STRATEGIC PLAN
The School of Biological Sciences
2005-2010
“To improve the quality of life through excellence in education and research”

Lawrence A. Dreyfus, Dean
February 28, 2005
I. VISION
To improve the quality of life through excellence in education and research

II. MISSION
The mission of the School of Biological Sciences is to provide outstanding undergraduate and graduate education in modern biology and to advance our understanding of molecular biology through basic research. We prepare undergraduate students and doctoral and post-doctoral trainees for careers at all levels in the life sciences. The synergy between our educational programs and our nationally recognized strengths in biomolecular structure and function, molecular genetics, and cell biology, is the essential element in our quest to improve the quality of life through teaching and research.

III. CURRENT ASSESSMENTS
A. Foundations. The School of Biological Sciences (formerly the School of Basic Life Sciences) was established on January 1, 1985 by then Chancellor George Russell to provide basic science instruction for the health sciences, establish a nationally recognized graduate program at the Master’s and Ph.D. levels and to generate a strong research effort supported mainly by extramural grants. In 1987 the Curators of the University of Missouri system designated the School as a Program of Eminence and Mission Enhancement funding was allocated to continue the growth of the School.

Resources allocated to the School over a 10-year period were used to build a program that would increase in quality and scope. Under this plan the School attracted national and internationally recognized faculty conducting outstanding research on fundamental problems in biology. This infusion of new talent to UMKC resulted in accelerated growth in research quantity and quality, as evidenced by support from external funding sources through the national peer review system.

In 1993 the Biology Department, housed in the College of Arts and Sciences was transferred to the School. With this move the School of Basic Life Sciences was renamed the School of Biological Sciences and the mission was broadened to encompass educational and research programs across the spectrum of modern biological sciences. Broadening the SBS mission necessitated the expansion of research faculty in new areas including evolution, molecular genetics, developmental biology, and bioinformatics. Today, the SBS academic programs and research expertise are representative of many disciplines of modern cellular and molecular biological sciences. A little more than a decade after the expansion of the SBS mission our School has matured into an established and well-rounded biological sciences program.

Building an academic research enterprise from the ground up demanded not only the hiring of quality faculty, but also building research infrastructure. Acquisition of funds from several sources including the Program for Eminence plan, dedicated federal equipment grants, individual investigator research awards, and gifts to the School supported development of our research infrastructure. Our ability to conduct cutting edge research and attract outstanding faculty requires continual development. In addition, the infrastructure built within SBS raises the recruitment and research potential of other science research units on campus. Our plans for the
next 5 years will, in part, emphasize integration of facility development, research and educational programs.

B. Organizational Structure. The School of Biological Sciences is currently composed of two academic divisions, the Division of Cell Biology and Biophysics and the Division of Molecular Biology and Biochemistry. Undergraduate and graduate academic programs and research activities are administered by the Divisions and executed by the faculty within those divisions. As their names imply, the Divisions house faculty with expertise in various disciplines of modern biological. (see SBS Faculty in the Appendices). The Division of Cell Biology and Biophysics offers academic programs and research activity in biophysics, cell biology, microbiology, neurobiology, and structural biology. The Division of Molecular Biology and Biochemistry offers academic programs and research in the areas of biochemistry, molecular biology, molecular genetics, and proteomics.

C. Academic Programs. The School of Biological Sciences offers a wide selection of undergraduate and graduate degree programs in modern experimental biological sciences. Currently the School of Biological Sciences is home to approximately 280 undergraduate biology majors and approximately 60 masters and doctoral students. In addition, approximately 80% of the 12,000 credit hours of instruction offered by the School annually is credited as service to other academic units on our campus.

Degrees Offered by the School of Biological Sciences

<table>
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<tr>
<th>Bachelors Degrees</th>
<th>Masters Programs</th>
<th>Doctoral Programs</th>
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<tbody>
<tr>
<td>Bachelor of Arts in Biology</td>
<td>M.A. Biology (Nursing Anesthesia)</td>
<td>Ph.D. in Cell Biology &amp; Biophysics</td>
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<tr>
<td>Bachelor of Science Biology</td>
<td>M.S. Cellular and Molecular Biology</td>
<td>Ph.D. in Biochemistry &amp; Molecular Biology</td>
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<td>M.S. Emphasis in Bioinformatics</td>
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<td>B.S. Emphasis in Bioinformatics</td>
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<tr>
<td>B.S. Biology- Pre-Dentistry</td>
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<td>B.S. Biology-Pre-Medicine</td>
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^1New for AY2004

Undergraduate Education

The SBS undergraduate program emphasizes the cellular and molecular aspects of modern biology. The intent of our program is to prepare our graduates for advanced biological sciences degree programs, health professional academic programs, as well as placement directly into the workforce. Our flagship bachelors program (B.S. in Biology) is unique in that it encourages students to participate in independent research under the direct supervision of an SBS faculty member.

Within the undergraduate program we also offer training to a select group of students through our Saper Vedere Scholars program. This innovative program introduces select and highly
motivated undergraduate students to independent research as an integral part of their matriculation. *Saper Vedere* Scholars work along side a faculty member mentor and their respective research team in a discover-based learning environment. Scholars are selected from the top 5% of all Biology majors and applicants to the program undergo a rigorous evaluation process. The *Saper Vedere* Scholars program is a unique and highly competitive program affording students an outstanding educational experience.

