

COLLEGE OF NATURAL SCIENCES STRATEGIC PLAN PHASE 3 PART 2

The UMass strategic planning document, "Innovation and Impact: Renewing the Promise of the Public Research University,"¹ presents two seemingly simple goals of the strategic plan – making our campus a “destination of choice” and making our campus a “partner of choice.” Understanding these two concepts is critical in interpreting the College of Natural Sciences’ strategic plan and in developing the path forward for each of our academic units in such a way to insure that the college is an “investment of choice” for the campus, for the state, for federal funding agencies and for industry.

The term “destination of choice” broadly refers to the goal of creating a high-quality “student experience” (both academic and co-curricular) here on campus. For many/most of the top students in California, Virginia and Michigan, their state’s flagship campus is a “destination of choice.” While the quality metrics of our incoming class are constantly improving, we are not yet a destination of choice for enough of best students in the Commonwealth and beyond.

Our status as a comprehensive research university can also make us a destination of choice – allowing students to take classes in wide range of disciplines, and to engage in cutting-edge research. Indicators of a unit being a “destination of choice” in this sense could be significant non-major student enrollment and large number of undergraduate students involved in research labs, seminar, or other research-related activities.

For the College of Natural Sciences, “destination of choice” also refers to a goal of creating a magnet for attracting premier faculty scientists who are drawn to the opportunity for innovation that comes from our uniquely collaborative scientific environment. It is these enterprising faculty scientists who will provide the mentorship that produces a ‘destination of choice’ for top students nationwide. Because the strategic plan calls for “promoting evidence-based, intentional resource allocation,” it will be important to identify quantitative “indicators of success” whenever possible.

The term “partner of choice” broadly refers to engagement with outside partners: federal agencies, the Commonwealth of Massachusetts, industry, foundations, and more – all of which provide funding that support our mission. World-class research excellence and alignment with state, regional and federal priorities are *necessities* for being a partner of choice – an external entity can partner with anyone globally, and does so based on its own needs and the perception quality/value of the partnership.

¹ <http://www.umass.edu/provost/sites/default/files/uploads/JTFSO%20Phase%20I%20Report.pdf>

For this part of the Strategic Plan, we have asked each of our academic units to ask “In what sense are we a destination of choice for graduate students and for faculty and in what sense are we a partner of choice?” The CNS Strategic plan is rooted in the belief that being a destination of choice and a partner of choice will insure that we are also an investment of choice.

BUILDING RESEARCH CAPACITY

Research Vision

The College of Natural Sciences will be a ‘destination of choice’ for faculty, internationally recognized for strengths in research capacity fostering transdisciplinary scientific discoveries. Achieving this goal will empower the college and the university to be a ‘destination of choice’ for top applicants for graduate programs and post-doctoral training positions, and for highly motivated undergraduates who prize direct involvement in research labs as a fundamental aspect of their scientific education.

We will deliberately build our research capacity in a manner that encourages other academic institutions, industry, the Commonwealth of Massachusetts, federal agencies, and private research foundations to seek out UMass Amherst as a ‘partner of choice’ for solving contemporary scientific problems and accessing scientific knowledge and discovery.

Research Mission

The College’s research mission is to ***foster scientific discovery*** in a wide breadth of scientific disciplines, while accelerating and supporting discoveries that are uniquely possible through transdisciplinary collaborations. Our research mission also includes ***disseminating knowledge of these discoveries*** to multiple stakeholders---a local and a global public, the international scientific community, industry, and governmental and NGO policy-makers. Finally, our research mission is a foundational element of the college’s ability to ***provide rigorous and innovative scientific education*** and training opportunities for undergraduates, graduate students, and post-doctoral scientists.

The College’s research vision and mission require that building our research capacity be a top priority. We will focus our capacity-building goals on four major areas of strategic action: 1) Developing Continuous Processes for Defining and Refining our Research Directions; 2) Aligning with UMass, State, and Federal Priorities; 3) Enhancing Research Support for Faculty; and 4) Enhancing our Research Profile.

