

## **STRATEGIC PLAN FOR THE SCHOOL OF NATURAL SCIENCES AND MATHEMATICS**

The School of Natural Sciences and Mathematics (NS&M) comprises six departments (Chemistry, Geosciences, Mathematics/Statistics, Molecular & Cell Biology, Physics, and Science/Mathematics Education), and seven externally funded centers/institutes (William B. Hanson Center for Space Studies, Nanotech Institute, Center for Lithospheric Studies, Sickle Cell Disease Research Center, Institute of Biomedical Sciences and Technology, Center for Applied Biology, and Center for Quantum Electronics). There are 71 T/TT faculty and 18 Senior Lecturers, representing 13% of the University total. Seven of UTD's 32-chaired professors are in NS&M. The School offers 43 degrees across all levels (BA, BA, MA, MS, MAT, Ph.D.) that account for approximately 22% of the University's total student semester credit hours (SSCH) in recent years. Of this total, NS&M accounts for approximately 25%, 9% and 19% of the UG, MS, and Ph.D. SSCH's, respectively. The NS&M faculty attracted >\$13M in externally funded contracts and grants in FY2004, which represents 53% of the University's total.

NS&M will play a pivotal role in UTD's ascendancy to a nationally recognized research institution over the next decade. Its contributions will derive from efforts within the school, through interactions with other schools at UTD, and through greatly enhanced connectivity with UT Southwestern (UTSW). The underlying strategy requires significant growth in research-active faculty, graduate student numbers, contracts & grants, and the addition of modern teaching and research facilities. Without all of these, UTD's ascendancy will be unacceptably delayed. A key factor will be initiation and expansion of interdisciplinary research thrusts. Growth and resources should be focused in several targeted areas including modern materials and instrumentation, biochemical/biomedical areas, and science education.

In order to accommodate this growth and allow the present and future faculty to achieve their research potential, the school must dramatically expand and improve the space it currently occupies. The imminent occupation of the Waterview Science and Technology Center, accommodating some of our Physical Sciences faculty, and the anticipated space in the new Natural Sciences and Engineering Research Building (expected occupancy in summer 2006) to house some of our Biology and Chemistry faculty, will afford short-term relief, while we address the longer term needs. It is imperative that *new research facilities* comprising 150,000+ additional square feet be integrated, as soon as possible, into the expansion plans for the School. Failure to do so will impede the institution's ability to attract top quality research faculty and graduate students.

The leadership, recruitment of faculty and students, mentoring of junior faculty, and review and promotion decisions for the school must be based on a clear vision and thorough understanding of how corresponding units in research intensive universities function.

The School of Natural Sciences and Mathematics has six primary 10-year goals:

- 1) Make *strategic hires* to reach at least 185 tenure/tenure-track faculty members.
- 2) Expect each faculty member to secure, as PI or Co-PI, at least one *major grant* at the national funding levels characteristic of the relevant field.
- 3) Increase both the quantity and quality of the graduate students in NS&M.

- 4) Create new joint doctoral programs with the School of Engineering/Computer Science, the School of Brain and Behavioral Sciences, and wherever possible, UTSW. Make joint hires across schools and institutions.
- 5) Improve and expand NS&M's facilities and infrastructure.
- 6) Establish dynamic, high-profile school and departmental external advisory committees, composed of leaders in similar fields from research-intensive institutions.

**Endowed chairs:** The expansion will optimally include endowing chairs in the research focuses. As a result of their international reputations, these chairs will nucleate growth (by attracting younger investigators), increase UTD's visibility, and increase overall funding. These individuals should have two or more federally funded grants. Providing opportunities and resources for National Academy members to relocate to UTD is paramount.

**Research competitiveness:** The University must continue to provide competitive start-up funds and salaries. The university should also supplement and expand successful efforts to obtain and maintain major equipment and create core facilities. Value would be added with competitive staff salaries and increased staff to provide help with grant applications and management, and staff that could provide training of equipment users and maintenance of core facilities. There is a very real need for short-term seed money to allow investigators to develop the preliminary data so necessary for competitive grant applications in new areas.