Presently, *SBS offers the only research-based undergraduate, graduate, and doctoral biology curricula in the greater Kansas City area.* In addition, Biology is one of the fastest growing programs at UMKC with a 33% increase in student credit hour production over the last 4 years.

<table>
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<tr>
<th>Semester</th>
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<th>% Increase UMKC</th>
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Student Enrollment Management initiatives and exciting new programs play pivotal roles in the growth of Biology on our campus. New initiatives for the undergraduate curriculum should accelerate this growth ever further. Measures to accommodate the projected increases in undergraduate and graduate enrollments will be a significant challenge and part of our focus for the next 5-year period.

**Graduate Education.**

Graduate programs offered by SBS are research-intensive learning experiences preparing students for careers in science. The SBS doctoral programs stand alone on the UMKC campus by offering students full stipends (currently $20,000 per year; $22,000 per year starting Fall Semester 2005), tuition and fee remissions (valued at approximately $7,000 per year), and a state of the art research-training environment. Recruitment of outstanding graduate applicants is a priority for the School. A standing subcommittee of the SBS Graduate Programs Committee is devoted solely to the recruitment and admission of graduate applicants. Strategies to attract the best applicants include: expenses-paid visits for all qualified domestic applicants, online application, nationally competitive stipends, personal attention, excellent mentoring, state of the art research facilities, and a collegial training environment.

Graduate and post-doctoral training programs at SBS are a direct reflection of the quality and productivity of our doctoral faculty (see **D. Research** below). Students benefit immensely from the mentoring received from outstanding faculty and post-doctoral staff. Our graduate students and training programs also benefit from an outstanding invited speaker seminar series. Throughout the academic year the weekly SBS seminar series hosts nationally recognized speakers on our campus. In addition, we annually sponsored and coordinate the *Trailblazers in Molecular Biology and Biophysics* lecture series. Since 1995 the Trailblazers series has hosted Nobel Laureates, members of the National Academy of Sciences, and other celebrated research
leaders in the areas of molecular biology and biophysics. The Trailblazers lecture as well as our weekly seminar series are vital components of the academic environment created at SBS. These lectures provide important educational opportunities for our students and post-doctoral fellows, and provide faculty an opportunity to exchange scientific ideas with some of the best scientists in their fields.

Over 35 students have received their Ph.D. degrees from one of our Programs in Cell Biology and Biophysics or Molecular Biology and Biochemistry. These graduates have gone on to post-doctoral appointments at some of the most prestigious institutions in the country (Appendicies).

The School also has entered into discussions with the Kansas University School of Medicine to develop a joint graduate research program for molecular and cellular biophysics. Our School's strength in structural biology is complemented by the research of a number of KUMC faculty in the Department of Biochemistry and Molecular Biology. This program would be the first of its type in the region and would provide the basis for programmatic funding at the national level and the attraction of quality graduate students.

National Research Council Recognition of SBS Graduate Programs

In 1995, the National Research Council’s evaluation of Research-Doctorate programs in the United States ranked the School of Biological Sciences’ program in Molecular Biology and Biochemistry on par with similar programs at the University of Texas Medical Branch at Galveston, SUNY Buffalo, and The University of New Mexico. Our program was ranked above those at the University of Kansas, the University of Miami, Kansas State University, Syracuse University, Georgia Institute of Technology and numerous other state and private institutions of much greater size, enrollments, and stature. In that same survey, a similar ranking of the School of Biological Sciences’ program in Developmental and Cellular Biology placed SBS ahead of such programs as those at Kansas University, St. Louis University, Tulane, The University of Kentucky, The University of South Carolina, Florida State University, and Arizona State University. (Source: Research-Doctorate Programs in the United States: Continuity and Change, Committee for the Study of Research-Doctorate Programs in the United States, National Research Council, Washington, D.C., 1995).

Given the National Research Council data, the University of Missouri Curators’ mandate for SBS to develop a nationally recognized academic research program was well underway. The trajectory of our ascent would have placed SBS in, or near, the top 50 programs in the Biochemistry and Molecular Biology and Developmental and Cell Biology in the United States by the time of the next NRC survey (2005). Unfortunately, cuts in state funding and even more devastating, misguided administrative policies, dealt a major blow to the vitality of SBS (see Research Support, Tenure-Track Faculty and NIH/NSF Awards for Year 2002-2003 compared with 2003-2004 in appropriate tables below). Although, SBS experienced the untimely departure of several top faculty members and concomitant loss in revenue, we have demonstrated hopeful signs of recovery.
D. Research

Research is central to the Mission of the School of Biological Sciences. Excellence in research and scholarship is the expectation for SBS faculty. Attracting and retaining the very best faculty able to successfully compete for extramural research support is mandatory for our Vision as a School. Successful faculty recruitment demands the operation and maintenance of state of the art research facilities, the availability of funds for competitive salaries and research start-up, and providing an environment conducive for research. Excellence in research not only raises the stature of our unit and the University, it also directly impacts the quality of our academic programs. Students are afforded the greatest opportunity for success when provided access to outstanding faculty and a cutting edge, research-oriented curriculum. Dollars generated by SBS research activity support initiatives within the School and across the University. Thus the value of investment in outstanding research cannot be understated.

Faculty Standards. Faculty recruitment has been developed as a highly honed skill. Great care in providing resources and start up funds is exercised to attract the best. Only those faculty candidates with chances to be among the top 5% in their category among the research universities nationwide are recruited. Once here, we provide the infrastructural support and necessary start-up funds to initiate a vigorous research program. Standards for promotion and tenure status of faculty are among the highest at the UM system.

