

THE FUTURE OF INTERDISCIPLINARY  
DOCTORAL EDUCATION  
AT WASHINGTON STATE UNIVERSITY

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# Executive Summary

In February 2005, President V. Lane Rawlins and Executive Vice President Robert C. Bates commissioned the first University-wide Graduate Education Commission (GEC) with the charge to articulate a new identity for graduate education at WSU and to propose the means to achieve this identity. The GEC report recognized the best features of graduate education at WSU including a diverse set of graduate programs and courses, disciplinary depth, well-delivered graduate offerings, world-class technological and distance education capacity, capable graduate students, an environment which values diversity, and caring faculty. The recommendation was made to build on these existing strengths to create a new vision for graduate education with a call to “embrace, evolve, and empower”. First, the University community must embrace the integral role of graduate studies in modern research universities. Second, the culture must evolve to the point where graduate programs become some of our strongest assets and efforts in these programs are valued and rewarded in a performance model for graduate education. Third, the university must be empowered to transform graduate education with the Graduate School taking a strong leadership role in the process.

In August 2005, the Dean of the Graduate School contracted with the Yardley Research Group to conduct a strategic assessment of a selection of the University’s doctoral programs, in order to benchmark them against cognate programs in the University’s institutional peer group. The recent internal (report of the WSU Graduate Education Commission) and external (report of the Yardley Research Group) assessments have concluded that, in order to progress to the next level in national and international stature, the university must nurture and strengthen opportunities for interdisciplinary graduate education without diminishing the strength of core disciplinary training programs. These recommendations are consistent with recent broader assessments of graduate education programs across the United States.

In recognition of the importance of interdisciplinary doctoral education as one component of world class graduate education at major research universities, the Dean of the Graduate School commissioned a Task Force on Interdisciplinary Doctoral Education in August 2007 with the charge to consider the future of interdisciplinary doctoral education at Washington State University and outline a strategy for positioning the university at the forefront of innovations in this area. Specifically, the task force was charged to:

- Articulate a vision for how Washington State University’s interdisciplinary doctoral programs can be enhanced significantly in the next decade.
- Review the range and nature of current interdisciplinary doctoral programs across the university and provide guidance as to how these might be enhanced.
- Recommend guidelines for the development, structure, governance and evaluation of existing and new interdisciplinary doctoral programs.
- Identify mechanisms that ensure faculty receive appropriate credit for participation in interdisciplinary doctoral programs.
- Suggest priorities for marketing, communication, and development plans related to interdisciplinary doctoral programs.

Over the next 6 months, the task force has met and debated the role of interdisciplinary doctoral programs within the University. The result of these discussions is the accompanying report with recommendations that are remarkably consistent with the recommendations of the GEC and

Yardley reports. The Task Force arrived at its final recommendations, outlined below, after recognition of several important considerations. First and foremost, the Task Force recognizes that strong interdisciplinary doctoral programs cannot exist without a base of strong and rigorous disciplinary programs. A commitment to the strengthening of interdisciplinary doctoral programs must not mean a lessening of the commitment to existing excellence in disciplinary programs. Moving to performance-based models of administration and budgeting with clear benchmarks of success for all graduate education efforts will help to ensure that strong, vibrant graduate programs in support of university priorities, whether they are discipline-based or interdisciplinary, continue to thrive and grow across the university.

Second, the Task Force recognizes that strong interdisciplinary doctoral programs provide many competitive advantages for major research institutions:

- Interdisciplinary doctoral programs provide a framework to organize a critical mass of faculty and resources to develop and sustain strong doctoral programs that might not otherwise exist.
- Interdisciplinary doctoral programs stimulate faculty engagement with colleagues with whom they might not otherwise interact, resulting in an enriched intellectual environment that provides fertile ground for development of new ideas.
- Interdisciplinary doctoral programs encourage increased quantity and quality of interdisciplinary research, which opens the door to increased funding; attract high quality applicants for doctoral programs.
- Interdisciplinary doctoral programs positively impact curricular development through faculty modeling of interactions across disciplinary boundaries, decreased redundancy of course offerings, and enhanced flexibility of programs
- Interdisciplinary doctoral programs provide economy of scale with increased efficiency in marketing, recruiting, and retaining graduate students.
- Interdisciplinary doctoral programs prepare graduates who are better able to engage the increasingly complex problems facing society today.

Third, the Task Force recognizes that current interdisciplinary doctoral programs at WSU have often struggled to succeed in a structure of graduate education that values departmentally based programs and rewards individual faculty effort within their administrative units rather than across the university as a whole. Financial strategies and promotion systems shape faculty and departmental attitudes toward graduate studies. In order for real change to occur, there must be a real cultural change across the university as a whole and this transformation must be encouraged by articulation of a vision of transformed, innovative, and integrative graduate education as integral to the fulfillment of WSU's strategic goals.

With these considerations, the Task Force offers the following recommendations to strategically enhance doctoral education at WSU:

1. **Change the institutional culture at WSU to value and encourage efforts that enhance interdisciplinary graduate education.** Both the GEC and Yardley reports clearly state the critical importance of central university administration in catalyzing a change in the culture of graduate education at WSU. The necessary change in culture and vision for the future of doctoral education at WSU must be clearly and persistently articulated by every level of university administration at every opportunity. Part of this message must be a clear commitment to the support of interdisciplinary doctoral education without compromising support for quality disciplinary doctoral programs.

Instead of developing numerous “new” doctoral programs, the university must facilitate efforts to restructure existing programs to create effective critical mass in strategic areas of importance. This may be accomplished by implementing policies for performance-based budgeting for all units across the University; changing the annual review and the tenure and promotion processes across the university to include consideration and credit for efforts in support of interdisciplinary graduate education; and ensuring that all academic units include appropriate recognition of quality and strategic interdisciplinary efforts in their annual review and tenure and promotion assessments.

2. **Empower the Graduate School to participate in the administration of degree granting doctoral programs that cross college boundaries.** When individual faculty are empowered with self-determination for programs that directly impact their research, there is a powerful incentive to strive for excellence. However, this culture of self-determination for doctoral education programs can become a major impediment to the effective governance of interdisciplinary programs that require disparate groups of faculty to function as a single unit. In the end, the success or failure of these programs depend on establishing a structure of governance that can effectively navigate the complexities of individual, departmental, and disciplinary personalities, policies, and preferences. The Graduate School can assist in this process without intervening in critical curricular and programmatic decisions that should and must be decided by the faculty within the programs themselves. This may happen through Graduate School coordination of a system of ongoing strategic planning and consequential review that identifies benchmarks of success for each program; assistance with identification of funding strategies for student stipends; support and encouragement of experimentation in novel styles and approaches to interdisciplinary doctoral education; and assistance with development of flexible guidelines for governance of interdisciplinary doctoral programs.
3. **Provide appropriate assistance to faculty seeking to develop new or enhance existing interdisciplinary doctoral education programs.** Faculty interested in developing cross-departmental and cross-college educational collaborations consistently report difficulties in navigating the labyrinth of requirements for establishing new programs. The Graduate School is available to help when requested, but it is surprising how few faculty actually consider requesting this help. Defining and advertising the mechanisms for support will stimulate faculty to seek assistance earlier in the process and further efforts to establish a collaborative culture that values interdisciplinary doctoral education.

This report is intended as a response to the call to arms issued by the 2005 GEC report. It is meant to serve as a road map for the University as it moves forward toward a stronger, more intellectually vibrant, diverse, and exciting future, where the world's best graduate students join with world-class faculty to solve important problems using innovative approaches. As acknowledged in the GEC report, none of this will work, however, unless there is effective cooperation between and among faculty, departments, schools, colleges, campuses, and University leaders. The University must become an interactive community of scholars who are not defined by the arbitrary boundaries of divisions and units, but instead live in a fluid environment defined by intellectual commonalities and curiosities, where each member of the faculty is comfortable expanding their personal boundaries and redefining their own scholarly focus in response to their community.

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# Background

In the last two years Washington State University has assessed the strengths and challenges of its doctoral education programs. Internal (report of the WSU Graduate Education Commission<sup>1</sup>) and external (report of the Yardley Research Group<sup>2</sup>) assessments have concluded that, in order to progress to the next level in national and international stature, the university must nurture and strengthen opportunities for interdisciplinary graduate education without diminishing the strength of core disciplinary training programs.