**Teaching assistants:** This is intimately related with research. The TA stipends should be more competitive, and there should be more of them. The ultimate goal should be acquisition of training grants. This requires establishment of a training record, difficult to do with the current small number of faculty. Acquisition of a training grant will initially require substantial support from the university and/or outside sources. As more students are funded as Research Assistants on C&G funds, the number of TA slots to support new students will proportionally increase.

**Other considerations:** Enhancing the research stature within the school will be addressed through a complex set of actions. Making strategic hires as described above is one such action. Others are based on the premise that UTD faculty need more time to write grant proposals and would benefit from greater exposure to other top tier faculty and funding agencies. As faculty numbers grow, the number of organized courses taught by research-active faculty members should decrease and ultimately approach two/year. This will then provide workload flexibility by allowing faculty members to teach all courses during one semester, when feasible, freeing up more "block" time for writing manuscripts and grant proposals. All faculty members, especially at the junior level, would benefit from better mentoring regarding funding opportunities and grantsmanship. One possible mechanism is to make available copies of successful grants and to establish a departmental internal review system for grant proposals. Senior faculty can assist in providing entrees/introductions to help junior faculty establish connections with funding agencies such as NSF.

## DEPARTMENT OF MOLECULAR AND CELL BIOLOGY

**Overview:** The Molecular & Cell Biology Department has 16 tenure or tenure-track faculty appointments. Collectively the MCB faculty received about \$3.0M in external funding in 2004 and generated 57 reviewed publications. Currently 854 undergraduate students are enrolled in the biology and molecular biology BS degree programs and 61 graduate students are pursuing MS and Ph.D. degrees in this department.

**Faculty size:** 14 public universities without medical schools ranking in the top 51-100 of 100 research universities have an average of 59 faculty in life sciences departments. The current MCB faculty is unacceptably small compared to these, with only 16 faculty members, and is woefully small given the growing number of majors which have more than tripled over the last ten years. A *minimum* faculty size of 50 research-active individuals in the life sciences is required. Considering attrition and retirements, an average rate of 3 to 4 hires per year will yield the required faculty size within a decade.

**Rationale:** Current faculty in the MCB department attract an average of \$220,000 per year per faculty member, which is comparable to faculty in departments of the top 51-100 research universities. Fifty research-active faculty are projected to attract over \$10 million/year at the present rate. This number of faculty also affords the diversity and breadth to compete for larger program and center-type grants.

**Space:** There should be about 1500 - 1800 assignable sq ft per faculty lab, plus space for offices, equipment and common facilities. The anticipated 50 research groups could be accommodated in a Life Science building of at least 150,000 gsf that includes an appropriate animal care facility.

**Types of future hires:** Our evolution into a research competitive university requires making initial strategic research hires to build a core group of individuals that will attract other talent. There must be increased synergy both among the life science faculty and with other research faculty at UTD and UTSW. Fertile areas for immediate departmental growth include biomolecular structure, cell biology, microbiology/biodefense. New research thrusts will emerge as interactions among these groups develop. It is indisputable that biology and related research (including biotechnology and bioengineering) will continue to be the drivers for research funding in this century.

## DEPARTMENT OF CHEMISTRY

**Overview:** The Department of Chemistry has 15 tenure or tenure-track faculty appointments. Collectively the Chemistry faculty received about \$4.4M in external funding in 2004 and generated 86 reviewed publications. Currently 191 undergraduate students are enrolled in the chemistry and biochemistry BS degree programs and 64 graduate students are pursuing chemistry MS and Ph.D. degrees.

**Faculty size:** The present Chemistry faculty, although reasonably diversified and in areas of future growth, is too small to form the synergistic groups that can compete for the larger program and center grants. Our goal is to make strategic hires to reach 40 tenure/tenure-track research faculty members, each expected to secure at least one major research grant.

