU proposes effective "parallel" mentoring that continues the existing strong disciplinary preparation and provides individuals with the expanded skills necessary to meet the U.S. STEM workforce needs of the future (http://grad.msu.edu/caffe/).

To be globally competitive, the U.S. needs STEM graduate-degree holders across a variety of sectors: academia, government at all levels, business/industry, and non-profits. The Graduate School developed a model to help students prepare themselves for these widely varying careers. Planning, Resilience, Engagement, and Professionalism, or PREP, has run for 6 years with evaluation data that supports calling this a success (http://grad.msu.edu/prep/).

The basic tenets are:

- **planning** throughout the graduate program to identify and successfully achieve career goals;
- developing **resilience** and tenacity to thrive through personal and professional stages;
- practicing active **engagement** in making important life decisions and in acquiring the skills necessary to attain career goals;
- and attaining high standards of **professionalism** in research and teaching.

A calendar of events http://grad.msu.edu/prep/docs/prepskillsworkshops.pdf helps graduate students, postdocs, and faculty plan the most effective use of their time.

One of the most useful aspects of the MSU model is that it is developmental, and is itself based on research on the factors affecting doctoral student attrition and completion, the personal and professional needs of students at different stages (from entry through graduation) of graduate education, and the key skills that employers say are crucial for career success. An interactive website for graduate students helps them assess where they are today in terms of their professional development and plan how to reach their goals in the future (http://grad.msu.edu/prep/stages.aspx). We are also engaging faculty in the use of PREP as a professional development planning tool. The goal of the website is to focus students on specific steps to take now and in the future for a successful career. An interactive website (publicly available) for graduate students helps them assess their current career and professional development, as well as what they might need in the future to reach their career goals. Postdoctoral trainees also find this site useful as they work with faculty on individual professional development plans.

The Post Doctoral Experience

Across the U.S., many Graduate Schools have an Office for Postdoctoral Trainees, often in partnership with the Vice President for Research. This is a reflection of the inter-related nature of graduate students' and post doctoral researchers' professional development needs. In the life sciences, a post doctoral experience is often required prior to assuming an academic position, and occasionally also for other employment sectors if the focus is exclusively research. These post docs form a vital link in the development of a STEM workforce. The essential skills needed, in addition to the expanded research experience, is very similar to those described for graduate students. In fact, providing programming that mixes the two audiences is valuable, especially for the graduate students who may, in fact, be informally mentored by pos docs. Appropriate attention to this group of individuals on our campuses is an important responsibility.

NSF- Funded Graduate Education Initiatives at MSU

NSF's Education and Human Resources Directorate programs are critically important to universities' abilities to promote and support change and improvement in STEM graduate education. In addition, the NSF pre-doctoral fellowships are also of vital importance**.** These provide the students with a degree of flexibility that a research assistantship does not. They permit the time for students to pursue additional skills needed for the careers they choose.

The NSF- funded initiatives are also vitally important for the development of a more inclusive STEM workforce. The AGEP and LS-AMP programs (see below) provide needed funding and, as importantly, a clear signal from NSF about the value of diverse students. Increasing inclusiveness in the STEM population at the highest levels of education is fundamental to ensuring the stewardship of the disciplines and their impact on U.S. competitiveness and innovation.

Similarly, the IGERT training grants also provide flexibility and the required program components that help the student with additional skills development that are important for career success. Internship opportunities, graduate level study abroad programs, and interactions with external (non-academic) boards of advisors are key activities for graduate student skill and knowledge development. IGERT and other fellowship programs provide some of the needed guidance and time/flexibility for students to develop these additional skills.

As an example of the power of these collective programs, MSU is now connecting five NSF-funded initiatives, all of which are focused on creating a competitive and diverse STEM workforce for the future. Our recently funded Innovation through Institutional Integration grant from NSF, Center for Academic and Future Faculty Excellence (CAFFE), brings together the NSF-funded human resource initiatives at MSU (http://grad.msu.edu/caffe/).

The CAFFE initiative brings pedagogical research for effective teaching and learning across employment sectors to our STEM faculty, graduate students, and postdoctoral trainees. Future faculty members must have an opportunity to develop as effective teachers, as well as researchers, in order to most effectively prepare the diverse STEM workforce of the future. Graduate students on research assistantships for most (or all) of their graduate careers do not always have the opportunity to develop these skills. CAFFE provides a menu of professional development opportunities for use in parallel (to the research activities) mentoring of students for success and for multiple career options. The NSF initiatives included in CAFFE are:

Alliance for Graduate Education and the Professoriate: http://grad.msu.edu/agep/. AGEP supports recruitment, retention, and graduation of U.S. students in doctoral programs to promote changes that transform U.S. universities to embrace the responsibility of substantially increasing the number of students from under-represented U.S. populations who will pursue academic careers in STEM and SBES (social, behavioral, and economic sciences) disciplines. Our Michigan Alliance (Michigan State University, University of Michigan, Wayne State University, and Western Michigan University) developed an active collaboration that works well to engage students in a supportive learning community with opportunities for professional development and socialization into doctoral education, along with national network connections

FIRST IV (for postdoctoral trainees): Faculty Institutes for Reforming Science Teaching: https://www.msu.edu/~first4/. FIRST is a national dissemination project designed to reform undergraduate science education through professional development of postdoctoral trainees as competent instructors with an understanding of science-based pedagogy and how that influences student learning. International postdoctoral trainees in particular, bring excellent research skills to our laboratories, but often have had no opportunity to engage in teaching or to think about how students learn and how teaching influences learning. This program is an innovative and effective way to bridge that gap.