Goal 1: Develop Continuous Processes for Defining and Refining our Research Directions

CNS will work with the campus to redesign the AQAD process to inject a greater level of creativity into planning the future directions of academic units. We are proposing that external review teams receive the departmental strategic plan in addition to the self-studies. The site visit would include a two-day “futures seminar”. The first day would be open to all and the second day would be internal--to discuss strengths and future growth. The focus would be on identifying where the field is going, and how the department would fit in—this second step is key. The exploration must be in the context of federal, state, and private funding opportunities.

The College of Natural Sciences will create an environment in which research activities that cut across departments, disciplines, and even schools and colleges can flourish.² We already do some of this well. There are departments in CNS that aren't disciplines, e.g. Food Science, Polymer Science and Engineering. In the life sciences, interdisciplinary grad programs and the Institute for Applied Life Science encourage these types of interactions. Interdisciplinary graduate programs have not developed an effective group membership culture due in large part to a lack of appropriate facilities. We need to develop common space to create a sense of community among students and faculty involved in the Interdisciplinary programs. Academic units must emphasize that common space is a priority that needs to be valued and addressed by the central administration. The planning process needs to include the interdisciplinary connections that underpin thinking behind cluster hiring.

A portion of the planning effort should be devoted to the formation of “mega” Centers. We need to look at the current affinities and also current gaps. The emphasis is on intellectual coherence. Conversations should bring people from different departments to find affinities for the creation of centers. We can also consider how centers and institutes can intersect with undergrad education.

Goal 2: Align with University, State, and Federal Research Priorities

In the University Research Strategic Planning Report, the university designated six areas of existing intersection between campus strengths and state, regional, or national priorities for which CNS is playing a pivotal role: Applied Life Science, Advanced Materials and Manufacturing; Cognitive Science; Energy, Climate Science, and Sustainability; Supporting Entrepreneurship; and Data Science. We seek to further develop these areas, as well as clarify newly emerging collaborative priorities.

² In a comprehensive survey of all CNS faculty regarding the college research environment (undertaken for the strategic planning process), faculty in the majority of departments rank the value of interdisciplinary research high. This finding was particularly strong among assistant professors.

Applied life sciences. CNS faculty already play major roles in the development, leadership and research enterprise of the Institute for Applied Life Sciences (IALS). This enterprise is highly productive and CNS is committed to its success. CNS is also collaborating closely with IALS and IALS director Peter Reinhart to lay the groundwork for new life science initiatives that complement the existing centers within IALS. Particularly promising opportunities that are being examined are an Integrative Neuroscience Institute and an expanded Plant Biology program. Regular interaction between CNS and IALS leadership to further develop these collaborative opportunities are a priority.

Advanced materials and manufacturing. As stated in their strategic planning document, CNS's Department of Polymer Sciences (PSE) is one of the world's top academic centers in the field of polymers, and is typically rated among the top ten U.S. materials departments. PSE has retained all its faculty members since 2005 but has not had a faculty search since 2007. CNS plans for increased hiring in PSE based on strategic alignment with university, state, and federal priorities.

Cognitive science. Within CNS, faculty specializing in cognitive science form a core division (one of five divisions) in the Department of Psychological and Brain Sciences. Faculty from this division have taken a leadership role in encouraging cross-campus collaboration and have created a proposal for an Institute of Cognitive Science and are highly involved in planning for the proposal for an Integrative Neuroscience Institute. CNS will work with other campus units to support the productivity of these new initiatives.

Energy, climate science, sustainability. The College has proposed to develop a School of Earth, Sustainability and the Environment (SESE), bringing together faculty from departments of Environmental Conservation, Geosciences, and the Stockbridge School of Agriculture to provide both undergraduate and graduate education and new research collaborations.

Supporting entrepreneurship. CNS has joined with the Office of the Vice-Chancellor for Research and Engagement, Technology Transfer Office, School of Management, and College of Engineering to support a suite of programs with the aim of increasing entrepreneurship at UMass. Efforts have been modeled on the NSF ICORPS entrepreneurial team approach with an ICORPS SITE proposal to NSF recently submitted. CNS has also initiated, in collaboration with the Technology Transfer Office, a new graduate/post-doctoral fellowship program, the Manning Entrepreneurial Fellowships, which is focused on assisting graduates and faculty in bringing their science discoveries to commercialization. Increasing the role of CNS faculty and students in entrepreneurship is a priority.