**Rationale:** Chemistry has been termed “the central science” and it is expected that it will further enhance its research synergies with other departments in NSM, EECS and BBS. Forty research-active faculty are projected to attract over \$11 million/year at the present rate and will also afford the diversity and breadth to compete for larger interdisciplinary-type grants.

**Space:** The proposed growth for the Chemistry department will require at least 95,000 gsf of space for research laboratories.

**Types of future hires:** Projected hires in Chemistry will emphasize research at its interfaces with biology, physics, materials science and nano(bio)technology, while maintaining sufficient breadth of chemistry required for an excellent Ph.D. granting institution. Hires will be made at both the Assistant Professor and Associate/Full Professor levels. Junior hires will help to secure the long-term future of the department; senior hires will accelerate the research reputation of UTD, as they will have established research programs with funding, and will serve to nucleate growth. Additional multidisciplinary thrusts such as imaging/visualization, biocomplexity, security, and/or energy are seen as areas of importance and sustainability in which chemistry will play a vital role. Every effort must be made to fill the now vacant second Welch Chair in Chemistry, ideally at the interface of chemistry and biology, and to use this hire to fill additional “biocentric” positions. Some of these will undoubtedly be associated with the planned Bioengineering department in EECS. With the additional growth of UTD, other degree programs, such as Medicinal Chemistry should be considered.

**Establishing stronger interactions with UTSW:** This is an ongoing effort and can be enhanced by immediate implementation of several actions including (a) participation in the seminar program(s) at UTSW, (b) establishment of a research fair with UTSW and enhance the involvement of UTSW faculty in the annual Chem/Bio Symposium at UTD, (c) facilitation of research rotations of biochemistry majors at UTSW [Dean Sherry, with the support of Provost Wildenthal, has proposed a program whereby junior Biochemistry majors will spend 1 semester in residence at UTSW completing the undergraduate research requirement for the UTD Biochemistry degree.], (d) establishment of a shuttle run between UTD and UTSW to facilitate interactions between the schools, including seminar attendance and undergraduate research.

## DEPARTMENT OF PHYSICS

**Overview:** The Department of Physics has 14 tenure or tenure-track faculty appointments. Collectively the Physics faculty received about \$4.3M in external funding in 2004 and generated 81 reviewed publications. Currently 78 undergraduate students are enrolled in the physics BS degree program and 72 graduate students are pursuing physics MS, MSAP (Master of Science in Applied Physics) and Ph.D. degrees.

**Faculty size:** The Physics Department plans to grow the faculty appointment to 40 by 2015, strengthen the current strong areas, initiate new research directions, and broaden the degree and teaching programs within the MSAP and Ph.D. tracks.

**Rationale:** Enrollments in physics majors and graduate students, together with the demands for introductory physics courses are steadily increasing. The department's emphasis will be on growing the MSAP and Ph.D. programs, and would like to target a total graduate enrollment of 100 by 2010, and 150 by 2015. To achieve these goals we must bring in top faculty whose research areas are attractive to students, and who are well funded to provide Research Assistantships. We will extend our graduate course offerings, increase significantly student recruitment activities, and optimize the physics graduate curriculum. These efforts have started in the Physics Department

**Space:** The proposed growth for the Physics department will require at least 95,000 gsf of space for research laboratories

**Other considerations:** It is important that the School makes available additional TA slots for Physics at a ratio of 1:1 between TA and RA in order to carry out the aggressive targets set forth here.

**Research and Faculty:** The current strength areas are: Space Sciences, Quantum Electronics, Nano/material Physics and High Energy Physics. We plan to maintain strength in Quantum Electronics and High Energy Physics, further strengthen Space Sciences by faculty additions in solar physics and bio-space physics, grow significantly in nano/material physics by strategic hires of faculty who will collaborate with EE/Biology/Chemistry, and initiate new areas that include Applied Computational Physics, Medical Imaging and Visualization with faculty hires who will collaborate with UTSW, CS, SOM, Biology, Geosciences and Chemistry. We expect these hires will be a mix of junior and senior appointments with an appropriate number of chaired positions.