These recommendations are consistent with recent broader assessments of graduate education programs across the United States. For example, task forces commissioned by the Woodrow Wilson Foundation<sup>3</sup>, the National Academy of Sciences (NAS)<sup>4</sup> and the Association of American Universities (AAU)<sup>5</sup> have attempted to define the elements of successful interdisciplinary programs. Their findings are perhaps best understood when considered in light of the changes in graduate education that have occurred nationally over the last two to three decades.<sup>6</sup> There has been a shift from open-ended support of basic research to more targeted allocation of federal funds to meet national and societal needs. Societal and legislative pressures encouraged scientists and engineers to contribute to debates on public policy, enhance global competitiveness, create jobs, and improve national education.<sup>7</sup> The result has been a gradual shift away from graduate education solely for the purpose of populating the academy and towards preparation of a highly educated and skilled populace that could meet a diverse range of needs in academia, industry, and government. To address this shifting emphasis, the National Academy of Sciences Committee on Science, Engineering, and Public Policy (COSEPUP) Report of 1995 made broad recommendations for graduate education that included enhancing flexibility of science and engineering programs so that students are more versatile and acquire a broader range of skills, monitor and control time to degree, and provide better and more timely career information and guidance.<sup>8</sup> They concluded by encouraging universities to reshape graduate education to address current national needs and realities. Subsequently, a trio of seminal research reports have further shaped national debate on graduate education.<sup>9-11</sup> Despite differences in perspective and approach, the conclusions from these reports have been remarkably similar to each other and to the conclusions of the COSEPUP report.<sup>6</sup> All emphasize the importance of increasing the versatility, and therefore the career options, of doctoral candidates and all encourage flexible interdisciplinary educational opportunities. It is also recommended that career options be enhanced through training in skills commonly required in business, industry and the private sector including communication, teamwork, and managerial skills; participation in internships; and through provision of career assistance and job placement. The importance of interdisciplinary educational opportunities was recognized because of its potential to prepare doctoral students for diverse career opportunities and also to encourage “adventuresome research”.<sup>3</sup> The vision is that of the student as “citizen-scholar” training to meet a broad range societal needs in a complex world.

## **INTERDISCIPLINARY GRADUATE EDUCATION MATTERS**

### ***What is interdisciplinary graduate education?***

Interdisciplinary education has existed for as long as there have been institutions of higher learning. In its simplest form, interdisciplinary work is the engagement of two faculty with differing academic and research backgrounds in an effort to solve a defined problem or reach a specified goal. At the other end of the interdisciplinary spectrum are large, multi-dimensional programs that result from purposeful investment of significant financial and human resources and may include collaborations spanning across universities, nations, and continents. In order to understand university and national dialogue regarding the future of U.S. graduate education,

it is imperative that discussants agree upon a definition of interdisciplinary education that will facilitate a clear understanding of goals: *Begin with the end in mind.*

Conversations with faculty in departments and colleges across campus reinforce the need for clarity of definitions and goals. For most faculty at WSU, the concept of interdisciplinary education is considered interchangeable with multidisciplinary or cross-disciplinary educational efforts. With the broadest possible definitions of interdisciplinary work (any effort involving faculty with diverse research and academic backgrounds), it is easy to conclude that WSU is rich with successful interdisciplinary endeavors. However, when the definition of interdisciplinary graduate education that is used by national entities such as the NAS and AAU is considered, it becomes clear that WSU has a significant need for clarification and expansion of its efforts in this area.

The National Academy of Sciences defines interdisciplinary research as *a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice.*<sup>4</sup> Thus, true interdisciplinary work goes beyond the separate and additive contributions of multiple traditional disciplines to solve a single research problem (more appropriately termed multidisciplinary research) to integrate and synthesize ideas and methods into a new field of study. By definition, interdisciplinary work extends across the boundaries of traditional disciplinary efforts to create new areas of knowledge. Many areas that are considered interdisciplinary today will become the “traditional” disciplines of tomorrow. The field of biochemistry, which grew from the traditional disciplines of biology and chemistry is now uniformly presented as a unique and well-defined individual discipline. In other words, the best, strongest, and most relevant interdisciplinary fields of study today will become the disciplines of tomorrow. Strong interdisciplinary programs then, by definition, position the university as a leader in research and graduate education. Students in strong interdisciplinary graduate education programs are prepared to investigate complex problems from the perspective of multiple fields of study.

By definition, interdisciplinary graduate education crosses the boundaries of traditional university departments and colleges. Programs may be structured in many ways depending on curricular goals: (1) degree-granting doctoral programs; (2) individualized interdisciplinary doctoral programs; (3) certificate-granting options in existing disciplinary doctoral programs; or (4) intensive individual courses that teach skills of value to doctoral students across a wide variety of disciplines. The availability of diverse interdisciplinary doctoral experiences is important if a university is to provide a flexible range of options to attract students with diverse backgrounds and goals.

- *Degree-granting interdisciplinary doctoral programs.* Fully interdisciplinary programs require creation of degree-granting units that operate outside traditional departmental structures. At WSU, the American Studies, Molecular Plant Sciences, and Materials Sciences programs are examples of such doctoral degrees. The program develops specific course work and core/elective course requirements and the degree title reflects the nature of the program.
- *Individualized interdisciplinary doctoral programs.* These programs provide the ultimate in individual flexibility by allowing students to identify faculty mentors and develop unique doctoral training programs that meet their professional interests. The Individual Interdisciplinary Doctoral Program (IIDP) at WSU has been an option for students since

1983. The program coordinator is housed in the Graduate School. Students are accepted into the IIDP because they have a research topic/proposal that cannot be adequately accommodated in an existing doctoral program. Students must identify areas of research and faculty advisors across three disciplines prior to initiating a formal application to the program.

- Certificate-granting options in traditional doctoral programs. Interdisciplinary graduate work may also be recognized by conferring graduate certificates in the interdisciplinary area in conjunction with a doctoral degree in a traditional department-based disciplinary program. In order to earn the certificate, students must complete specific course and activity requirements in addition to regular departmental degree requirements. The Protein Biochemistry Certificate awarded by the Biotechnology training program at WSU is an example of such a program.
- Interdisciplinary courses that teach broadly applicable skill sets. In some instances interdisciplinary education may include programs that train students with mastery and depth of knowledge in a traditional discipline but with access to elective courses that teach the tools to communicate and collaborate with scientists in disparate fields or train students in the use of the techniques from multiple disciplines to solve defined problems. These types of courses provide focused training opportunities in areas of importance to students from a broad range of disciplines. Examples include intensive summer course work in communication and leadership, entrepreneurial experiences, or team-based project courses.

### ***Why is interdisciplinary graduate education important?***

Researchers are driven by curiosity about the world around them – its social structure, its natural phenomena, the complexities of life. Although the objectives of an individual project may appear to be finite and limited, the questions that led to that project are almost invariably large and complex. According to the National Academy of Sciences<sup>4</sup> four factors drive interdisciplinary research and education: an increasing recognition of the inherent complexity of nature and society; the desire to explore questions that are not confined to a single discipline; the need to solve complex societal problems; and the power of new technologies. However, strong interdisciplinary programs cannot exist in a university that lacks strong disciplinary programs. The two efforts are not mutually exclusive, but rather must be fostered together as complementary and mutually enhancing.

Problems facing the world today are complex, multidimensional and challenging: for example, understanding the physical processes that impact global climate change; developing an integrated understanding of social, cultural, and economic issues that drive global politics; designing alternative energy strategies that are sustainable and affordable; integrating artificial intelligence into daily life in a way that enhances society; deciphering physical and biological processes that are the basis of life. The intellectual leaders who solve the problems of today and tomorrow must be curious, innovative, flexible, and willing to take risks inherent in social and scientific experimentation. They must be competent and effective in team problem-solving. They must be able to communicate complex ideas in terms that are understandable by colleagues with varying backgrounds and expertise. Doctoral training programs that foster scholarship, leadership, and communication will produce tomorrow's leaders.