Center for the Integration of Research, Teaching and Learning (CIRTL) (UW-Madison, lead): http://www.cirtl.net/. CIRTL is a growing national network of institutions seeking to improve the learning of students at every college and university, and thereby increase the diversity in STEM fields and STEM literacy of the nation. CIRTL uses graduate education as the leverage point to develop a national STEM faculty committed to implementing and advancing effective teaching practices. (see Professor Bob Mathieu's testimony).

ADVANCE (recruitment and retention of women faculty in STEM): http://www.adapp-advance.msu.edu/. The goal of ADVANCE is to strengthen the scientific workforce through increased inclusion of women in STEM.

LS-AMP**:** Louis Stokes Alliance for Minority Participation: http://www.egr.msu.edu/egr/departments/dpo/programs/milsamp/. With the same alliance partners as AGEP, the goal of this program is to significantly increase the number of under-represented minority students earning baccalaureate degrees in STEM fields and prepare them for entry into graduate programs.

In addition, MSU operates an NSF-funded GK-12 grant (at our Kellogg Biological Station, http://www.kbs.msu.edu/education/k-12-partnership/gk-12-program) that provides funding for graduate students in NSF-supported STEM disciplines to bring their leading research practice and findings into K-12 learning settings. The graduate education community is interested in learning more about how graduate students, K-12 teachers and K-12 students benefit from this program.

Lessons Learned Through NSF Funded Graduate Education Programs

There are two important lessons-learned from these NSF-funded initiatives at MSU: first, education research on effective environments and processes for STEM undergraduate and graduate education are likely to be believed and adopted by STEM faculty only when the research is either done by those STEM faculty members themselves or in close collaboration with them. STEM faculty members expect and respect a high level of rigor in research. Education research must be shared, explored, reviewed, and vetted in the science and engineering disciplinary communities to have an impact. Lack of the connection between the research generation and those who would need to implement it represents a major barrier to implementing improvements. On our campus, a few active research scientists also conduct research on scientific teaching methods and use these in their undergraduate classrooms. Those faculty members are changing their colleagues methods and practices, as well as sharing with postdocs and graduate students (collectively, our future faculty), who are open to learning.

Second, the key barrier to implementing an effective learning environment and activities for STEM graduates across the employment sectors is most often, simply, time. The graduate education system, as described above, is inextricably connected to faculty research programs. Learning to be an effective STEM researcher which is the goal of a doctoral program, requires intense, focused time. It is not simply additive to the coursework. It is not something students have had enough opportunity to learn through K-12 or undergraduate education. The competition for research grants is intense and based in large measure on the prior productivity and generation of data. It is often easier, and less time-consuming, for faculty to stick to the traditional models, of educating graduate students, than to invest the time to learn and adapt a new method. That level of time and creativity is invested in the research enterprise.

The Importance of Interdisciplinary Training

Interdisciplinary training is a key component of graduate education and in the preparation of the future highly skilled workforce the U.S. needs to remain competitive in the global economy. This is a mantra that many individuals discuss, but the implementation is clearly not trivial.

“Global changes have created an important transitional moment for higher education, one that is redefining the nature and the context for teaching and learning; for research, scholarly, and creative activities; and for the outreach and engagement missions of our universities and colleges. The challenges now confronting the nation and the world underscore the need for higher education institutions to engage, with passion, intention, and innovation, as engines of societal growth and transformation. There is a need for a continued research and educational focus on problems that span the boundaries of disciplines, nations, and cultures. Because higher education institutions are intimately linked to societal growth and transformation, they can help create and instill both the basic and applied knowledge that provides opportunities for all peoples and nations to achieve a heightened state of social and economic well-being and sustainable prosperity." (Michigan State University President Lou Anna K. Simon; http://worldgrant.msu.edu/)

One of the strengths of STEM disciplines at Michigan State University is the openness to integration with the social, behavioral, and economic science disciplines in both training and research. Faculty and leaders acknowledge that the social sciences are a catalyst for the adoption and implementation of important STEM advances. The current grand challenges facing the U.S. (e.g., energy independence, climate change, the bioeconomy, health care, etc.) depend on the contributions of social, behavioral, and economic scientists to maximize the impact of new discoveries in the STEM disciplines. The most effective investments in STEM education and research focused on solving real-world problems will include social science disciplines as partners. In addition, research from the social sciences on how the human mind interprets, stores, organizes, and retrieves information should be connected to the development of effective pedagogical practices in STEM. Again, to be effective and outcomes-oriented this requires considerable time and focused attention by faculty and their graduate students and postdocs to work across disciplinary boundaries and to focus on the nexus between research and initiatives in both STEM and policy arenas.