Data Science. Faculty in CNS's Department of Mathematics and Statistics have close ties to the Computational Social Science Institute, the new Center for Data Science, and emerging cross-campus efforts in cybersecurity. These endeavors and other 'big data' research areas, such as astronomy and computational neuroscience

depend on state-of-the-art computing facilities. As noted below, increasing ease of access to MGHPCC facilities is a priority for CNS.

Goal 3: Enhance Research Support

We aim to significantly enhance support to CNS faculty to boost their achievement of innovative research goals at each stage of their careers. This requires targeted strategies to strengthen our capacity in: a) recruiting, equipping, rewarding, and retaining the best faculty; b) effectively competing for research funding and research partnerships; c) assisting faculty in disseminating their research discoveries; and d) providing state-of-the-art computing and IT resources.

A. Improve Recruiting, Equipping, Rewarding, and Retaining Faculty

Departmental search committees for new faculty hires will focus on increasing faculty candidate diversity to identify the highest quality candidate. All CNS faculty will receive information about diversity of their peer and aspirant departments to set goals. Timely, ongoing trainings and individual consultations with each search committee will focus on increasing diversity within their field.

Two senior hires will be restricted to faculty who are already in the National Academy of Sciences who might then open the gate for other faculty in the University.

We will prioritize and advocate for a coordinated approach to facilities renovations at the university, especially as it impacts large initiatives and departmental priorities and renovations for new faculty. Of immediate attention is the plan to move up the process by which facility renovations are requested for new faculty so that new hires arrive to research labs that are fully operational.

The College will continue to streamline and improve retention efforts to maintain its faculty. Efforts to expand highly successful faculty peer-to-peer mentoring programs will continue. CNS will evaluate and analyze the college's history of successful and unsuccessful retention efforts, using exit interviews and surveys (among other methods), in order to determine improved strategies and to address retention challenges sooner.

A long-standing but increasingly important concern in our efforts to retain our most productive faculty is developing an effective partner employment program. Designing a network of effective strategies to address partner employment has become a priority for CNS. An initial aspect of this will be to work with other campus units to assess the value of having a UMass staff position dedicated to coordinating job opportunities for partners within commuting distance of Amherst.

CNS will support Department Heads and Chairs to meet the challenges of their roles as leaders within the college by providing increased support and training. CNS will expand successful departmental leadership peer mentoring programs throughout the year. In

particular, targeted training around how to effectively implement our new budgeting model will be prioritized.

B. Improve Ability to Compete for Research Funding and Partnerships

A comprehensive assessment of college-wide grants administration services capacity will be determined to increase federal, foundation and corporate funding research support for all faculty within the CNS. To efficiently coordinate pre-proposal submissions and assist departments who have limited staffing support, centralized research support services will be further developed through the college's Research Support Services office.

Expanded grant development programming, designed to mentor and teach faculty grant writing skills will be offered. For example, a capacity-building grantsmanship training program, The Individualized Proposal Development T3 program, will be piloted next year, in collaboration with the Office of Vice Chancellor for Research and Engagement. This new initiative will provide selected faculty with intensive grant proposal development consulting to work intensively on a specific proposal for extramural funding throughout the year. Participating faculty will also receive training to later become peer mentors and reviewers for CNS faculty in subsequent years. Support for interdisciplinary center-based research and grant development mentoring programs, such as the Center for Research on Families, will be continued.

Innovative programming to demystify the UMass submission process and increase communication will be offered through forums entitled 'Research Dialogues' which will increase timely information exchange among faculty and administrators.

Faculty will receive enhanced post award training and information to oversee their large projects through the "I'm a PI: now what?!" program.

Faculty and graduate students will receive enhanced training and peer-mentorship on how to successfully integrate undergraduates into their research labs effectively, efficiently, and productively.