Graduate students are being trained for a wider variety of careers than ever before. No longer can it be assumed that all students in training desire to enter the academy. Entry of graduates

into government and private-sector careers can no longer be viewed as a “second class” outcome. Students must receive experience relevant to academic and nonacademic careers through mentoring and internship opportunities in a wide variety of settings if universities are to meet the changing needs of society. Similarly, the best graduate programs of the present and future must recognize and embrace the globalization of research and career opportunities, providing students with an international understanding of their field and preparing them for global communication challenges. This includes developing understanding of complex business, social, ethical, cultural and policy issues that inevitably complicate and impact global problem solving.

***How do strong interdisciplinary graduate education programs strengthen the university?***

1. Strong interdisciplinary doctoral education provides a framework for excellence based on a solid critical mass of faculty and resources.

Building world class graduate programs requires a core of faculty committed to each program. The recent Yardley report recommends that “critical mass” needed to develop and sustain a program should include a minimum of seven research-active faculty.<sup>2</sup> The small size of some current doctoral programs makes it difficult to offer core courses and specialization electives on a consistent basis. In some cases, this problem has been addressed by combining departments and programs. Examples of this include formation of new groups in biosciences and in economics/agricultural economics by combining pre-existing smaller departments. However, in many cases the original disciplinary groups have continued to offer separate disciplinary degree programs and faculty continue to function in graduate training in the same way that they did when they were in separate departments. A lack of critical mass also impacts the strength and productivity of research programs. The Yardley Group report uses the example of an individual department that self-identifies with four areas of specialization within their discipline with only 10 faculty in the department. Clearly, it is difficult to build national and international stature in specialty areas when the emphasis is breadth rather than depth of expertise. Establishing broad-based graduate education programs that are truly interdisciplinary provides a partial solution to the problem of cultivating critical mass in specific disciplines. However, this approach requires a willingness on the part of the university and individual faculty to give up on “a model of comprehensive higher education that has been economically unfeasible for most public universities since at least the 1980’s”.<sup>2</sup>

2. Strong interdisciplinary doctoral education stimulates faculty engagement with colleagues with whom they might not otherwise interact, resulting in an enriched intellectual environment that provides fertile ground for development of new ideas.

The development of curricula and training plans for world class interdisciplinary doctoral education programs requires that groups of faculty interact to develop interdisciplinary courses, new curricular structure, and supervise graduate research programs. This process inevitably brings together faculty from multiple disciplines, departments, and colleges in new ways to foster the “culture of collaboration” that was encouraged by the recent Yardley Group review of WSU graduate education.<sup>2</sup> This is evident in the outcomes assessment surveys of faculty involved in the National Science Foundation’s Integrative Graduate Education and Research Traineeship (IGERT) programs.<sup>6</sup> Nearly three-quarters (72%) of faculty report that participation has enabled them to work with faculty in other departments who they would not otherwise have met, and 77% report that being a part of this type of interdisciplinary graduate education program enabled them to get exposure to new ideas outside their area of knowledge. Almost half of involved faculty (49%) report having learned new research techniques. Department

chairs agree with these faculty assessments and report that IGERT involvement has improved the quality of faculty research (54%) and altered the research scope of involved faculty (44%),

3. Strong interdisciplinary doctoral education encourages increased quantity and quality of interdisciplinary research, which speeds the solution of complex societal problems and opens the door to increased funding.

Participation in interdisciplinary graduate programs such as IGERT leads to enhanced research funding. Approximately 80% of IGERT faculty were awarded new research grants during their period of involvement with the programs as compared to only 67% of non-IGERT faculty.<sup>6</sup> Not surprisingly, IGERT faculty produced more multi/interdisciplinary publications during that period than did their non-IGERT peers (76% and 60% respectively). IGERT faculty were one and one-half times more likely to have presented their research results at conferences outside their home disciplines and were more likely to publish their research findings in journals outside their home disciplines (63% and 48% respectively).

4. Strong interdisciplinary doctoral education attracts the highest quality of applicants.

At Iowa State University the average GRE scores for students in 10 interdisciplinary graduate programs exceeds that of students in the 10 most similar traditional departmental degree programs.<sup>12</sup> The desire to participate in interdisciplinary graduate education probably reflects the increased intellectual curiosity of the best students. There is a strong perception among the public that the leading edge of science crosses boundaries and the excitement of science springs from the tangible possibility of understanding the complexities of nature. For example, students learn in high school and undergraduate studies of the exciting breakthroughs that are solving heretofore unsolvable biomedical and biological mysteries. Truly great students are enthusiastic about the possibility of exploring several areas of research at the boundaries of science where breakthroughs are most likely to occur. Students are attracted to the depth and breadth of courses that can be offered when participating faculty originate from a diverse array of departments and colleges. Freedom to choose a thesis project from amongst the work of a diverse group of world-class faculty is a strong enticement for student enrollment and access to great graduate students is a primary driving force for active faculty participation in interdisciplinary doctoral programs.

5. Strong interdisciplinary doctoral education positively impacts curricular development through faculty modeling of interactions across disciplinary boundaries, decreased redundancy of course offerings, and enhanced flexibility of programs.

Vibrant graduate education requires constant vigilance to monitor the rigor and currency of curricular requirements. In order to attract students with diverse backgrounds, skills, and talents, programs must be flexible and contemporary. Establishing and maintaining strong interdisciplinary doctoral programs require faculty to regularly review curricula and clearly articulate the importance of core requirements to colleagues in other departments and colleges. Quality interdisciplinary doctoral programs should have fewer core course requirements than their disciplinary parallels. Faculty from involved disciplines must mutually answer the question, "What is core knowledge?" This exercise may have the added benefit of stimulating faculty to have similar discussions regarding "core knowledge" in disciplinary programs resulting in increased flexibility for all university doctoral education. Active mentoring of students by program faculty then identifies elective course work that best meets the needs of the individual student. This approach requires that faculty trust in the integrity of the system and their colleagues as well as the intellectual curiosity of students to maintain the desired level of rigor.

Success within these newer programs may then provide faculty with the confidence to increase flexibility within existing disciplinary doctoral programs, enhancing the quality of doctoral education across the university. Team-teaching is a common and desired component of interdisciplinary graduate education. Courses that are team-taught can foster efficient use of faculty time by decreasing redundancy of courses that are broadly applicable to students in many programs (e.g. statistics, ethics). Well designed, team-taught courses have the potential to model interdisciplinary interactions and applicability to students, provide a venue for enhancing communication skills across disciplinary boundaries, and provide a framework for team-based, project centered activities.

6. Strong interdisciplinary doctoral education provides economy of scale with increased efficiency in marketing, recruiting, and retaining graduate students.

There is increasing national and global competition for top graduate students. Small programs struggle for visibility in this environment and often lack the resources to compete effectively. Interdisciplinary programs are larger and can draw on varied department, college, university and external resources to “brand” their program and enhance recognition of quality at a national and international level. Hosting recruiting fairs can be an efficient way to attract quality doctoral applicants to campus for targeted recruiting. Participation of many applicants and faculty over 2 or 3 days can generate a sense of collective excitement and enthusiasm that is difficult to replicate with individual student visits to campus. Prospective students can witness a collegial team atmosphere that inspires them intellectually and personally. Intensive recruiting events also use faculty time for recruiting more efficiently than individual student visits. By appropriately identifying students prior to their visit and investigating their individual goals and talents, interview and discussion time with individual faculty or teams of faculty within the larger interdisciplinary group may be arranged. This provides the excitement and enthusiasm of large group interactions with a level of personalization that promises a quality mentoring experience.

7. Strong interdisciplinary doctoral education prepares graduates who are better able to engage the increasingly complex problems facing society today.

