

Penn State
Department of Mathematics

Strategic Plan 2007 – 2012

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Vision

Mathematics permeates the universe – both the natural universe, and the universe of human artifice. It is therefore a core component of the work of the university. More and more, research and discovery in the sciences require sophisticated mathematical theory. More and more, mathematical literacy is a prerequisite for productive employment and for engaged global citizenship. More and more, mathematicians need to develop powerful new tools to help understand, and perhaps even resolve, the complex problems of the world.

Our vision is of a mathematics department which energetically and straightforwardly assumes this central role. It is a department which is committed to research, to instruction, and to collaboration. It is a department which serves the wider community. It is a department which is a hub of intellectual activity for the whole campus.

This vision leads us to articulate six strategic goals.

1. The Department will advance knowledge through fundamental research at the highest level in both pure and applied mathematics.
2. The Department will make the resources of mathematics available to as wide a constituency as possible through increased involvement in interdisciplinary research and education.
3. The Department will enrich the educational experience of undergraduate students at every level by empowering them to understand, communicate, and apply the core concepts and techniques of mathematics.
4. The Department will recruit highly motivated graduate students and provide them with the opportunity to develop a deep understanding and enjoyment of mathematics, to carry out original research, to become effective teachers and communicators, and to prepare themselves for their future careers.
5. The Department will build collegiality among diverse faculty, staff, and students, and will pursue a shared sense of intellectual community, openness, and quality of life.
6. The Department will manage its resources prudently and will actively aim to secure a resource base that will enable it to maximize its contribution to the University's mission.

To keep these goals in focus we will identify a departmental “champion” for each one. These “champions” will ensure that each goal is considered as part of the department’s decision making process. They will regularly assess our progress towards the goals and report back to the department on their findings.

Goal 1: The Department will advance knowledge through fundamental research at the highest level in both pure and applied mathematics.

Our fundamental mission as a research department is to bring new knowledge to light. This can mean the development of new mathematical tools, and their application to the solution of problems either internal to mathematics itself, or in other scientific disciplines; the discovery and exploration of new mathematical phenomena; or the organization and abstraction of existing knowledge in a new conceptual framework. The most important resources for success in this mission are *people* and the creative insights that they bring. To achieve our goal we must therefore *recruit* and *retain* first-class researchers and provide them with the means both for intense *reflection* and for lively *interaction*.

We will take the following steps to hire and retain excellent researchers.

- The Policy Committee will carry out an audit of departmental research strengths, needs and objectives. This will lead to the creation of a long term hiring plan.
- In implementing this plan we will energetically seek out and aggressively recruit top-quality research faculty. We will nurture the research activities of newly appointed faculty through individualized mentoring[†].
- We will reward and celebrate research excellence through formal and informal mechanisms (see Goal 5).
- We will review the structure and support of our research groups and the associated seminars. The review will aim to maximize the resources available to all faculty members for research-level interaction with colleagues both inside and outside the Department.
- We will recruit excellent postdoctoral scholars to Penn State and we will attempt to increase the number of such positions available in the Department.
- We will maintain an outstandingly good working environment for all faculty members. This includes office space, computer and staff support, and specialist laboratory space where required.
- If need arises we will act pre-emptively to retain top-quality researchers at Penn State.

Through these actions we will make a permanent place for Penn State's mathematics department among the top twenty research departments in the nation[‡]. We will be active in research across the spectrum of mathematics, and among our research groups we will sustain some that are of unsurpassed excellence on a global scale.

[†] We will need to make sure that mentors receive appropriate professional development and that high quality mentoring is appropriately rewarded. See Goal 5.

[‡] As measured for instance by the National Research Council surveys or by Academic Analytics.

Goal 2: The Department will make the resources of mathematics available to as wide a constituency as possible through increased involvement in interdisciplinary research and education.

Mathematics is at the center of increasingly important developments in education and society. National reports such as *Rising Above the Gathering Storm*[§] have highlighted the importance of STEM training for the workforce of the future. Technologies such as encryption and tomography, and whole new sciences such as genomics, increasingly embody sophisticated mathematical ideas. In these times, a mathematics department must not be the terminus at the end of the line of abstraction, where the train arrives nearly empty because most of the passengers have already gotten off. Instead, it should be a busy hub through which all the intellectual traffic of the university is continually passing.

