

STRATEGIC PLAN, SCHOOL OF BIOLOGICAL SCIENCES, FEBRUARY, 2010

The priorities of the School of Biological Sciences (SBS) are to provide high quality undergraduate and graduate education while continuing as a leader in biological research. We propose a systematic approach to faculty hiring, increasing support for the SBS undergraduate program while facilitating integration of the Life Sciences curriculum, increasing the size and quality of our graduate programs, and moving SBS forward on the cutting-edge of biological research.

Long-Term Vision

Our Vision of the Future of Biology: The last three decades have seen dramatic advances in biological science, including the revolution in cell and molecular biology, the emergence of bioinformatics, genomics and proteomics, the maturing of sophisticated, quantitative evolutionary biology and the emergence of new tools and approaches to understanding ecological communities and ecosystems. Many of these advances originated in subdisciplines of biology, but their emergence sends a crucial strategic message: biology has become integrative. Understanding biological systems requires investigation at multiple organizational levels: from molecules and genes to cells, from organisms to populations and from communities to ecosystems. The distinctions between traditional areas of biological research will become blurred and biologists will integrate ideas and methodologies from fields outside of biology, including mathematics, engineering and computer science. Integrative system approaches will become increasingly necessary to solving important problems such as the biology of human health and disease or understanding how biological systems adapt and influence global processes such as climate change. A major challenge to realizing this vision is finding effective ways to integrate disciplines by promoting collaborative approaches to research and education in the Life Sciences and related disciplines.

Our Educational Vision: This integrative future of biology has implications for the education of undergraduate and graduate students. We need physicians who know molecular and evolutionary biology; conservation biologists who know microbiology, bioinformatics and molecular techniques; evolutionary biologists who can read and interpret microarrays. Undergraduate and graduate training in Life Sciences must become more integrative. This affects the SBS curriculum, and also provides a strong intellectual rationale for integration of the Life Sciences curriculum.

Our Educational Challenge: The intellectual challenge is clear; so is the practical challenge. With the increased popularity of Biological Sciences and the increased size of the UNL student body in recent years, demands on the SBS instructional program have increased substantially. The development of a coordinated Life Sciences curriculum will increase those demands. Meeting these challenges will require increases in faculty and staff support for SBS instruction coupled with increases in teaching space, especially teaching laboratories.

Meeting Strategic Priorities: Our proposals are fully consistent with College and UNL priorities, especially those related to achieving the levels of excellence of *Vision 2020* while enhancing the undergraduate experience. These goals will be accomplished by increasing graduate student and staff support for instruction, adding faculty expertise devoted to instruction and research, and improving the number and quality of classrooms and laboratories for faculty and students.

Action Plan for Meeting These Challenges

Our plan for achieving our priorities over the next 5 years call combines our instructional and research needs.

Instructional Needs. SBS provides more Life Science credit hours than any other UNL department, meeting important instructional responsibilities beyond the needs of its majors. We

provide instruction to our majors as well as basic Life Science instruction to a wide array of non-majors, including health pre-professionals, future teachers, agricultural science majors and other biology-related majors, as well as educating a biologically-informed citizenry. Overall demand for our courses has increased dramatically in the past 6 years (more than 25% in SBS service and core courses). This is much greater than the overall increase in UNL enrollment and is partially due to a general increase in the popularity of Life Sciences. It is also the result of the effects of integrative biology on instructional needs. As many conceptual approaches and technical methods are applied more broadly (e.g., molecular techniques, quantitative evolutionary modeling, bio- and ecoinformatics), there is increased emphasis on basic knowledge that applies across Life Sciences. This produces increased demand for core biology and other fundamental courses, many of which are offered by SBS (e.g., BIOS 102, 103, 205, 206, 207, 213, 214 and 312). For this reason, several Life Sciences departments now require SBS core courses for their own majors and as UNL Life Sciences curriculum coordination proceeds, this trend is likely to continue. These enrollment increases will require additional SBS faculty to teach basic courses, (e.g., 100/200 level), an increase in the number of graduate teaching assistantships (to meet the increased need for laboratory and recitation sections), increased administrative support for our educational programs and increased space for instructional purposes.