The changing face of graduate education in the United States is occurring in response to the increasing globalization of problem solving and the recognition of the interrelatedness of all communities. As a society, we can no longer afford to examine problems solely from the relative isolation of the university environment. Faculty and students must expand their vision and embrace collaboration, innovation, and extension of their mission beyond the academy. Academic institutions are notoriously slow to change. A study of universities within the United States revealed that the average time between adoption of an innovation by the first institution and its adoption by half of the rest of the institutions studied was more than 25 years and that this process was apparently random.<sup>13</sup> The key to survival and growth in a rapidly changing world is the ability to respond rapidly to change. The university must find ways to reward innovation in graduate education just as it rewards innovation in research and scholarly activity. Today’s graduate students have grown up with rapid technological and societal change. They are more comfortable with rapidly shifting paradigms and programmatic experimentation than are many university faculty and administrators. Today’s doctoral candidates are searching for an environment that provides them with rigorous training that can be applied to problems of global significance. They want to see the significance of their individual work with in the context of a broader world view. They recognize that the exact nature of the problems being investigated will certainly shift over their professional lifetime and that they need a flexible, dynamic educational program that will better prepare them to shift with their world.

### ***Why not interdisciplinary graduate education?***

Although there are clearly compelling reasons for the development of interdisciplinary doctoral training programs, these efforts will not be embraced across the university without first confronting concerns regarding such initiatives. Faculty cite three major worries when they contemplate a growing university emphasis on interdisciplinary graduate education: (1) fear that depth of disciplinary understanding will be sacrificed in favor of breadth of training experiences; (2) loss of marketability of graduates because they do not fit traditional disciplinary academic molds; and, (3) lack of value to funding agencies that support graduate stipends for specific research efforts.

Many faculty are understandably wary of graduate training programs that provide breadth of knowledge at the expense of depth of understanding in a major field of study. In its worst form, this undermines the very heart of graduate education. However, outcome assessments of students in interdisciplinary graduate programs suggest that such concerns are largely unwarranted. Outcome surveys of students and faculty involved with the NSF's interdisciplinary graduate education programs (IGERT) show that only 21% of involved faculty felt that IGERT students had diminished "content expertise" because of spending time working across disciplines.<sup>6</sup> When IGERT faculty were asked to assess how well their students were being prepared to know their own discipline in depth, their assessments of their students' preparation was similar to assessments by non-IGERT faculty of the preparedness of their respective doctoral students.<sup>6</sup>

A second frequently cited concern regarding interdisciplinary graduate education is the possibility that students will not be prepared for traditional academic careers because of the nature of their program or the title of their degree. This may be a very real concern in some disciplines where specific professional training and licensure eligibility is implied by a specific degree program or title. However, for the majority of programs the concern appears to be more perceived than real. Students participating in IGERT interdisciplinary programs are just as likely to report that their program prepares them for work in an academic setting as are their non-IGERT peers (82% and 78% respectively).<sup>6</sup> All doctoral students are less likely to feel as if their graduate education prepares them for work in industry as compared to academic employment, but IGERT students report a better feeling of preparation than their non-IGERT peers (40% and 29%, respectively). Indeed, in a pilot survey only 8% of IGERT graduates overall reported difficulty in finding their current job compared with 25% of non-IGERT graduates. Furthermore, the real or perceived impediments of degree title may be overemphasized if it is considered that doctoral degrees at WSU are awarded in the name of the Graduate School and not individual programs. The only place a degree title appears on student records is as the "major" listed on the transcript. The name that is used is largely at the discretion of the program involved and the person receiving the degree.

The third concern voiced by faculty at WSU related to an increasing emphasis on interdisciplinary graduate education is the real or perceived lack of value to funding agencies when grant dollars are used to pay stipends to students who are not devoting their entire attention to the funded project. Faculty at WSU are more reluctant than faculty at peer institutions to include graduate student stipend requests on extramural grant proposals. Major granting agencies such as the National Institutes of Health and the National Academy of Sciences are strongly committed to support of quality graduate education. They recognize and emphasize the value of interdisciplinary research and graduate training and it is inconsistent with their values and funding policies to think that they would not recognize and encourage use of funds in support of the strategic benefits derived from innovative and flexible doctoral educational programs.

World class doctoral education at WSU will require continued attention to a core of traditional, rigorous, discipline-based graduate programs. It is impossible to build quality interdisciplinary graduate programs unless there is a solid foundation of disciplinary strength. However, in order to establish and maintain a position at the forefront of graduate education it is clear that the university must also cultivate complementary interdisciplinary programs as well.

***What are the challenges facing the growth of interdisciplinary graduate education at Washington State University?***

Engaging in faculty dialogue about interdisciplinary graduate education at Washington State University quickly reveals that faculty are very interested in these types of programs and recognize their strengths and advantages to students, faculty and the university. However, such dialogue and supporting investigation reveals that there are three major challenges facing the growth of interdisciplinary graduate education programs at WSU:

- Lack of focus in the development and growth of programs.
- Lack of perceived or real credit for faculty efforts.
- Insufficient funding for student stipends from TA, RA, or training grant sources.

***Lack of strategic focus in the development and growth of programs***

To date, interdisciplinary graduate education has grown from faculty initiatives in response to a perceived individual need. In many cases, program development was driven by the recognition that faculty numbers in traditional department-based disciplines were insufficient to achieve national and international recognition or ranking in a specific program area. For example, the desire to achieve critical mass and recognition in a specific area of research or graduate education prompted faculty from diverse backgrounds to join forces to create new programs such as Materials Science and Molecular Plant Sciences that would have greater depth of support across the university and greater visibility within the academic community. In many cases, interdisciplinary efforts were initially focused on facilitating related research efforts, and initial goals included combining resources to acquire and manage shared facilities and equipment. Graduate education was included as a secondary consideration and was designed to fit into existing departmental programs as certificate programs (e.g., Biotechnology). For other programs, the interdisciplinary effort was confined to initial recruiting and marketing efforts and the first year or two of the doctoral program, after which students completed their education in a traditional department-based program (e.g., proposal for Life Sciences Program).

The grass roots approach to development and growth of interdisciplinary graduate education has the advantage of ensuring active faculty engagement and investment in the programs. The corresponding lesser degree of central involvement is a strength in providing a free environment for individual faculty thought and innovation. However, attempts to design interdisciplinary programs that can fit into the established culture of traditional discipline-based doctoral programs has, not surprisingly, resulted in a variety of challenges to their success. The minimal central administrative involvement, although providing an environment of intellectual freedom, also impedes program development and growth in several ways.

1. *Faculty interested in developing new interdisciplinary graduate programs lack support services and resources to assist them with the process.*

In essence, each group of faculty interested in developing a new interdisciplinary graduate education program must “reinvent the wheel”. There are no readily accessible human, fiscal, or physical resources to assist them in understanding the steps to develop a program. As a result, faculty must identify important criteria, develop plans to finance their efforts, negotiate resources from multiple departments in multiple colleges, design a curriculum that meets university requirements, design an effective administrative structure, and determine how to align their goals with the goals of individual departments, colleges, and the university as a whole.

Discussions with faculty currently working to develop interdisciplinary doctoral programs in STEM education and biotechnology quickly reveal that those faculty have had minimal dialogue with leaders of established interdisciplinary programs on campus. As a result, they are struggling with problems and roadblocks that have been previously negotiated by earlier programs. This lack of dialogue results, at best, in frustrating delays and, at worst, completely derails new programs. Access to resources that clearly outline the steps in program development and provide direction to resources that can illuminate options for resolution and compromise in program development would significantly enhance the likelihood of developing programs successfully from idea to reality.

2. *There are no readily accessible models or guidelines for the governance and administrative structure of interdisciplinary graduate education programs.*

Current interdisciplinary graduate education programs at WSU vary widely in their approach to program administration and governance. When lines of communication, reporting, and resource allocation are unclear and involve multiple departments or colleges, the situation is ripe for competitive strife. Although joint responsibility for program success is a laudable ideal, this administrative structure may set the stage for joint denial of responsibility and can leave directors and programs in stalemate situations as they try to navigate organizational and funding labyrinths that are complicated by personalities and perceptions of power. Furthermore, these joint structures are more subject to instability when there is turnover among the multiple department chairs and deans on which the program depends.

It would be extremely difficult to develop a single model of governance that would meet the needs of widely diverse programs. However, it is equally clear that the administrative structure of an interdisciplinary graduate program has a tremendous impact on its success. It is imperative then that the university provide guidelines or best practices for administrative options if interdisciplinary graduate education programs are to have an optimal opportunity for success. Such guidelines should be flexible so that they may be adapted to the diverse needs of the university community but must clearly define the duties and responsibilities of all parties.