We need to help our colleagues elsewhere in the university to buy into the “hub” picture of mathematics, and to see how our department can better serve them in this role. To position the department as an intellectual hub we will implement the following strategies

- We will develop a new PhD program in Interdisciplinary Mathematics (cf. Goal 4). Students in this program will be jointly advised, with one adviser in Mathematics and another in a partner department.
- We will provide encouragement and resources for faculty members in Mathematics to pursue interdisciplinary research.
- We will develop joint research and instructional centers with other departments. An example is the proposed Center for Stochastic Science, in partnership with the Statistics Department, the Business School, the Center for Infectious Disease Dynamics, and other Penn State groups.
- We will carefully pursue co-hires with other PSU departments and centers. Such co-hires require extensive discussion to prepare the ground on both sides, before any specific candidate is considered and a joint interview process begins. We will aim to maximize joint commitment to the hire throughout this process, and so that the result is a “win” for all partners.
- We will reach out to faculty in other departments in all activities. Specific examples may include consultations on the improvement of service mathematics courses; co-taught; developing dual majors and interdisciplinary minor programs; and creating opportunities for interactions that will lead to shared research projects. A number of such initiatives are already under way.
- We will reach out to the public in Centre County and beyond with events aimed to improve public understanding of mathematics and its importance.
- We will appoint an associate head with specific responsibility for connections with other departments and disciplines.

[§] The National Academies Press, 2007. Available online at http://books.nap.edu/catalog.php?record_id=11463

Goal 3: The Department will enrich the educational experience of undergraduate students at every level by empowering them to understand, communicate, and apply the core concepts and techniques of mathematics.

Our Department plays a number of roles at the undergraduate level, from preparing strong undergraduate mathematics majors to servicing a large and varied student population through the delivery of numerous general education courses for both technical and non-technical majors alike. We shall continue to foster pride in such service and to pursue it with energy and enthusiasm. As we look to the future, we owe it to our students, and to other stakeholders, to offer them programs that are well-designed and coherent and that measurably advance their progress towards central learning goals. The need to state clearly what goals we want students to accomplish – within a course or as a major program – and then measure progress towards them is the crux of program assessment which must be completed by our department in the coming months and years.

To further deepen and strengthen our undergraduate program

- We will carefully review our major and minor offerings, developing new programs (including joint programs) as necessary and revising curricula that no longer correspond to today's needs.
- We will foster intellectual community (see Goal 5) and pride among mathematics majors. This 'community' must include a way in which student feedback is clearly heard and respected by the department's administration.
- If we succeed in obtaining appropriate resources (see Goal 6) we will aim to increase the number of mathematics majors by 50% over the five year life of this plan.
- We will make research experiences in mathematics available to undergraduate students from the First Year Seminar onwards through the new Center for Undergraduate Research in Mathematics. We will continue and strengthen the MASS and REU programs which attract students from around the country to high-level mathematics at Penn State.
- We will clarify the learning goals for students in our courses and programs and develop processes to assess whether these goals are being achieved. We will use the results of assessment in a process of continuous improvement.
- We will investigate alternative methods of course delivery, especially in the lower-division courses, to find those which maximize student's intellectual development and opportunity for success. The upcoming appointment of a Director of Online Instruction in Mathematics is part of this process.
- We will offer all instructional faculty members in the department the opportunity for appropriate professional development and for promotion within the Instructor or Lecturer scales.
- We will build relationships with campus faculty in the mathematics "disciplinary community" (again, see Goal 5).

Goal 4: The Department will recruit highly motivated graduate students and provide them with the opportunity to develop a deep understanding and enjoyment of mathematics, to carry out original research, to become effective teachers and communicators, and to prepare themselves for their future careers.

An active graduate program is the core of a thriving mathematics department. It is here that talented young people acquire the knowledge and skills to become professional mathematicians – whether in the academy, in industry, or in other careers. These include the knowledge, patience and intellectual discipline required to create new mathematical knowledge; the ability to systematize and communicate that knowledge; and the interpersonal skills to manage a classroom and to work effectively in a research group.

Through an integrated graduate training environment we must recruit, mentor, and retain students. To ensure that our graduate program continues to carry out these tasks more effectively

- We will sustain our effort in student recruitment, especially in the recruitment of excellent students from US undergraduate schools. We will continue to build recruitment relationships with excellent small colleges.
- We will cooperate in recruitment with the Center for Undergraduate Research in Mathematics, and with the MASS program which combines advanced learning with research initiation for talented domestic undergraduate students.
- We will build on the reforms of 2007 to develop a qualifying exam and comprehensive exam system that is rigorous and yet accessible to students with varying backgrounds and that trains graduate students in content knowledge and in communication skills. We will develop new courses and programs that bridge the gap between undergraduate and graduate studies.
- We will provide all graduate students with the opportunity to work as respected members of a supportive intellectual community (see Goal 5)
- We will create a student research grant to give students first-hand experience in developing research proposals.
- We will develop an interdisciplinary PhD program (see Goal 2) and professional Master's degrees.
- We will further develop the training and oversight program for graduate teaching assistants.
- We will ensure that graduate students have opportunities to use their skills through internships in industrial or national laboratories.
- We will carefully mentor** students and monitor degree completion rates (including median time to degree) to maximize success.