Our goal is to increase our instructional capacity while improving the quality of the undergraduate learning experience, especially in (but not limited to) the lower division core courses. Strategies to meet this goal include: (a) increasing number of faculty directly involved in lower division instruction, partially through our hiring plan (e.g., the recent hire of S. Smith who has expertise and interest in BIOS 103 and the pending hire of a professor of practice); (b) proactively seeking increased cooperation from other UNL Life Science units to deliver a well defined set of core courses, including involving faculty from other units in lower division Life Science instruction; (c) providing additional resources to facilitate and implement course delivery, particularly for laboratory sections and large lecture courses, including increasing technical support as well as the number of Graduate Teaching Assistants; (d) enhancing the size and quality of the SBS graduate program to benefit both the graduate and undergraduate program; and (e) increasing and enhancing Life Science laboratory teaching space with an addition to Manter Hall.

Research Needs. The integrative perspective mandates building a cutting-edge unit of biologists working at multiple levels. A crucial aspect of this effort is identifying links between levels; it is primarily through such level-by-level integration that critical questions of biological complexity can be addressed, in areas such as human health, ageing, disease, complex behavior, biodiversity, global climate change and invasive species. SBS is well-positioned for this effort as most recent faculty recruitments have had an integrative emphasis and SBS has maintained considerable strength in key areas of integrative biology. Our hires have also been strategically consistent with CAS signature program priorities in bioinformatics, biological modeling and virology as well as with Programs of Excellence in Population Biology, Plant Science Innovation and Microbiology. Our current plan builds on these successes with the goal of firmly establishing SBS as the campus leader in 21st century basic Life Science research and instructional programs.

Long-term Faculty Hiring Plan: Taking into account instructional and scientific needs, we envision 8 - 10 faculty hires by 2015, including the two searches authorized this year (one of which is paused). Allowing for probable joint hires with other departments/programs, this will amount to 7-8 FTEs. The specific number will depend upon several factors including retirements, construction of the addition to Manter Hall, renovation of Manter 4th floor, and successful partnering with other units/centers. Our plan is to hire new faculty who, as a group, have both the integrative research

expertise and teaching interests to contribute to the SBS teaching program, especially in core and other required courses.

By definition, integrative biology encompasses a wide spectrum of phenomena. We have found it useful, therefore, to conceptualize our hiring plan in terms of three overlapping organizational ranges, and propose to hire faculty working at levels of analysis from molecules to organisms, from genes to populations, and from populations to ecosystems.

Molecules to Organisms: Three scientists working on (1) Analysis of complex phenotypes, perhaps involving neurobiology or endocrinology/behavior; (2) Microbial gene regulatory networks, providing a link with the pending EPSCoR Biofuels proposal and the Nebraska Center for Energy Research; (3) Evolutionary approach to development (evo-devo), using comparative genomics, integrating the study of crucial developmental processes with bioinformatic approaches.

Genes to Populations: Three scientists working on (1) Molecular evolutionary biology, using molecular genetic methods to study evolutionary and ecological questions in a phylogenetic context (replaces essential expertise lost when Orti resigned); (2) Plant population biology, perhaps with emphasis on studying interspecific interactions (replaces essential expertise lost when Louda retired) and (3) plant evolutionary ecology, with a research program with a strong field component. The plant positions create opportunities for partnerships with the Center for Plant Science Innovation (PSI), School of Natural Resources (SNR) and/or Department of Agronomy.

Populations to Ecosystems: Two scientists working on (1) the effects of global change in emerging diseases in natural plant, animal or human populations which could create collaborative opportunities with the Virology Center or an IANR unit; and (2) evolutionary and/or ecological consequences of global change, which could involve partnerships with Geosciences or the SNR.