C. Assess, Target, and Strengthen IT Capacity

The College will investigate and understand the role and challenges of IT in CNS Research Facilities and Operations. IT presents a specific and enormous challenge for research, learning and productivity. CNS will develop an IT task force to work directly and coordinate with OIT to study and develop a working plan to identify and meet the challenges.

Goal 4: Raising our Research Profile

CNS has identified a critical need to raise the research profile of the college within the Northeast and nationally. Raising our research profile and branding CNS as a center of research excellence will be a targeted priority. Research achievements of our faculty and students are exceptional, but are less recognized than is warranted.

We see this endeavor as critical for supporting CNS and UMass as a destination of choice for faculty and students and as a partner of choice for other research institutions. In this effort we want to capitalize on our existing strengths and present a visible and coherent presence to these strengths. At times, a more visible presence simply requires formal designation to create an improved brand. We will create a process within the Dean's office for assessing college-wide efforts that could benefit from comprehensive branding. Existing successful examples of similar efforts to create an enhanced research presence that attracted new external partnerships include Mass Nanotech and IALS.

A related priority is for the college to increase targeted efforts to more effectively disseminate the research discoveries of our faculty and students. Faculty are experts in communicating to their scientific disciplinary forums, and the college recognizes this as of paramount importance. Many of our faculty are also excellent ambassadors for their research to other important audiences, such as policy-makers, community organizations and schools, and the interested public. Many faculty, however, are either unaware of the value of this endeavor for their research or for the university or feel unprepared to communicate the importance of their science to the policy-makers and the public. CNS's efforts to support faculty in broader dissemination of their research discoveries include support of the new Public Engagement Scholars program, which trains faculty to effectively work with the media and public policy leaders to make their research findings accessible to the public.

ENHANCING GRADUATE EDUCATION

Goal 1: Integrating graduate education programs

There are currently a plethora of graduate programs in CNS. These include both departmental and interdisciplinary programs. They include Ph.D. and several types of Masters' program (traditional and professional). There is also a large postdoc constituency. The Ph.D. programs were recently evaluated as part of a campus wide process managed by the Graduate School. CNS has also initiated the process of reorganizing the four interdisciplinary programs under a single leadership model. This process has yielded a recommendation for a reorganization that incorporates relevant life science department-based programs and anticipates the inclusion of potentially new interdisciplinary programs.

There is a need for better communication between programs. It is apparent that each program exists, to some degree, in isolation and devoid of understanding the challenges faced by other programs in the college. One major challenge that was evident from the Graduate Program evaluation process is that our programs in general have a longer time to completion than our peer or aspirant universities. On its face, this fact minimally requires an examination of the root causes of this problem. There are also practical considerations such as the current federal funding climate. Grant award periods have shortened in recent years leading to scenario

where there the average student may need to be supported on two to three consecutive grants. Thus, maintaining an appropriate time to completion is critical to maximizing grant productivity.

The Graduate Council provides oversight of the various graduate programs and communicates the broad rules and regulations that govern the entire campus. However, it is evident that science programs have demands that are inherently different from those of other colleges. Thus, the Graduate School's efforts do not meet the needs of the students and postdocs in CNS. For example, the Graduate School has a rule allowing for the submission of the Prospectus within seven months of defending the thesis. While this works fine in other disciplines, it does not work well in hypothesis-driven disciplines. A CNS-based process could provide guidelines that are more appropriate for science students while adhering to the broader Graduate School regulations.

Strategies

1. CNS will assign the function of Graduate Program oversight to an Associate Dean. This individual will be charged with representing CNS on the Graduate Council. The Associate Dean for Graduate Programs will regularly assess the successes and challenges of each program. The Associate Dean will work with individual programs to facilitate initiatives that enhance the various programs. For example, one goal would be to relieve the time to completion problem. Such an effort might involve developing appropriate checkpoints for progress towards degree completion. While many of the programs already have such measures in place, it is challenging to adhere to them. The college could function as an additional level of support to keep students on track towards successful completion of the degree in a timely fashion. The Associate Dean will meet regularly with a group of Graduate Program Directors to discuss problems that arise. These meetings will also be a venue for discussing best practices towards degree completion, dissemination of information from the Graduate School, and the development of new initiatives. The Associate Dean will also work with GPDs to facilitate navigating the collectively bargained agreements with students and postdocs. This office will also compile and maintain records on the placement of students and postdocs once they leave UMass. This is an important element of assessing the success of the programs and is often the least complete information in such assessments. Most importantly, the regularly scheduled interactions among the GPDs would foster cooperation among the programs and break down of silos.