Areas of Research Focus and Strength. Research activity within the School focuses on Molecular Recognition, that is, the underlying molecular mechanisms that drive all biological processes. Three areas of research concentration within the School are biomolecular structure and function, molecular genetics, and cell biology. Although each of these discrete disciplines, they are interdependent and interdisciplinary in their foundation. Our objective is to build upon these strengths and to expand our concentration of research efforts in areas that complement our current strengths.

The NIH “Roadmap” for biomedical research in the 21st century, as defined by the current Director, Dr. Elias A. Zerhouni, was developed with input from more than 300 nationally recognized leaders in academia, industry, government, and the public. The NIH Roadmap provides a framework of the NIH priorities in the areas of discovery, extramural funding, and education. The School of Biological Sciences is poised to benefit greatly from our current research activities in two of the Roadmap priority areas, Structural Biology and Proteomics. Moreover, our planned Systems Biology Initiative (see section IV. Goals) provides the appropriate context for optimal positioning vis-à-vis NIH resources.

Research Support. Support for research comes from a number of sources, both state and extramural. Current and recent funding agencies providing support for SBS are listed in the Appendices. Total sources and National Institutes of Health- and National Sciences Foundation-derived research support over the last three years is shown below. The significant loss in revenue between FY03 and FY04 represents part of the loss incurred during the Gilliland administration. Another loss occurring in FY04 was offset by several first-time awards to new SBS assistant professors. The three-year total for all sources of support garnered by SBS faculty is $18.2 million.
An important inference to be drawn from these data relates to the quality of research as evidenced by the high percentage of NIH and NSF sources of funding. Because of the rigorous peer-review evaluation process and the competitive climate for extramural support, individual investigator awards from the NIH and NSF are considered to be the “gold-standard” for research funding. The high percentage of funding to SBS faculty from NIH and NSF sources (80-90%) speaks to the quality of faculty research projects.

Another important consideration in the analysis of research support is the number of NIH and NSF grant awards, and the total dollars per tenure track faculty. These data serve as additional quality measures. It is possible for an academic unit to equal the total extramural resources of SBS with one or two large awards. Although the total research dollars are the same whether they come from 2 or 20 faculty, the former is an unhealthy scenario creating instability within the unit and the university. This scenario demands that large awards be continually renewed to sustain grant productivity and unit viability. Moreover, if the PI of a single large award were to leave, the award would leave as well. The data shown below illustrate that the opposite is true for SBS. Over the last three years the size of our tenure-track faculty has averaged 31 while the number of NIH/NSF awards has averaged 25. In other words, over the last three years 80 percent of the SBS tenure-track faculty members have had multi-year federal awards. This number becomes even greater when you consider that three of the current SBS tenure-track faculty members have full-time administrative positions (Dr. Lawrence Dreyfus, Dean of SBS; Dr. Ron MacQuarrie, Dean of Graduate Studies; and Dr. Bibie Chronwall, Vice Provost).

Recently hired junior faculty within the School have also successfully competed for grant support. Of the seven tenure-track Assistant Professors hired by SBS between 2001 and 2004, all have competitive research support. Moreover, five of the seven faculty members have either NIH or NSF awards. These data are evidence for the successful hiring practices of SBS and the creation of a research environment conducive for success.
Other measures to consider when evaluating research productivity and success are the number of award dollars per FTE (currently $186,673) and the total dollars per ft$^2$ of research space (based on 42,000 ft$^2$). The target goal for most universities is to return $100 per ft$^2$ of research space. Over the last three years, SBS has returned an average of $145/ft^2$.

Taken together, the SBS research productivity data validate our faculty recruitment strategies, quality assurance practices, and research support services provided by the School. Since all facets of quality stem from the faculty of our School, we intend to redouble our efforts to attract and retain the very best faculty possible. **One of our goals will be to see a net growth in our faculty ranks. Our proven success should warrant the investment, even in times of limited resources.**

**Research Facilities.** By its nature, biology is an interdisciplinary field. SBS faculty members conduct research on a number of areas relating to basic biological sciences. Modern biology research requires sophisticated equipment with purchase and maintenance costs beyond the budgets of individual grant awards. Thus, considerable investment has been made by the School of Biological Sciences to establish and maintain critical research facilities and services. Funded by a combination of funds from the State of Missouri (Program for Eminence funds), federal grants and gifts, our facilities support researchers from SBS and other research-active units on our campus and at other institutions.

Today the School of Biological Sciences supports several state-of-the-art facilities. Research facilities include those to support research in: structural biology (nuclear magnetic resonance spectroscopy, X-ray crystallography, conventional- and cryo-electron microscopy, Raman spectroscopy, and electron spin resonance); molecular genetics (DNA sequence and gene expression analyses); fluorescence microscopy (confocal laser imaging microscopy and single molecule real-time image analysis); protein analysis and dynamics, and proteomics (MALDI-TOF and nano-ESI-LC-MS/MS mass spectroscopy, multidimensional protein separations, and yeast two-hybrid analyses).

Expansion of our facilities in the last three years includes the NMR structural biology facility and the mass spectrometry and proteomics facility. In the case of both facilities, hiring expert faculty in these respective research areas drove the development of these laboratories. This critical point will be expanded upon in a later section.