3. *Programs have no mechanism for consequential internal or external assessment of performance.*

As a result of the diversity of administrative structures for current interdisciplinary graduate education programs and in an attempt to conform to a university culture that tends to spread resources too thinly, based on historical patterns, most interdisciplinary (and for that matter departmentally-based) doctoral programs at WSU have evolved without clearly defined mechanisms for periodic strategic planning, assessment, and consequential review. Faculty members are required to provide annual review documents to their department chair to assess performance and establish future job expectations. Departments provide annual reports to the

College for similar evaluative purposes. Colleges report to the university their strategic plans and progress toward established benchmarks. It is illogical to establish interdisciplinary programs that have no accountability, undergo no periodic strategic planning, lack mechanisms for periodic review, and have no mechanisms for consequential assessment of progress toward established benchmarks of success.

University faculty are often averse to the idea of assessment because of the resistance to “reductive and ultimately misleading measures of educational quality”.<sup>3</sup> These fears are especially warranted when review occurs by administrators who are removed from the actual programmatic effort. There must be a conscientious dialogue between the program, department, college, and graduate school to establish mutually agreed upon measurable and substantive benchmarks of success. Although these activities may be viewed as tedious and time-consuming by faculty and directors, they provide a critical opportunity for reflection and clarification of program direction. Good assessment promotes a dialogue between the program, department, college, and graduate school. Consequential evaluations also allow program directors to advocate for resource allocation. If resource allocation is clearly aligned with assessment of progress toward mutually agreed upon benchmarks, goals, and other indicators of impact and value, programs have a strong incentive to perform to their full potential. In short, attainment of specific objectives must be rewarded with commensurate increases in the allocation of valuable resources. Similarly, failure to attain objectives and build quality programs that strategically advance the university, must have consequences.

4. *There are no resources allocated to nurture the development of nascent interdisciplinary doctoral programs or to reward the continued success of established programs.*

There can be no *consequential* assessment of program performance as described above if there are no meaningful positive or negative *consequences* of performance assessment. In any environment, the allocation of human, physical, and fiscal resources in support of successful programs, or those with potential for success, is a strong predictor of positive performance outcomes. At this time, interdisciplinary graduate education programs rely upon benevolent allocation of resources from participating departments and colleges. This system does not work for support of interdisciplinary graduate programs unless departments and colleges have an altruistic approach to resource allocation that is rarely observed in modern universities. One possible solution, and one that has been implemented at many of WSU's peer research universities including the University of California at Davis, Arizona State University and the University of Washington, is for interdisciplinary graduate education programs to report to the Graduate School.

The National Academy of Sciences identified traditional departmental based allocation of financial resources as one of two structural impediments to successful interdisciplinary research and teaching (the other is the academic promotion and reward system as discussed below). In its report entitled *The Responsive PhD: Innovations in U.S. Doctoral Education*, the Woodrow Wilson National Fellowship Foundation identified four principles that should guide development of doctoral education in the future.<sup>3</sup> The first of these principles states that “*the Ph.D. degree requires strong graduate schools and graduate deans with real budgets and real scope – a far stronger central administrative structure than typically exists at present*”.<sup>3</sup> If the university desires to build strong graduate programs, especially interdisciplinary graduate programs, there must be significant realignment of resource allocation processes in accord with this goal. The graduate school must have a budget with a function – the function of nurturing the growth and meaningful development of graduate programs across the university.

5. *When programs develop strictly from faculty initiatives, there is no targeted development of programs that are in alignment with strategic university priorities.*

Six areas of established pre-eminence in research, scholarship and graduate education have been proposed at WSU: Molecular Basis for Mammalian Reproduction, Advanced Materials Technologies, Molecular Plant Science and Genetics, Infectious Disease at the Human-Animal Interface, Linking the Brain to Behavior and Performance, and Clean Energy Technologies. There are established interdisciplinary doctoral education programs that complement three of these areas: Materials Science, Molecular Plant Sciences, and Neuroscience.

The national and international reputation of research universities depends largely upon the national and international reputation of their research and associated doctoral programs. If the university is to move forward with specifically identified areas of research excellence (that is, “peaks”) that are integrated across the university system, these peaks must coincide with areas of excellence in doctoral education or they will not rise to national and international prominence. Strong interdisciplinary research programs cannot exist in the absence of parallel strength in interdisciplinary doctoral education programs. It is logical that the university should prioritize resource allocation for real investment in the development and strengthening of graduate programs that are in direct alignment with its stated priorities.

Resource allocation in support of targeted university priorities may take the form of reassessment of strategies for graduate assistantship distribution, targeted hiring of faculty in strategic areas, changing faculty effort distributions to allow talented researchers sufficient time to mentor additional students, and providing departments with resources to compensate for faculty participation as directors or administrators of programs

*Lack of perceived or real credit for faculty efforts.*

The participation of talented and productive faculty is an essential component for success of interdisciplinary programs. The report of the Interdisciplinarity Task Force of the AAU states that “the quality and engagement of the faculty is the reason most consistently given to explain why highly successful interdisciplinary centers achieve their success”.<sup>5</sup> Yet, numerous evaluations of interdisciplinary graduate education in the United States have concluded that traditional university tenure and promotion procedures are a major impediment to developing strong interdisciplinary doctoral programs.<sup>1-5</sup> In order to attract and sustain the participation of great faculty members in interdisciplinary programs, these faculty must receive tangible intellectual and professional recognition and reward for their efforts.

The importance of this point in promoting real and sustained growth in interdisciplinary graduate education at WSU was emphasized in the recent report of the WSU Graduate Education Commission when they recommended that the university “promotion and tenure procedures and other University policies need to be reworked to help promote interdisciplinary scholarship, teaching and training” and that the university must “develop reporting and accounting procedures that give appropriate credit (e.g. for teaching, graduate student advising, publication, and grant expenditures) for interdisciplinary contributions”.<sup>1</sup> These recommendations are nothing short of a call for culture change within the university resulting in a removal of real and perceived institutional barriers to collaboration.

1. *Difficulties in accurately assessing faculty effort in interdisciplinary programs.*

The Assessment of Doctoral Programs for Washington State University prepared by the Yardley Research Group<sup>2</sup> included in its Executive Summary a call for development of a budgeting and

accounting system such “that costs, revenues, and other productivity indicators can be tracked flexibly and not simply on the basis of defined administrative entities”. In other words, the university must devise a system to account for faculty efforts when those efforts span departmental and college boundaries. Flexible accounting systems are being investigated and implemented by major research universities across the nation so that the university can track cost, revenue and other measures of productivity in any way it desires. For example, an individual faculty member may be coded to reflect membership in a program, department, college, interdisciplinary program, etc. and their productivity readily attributed to one or more of these entities as deemed appropriate.

2. *A long-standing culture of individual effort and reward.*

The academic promotion and tenure system is based on assessment of individual productivity and accomplishment: the number of books authored, the number of primary author peer-reviewed papers, the number of grants as principal investigator, the number of courses taught. Because professional advancement is based largely on assessment of these individual efforts, mentors and department chairs at times actively discourage young faculty from participation in interdisciplinary, collaborative efforts. If the university values interdisciplinary efforts, then the tenure and promotion system must be revised and implemented to reflect this value. Tenure decisions for young faculty may require input from tenure committees with interdisciplinary representation. Similarly, interdisciplinary participation must be assessed and rewarded for all faculty at the time of annual review.

3. *Concern regarding the impact of interdisciplinary graduate programs on national rankings of programs that have traditionally been departmentally based.*

Regardless of the accuracy of such assessments, independent national rankings undoubtedly impact perceptions of the quality of graduate programs and influence student decisions. When university accounting systems do not accurately reflect faculty effort and student numbers, there is the very real possibility that the numbers reported to ranking agencies will not reflect the true status of a program. In areas such as engineering, business, and health sciences such inaccurate rankings can lead to real difficulties in recruiting top graduate students. The Office of Institutional Research is aware of these issues and could take a leadership role in developing policies and procedures that can reflect programmatic concerns while maintaining accuracy of reporting.