To implement this hiring plan cohesively and effectively, we will employ several strategies:

1) Focus our hiring on biologists who work at understanding living systems at multiple levels of analysis and/or have expertise in the new tools and techniques that are driving biological integration, e.g., genomics, proteomics, mathematics, phylogenetics, or bio- and eco-informatics.

2) Encourage strategic interdisciplinary hires outside of the traditional boundaries of biology (e.g., mathematics, physics, chemistry, computer science) because many of the new tools and approaches involve these other disciplines.

3) Because SBS is a relatively small unit in comparison to most biology departments at similar universities, making strategic hires in partnership with established Research Centers (e.g. NCV and PSI) is an effective way to further our goals. Three of the last four SBS hires and one current search involve such collaborative hires with NCV and/or PSI.

4) Contribute to promoting broader integration of Life Sciences across UNL campuses and with UNMC, positioning SBS as a leader in transforming the broader Life Science community. This will facilitate the recruitment of high-caliber faculty and students to UNL while advancing the effective integration of basic and applied research that will promote the continued growth of Nebraska's biomedical and agricultural communities. These goals are consistent with the UNL and College commitments to continue to propel us towards the research goals of the 2020 report.

Short Term Goals and Action Plans (for AY 2010/11)

1. Faculty Hiring during 2010/11 and 2011/12: In view of budgetary uncertainties and the ongoing recruitment of a new SBS Director, we are describing the four highest SBS priorities for faculty hires (not including a new Director), which ideally would be met with searches during the 2010/11 and 2011/12 academic years.

Seven faculty have been hired since 2007 (Brown [0.6 FTE], Grass, H. Moriyama [0.6 FTE], Weber [0.6 FTE], Yu [0.6 FTE], Brisson and C. Zhang [0.6 FTE]), and another faculty member recruited last year and arriving next Fall (S. Smith). There is a faculty search underway in Viral Evolution (0.6 FTE with Virology Center and PoE funding). The four hires which are essential for recruitment in the next two years (2010/11 and 2011/12) are:

(1) Assistant Professor of Practice (authorized but now paused), with expertise at 100- and 200-level, especially in cell biology and human physiology, a position that is critical for our ability to meet instructional demands. Benchmark: increase SBS capacity to teach 100-level BIOS courses and in the Human Physiology and Anatomy lectures and labs. Costs: Salary \$47,000. Renovation of office space: \$25,000; anticipate 50-50 cost-sharing of renovations with College.

(2) Molecular Evolutionary Biology. Benchmarks: enhanced instruction in phylogenetic genomics and Bios Organismic Biology and Ecology and Evolution. Costs: \$76,000 salary; \$450,000 startup/renovations, costs to be shared by SBS, College & VCR.

(3) Analysis of Complex Phenotypes. Benchmarks: Enhanced research capacity in Integrative Biology; increased instructional capacity in integrative biology, development of upper level course. Costs: \$76,000 salary; \$450,000 startup/renovations, shared by SBS, College & VCR.

(4) There are two alternatives for the fourth position, depending on the pending Biofuels EPSCoR proposal. If that funding is obtained and SBS participates as planned, the fourth position would be in microbial gene regulatory networks; Benchmarks: increased instructional capacity in microbiology, providing a link with the pending EPSCoR Biofuels proposal and the Nebraska Center for Energy Research. Costs: Salary: \$76,000; startup, \$450,000; startup costs to be shared by EPSCoR project, SBS, College and VCR (details being negotiated).

If, however, that project does not proceed as expected, the fourth position would be in plant population biology, with emphasis on interspecific interactions. Benchmarks: enhanced capacity in Organismic Biology and Ecology and Evolution; possible links to PSI. Costs: \$76,000 salary; \$450,000 startup, renovations, costs to be shared by SBS, College & VCR.

It should be noted that although space that is either currently available or will become available through anticipated retirements will probably provide sufficient space for the hires proposed over the next two years, there is not enough space currently available for the remainder of our long-term plan. Thus the renovation of the former Library space in Manter Hall and/or construction of the Manter addition will be essential for realizing the long-term plan.