** A training program for mentors will be appropriate.

Goal 5: The Department will build collegiality among diverse faculty, staff, and students, and will pursue a shared sense of intellectual community, openness, and quality of life.

The Carnegie Foundation Commission on the Doctorate^{††} recently completed a five-year survey of doctoral departments in six fields (including mathematics). Here is their key conclusion: *Doctoral students bring different motivations to their work, but most want to be surrounded by others who share their passion. They long to be part of an intellectual community, and they are right to want that because intellectual community is not simply a feel-good atmosphere. It is the foundation for the core work of doctoral education: building knowledge.*

The core value that the Carnegie Commission identifies does not apply only to graduate education. A successful department will foster intellectual community and common purpose among faculty, staff and students. Components of this common purpose will include

- Belief and “buy-in” to the mission of the department (as set out in this document for instance).
- General interest in one another’s work; mutual support and advice. A sense that we are a *department* rather than a disjoint union of research and teaching groups.
- Willingness to take on necessary tasks such as course coordination and departmental service obligations of various kinds.
- Sense that all contributions to the department are appropriately recognized and honored.

While the departmental administration cannot impose these by decree, it can take several actions that work towards them.

- We will take all possible steps towards transparency in the reward and recognition structure within the department. It may be appropriate to institute some kind of “points” system for evaluating levels of departmental service. In this way, the rewards for taking on departmental tasks would become more explicit.
- We will work to enhance the status of the weekly colloquium as the central event of the department’s research activity, and as a celebration of departmental achievements.
- We will encourage respected senior faculty to set a positive example..
- We will continue to strengthen regular communication with Department members through means such as the newsletter, surveys and feedback, departmental social events, continuing to involve all department members in the hiring process, and widening the base of decision-making.
- We will review the current structure of the “departmental tea” and try to find a way to make it more effective.
- We will consider an off-site departmental retreat to build consensus and energy around departmental values.

^{††} *The Formation of Scholars: Rethinking Doctoral Education for the Twenty-First Century*, Carnegie Foundation, 2008 (see <http://www.carnegiefoundation.org/publications/pub.asp?key=43&subkey=712>)

Goal 6: The Department will manage its resources prudently and will actively aim to secure a resource base that will enable it to maximize its contribution to the University's mission.

In round figures, the annual budget of the Mathematics Department is \$10m^{‡‡}. The majority of this figure of course derives from the central funds of the university, but we also receive significant support from Federal and other research agencies, from endowments, and from individual donors and private foundations. We are accountable to the university and to our other stakeholders for the efficient and responsible use of these resources in support of well-defined goals.

To demonstrate our responsibility and to increase our level of support

- We will improve internal budgetary processes so that responsibility for financial management can be more widely shared and so that the use of funds can be more easily traced to specific project expenditures.
- We will maximize our efforts in seeking support from external funding agencies both for traditional, individual research grants and for large “project” grants such as MCTP or IGERT. Work on preparing such large grant proposals should be counted as departmental service and rewarded appropriately (see Goal 5).
- We will press the university to adopt a “responsibility-centered budget” or similar model that automatically provides resources to address the regular fluctuations in program enrollments. In particular, we will seek the faculty and instructional resources necessary to support a significant enhancement of the mathematics major program (see Goal 3) including the development of interdisciplinary majors.
- We will develop online education as a means of generating revenue for the department (see Goal 3)
- In conjunction with the College of Science Development Office, we will set a fund-raising target and will work vigorously with individual and corporate donors to raise support for educational and research initiatives including graduate and undergraduate scholarships, the MASS program, and other discretionary funds available to the department head.

Value and priority judgments are unavoidable throughout the budgetary process, from the judgment of the researcher deciding which problem to study, through the NSF panelist deciding which grants to fund, to the academic department deciding in what area to hire. It is the nature of such decisions that many alternative courses of action are rationally defensible. Nevertheless, it is the responsibility of the department, through its head, to set priorities and to carry them out to achieve the desired focus of excellence set out in Goals 1-4. We will be as open as possible about this goal-setting process and aim, through it, to increase the department's sense of common purpose (Goal 5).

^{‡‡} Our teaching effort produces significantly more tuition revenue for the university than our total budget; nevertheless, our overarching goals are not centered on revenue maximization but on education, research and service.