Importantly, interdisciplinary study and approaches, especially those that span very different disciplinary approaches, require more time investment by individuals and over a longer period for success. Institutional support and recognition of this is requisite for faculty and graduate students to engage for the long term. Funding agencies must also recognize and reward this fundamental difference between a narrowly-focused research topic and one that is interdisciplinary in nature.

Summary

In summary, U.S. graduate education is a strategic national asset. A robust graduate education system across all fields is essential if our country is to continue to prosper in the future. Graduate education in STEM fields is particularly important if we are to have the future scientists, engineers, educators in higher education, and knowledge creators we need to respond to current and emerging global grand challenges in energy independence, climate change, health care, cyber security and others.

Some of the major challenges we face in improving graduate education include:

- recognizing and supporting graduate education as a key driver of competitiveness and innovation
- creating better alignment between K-12, undergraduate and graduate education and signaling career pathways to students to achieve a better understanding on their part about the multitude of career options associated with a graduate degree
- recognizing the importance of interdisciplinary research and training and adequate support for successful outcomes by funding agencies

- continuing to provide opportunities for success for an inclusive population of students so that their representation in graduate education begins to approach their percentage in the U.S. population.

Graduate programs at NSF including the IGERT and GRF programs are critical. I strongly encourage continued support for these programs as proposed by the Administration and supported by this Committee. Additionally, I encourage the Committee to consider the need for an additional federal graduate traineeship program as described in the recommendations below.

Recommendations:

As the Subcommittee prepares for reauthorization of the COMPETES Act, I ask that you address the vital role of graduate education as a key driver in developing the intellectual leadership necessary to compete effectively in the global economy:

- **Retain current provisions in the COMPETES Act that support graduate education**

The current statute supports a number of graduate education programs including the Protecting Americas Competitive Edge (PACE) Fellowship program at the U.S. Department of Energy, the Professional Science Master's degree (PSM) at NSF and increased in funding levels for the NSF IGERT and GRF programs. I ask that all of these provisions be retained and supported in the upcoming reauthorization.

- **Consider the need for a new traineeship program for doctoral students to prepare future leaders to address grand challenges in health care, energy independence, climate change, cyber security and other areas.**

State government budgets are not likely to rebound anytime in the foreseeable future and there is a pressing need to enhance the federal role in supporting graduate education, particularly at the doctoral level. While all forms of support are important, traineeship programs offer several advantages. Traineeship funds are awarded on a competitive basis to institutions which in turn award fellowships to doctoral students. Funds may be targeted toward strategic national priorities and mission objectives rather than dispersed across a variety of research paths chosen by individual students or individual Project Investigators (PIs). Given the fiscal constraints facing the country, the opportunity to target funding for the preparation of new talent to areas of known national need offers a clear advantage.

- **Review and consider the forthcoming recommendations from the Commission on the Future of Graduate Education.**

Particular attention should be paid to those that relate to enhancing traineeship opportunities for doctoral students and enhancing support for Professional Master's programs building off the success of the Professional Science Masters (PSM) degree.

Recommendation on IGERT grants

NSF should convene an annual meeting of graduate deans and interested STEM faculty and administrators to share best practices and challenges related to the institutionalization of IGERT-supported professional development and approaches to interdisciplinary research. Attendees for this meeting should include IGERT Principal Investigators, interested STEM faculty and administrators across higher education, IGERT and non-IGERT graduate student representatives, and postdoc representatives. The transformational promise of IGERT grants for interdisciplinary research and workforce development should be made transparent in order to encourage successful dissemination. The intended outcome of the meetings is the explicit sharing of "lessons learned" from IGERT institutions in order to identify possible programmatic changes to enhance graduate student support and to encourage change in approaches to interdisciplinary research.

Thank you for the opportunity to share my views about central role of graduate education in supporting our national innovation enterprise.

Karen Klomparens brief biography

I serve as Dean of the Graduate School and Associate Provost for Graduate Education at Michigan State University and have done so since 1997. As a Professor of Plant Biology (specifically mycology) and especially as past Director of Michigan State University's Center for Advanced Microscopy—the core facility for electron, confocal, and scanning probe microscopy—I worked with graduate students across the STEM disciplines during my 32 years as a faculty member at MSU. Prior to becoming Assistant Dean for Graduate Student Welfare in 1994, I was a Fulbright-supported fellow during a sabbatical at the University of Cambridge, England where I worked with two of the foremost electron microscopists at the time. In 1998, with the important intellectual contributions of my Graduate School colleagues, we developed a program on "Setting Expectations and Resolving Conflicts in Graduate Education." A monograph, published by the Council of Graduate Schools in 2008, plus current training sessions around the U.S. and Canada widely disseminate the key concepts and training methods for this important skill for career success. To contribute ideas and energy to the national discussions and actions related to graduate education, I served a 2-year term as the Chair of the Big Ten (CIC) graduate deans group, 3 years on the Executive Committee and 5 years on the Board of Directors for the Council of Graduate Schools, 2 years on the Professional Science Master's Board of Directors, 2 years of service on the GRE Board, 2 years on the Executive Committee of the Association of Graduate Schools (AAU).