In addition, SBS owns shares through the South East Regional Access Team (SER-CAT) in the high-energy X-ray Advanced Photon Source (APS) at the Argonne National Laboratory. The high-energy X-ray source at APS is specifically equipped for crystallographic analysis. This membership provides SBS scientists and students beam time for high-resolution determination of protein samples. SBS also maintains its own X-ray source and detector for “in-house” diffraction analysis.

Continual development of research infrastructure is a vital aspect of the mission of SBS. Our plans for the next 5 years will, in part, emphasize considerable investment to upgrade and expand current facilities and to integrate facility development and research with our educational programs.
IV. STRATEGIC ISSUES

Resources. Building a top tier research unit demands considerable investment. However, if carefully executed, the return on that investment can be considerable. Over the last three years SBS faculty, through competitive grant support, has returned $2 per dollar invested. If the goal of the University is to build excellent research programs, the question should not be how can we afford the investment, but rather, how can we afford not to invest in productive research programs.

Given the prospect of a flat budget growth for the State of Missouri, it is our responsibility to raise public awareness of the importance of basic science endeavor and to leverage resources at all cost to continue to build in a fiscally prudent climate. Without the basic science breakthrough of the past two decades, we would not, as we do today, see the reality of cancer cured in our lifetime. The keys to unlocking the mysteries of cancer and other equally devastating genetic, metabolic and infectious diseases lie in a commitment to basic research. The School of Biological Sciences is a necessary and strategically centered participant in efforts to address these and other fundamental problems in biology.

The School of Biological Sciences is the University’s best value for return on resource investment.

Funding trends and priorities at the federal level. Doubling of the NIH budget from $13.6 billion to $27.3 billion over the 5-year period from FY1998-2003 resulted in an unparalleled time of scientific discovery in life and health sciences. Unfortunately, this pace has been followed by three years of meager budget increases that were well below the rates of inflation over the same time period. Other federal agencies engaged in research funding for life sciences research have seen similar slow budget growth in recent years. These funding trends along with congressional mandates in areas of bio-weapons, bio-terrorism food safety, and targeted diseases has translated to fewer basic sciences funding opportunities as evidenced by the declining number of individual investigator awards and smaller budgets relative to inflation.

Since implemented in 2004, the NIH Roadmap has significantly shaped the funding priorities of this agency. The roadmap themes define priorities for a significant portion of extramural research. One theme, New Pathways to Discovery does address basic science through the following priority areas:

- Building Blocks, Biological Pathways, and Networks
- Molecular Libraries & Molecular Imaging
- Structural Biology
- Bioinformatics and Computational Biology
- Nanomedicine
At a time when total dollars for research are shrinking, a bright spot in the outlook is that the School of Biological Sciences is uniquely positioned to compete for Roadmap dollars in the New Pathways priority areas. Moreover, our planned Molecular Systems Biology Initiative addresses the interdisciplinary approaches to these target areas, another Roadmap theme.

**Critical mass.** By the end of the Program for Eminence plan in 1998, the School of Biological Sciences hoped for growth of our tenure-track faculty to 45. By national standards, this number would have approached the critical mass necessary to sustain productivity and address the academic needs on this campus and our programs would have continued to rise in stature as recognized by the National Research Council. Growth of the School was critically hurt when in 1998 11 faculty members were transferred to the UMKC School of Medical. We had not fully recovered from this setback when 7 additional tenure-track faculty members left between 2001-2003 due to the declining support for our School by UMKC administrators.

Despite the negative impact of these occurrences, and given declining local and state support, the School has survived and demonstrated remarkable resilience. Renewed growth of the SBS tenure-track faculty ranks will reinvigorate the path to a critical mass, self-sufficiency, and national prominence.

**Research Focus.** Recruitment over the 20-year history of the School of Biological Sciences has focused on quality of faculty with expertise in the mainstream of the current trends in molecular biosciences. In doing so, we have kept pace with the cutting edge of fundamental problems in biology. At the same time we have balanced our research focus with the needs of our academic programs. Our focus on *Molecular Recognition* has lead to natural strengths in the areas of structural biology, molecular genetics, and cell biology.

In the “post-genomic” era our focus will remain on the molecular mechanism underlying biological function, however, the vast data mine of genomic information compels us to pursue a systematic approach to our efforts. Our *Molecular Systems Biology Initiative* focuses on post-genomic approaches that will position us at the current frontier of scientific discovery that will continue into the next decade and beyond.

**Academic Matters**

**Undergraduate Programs.** In 1993, the School of Biological Sciences created a new and innovative undergraduate biology program. Since that time, the program has increased in size to the extent that we have outgrown our teaching laboratory space. At present, the availability of teaching laboratory space represents a roadblock to continued growth. Moreover, current teaching laboratory space is outdated and in critical need of renovation.

Our undergraduate curricular emphasis in cellular and molecular biology, prepares students for a number of options including graduate school in a life sciences field and a career in a health science profession. Biology graduates perform above the national average on standardized subject-specific exit examinations. An area within our own discipline that we have not fully developed is biotechnology. Biotechnology has experiencing rapid and sustained growth.
globally for the past two decades. Regional growth, although slower to take hold, is the recent focus of intense positioning by both Missouri and Kansas legislatures as these states develop strategies to attract new biotechnology industry to the Interstate-70 corridor.