4. *Departmental and college reluctance to allocate substantive faculty time to support of interdisciplinary programs.*

Perceptions of the inherent inadvisability of participation in interdisciplinary programs are not limited to individual faculty. In many instances these perceptions, and hence their realities, are promoted and reinforced by department chairs and deans who actively advise faculty, especially pretenure faculty, not to become involved with such efforts. As noted in the recent WSU Graduate Education Commission report, “...interdisciplinarity at WSU is essentially volunteer work, and department chairs often view it as detracting from departmental efforts.”<sup>1</sup> These perceptions and realities will only change when the perceptions and realities at the highest level of university administration change. The university must recognize “*the folly of rewarding A while hoping for B*” and truly realign reward systems with stated priorities. Of course, the realities of faculty time management compel the realization that addition of new interdisciplinary obligations, rewarded or not, cannot come in addition to existing faculty responsibilities. These interdisciplinary obligations must replace current job responsibilities. This revision of job descriptions for faculty must be done thoughtfully with a view of the “bigger picture” of educational and research goals in the department, college, and university – and the resources so that budget matches all priority missions.

*Insufficient funding for interdisciplinary student stipends.*

Many aspects of recruiting and retaining quality graduate students depend upon a program's ability to provide adequate stipend support throughout the student's tenure at the university. Historically, these stipends are provided through Teaching Assistant (TA) and Research Assistant (RA) funding. This funding may originate from many sources, most notably state funds, individual research grants, and graduate training grants. Stipend support for students in interdisciplinary programs suffers as compared to funding for students in traditional discipline based programs for several reasons.

1. *Lack of access to TA funding.*

As at most major research universities, TA positions at WSU are allocated to individual colleges and departments to support important undergraduate teaching missions. Departments then typically assign TA support to graduate students in the departmentally based doctoral programs for which their department is directly responsible. Interdisciplinary doctoral programs such as American Studies or Materials Sciences have no access to this TA support without making strongly justified individual requests to departments or colleges. This puts directors of interdisciplinary programs in the uncomfortable position of having to compete with their own department for access to resources. The inconsistent (or complete lack of) access to TA or fellowship support significantly undermines the ability of interdisciplinary programs to guarantee support to talented incoming graduate students. Hence, students must be funded throughout their academic training on RA support from an individual faculty member. If the faculty mentor has a lapse in research funding for a period of time there is no TA funding to ensure that graduate students can continue their program. As a result, most graduate students in interdisciplinary programs at WSU obtain no teaching experience while in their doctoral training program. This leaves them unprepared and untrained for a very important aspect of their job if they should continue on in academia. In order to balance undergraduate teaching needs and graduate support needs, there must be a change in the culture of how students are chosen to fill TA slots. However, award of TA slots to students in interdisciplinary programs must not remove undergraduate course directors and department chairs from the process of TA selection for their courses. Department chairs have ultimate responsibility for the quality of undergraduate teaching and must therefore retain final authority in selection of TA support for their courses.

2. *Insufficient numbers and quality of graduate training grants.*

Federally or privately funded graduate training grants provide an excellent mechanism for support of graduate training programs. Although not all training grants are interdisciplinary in nature, many are. The Graduate Education Commission report<sup>1</sup> noted that "for a university of our size and research productivity, we would expect significantly more training grants from the NIH, NSF, and other agencies". According to their data, WSU currently has 3 training grants (2 from NIH, one from NSF) whereas peer institutions average 15 such grants (9 for peers without a medical school.<sup>1</sup> Institutionally, we have not promoted such grant activity and we have not established central support mechanisms to aid preparation and submission of these proposals. The preparation of a competitive training grant proposal can be tedious and time-consuming, especially in an environment where required statistical information is not readily available and there are no designated support mechanisms for acquiring these data. Given the inherent difficulty of the task, the lack of a strong central message in support of training grant proposals, and the historical lack of emphasis on doctoral training within the university, it is not surprising that faculty do not pursue these granting opportunities.

## MOVING FORWARD

The challenges and opportunities described in this report are not unique to WSU. There are innumerable experiments in graduate education underway at research universities across the country designed to address one or more of these challenges and opportunities. The diverse spectrum of approaches provides a varied palette of opportunities for the design of programs that complement the unique talents and strengths of WSU faculty. The variety of programs in various stages of consideration and development at WSU clearly indicates a broad faculty interest in interdisciplinary graduate education. What is missing is a clear articulation of vision from the university administration and implementation of a support structure to guide the development of new programs and nurture the continued growth of existing programs.

The plan presented in the next section of this report is offered as a roadmap to achieve specific goals that will collectively enhance interdisciplinary graduate education in a way that enriches the educational experience of students and maximizes the intellectual return for faculty.

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# Recommendations

# **A Plan for Enhancing Interdisciplinary Doctoral Education at Washington State University**

## **1. Change the institutional culture at WSU to value and encourage efforts that enhance interdisciplinary graduate education.**

Since its last strategic planning in 2002, Washington State University has made significant investment in world-class undergraduate education programs. Results of this investment have been impressive. It is now time for the university, without lessening its commitment to strong undergraduate education, to turn its attention to a second principal goal of the 2002 plan: to nurture a world-class environment for research, scholarship, and graduate education. This shift in focus was heralded by commissioning of internal and external reviews of current doctoral programs.<sup>1,2</sup> The reports that emerged from these reviews offer a comprehensive assessment of current strengths and weaknesses in doctoral training programs at WSU. Both groups clearly state the critical importance of central university administration in catalyzing a change in the culture of graduate education at WSU. Indeed, the first recommendation for change from the Graduate Education Commission is that “the Washington State University community, from regents to individual faculty, articulate its commitment to graduate education, and especially to doctoral programs, and develop and implement precise policies, procedures, and resources to deliver on this commitment”. The necessary change in culture and vision for the future of doctoral education at WSU must be clearly and persistently articulated by every level of university administration at every opportunity. Part of this message must be a clear commitment to the support of interdisciplinary doctoral education without compromising support for quality disciplinary doctoral programs. Instead of developing numerous “new” doctoral programs, the university must facilitate efforts to restructure existing programs to create effective critical mass in strategic areas of importance.

### ***1.1. Articulate from the highest levels of the university a clear vision that supports strategic enhancement of quality interdisciplinary doctoral education.***

In the last two years, this university has conducted a dialogue with the purpose of envisioning the future of graduate education at WSU. It is clear that faculty leaders across all colleges recognize the importance of interdisciplinary programs to the future of doctoral education at WSU. In short, the vision of the future has been established from dialogue and recognition of shared goals and aspirations. It is now time for the university administration at every level to embrace the vision with enthusiasm and ensure its effective communication across all parts of the campus. A sharply defined vision statement must be drafted and articulated using available marketing expertise. This vision statement and its associated symbols must be used to punctuate university communication at every available opportunity and in every available venue. It is notoriously difficult to bring about change within a large institution populated with diverse, confident individuals; however, with repeated discussion and exposure to new approaches, the new becomes old and a change in thought patterns emerges across the community. It is the responsibility of the administration to refine and share the common vision of interdisciplinary doctoral education at WSU with enthusiasm and optimism.

**1.2. Ensure that every step in the process of achieving this vision is transparent and clearly communicated.**

At the heart of most interpersonal and professional conflicts are difficulties with the quantity or quality of communication. Certainly, in an academic environment, the failure to adequately communicate the progress of change to individuals directly or indirectly affected by that change is an almost certain recipe for conflict and failure. If a shared vision is to be developed, communicated, and adopted across a widely diverse group of people, it is incumbent upon the Graduate School to keep those people informed. Because different people communicate with different styles and in different media, the communication must occur in multiple styles and media. Also, it cannot be overlooked that the most effective communication remains “face to face”. The enthusiasm and commitment to change that is communicated by walking the corridors and across the campus lawns to visit and speak directly with faculty must not be underestimated.