## DEPARTMENT OF MATHEMATICAL SCIENCES

**Overview:** The Department of Mathematical Sciences has 10 tenure or tenure-track faculty appointments. Collectively the Math faculty received about \$76,000 in external funding in 2004 and generated 17 reviewed publications. Currently 130 undergraduate students are enrolled in the Mathematics BS degree program and 65 graduate students are pursuing math MS and Ph.D. degrees.

**Faculty Size:** The MMS department, with only ten T/TT faculty, though woefully too small, continues its tradition of quality research published in highly regarded refereed journals, along with many articles in proceedings and invited presentations in international conferences. The MMS' Master and PhD production rates *per faculty member* are higher than those of universities that we are usually compared with, i.e. UT-Austin, A&M, Georgia Tech, University of Houston, TX Tech, UNT, SMU and UT-Arlington, though the number of T/TT faculty is considerably smaller than these universities. We aim to increase the number of faculty members to reach a steady state of 30 by 2015.

**Space:** The Department lacks contiguous space and the supported students are housed in a different building. This leads to a genuine feeling of disconnection within the department and its students. The Department also lacks basic amenities such as a common room to promote interaction between faculty and students. Clearly such a condition is not conducive to attracting new faculty, quality students and fostering collaborative research among faculty. Sufficient, attractive and contiguous space for MMS needs to be a very high priority. We estimate that this number of research active faculty members and students will require at least 25,000 gsf of space.

**Types of future hires:** The above increase in the size of T/TT MMS faculty members will accommodate the real needs both in the department and other departments of UTD and UTSW for collaborative high-level interdisciplinary research with extensive mathematical components, with high impact and high potential for substantial external funding. Some of these thrust areas are: bioinformatics, computational biology, biostatistics, nonlinear dynamics, stochastic processes, brain imaging, fMRI and mathematics of risk analysis. These interdisciplinary areas are under rapid development in other UTD and UTSW departments and The MMS faculty already has several limited collaborations with these departments. More faculty are needed, however, to provide the needed expertise and the critical mass in these promising research areas. To coordinate our efforts and hires with other departments and UTSW, the membership in search committees will include faculty members from other UTD and UTSW departments.

**Other considerations: The teaching mission:** The number of SCH taught by MMS has increased by 86% over the last 10 years and we generate on average about 9% of total UTD's SCH and about 40% of NS&M's despite a 23% Decrease in the number of T/TT faculty over the last 10 years. More T/TT faculty are needed to provide quality education to the growing number of students at UTD. Also the increase in lower division enrollment requires having a sufficient number of TA's to run the problem sessions and assist in grading. It is anticipated the existing trend will continue and the number of SCH generated by MMS will double in the next ten years. It would be contrary to the aspirations of the University, if the anticipated increase in the number of needed instructors is solely met by hiring more senior lecturers.

## DEPARTMENT OF SCIENCE/MATHEMATICS EDUCATION

**Overview:** The Science/Mathematics Education Department has 5 tenure or tenure-track faculty appointments. Collectively the SME faculty received about \$0.3M in external funding in 2004 and generated 6 reviewed publications. Sixty-one graduate students are enrolled in the department.

**Faculty size:** The SME Department, with only 5 T/TT faculty, is missing key personnel needed to maintain/grow a vigorous program. It proposes to increase the faculty appointments to 15 by 2015.

**Rationale:** By the nature of their work in education, SME faces special restrictions on grant funds that are unique within NS&M and impair their research efforts. With no Ph.D. program they lose students almost as soon as they begin fruitful research in science/mathematics education and are at a significant disadvantage in obtaining federal funds.

**Space:** To continue to nurture our research/teaching focus and to reach our goal of establishing a nationally recognized research/teaching program, we envision a state-of-the-art facility for teaching and conducting research in science/mathematics education and in science and mathematics under the umbrella of the Center for Science/Mathematics Education Research (C-SER). This facility will be available to our faculty, our graduate students, local administrators, local teachers, and researchers interested in science and mathematics teaching and learning. The proposed growth for the SME department will require at least 25,000 gsf of space for research laboratories.