Graduate Programs. Operation of a quality graduate program requires not only outstanding graduate faculty but also quality graduate students. Significant emphasis has been placed on attracting and retaining the very best students in our graduate and doctoral programs. Despite our efforts, competition among other outstanding graduate programs in the Midwest region is intense. Resources and recruitment strategies are needed to keep pace with the demand for the very best graduate applicants.

STRATEGIC PLANS

Molecular Systems Biology Initiative. Discovery in the area of molecular biosciences is unfolding at an unprecedented pace. This is, in part, a consequence of recent efforts to obtain genomic data for a wide variety of organisms including the newly completed assembly of the human genome. Investigative approaches spawned by the volumes of genomic data include comparative genomics, functional genomics, and molecular evolution to name a few. Coupled with recent advances in analytical mass analysis instrumentation the related fields of proteomics and metabolomics are now a reality. Once regarded dreams for the future, these areas of investigation are rapidly becoming standard approaches for all molecular and cellular investigations.

The complexity of biological information is formidable. Signal transducing pathways, gene expression networks, and the interplay of metabolic pathways are examples complex biological systems that must be grappled with to completely understand biological function at the cellular and whole animal levels. A molecular systems biology approach to these and other areas of investigation takes advantage comparative genomic sequence data, protein structure and dynamics, signaling networks, gene expression cascades, metabolic pathways, and informatics tools to build models for molecular and cellular function. These models are then tested, refined and analyzed.

Existing research strengths within the School of Biological Sciences in areas of protein structure and function, molecular genetics, and cell biology provide the framework for molecular systems biology. This approach invites interdisciplinary collaboration to fundamental problems in biology. In addition, Molecular Systems Biology addresses NIH Roadmap initiatives in the area of New Pathways to Discovery thus providing a competitive positioning for continued success at attracting extramural support within the context of the Roadmap initiatives.

Specific Actions:

- Constitute the Committee on Molecular Systems Biology to direct the initiative, foster collaborations, and identify programmatic funding.
Host a National Conference on Molecular Systems Biology.

Complete work on the SBS Genomics Facility now in progress.

Complete expansion of Proteomics Facility now in progress.

Initiatives to Expand Existing Programmatic Strengths.

Over the past decade, all of the three major areas of structural biology, X-ray crystallography, nuclear magnetic resonance (NMR) spectroscopy and cyro-electron microscopy (cryo-EM) have been implemented at the School of Biological Sciences. In addition, SBS owns shares through the South East Regional Collaborative Access Team (SER-CAT) in the Advanced Photon Source (APS) at the Argonne National Laboratory. The in-house X-ray equipment is now over 10 years old and in need of upgrade. In addition, the equipment is receiving increased usage due to new faculty hires both at SBS and at the KU medical center.

Another area in need of development is cryo-EM. Cryo-EM has a unique position in the structural biology trilogy. This technique provides the means to determine macromolecular structure on a scale much greater that X-ray or NMR although at lower resolution. It also provides avenues to determine membrane protein structure and the structure of macromolecular assemblies - large complexes made up of several individual proteins or protein and nucleic acid complexes. These are two priority areas for the structural biology initiative of the NIH Roadmap. The current equipment housed in SBS, although still functional for moderate level resolution, is lagging behind the cutting edge of what is currently available for molecular resolution at near atomic level.

The structural biology research team at SBS is a significant component of our Molecular Systems Biology Initiative. Comparative structural biology, structure-function analyses, protein folding, and protein dynamics are all areas of investigation that rely on structural data. Building on the current areas of expertise will entail hiring additional faculty with research areas in on of the above structure-related areas.

Development of the proposed joint graduate research program for molecular and cellular biophysics lagged during periods of changing leadership both at the KU Department of Biochemistry and Molecular Biology and at the School of Biological Sciences. With the recent open of our state of the art NMR facility, and the hiring of additional structural biologists and biophysicists both at KUMC and SBS, the time for moving ahead with this joint academic program has never been better.

Molecular genetics is another area of research strength within the School. Building our molecular genetics focus within the context of our Molecular Systems Biology Initiative
would focus new faculty hires in areas such as evolutionary biology, comparative genomics, and functional genomics.

- Over the next 5 years SBS will see at least three retirements in our current faculty including the Head of Cell Biology and Biophysics and an Endowed Professor in Cell Biology and Biophysics. Recruiting nationally recognized leaders in areas critical to the focus of the CBB Division and the overall research focus of the School will be a top priority. Strategies will be in place to specifically target these hire to areas related to structural biology, biophysics, or molecular cell biology.

**Specific Actions**

- Upgrade existing in-house X-ray generator and detector
- Upgrade Cryo-EM facility to house a high resolution field-emission gun electron microscope (FEG-EM)
- Fully develop the joint graduate research program in molecular and cellular biophysics with the Kansas University Medical Center
- Recruit 4 additional faculty in areas related to structural biology and molecular genetics.
- Recruit a new Division Head for Cell Biology and Biophysics and a new endowed professorship in CBB.

**Academic Program Initiatives**

- **Undergraduate Biology Program.** The undergraduate program has not undergone substantive changes since its inception in 1993. Our undergraduates benefit from an outstanding faculty, and a modern curriculum. Many of our undergraduates participate in independent research projects which greatly improves their opportunities for advancement following graduation. This is especially true of Saper Vedere Scholars. The success of our graduate program also hinges on the quality of our students.