**1.3. Implement policies of performance-based budgeting for all units across the university.**

The “folly of rewarding A while hoping for B” has long been recognized within the business community<sup>14</sup> and yet the academic community often ignores this basic tenet of professional motivation. The Yardley Group report on graduate education at WSU adamantly insists that “the University needs to move away from its current isolationist practice of egalitarian budgeting toward a system of performance-based measurement and budget allocation” so that the University can “align its budget in order to further specific strategic intentions”.<sup>2</sup> Motivating change is greatly facilitated when there are tangible rewards for that change. In the case of interdisciplinary doctoral education, this may take various forms including: (1) salary release money awarded to departments in exchange for faculty time committed to directing or teaching in interdisciplinary doctoral programs; (2) salary supplements for faculty who take on administrative work in such programs without giving up substantial portions of their other academic commitments; (3) teaching or research assistantship support; (4) funds for administrative support staff; or (5) funding and support for marketing and recruitment of graduate students.

**1.4. Change the annual review and the tenure and promotion processes across the university to include consideration and credit for efforts in support of interdisciplinary graduate education.**

In the final analysis, faculty performance is measured by the annual review process, culminating in decisions related to tenure, promotion, and salary adjustments. If faculty commit a significant proportion of their time to pursuing interdisciplinary graduate mentoring, they run the very real risk of having those efforts unrecognized by their “home” department and college in their annual review. A number of possible solutions to this dilemma might depend on changing the perception of the value of this work to the university as a whole or changing the way that tenure, promotion, and salary adjustments are considered. Certainly, definitive evidence of the value of interdisciplinary work across all units of the university will assist in changing the *perception* of a problem. Changing data reporting practices at the Office of Institutional Research will further improve the situation by providing mechanisms for accurately accounting for effort across disciplinary boundaries. Other solutions that have been implemented at peer institutions include requiring interdisciplinary tenure and promotion committees, specifically evaluating

interdisciplinary activities as a discrete section of the annual review process, and requesting evaluation letters from deans, department chairs or program directors that oversee the interdisciplinary programs in which the faculty member is involved. Finding creative solutions that will work at WSU will require input from many stakeholders and careful consideration of the broader implications of any approach. Strategies that work in one department or college may differ from those ultimately chosen for other units. However, the overall outcome should be the same: appropriate recognition and reward for substantive faculty contribution to those interdisciplinary doctoral education programs that strategically advance the mission and reputation of the institution.

**1.5. Ensure that all academic units include appropriate recognition of quality and strategic interdisciplinary efforts in their annual review and tenure and promotion assessments.**

The real or perceived lack of “credit” for faculty efforts is one of the most frequently cited reasons for reluctance to participate or encourage participation in interdisciplinary doctoral education programs, and its importance must not be underestimated. The real problems must be addressed largely through revisions in policies and procedures within the Office of Institutional Research. This is in accordance with recommendations from the Yardley Report that strongly suggest that WSU develop “a budgeting and accounting system that defines “unit” as the individual faculty member” such that “an individual faculty member can be coded so that (s)he is a member of a program, a department, a college, an overarching research initiative such as reproductive biology, or any other larger group of faculty which the University is using to accomplish some strategic purpose”.<sup>2</sup> The issue of credit for participation in interdisciplinary work is being confronted by all major research universities as they transition from the traditional single investigator approach in research and disciplinary graduate education toward a larger vision of interdisciplinary work. An informal survey of 12 peer universities across the country revealed universal awareness of the issues related to documenting effort (information from Tom Martin, Area Finance Officer for the College of Sciences at WSU) . Of the 12 universities surveyed, 6 had implemented changes in their accounting systems to address the problems (University of Washington, Michigan State University, University of Wisconsin, North Carolina State University, Iowa State University, University of California-Davis). In most cases, their solutions involve “double counting” of faculty teaching and mentoring efforts in multiple categories in a flexible system. It is logical that we should invest time and effort to explore successes and failures at other universities before we make similar investments in change at WSU. After the challenges associated with Institutional Research data have been successfully met, the *perception* of the “credit problem” must be remedied through educational efforts across all levels of university faculty. It will not matter that the system has been changed if faculty, department chairs, and deans are unaware of, or do not understand, the significance and application of the changes.

**2. Empower the Graduate School to participate in the administration of degree granting doctoral programs that cross college boundaries.**

The Woodrow Wilson National Fellowship Foundation recently partnered with 14 diverse national research universities to review studies funded by The Pew Charitable Trusts and other foundations and organizations to identify basic themes in graduate education in the United States.<sup>3</sup> The goal was to identify innovative models and promulgate them nationally. The first

theme articulated in their final report was the recognition that “the PhD degree requires strong graduate schools and graduate deans with real budgets and real scope – a far stronger central administrative structure than typically exists at present”.<sup>3</sup> This conclusion was based on the recognition that national pre-eminence of a university depends “in large measure on the perceived quality of graduate programs” yet “the graduate level is the very place where the central administration exerts the least quality control”. These strong conclusions are correctly tempered by the recognition that the doctoral degree differs from undergraduate degree programs in its reliance on research and the research productivity of individual faculty to drive national reputation. When individual faculty are empowered with self-determination for programs that directly impact their research, there is a powerful incentive to strive for excellence. However, this culture of self-determination for graduate education programs can become a major impediment to the effective governance of interdisciplinary programs that require disparate groups of faculty to function as a single unit. In the end, the success or failure of these programs depend on establishing a structure of governance that can effectively navigate the minefields of individual, departmental, and disciplinary personalities, policies, and preferences. There are several examples of current interdisciplinary efforts at WSU that are teetering on the brink of failure because of these very difficulties. In some instances, directors of interdisciplinary doctoral programs at WSU report that they have no requirement to report to anyone, no requirement for strategic planning, and no recognition of the time spent in directing programs in their personal annual review process. The time and effort they expend in support of these programs is seen in essence as “charity”. As pointed out by the Yardley Group in their recent external review of graduate education at WSU, “It is by now almost a cliché to say that departments are not the proper structural entities for offering state-of-the-art interdisciplinary graduate programs.”<sup>2</sup> It is logical then to consider the model of an enhanced administrative role in these programs by the Graduate School as is currently happening at many institutions including the University of Washington, University of California Davis, and Arizona State University.

***2.1. Change the central culture of the Graduate School at Washington State University from that of an administrative unit that monitors compliance to an administrative unit that provides leadership in graduate education issues across the university.***

With the undertaking of the Graduate Education Commission and Yardley Group reviews of doctoral education at WSU, the Graduate School stepped forward into a more active leadership role within the university. This change is critical if the evolution of doctoral education at WSU is to keep pace with that which is occurring nationwide. The rapid rate of societal change and its accompanying complex challenges demand an educational system that is agile enough to meet societal needs without sacrificing quality and rigor. Coordination of complex, rapidly evolving doctoral education programs while concomitantly assuring quality and rigor can only occur if a Graduate School with real resources plays a more active role in assisting faculty efforts in these directions.

***2.2. Implement a system of ongoing strategic planning and consequential review that identifies benchmarks of success for each program.***

The Yardley Group made clear in its recommendations to the university community that it is important for “the Graduate School to initiate periodic and consequential reviews specifically for doctoral programs” with the purpose of monitoring progress toward previously agreed measures of achievement “paying particular attention to external benchmarks and taking corrective action

as required, including discontinuing programs that are habitually unproductive”.<sup>2</sup> Although corrective action is certainly warranted for programs that are under-performing, consequential review is an even more powerful motivator if it provides meaningful **positive** reinforcement for success. All interdisciplinary (and disciplinary) doctoral programs across campus should be engaged in regular strategic planning with the goal of reporting specific, measurable, and achievable goals to the Graduate School. The Graduate School must then be empowered to review progress toward strategic goals and reward programs that reach benchmarks that contribute to the university intellectual community and align with stated university strategic priorities. This approach will be most beneficial if all interested stakeholders are involved in defining acceptable measures of success at the beginning of the review period and identifying appropriate rewards for achieving those benchmarks of success. This strategy will absolutely require that the Graduate School be empowered to strategically allocate resources such as salary release funds for program directors, administrative support personnel for programs, funds to develop or implement novel courses, and teaching assistantships (TA) or research assistantships (RA). At the current time the Graduate School has limited RA positions to allocate and no influence on allocation of TA positions across campus. The Yardley Group observed that “the colleges and departments are too focused on using TAs to cover instructional gaps, especially in lower division courses”.<sup>2</sup> They contend that the result is an inappropriate balance in the utilization of available TA positions. “A teaching (or research) assistantship should be primarily a training opportunity for graduate students and should contribute to their educational and professional development.”<sup>2</sup> This report suggests that consideration be given to transferring control of some TA lines to the Graduate School for distribution on an “incentive basis”.