Goal2: Attracting the Best Students

In general, there is good satisfaction with the quality of students across the various programs. Ph.D. graduates are successfully identifying positions as postdocs in top academic institutions and/or industrial settings. Likewise, the various Masters' programs are successfully placing students in appropriate positions. Nevertheless, recruiting students is very competitive, especially in the era of information

availability. Consequently, it is imperative that we minimize any deficiencies, real or perceived, when potential students compare our programs to those of other universities.

A vast majority of Ph.D. students are supported on either TA or RA. TAs are used to support students in the first year, students in new investigator labs and students in labs that have recently lost federal funding. None of these uses is any different from those of peer and aspirant universities. Admissions are greatly dependent on TAs and aided to some extent by College Fellowships. Three main issues are the size of stipends, the number of available TAs, and the configuration of fellowships.

- Stipends are low for many programs, with examples cited of 10% lower or \$4K lower than peer institutions. Likewise, summer support is inconsistent in some programs. There is a distinction between departmental and interdisciplinary programs in terms of the flexibility to cover summer stipends from operating budgets.
- For about 1/3 to 1/2 of departments, total number of TAs per discipline are low compared to peer institutions. Obviously this affects the ability to compete with like programs in terms of recruiting students.
- Some fellowships do not cover all the expenses that a student must pay. It can be difficult to find funds to make whole students being award fellowships. For example, T32 fellowships cannot be supplemented by federal funds. The grantee is typically ineligible for GEO so if they need family health coverage, these fellowships do not work for them. Programs address this by providing half of a TA. However, this is also a burden since the TA must be used in the first semester in order to provide the necessary healthcare coverage for the year with students having to front the costs. This creates an imbalance in TA appointments for departments. Some programs do have funds that they can use to supplement fellowships, but others do not. In either case the cost of supplementing the fellowship is substantial.

Strategies

1. Increase the stipend amount. It is obviously a real challenge to increase the amount of stipends as well as the number of TAs. One possible source of funds is the Graduate School fellowships, now administered by each college. Different programs have used these fellowships in different and creative ways — for example, some use it for signing bonuses. A valid question is whether these funds are truly successful in recruiting better students or whether they would have a more significant impact if applied to bring stipends to competitor levels. The fellowship funds may not be sufficient to accomplish the goal but may do so coupled with other changes. Alternatively, programs could accomplish the goal of increasing stipends on their

own with some flexibility in funds and the ability to bank funds. Lab fees must be spent on things visible to students.

2. Increase TA numbers. What is the justification for increasing the need for TAs? The fact that more instructional support is needed is not debatable. However, the need may be met by part-time instructors, which are more cost effective. It can also be supplemented with undergraduate instructors. None of these solutions are mutually exclusive. However, if we are to compete effectively with aspirant universities then we need to recruit more students and additional TAs are the most cost effective way of accomplishing this goal. One possible solution would be to use vacant tenure-track lines in return for more TAs.

3. Establish mechanisms to make fellowships equivalent to TA or RA support. Having to make students whole costs the faculty, departments and students a large amount of time. We are interested in getting as many high-quality PhD students on campus as possible, and the fellowship winners are being harmed. We wish to facilitate this process as much as possible. Students cannot be working fellows. What is needed is a uniform way of dealing with curriculum fees, tuition waivers, and GEO health coverage. GEO *could* cover non-working fellows if the rules were changed. The Graduate School should work with GEO to find mechanisms to make whole students receiving fellowships regardless of the source of the fellowship.