- **Teaching facilities.** Introductory Biology Laboratory is presently offered in 2 laboratories on the first floor of the Biological Sciences Building each equipped to hold approximately 40 students. The 8 sections required to accommodate the size of Biology 108 is the maximum that can be scheduled during the week. Biology is growing at a rate that is almost double that of the University as a whole. In addition, many of the students enrolled in Biology 108 and 109 are Arts and Sciences majors taking Biology as their required life science course. Additional adjacent laboratory space to run concurrently with the existing 2 laboratories is absolutely mandatory to accommodate growth.

- **Biotechnology Degree Program.** An undergraduate degree program in Biotechnology would be the first of its type in the Midwest region. The program will be designed such
that in addition to the fundamental aspects of cellular and molecular biology, students would receive introductory training in the principles and practices of modern biotechnology including, large scale culture of recombinant organisms, nucleic acid manipulations, gene cloning, gene alterations, protein purification, protein analysis, antibody methods, mass spectroscopy methods and others. The program would serve to fill a current void in preparing students for jobs in the biotechnology industry as well as serving as an excellent alternate track for students bound for graduate and doctoral programs in biology as well as students entering health professional career programs. The program will be initially developed as an emphasis area, thus providing transcript recognition. Progress to a Bachelor of Science in Biotechnology degree will progress in a manner consistent with success of the emphasis area.

- **New laboratory Class Opportunities.** Our Bachelor of Science degree program requires completion of at least two organized laboratory classes. Current offerings include Microbiology, Biochemistry, and Histology. A planned course in Developmental Biology and Genetics will be offered for FS06. In addition, the Biotechnology degree program will require a Biotechnology Laboratory class which will be developed during the 05-06 academic year for first offering during WS07. The addition of these two laboratory courses will complete the balance required for a well-rounded Biology B.S. curriculum.

**Graduate Programs Initiatives**

- **Graduate Stipends.** Stipends for students in doctoral degree programs in the sciences are absolutely mandatory. Traditionally, the sciences have led the way in the use of stipends as a mechanism to attract and retain the very best students in these disciplines. The School of Biological Sciences offers full stipends and tuition and fee remissions for all students enrolled in its two doctoral degree programs (Cell Biology and Biophysics and Molecular Biology and Biochemistry). Stipends for SBS doctoral students are currently $20,000 per year with annual costs for tuition and amounting to an additional $7000. Although this level is well above other programs at UMKC, these numbers are comparable to regional programs (Missouri-Columbia, Kansas University-Lawrence, KUMC, and Kansas State University) but slightly below national levels. To remain competitive and keep pace with national programs we aspire to emulate, we must continue to invest additional resources into graduate student support.

- **Graduate Student Recruitment Strategies.** Recruitment of outstanding graduate students is critical to maintaining the quality standards of the School. Two years ago, SBS launched a web-based application and admissions utility for graduate applicants including online application fee payment. The result of this strategy was a 40% increase in inquiries and a 60% increase in the number of completed applications. Although increasing the number of completed applications is an important recruitment strategy, this measure does not address applicant quality. The SBS web site provides an opportunity to increase the visibility of our School. The SBS web site is in the process of redevelopment and a facet of this redevelopment will be student recruitment. The SBS
A seminar program also serves to increase the visibility of our program to scientists with national prominence, as does participation by our faculty at regional, national, and international scientific conferences.

**Specific Actions:**

- Double the size of the *Saper Vedere* Scholars Program.
- Develop the undergraduate Biotechnology degree program first as an emphasis area followed by a new degree offering.
- Expand undergraduate laboratory class offerings to include Developmental Biology and Genetics (FS06) and Biotechnology Laboratory (WS07).
- Begin planning and resource allocation for renovation and expansion of existing teaching laboratory space.
- Create a Graduate Scholars Endowment fund through alumni and community support, the annual distribution of which will offset funding for first-year graduate stipends.
- Redouble graduate recruitment efforts to include, web based and personal contact initiatives.

**Development Initiatives.**

The School of Biological Sciences is a relatively new and small academic unit with the first graduates to identify with our undergraduate program emerging in 1998. We therefore have a young alumni base that, for the most part, are still in the formative stages of their chosen career paths. None-the-less, the SBS alumni base must be fully engaged in the activities of our School and their support in our current and future objectives is of paramount importance. Our development strategies for the School must include a strong component of alumni support.

Many of the initiatives we hope to accomplish in the next 5 years will require considerable capital investment. Part of this may come from grants and awards specifically earmarked for equipment and facilities. Recently, the School was awarded $894,150 from the United States Department of Housing and Urban Development to continue progress on our Proteomics and Genomics Facilities. These types of awards are invaluable in developing facilities. Additional sources of funds need to be secured for teaching laboratories and general facility upgrades.

The growing biotechnology industry in the northeastern Kansas – western Missouri region is another potential source for support. Development of our undergraduate Biotechnology Program provides an opportunity to engage the biotechnology industry in our region. Measures to partner with this regional industry will be initiated.
Specific Actions

- Aggressively build a relationship with the SBS alumni.
- Form an alumni engagement committee with membership from faculty, current students, and prominent local alumni.
- Develop key partnerships with local and regional Biotechnology corporations as an avenue to build infrastructural support.
- Open discussions with the UM System to build a regional Missouri Structural Biology consortium with UMKC facilities and scientists serving as the Kansas City-based component.