**Types of future hires:** the *strategic plan* of the SME faculty is to focus our research on the Pre-Kindergarten through 14 (sophomore year in college) Learning Continuum in STEM (Science, Technology, Engineering, and Mathematics) fields. As one of a handful of universities in the nation with a faculty mixing expertise in science and mathematics research with expertise in science and mathematics education research and practice, we already have an advantage in creating partnerships that bridge the diverse education and STEM disciplines. As we grow our program we intend to continue to forge partnerships with public and private pre-college schools, other institutes of higher education, informal education entities, and most importantly, other departments and schools within the University of Texas at Dallas. Near-term hires would comprise one science education researcher, biology and chemistry content specialists and a senior lecturer/grant writer/assistant director associated with the Center for Science/Mathematics Education Research (C-SER). Additional hires in these fields and mathematics education would then follow.

**Other considerations** Also essential in growing the research/teaching programs to reach national and internationally recognized status is the addition of Ph.D. programs in science and mathematics education. Each year many talented students interested in continuing their research and learning with us as they earn a Ph.D. are turned away. Without a Ph.D. program and the investment in research such a program represents, SME is at a significant disadvantage in competition for national research funding and must rely on first or second year graduate students to assist in research.

## DEPARTMENT OF GEOSCIENCES

**Overview:** The Geosciences Department has 11 tenure or tenure-track faculty appointments. Collectively the Geosciences faculty received about \$1.2M in external funding in 2004 and generated 26 reviewed publications. Currently 33 undergraduate students enrolled in the Geosciences BS degree program and 56 graduate students are pursuing Geosciences MS and Ph.D. degrees.

**Faculty size:** We propose to make strategic hires to maintain the current steady state of 11-12 faculty members, aimed at increasing the research productivity of the department, especially in digital geosciences and reservoir characterization.

**Space:** To increase the productivity of our present and future faculty, we estimate that at least 25,000 gsf of adequate research space is necessary.

**Types of future hires:** In the near-term, Geosciences needs to deal with recent faculty losses. We are presently in the final stages of negotiating to hire a new Geoinformatics faculty member, to support the newly initiated multi-departmental Ph.D. in Geospatial Informational Systems (GIS). Two additional faculty hires are proposed. The first is in the field of sedimentology to replace a recent faculty departure. This is necessary to teach undergraduate majors, to supervise graduate students (typically 5-10 graduate students seek supervision in this field), and to help maintain the reservoir characterization strategic initiative. The successful candidate in this search can reasonably be expected to have skills that also strengthen the GIS initiative. The second position would fill a vacancy soon to be opened by the retirement of a senior faculty member working in the field of micropaleontology. Although this is a valued expertise, we intend to hire a replacement in the field of Digital Geosciences (GIS-GPS-Remote Sensing). These three hires would allow us to maintain excellence in reservoir characterization at the same time that we effectively modify our undergraduate major to better prepare our students for the future and to strengthen GIS efforts at UTD.

**Other considerations:** Planning for the future of UTD Geosciences will be in concert with UTD's strategy to expand and intensify partnership relations with business, governmental and educational neighbors, and to actively pursue external support and funding for the ambitious academic and service programs integral to its mission. To accomplish these goals, UTD Geosciences needs to strengthen interactions with other Geosciences departments in the DFW region, not only for its own sake but also to serve as an innovative model for other small departments in Texas public universities. We believe there is a significant opportunity to strengthen and expand on the relationships with sister UT campuses. We already have informal co-operative arrangements with UT Arlington but further development and 'merging of departments' must be fully explored at the highest levels. UTD's commitment to establishing a state-of-the-art telecommunications facility for synchronous delivery of physics courses to UT Brownsville (UTB) could easily be used for Geosciences lecture course delivery to/from UTA. We are also interested in the possibility of partnering with UT Brownsville to better teach undergraduates. UTB does not have a Geosciences department but is interested in better teaching this subject to the rapidly growing UTB undergraduate population. These discussions have recently been initiated.