Goal 3: Comprehensive Professional Development (Preparing Students for Multiple Career Options)

There is widespread need for professional development. All CNS programs identified a need for professional development opportunities for their students, although as is to be expected, these needs varied across departments. To take but a few examples, the graduates of some departments, such as Chemistry, go on to careers that include industrial leadership, research, and positions in academia at all levels. Polymer Science graduates largely go into industry, with a much smaller number joining the faculty of R1 institutions, but very few go on to teaching-intensive institutions. Other programs (e.g., OEB) send graduates to a wide variety of faculty positions and to federal and non-profit institutions, but graduates rarely go into industry. In spite of this wide range of needs, there is ample overlap across programs, affording opportunity for coordination in offering professional development. There is also widespread agreement that professional development opportunities should be offered to postdoctoral researchers as well as graduate students. While professional development programs are essential to our students and postdocs, it is paramount to balance the many professional development activities and the creation of a robust research program.

Current Offerings

Graduate-program based offerings

A number of graduate programs offer professional development programming such as presentations from relevant "alt-academic" speakers about jobs outside academia; grant-writing workshops; mentorship of teaching assistants or teaching associates above and beyond what is typical; training in project management; and courses in teaching, grant writing, and science communication.

Office of Professional Development

The recently established Graduate School OPD is widely viewed as a valuable asset for our graduate students. The OPD's mission is to foster professional knowledge and skills necessary to thrive in academia, industry, public policy, and the nonprofit area. They offer programming ranging in duration from one hour to a semester or longer. Each program fits in one or more key areas:

- Career preparation: Identifying and exploring career paths; job search
- Communication: Writing, publishing, presenting, and applying for grants and fellowships
- Leadership and management: Entrepreneurship, science policy, business skills
- Teaching strategies: Understanding and carrying out best teaching practices, developing a teaching portfolio

Numerous events are offered (e.g., 59 in F14). CNS graduate students attended the programs in especially high numbers. They also participated in the new Business Foundations Series for Scientists and Engineers, a result of partnership between the OPD and the Isenberg School of Management, as well as the Research2Innovation workshop to translate research into commercial opportunities. There is clearly interest among our students to warrant further investment.

Center for the Integration of Research, Teaching, and Learning (CIRTL)

Nearly 80% of STEM PhDs in the U.S. are granted at only 100 research universities, and from there these graduates go on to teach at a wide variety of institutions of higher learning. To effectively reach these future faculty, the 22-member CIRTL Network focuses on teacher training in R1 institutions. CIRTL offers centralized on-line courses and each member institution also offers local programming. CIRTL at UMass provides on-campus workshops (one per month during the academic year) and mentorship of CIRTL Practitioners and CIRTL Scholars in evidence-based teaching projects. In addition, CIRTL has recently taken over training and mentorship of the new CNS Teaching Fellows that will be teaching the first-year seminars in the fall. CIRTL events are well attended and highly rated.

Graduate Women in STEM (GWIS)

Originating within CNS in 2012, GWIS has now successfully expanded to serve CNS and COE, with both colleges and the Graduate School providing annual support.

The mission of GWIS is to promote the success of women in STEM through professional development, mentoring, and outreach opportunities accessible to all STEM graduate students. This organization sponsors 20-30 events per semester, which have received overwhelmingly positive feedback and support from participants.

Strategies

1. Centralize professional development as much as possible. The OPD is widely regarded as very effective, and it deserves the support of both CNS and the central administration. To meet the needs of CNS graduate students and postdocs and lower barriers to participation in OPD programs, we recommend that CNS establish a mechanism to routinely coordinate with OPD. Specifically, the OPD is willing to work with CNS to embed OPD activities into existing classes and colloquia (so graduate students do not need to find "extra" time to participate), to align offerings with our needs, and to coordinate the logistics for workshops offered by CNS faculty. In addition, PIs wish to get more information from the OPD about their offerings so that they may direct their students appropriately.

2. Stabilize support for teacher training initiatives. Currently, training for future faculty is split between the OPD and CIRTL. OPD programming is taught by a graduate student jointly appointed by the Graduate School and the CTFD. CIRTL is focused on STEM training, and is currently funded by NSF and the Great Lakes Higher Education that will run out in two years. It is run by a faculty member and an Associate Dean (COE) with support from the CTFD and Graduate School. Thus, neither of these training programs are permanently staffed.