V. INTENDED OUTCOMES

- **Attract and Retain the Highest Quality Faculty Possible.** In measuring the success of an academic unit, look no further than the quality of the faculty. Attracting the very best faculty requires among other things, competitive salaries and start-up funds, outstanding research infrastructure, and collegial support. As we continue to grow and develop as a School our commitment to attracting and retaining the highest quality of faculty possible remains as strong as ever.

- **Vibrant Academic Programs.** In recent years, the SBS undergraduate program has grown at a rate almost triple that of the University as a whole. Students are selecting Biology in greater numbers because we live in a time when Biological questions and issues are more relevant than at any other time in our history. Keeping pace with the demand for training biological sciences compels us to offer not only relevant programs but programs that are of the highest quality. Execution of our academic initiatives set forth in this plan are aimed at intensifying our focus on undergraduate and graduate programs with the intent of providing the best educational experience possible.

- **National Recognition.** A new phase in the life of our School will be marked by the beginning of our Molecular Systems Biology initiative. Constituting a program in Systems Biology in itself is without merit unless we strategically build the composition of our faculty and our research focus to capitalize on the current and future trends of our field. With a number of faculty slots opening in the next few years, our goal is to attract the very best faculty candidate in key areas of research. Our goal will be to build the very best faculty at all cost.
APPENDICES
Where our Ph.D. Graduates Train as Post-Doctoral Students
(Graduates Since 1996)

University of Helsinki
Vanderbilt University (2)
University of Leicester
University of North Carolina Chapel Hill
St. Jude’s Children’s Hospital
University of Chicago (2)
California Institute of Technology
Kansas University Medical Center (2)
The National Institutes of Health
The Scripps Research Institute (2)
The University of California San Francisco
Washington University
Harvard University
The University of Indiana
The University of Dallas
The Parkinson’s Institute (Sunnyvale, CA)
The University of Western Ontario
JRH Biosciences (Kansas City)
The Stowers Institute for Medical Research
New York University
Current and Recent Sources of SBS Grant Support

National Institutes of Health

National Science Foundation

Department of Health and Human Services

Health Resources and Services Administration

Department of Housing and Urban Development

American Heart Association

United States Department of Agriculture

United States Department of Defense

Missouri Research bard

Kansas City Life Sciences Institute

Marion Merrell Dow Foundation
The School of Biological Sciences

Strategic Plan Update: 2006-2007

“To improve the quality of life through excellence in education and research”
Mission

- Provide outstanding education in modern biology
- Prepare undergraduates and doctoral and post-doctoral trainees for careers in the life sciences
- Advance the frontier of cellular and molecular biology through basic research
- Excellence in research supports academic mission
- Improve the quality of life through education and research
The School of Biological Sciences: 
Uniquely Positioned to Lead in the Life Sciences

• Created and developed as a research-intensive basic life sciences unit
• Our mission is central to UMKC’s goal to lead in the life and health sciences
• Only School in Kansas City offering comprehensive academic and research programs in the life sciences
• Collaborations with KU-Med Center, Stowers Medical Research Institute, KU-Lawrence, and MU-Columbia support our mission
• Strength in structural biology complements those of neighboring institutions
School of Biological Sciences: Priorities

- Continue to develop quality academic programs
- Reach a critical mass of tenure-track faculty
- Expand research infrastructure
- Develop capital resource base
- Remain an independent and viable academic unit
Strategic Issues

- Critical mass
- Grant productivity
- Graduate student recruitment
- Student credit hour production
- Teaching and research facility expansion/upgrade
- Capital development
Academic Programs
Academic Divisions

Division of Cell Biology and Biophysics
Division of Molecular Biology and Biochemistry

CBB
25 Faculty
(16 Tenure-track)

MBB
20 Faculty
(14) Tenure-track)
# Degrees Offered by SBS

<table>
<thead>
<tr>
<th>Bachelors Degrees</th>
<th>Masters Programs</th>
<th>Doctoral Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Science in Biology</td>
<td>M.S. Cellular and Molecular Biology</td>
<td>Ph.D. in Cell Biology &amp; Biophysics</td>
</tr>
<tr>
<td>Bachelor of Arts in Biology</td>
<td>M.A. Biology (Nurse Anesthesia)</td>
<td>Ph.D. in Biochemistry &amp; Molecular Biology</td>
</tr>
<tr>
<td>B.S. Medical Technology</td>
<td>M.S. Emphasis in Bioinformatics(^1)</td>
<td></td>
</tr>
<tr>
<td>B.A.-M.D. Biology(^1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.S. Emphasis in Bioinformatics(^1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.S. Biology- Pre-Dentistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.S. Biology-Pre-Medicine</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)New for AY2004
Bachelor of Science in Biotechnology

• 155 Biotech Firms in Interstate-70 Corridor*
• Workforce: 12,000-15,000*
• >50% of workforce in KC Metro area*
• Fall 2006 B.S. in Biology with Emphasis in Biotechnology
• Fall 2008 Bachelor of Science in Biotechnology

*Data provided by KCALSI Survey, 2003
Student Credit Hour Production by SBS vs. UMKC