2. Other Support for Instruction.

Although adding faculty is necessary for SBS to fulfill its expanding, multiple instructional missions, it is far from sufficient. Increasing our instructional capacity will require increasing the number of laboratory and recitation sections in many courses, especially SBS core and required courses. SBS cannot meet these demands and maintain the quality of our instructional program without additional Graduate Teaching Assistants (GTAs) and laboratory coordinators.

GTAs are particularly crucial and we (again) request two additional GTA positions for the coming academic year (cost, \$32,600). Our long-term goal is adding 6 GTAs over the next 3-4 academic years, which would be commensurate with our increasing load. This will require enhanced graduate recruitment and we are experiencing difficulty recruiting graduate students; many of the universities with which we compete (for example, Kansas State) offer stipends 20-25% greater than ours. We also therefore also request funds to increase our TA stipends by 12% (cost: \$66,000). (Note that the number of applicants to our graduate programs the past two years have increased substantially and we could increase the number of graduate students we recruit

without affecting standards.) The requested increase in GTAs in SBS would be an excellent investment in undergraduate instruction. It would also be an excellent investment in the SBS research program. SBS has more research active faculty, publishing more work and garnering more extramural support, than at any time in its history. Increasing the size of the SBS graduate program would support these improvements and facilitate further success in our research program.

We also need at least one additional teaching lab coordinator. Over the past several years, SBS has significantly upgraded its undergraduate educational program, in part by increasing support for undergraduate lab instruction. During 2006-2008, we established budgeted lines for laboratory coordinators in Microbiology and Physiology & Anatomy. During 2008/09 we achieved our two top priorities in this area, creating an additional laboratory coordinator to provide support for SBS core and service courses and creating a full-time undergraduate secretary position. Such increases in support have had direct and indirect positive effects on instruction, including increasing faculty time to invest in course improvements (e.g., developing new materials, implementing new technologies), and encouraging faculty to take on difficult teaching assignments and providing an environment in which we can offer additional lab and recitation sections of high enrollment courses. With the continuing increased enrollments in core courses, the appointment of an additional lab coordinator for Zoology and Ecology and Evolution is essential. These individuals play a crucial role in maintaining and enhancing the quality of our lab courses. Total cost (Salary and wages, full-time 9-month position \$21,000 plus fringes). Note that SBS has already funded significant portions of the additional secretarial and lab coordinator positions (as well as covering shortfalls in Temporary Instructional funds support) through internal re-budgeting. SBS has no ability to contribute further funds to this effort.

The involvement of Life Science faculty outside of SBS in core course instruction is both desirable and possible, with encouragement from UNL administration. We have initiated a pilot project in which a CASNR faculty member is teaching a new section of 100-level Microbiology, helping meet student demand, and SCH credit generated will go to the faculty's home department.

3. Service and SBS core courses.

Over the past several years, SBS has reviewed its basic SBS Life Science core courses, primarily BIOS 101, 102, 103, 205, 206 and 207. This has resulted in better coordinated coverage of key concepts in these courses and a growing acceptance of BIOS 101 as a course targeted for students whose majors are not in the Life Sciences. As a result, many of these courses (besides 101) could be of broad value to many Life Science majors. Our goal has been to make these basic SBS courses effective for as many Life Science majors as possible. We stand ready to work with other departments and units to develop a common core curriculum in Life Sciences at UNL.

We must, however, reiterate that a primary challenge that must be overcome in the development of a coordinated Life Science core curriculum is space, particularly for teaching labs. The best solution to this problem would be construction of an addition to Manter Hall (with a basement), as recommended by external consultants. This project is currently a College of Arts and Sciences priority and has been identified as a serious need by UNL administration.

Process For Developing This Plan: This document is an update of the 2008 Strategic Plan, which was updated in 2009. A preliminary draft was written by Al Kamil, circulated to and discussed by the SBS Executive Committee on January 14, 2010, discussed further at an SBS Faculty Meeting January 19, 2010, revised, reviewed and voted on by email ballot by the SBS Executive Committee and faculty during the last week of January (26 in favor, none opposed).