We recommend the establishment of a new permanent staff position who will oversee teaching training for future faculty (graduate students and postdocs). Logically, this position would reside in the CTFD, which offers parallel programming for faculty, but would also coordinate with the Graduate School and CNS. In particular, a person with expertise in STEM education would be most valuable for CNS.

CIRTL also requires membership dues and "in-kind" contributions to the online teaching mission. To retain our membership in CIRTL, it would be useful to have financial support to pay faculty to teach these required course contributions, as they are currently taught as an overload.

Goal 4: Enhance the CNS Image through Appropriate MSc Programs

The 22 degree programs that award MSc degrees within CNS attract students who plan for careers both outside and inside of academia. Of the total 240 enrolled MSc students in our 7 major MSc-training departments, ~140 come here primarily for career preparation, knowing that the MSc credential will lead them to jobs that pay \$15,000 more than they could get with only a bachelors degree. Approximately half of the 100

MSc degrees presently awarded each year by CNS represent a "progress checkpoint along the way" for students who are here primarily to earn a PhD.

In several CNS departments, the MSc degree offers better prospects for future employment for than a PhD. For example, job opportunities in the field of Food Science are greater for those students with a MSc than a PhD. These job opportunities, mostly in industry, lead many students nationwide (and here at UMass) who earn a MSc in Food Science to not continue on to a PhD. The same holds true for MSc level education in GeoSciences, in Conservation Sciences, and in Mathematics. At a time when universities award 7 times more PhDs in STEM than there are newly available faculty positions, CNS is successfully training MSc students for professional positions that require scientific and technical training; alumni who seek these positions will work in local, state or federal government agencies, non-governmental agencies, and business/industry/consulting firms.

There is significant diversity in CNS departments' approaches toward the MSc. Of the 14 departments in CNS, 6 are active in recruiting MSc students and together account for ~ 80% of enrollment each year. Among these, Math and Geo each offer 2 distinct MSc degrees (*Mathematics*; *Applied Mathematics*; *Geology*; and *Geography*), and ECO offers 3 (*Environmental Conservation*; *Sustainability Science*; and *Marine Science and Technology*). The 4 CNS interdepartmental programs collectively enroll 6-14 MSc students each year. Five departments accept students only into a PhD program.

Since 2010, several CNS departments have responded to a campus-level call for new ways to deliver MSc education, and have created two types of accelerated programs: a 5th year BS/MSc degree and an accelerated 1-year MSc degree. Accelerated MSc programs of both types are now being offered in Food Science, Sustainability Science, Microbiology, and Hydrogeology. Several other CNS departments have expressed interest in launching these kinds of revenue-generating programs. In terms of retaining top undergrads for an additional year and attracting new students, CNS' experience has been extremely positive: the departments who first established these programs have all seen growth in enrollment, are drawing highly competitive students, and the programs are yielding at least as much, and in some cases *more* new revenue for the campus as they originally set out to do 5 years ago.

Strategies

1. Because the one-size-fits-all does not apply to MSc programs in CNS, we urge that decisions regarding TA allocation and tuition waivers for MSc students remain at the program and college level. There is great variation between the relative roles of the MSc degree within CNS programs.
2. Given the economic situation of the last 5 years, students may be less likely to enroll in a 2-year graduate program. A trend in higher education will likely involve shortening MSc programs to a single year. CNS has now built up substantial expertise in creating, marketing and implementing both 5th year BS/MS programs and 1-year accelerated MS degrees, and several departments (e.g., SSA, Biology, Geosciences) have expressed interest in developing new programs. Both CNS and the departments have contributed

significant funds to set up such programs with the understanding the revenue would be used for pay back and operations.

3. Several CNS departments are involved in discussions to co-brand, co-market, and co-manage interdepartmental clusters of programs (e.g, Life Sciences and Earth, Sustainability and Environmental Sciences). Discussions are also beginning about the pros and cons of broadening existing departmental grad programs (e.g., Microbiology, or Environmental Conservation) into inter-departmental programs, and starting new programs (e.g., research-based MSc and PhD program in Sustainability Science, or new program ideas in the Stockbridge plan to address their lack of a graduate program).