<table>
<thead>
<tr>
<th>Semester</th>
<th>SCH*</th>
<th>% Increase SBS</th>
<th>% Increase UMKC</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS00</td>
<td>5815</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>FS01</td>
<td>5818</td>
<td>7.4</td>
<td>2.3</td>
</tr>
<tr>
<td>FS02</td>
<td>6181</td>
<td>6.2</td>
<td>1.2</td>
</tr>
<tr>
<td>FS03</td>
<td>6724</td>
<td>8.9</td>
<td>3.3</td>
</tr>
<tr>
<td>FS04</td>
<td>7189</td>
<td>6.9</td>
<td>4.1</td>
</tr>
<tr>
<td>FS05</td>
<td>7364</td>
<td>2.4</td>
<td>2.1</td>
</tr>
</tbody>
</table>

*Fall Semester Count; AY05 Total ~15,000
Biology Majors Headcount History

* Projections based on last 3-year average increase
Student Credit Hour History

* Projections based on last 3-year average increase
Undergraduate Programs Initiatives

• Biotechnology emphasis/degree plan
• Expand Saper Vedere program
• Promote BA-MD degree program
• Emphasis on undergraduate recruitment/retention
• Begin plans for additional teaching laboratory space
• Begin teaching lab renovations
Graduate Programs Initiatives

- Redesigned graduate studies poster
- Complete redesigned Graduate Brochure this Summer
- Increased Ph.D. student stipends to $22,000 for FS05
- Redesigned Web Site with improved entry point for applicants
- Recruitment visits to regional campuses by SBS faculty
- Enlist Stowers Institute adjunct appointees in recruitment
- Establish Graduate Scholars Endowment Fund (Goal: $4 Million)
Faculty Research Focus
SBS Research Focus

• Structural Biology
  • Recruit additional structural biology faculty
  • Develop cooperative graduate program with KU-Med Center
  • Support MU Structural Biology Center (Multi-campus)
  • Continue collaboration with MU-Columbia for ultra high-field NMR
  • Position SBS to be a regional leader in Structural Biology

• Molecular and Cellular Biology
  • Recruit additional Molecular/Cell Biology faculty
  • Continue to expand existing single molecule microscopy facilities
  • Continue to expand the molecular genetics facility
SBS Faculty Development Plan

Recruit 10 additional faculty between now and 2010

Recruit 4 new faculty members to join SBS Summer/Fall 06

Plan for 2 additional faculty members for each of Fall 07/Fall 08

Recruit 1 additional faculty member for AY2009 and AY2010
Capital Development
Development Initiatives

• Aggressively build relationships with SBS alumni
• Create and develop Alumni Committee
• Develop relationships with local biotechnology corporations
• Begin plans for teaching laboratory renovation/expansion
• Work with Development Office and explore gift opportunities to upgrade X-ray generator/detector and cryo-EM facilities
• Continue discussions with UM-Columbia for a Regional Structural Biology Center
SBS Research Grant Productivity
## SBS Grant Productivity

<table>
<thead>
<tr>
<th>Year</th>
<th>NIH/NSF</th>
<th>All Sources</th>
<th>NIH/NSF Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2003</td>
<td>$6,378,678</td>
<td>$7,926,612</td>
<td>80%</td>
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<tr>
<td>2003-2004</td>
<td>$4,374,202</td>
<td>$4,684,093</td>
<td>93.4%</td>
</tr>
<tr>
<td>2004-2005</td>
<td>$4,373,556</td>
<td>$5,600,210</td>
<td>78%</td>
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</table>
## SBS Grant Productivity

<table>
<thead>
<tr>
<th>Year</th>
<th>Faculty</th>
<th>NIH/NSF Awards</th>
<th>Federal $/FTE</th>
<th>$/FTE All Sources</th>
<th>Dollars/ ft² Research Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2003</td>
<td>33</td>
<td>27</td>
<td>$193,293</td>
<td>$240,200</td>
<td>$189</td>
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<tr>
<td>2003-2004</td>
<td>31</td>
<td>27</td>
<td>$141,103</td>
<td>$151,100</td>
<td>$112</td>
</tr>
<tr>
<td>2004-2005</td>
<td>30</td>
<td>22</td>
<td>$145,807</td>
<td>$186,673</td>
<td>$133</td>
</tr>
</tbody>
</table>
Grant Award Strategies

• Increase total number of applications
• Increase application to Federal but non-DHHS agencies (USDA, DOD, DOE, etc.)
• Consider non-federal sources (American Heart, American Lung, etc.)
• Joint/individual responses to RFPs
• Mandatory review for extramural applications until funded
• Performance incentives for grant application/success
## Projections

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenure-Track Faculty</td>
<td>30</td>
<td>39</td>
<td>46</td>
</tr>
<tr>
<td>Total Grant Revenue</td>
<td>$4.7 Mil</td>
<td>$5.9 Mil**</td>
<td>$6.9 Mil**</td>
</tr>
<tr>
<td>Headcount</td>
<td>339</td>
<td>440***</td>
<td>550***</td>
</tr>
<tr>
<td>SCH Total</td>
<td>15,537</td>
<td>20,058***</td>
<td>25,894***</td>
</tr>
<tr>
<td>Total SCH Revenue*</td>
<td>$3.4 Mil</td>
<td>$4.3 Mil</td>
<td>$5.6 Mil</td>
</tr>
</tbody>
</table>

* Based on undergraduate rate
** Increases based on current rate of ~ $150,000 per tenure-track faculty member
*** Increase based on last 3-year average rate increase
Intended Outcomes

- Attract and Retain Quality Faculty
- Develop Relevant Academic Programs
- Attain National Prominence
- Continue as a vibrant and independent academic unit