### ***2.3. Develop flexible guidelines for administration of interdisciplinary degree granting doctoral programs through the Graduate School.\****

Site visits to carefully selected peer institutions with successful interdisciplinary doctoral programs may help identify common characteristics of successful programs and potential pitfalls in administrative structure. Benchmarks for success or failure of interdisciplinary programs at WSU must be clearly articulated with agreement between participating faculty and the Graduate School regarding available enhancements for programs that meet those benchmarks. The type of cultural change that is described in this plan will be difficult for many faculty, department chairs, and deans at WSU because of our strong history of self-governance at all levels of program development and administration. Effective changes cannot be made if faculty, departments, and colleges are forced to participate. They must be enthusiastic about the long-term vision and they must recognize immediate benefits to change. This will require strategic allocation of resources in return for participation. If successful, these administrative policies may be extended to include traditional doctoral programs that operate outside a single administrative budgetary unit with the result that effective critical mass for stronger disciplinary doctoral programs is also created. The resultant increasing porosity of departmental boundaries in defining graduate faculty in support of individual programs, disciplinary or interdisciplinary, will provide optimal opportunities for all faculty to achieve their greatest potential to contribute to doctoral education at WSU.

\*During the latter stages of task force deliberations the group discussed the limitations imposed on faculty because of the arbitrary barriers to obtaining graduate faculty status within a graduate program housed in another academic unit. There appear to be no university restrictions to granting qualified faculty full (not adjunct) graduate faculty status within any program, regardless of its administrative home. By encouraging graduate programs to develop specific criteria for

approval of graduate faculty, regardless of their home department or college, the university could very quickly and easily develop a mechanism to greatly enhance interdisciplinary collaboration across the university. Such a system would, for example, enable an appropriately qualified faculty member in the College of Veterinary Medicine to apply and receive full graduate faculty privileges within a graduate program in the College of Sciences. Because each individual graduate program would develop and maintain appropriate criteria for granting graduate faculty status within their program, appropriate rigor and academic standards would be maintained. As a result, individual faculty may have full graduate faculty status within more than one graduate training program and be able to select the best program for each individual student on the basis of the student's background, prior educational or work experiences, research interests, and career goals. The inclusion of more diverse faculty within each graduate program would enrich the graduate program itself by providing ideas and insights from well-qualified faculty of diverse backgrounds and encourage interdisciplinary research and graduate education without direct involvement of the Graduate School in the administration of those programs. This type of "open door" graduate faculty policy would be especially beneficial for faculty currently housed in academic units that do not currently have approved doctoral programs.

***2.4. Identify funding mechanisms to guarantee one year of university support (not from research grants) for all doctoral students accepted into major interdisciplinary doctoral degree programs.***

The paucity of available funds for central support of students enrolled in interdisciplinary doctoral programs greatly limits the recruiting power and flexibility of these programs. When all students must be funded strictly from external research dollars throughout their graduate education, it can be difficult to attract top quality students who have not yet identified a specific project or mentor. Students with this restrictive funding miss out on the opportunity to rotate through multiple laboratories during the first year of their program, do not have an opportunity to gain experience and skills in teaching, and have their education placed in jeopardy if faculty mentors have a temporary lapse in funding. The university, in partnership with the colleges and departments, must identify strategies that will guarantee at least one year of financial support that does not originate from research grant funding to all students in major interdisciplinary doctoral programs. This support may come in the form of state-funded TA, RA, or fellowship money. Because of the limited opportunities for substantive new funding from state sources, this effort will require reallocation of existing resources and substantive efforts to secure private fellowship funding.

***2.5. Foster and support experimentation in novel styles and approaches to interdisciplinary doctoral education.***

Developing interdisciplinary degree-granting programs is not the only way to encourage interdisciplinary doctoral education. There are many ways to enhance the opportunity for students in discipline-based degree programs to expand their horizons and gain experience and expertise that will complement their disciplinary training. Several novel approaches to these types of programs have been described in publications such as the report of *The Responsive PhD: Innovations in US Doctoral Education*.<sup>3</sup> Strategies include certificate options for completion of a prescribed interdisciplinary curriculum embedded in a discipline- or department-based doctoral program (e.g. the Biotechnology program at WSU), intensive summer courses or internships in areas of applicability to a wide range of disciplines (e.g. entrepreneurship, leadership, communication, scientific writing), and project-based courses that attract students

from disparate fields of study. Such opportunities in graduate education can transform a program perceived as average to one that is recognized as truly world class in scope and content. In order to obtain this standard of excellence, there must be substantive cross-campus collaboration between departments and colleges that may not appear to have much in common. For example, the faculty from the College of Business might lead a summer program in entrepreneurship that attracts doctoral students from science, engineering, and the liberal arts; the faculty from the School of Communication and the Department of English might design a project-based course that teaches students in all fields of study how to communicate effectively with the public and the media. These types of experiences are clearly of value in building basic skills among participating doctoral students. In order to succeed, however, they must be of value to the content experts who prepare and deliver the course material. This will mean negotiating memoranda of understanding between participating departments, colleges and the university that clearly delineate agreements related to time commitments and asset exchange between units and/or the university in direct reimbursement for efforts in support of interdisciplinary training. Encouraging the participation of post-docs in these activities can further enhance a culture of collaboration across all of the university. Fostering experimentation in these approaches is important if WSU is to provide a full spectrum of opportunities for interdisciplinary experience. Recognition and reward for these efforts will further reinforce the culture of interdisciplinary doctoral education across the campus.

### **3. Provide appropriate assistance to faculty seeking to develop new or enhance existing interdisciplinary doctoral education programs.**

Faculty interested in developing cross-departmental and cross-college educational collaborations consistently report difficulties in navigating the labyrinth of requirements for establishing new programs. The Graduate School is available to help when requested, but it is surprising how few faculty actually consider requesting this help. Defining and advertising the mechanisms for support will stimulate faculty to seek assistance earlier in the process and further efforts to establish a collaborative culture that values interdisciplinary doctoral education.

#### ***3.1. Designate a position within the Graduate School to advise and assist with developing and maintaining interdisciplinary doctoral programs at WSU.***

The increased responsibility for program development and review described in this plan requires access to new human and financial resources for the Graduate School. The University should fund a position within the Graduate School to advise and assist with developing and maintaining interdisciplinary graduate programs. This individual will provide administrative support for faculty to navigate the labyrinth of requirements for establishment of new degree-granting units within the university and provide administrative support for the Graduate School in monitoring strategic planning and review processes for interdisciplinary degree-granting programs. As we move toward “a graduate school for real”<sup>3</sup>, these resources will be critical to promote successful culture change are a smart investment for the future of WSU as a world class research university.

#### ***3.2. Develop interdisciplinary doctoral programs that are in accordance with university strategic priorities.***

Because it is prohibitively expensive for the university to cultivate strengths in every area of study, it is important that the university leverage its resources strategically for support of identified areas of research excellence: Molecular Basis for Mammalian Reproduction, Advanced Materials Technologies, Molecular Plant Science and Genetics, Infectious Disease at the Human-Animal Interface, and Linking the Brain to Behavior and Performance. At this time there are established interdisciplinary doctoral programs in direct support of research efforts in Materials Science and Engineering, Molecular Plant Science, and Neuroscience. Strong departmental based programs in the other areas have potential for expansion into interdisciplinary programs. This potential should be explored to identify the strengths and weaknesses of an interdisciplinary approach. Identifying a doctoral program that directly supports an area of excellence should not be taken as prima facie evidence that the program should be interdisciplinary in nature. Nor do we mean to imply that there can be no more than one program that supports a strategic emphasis. It is imperative that changes, if they occur at all, be seen as mutually beneficial to graduate students engaged in that area of study, to faculty involved in those research emphasis areas, and to the strategic purposes of the university as a whole. Similar dialogue with faculty engaged in research in emergent areas should be encouraged. It is possible that strengthening doctoral education by establishing a strong interdisciplinary program might catalyze growth of an emergent program into a recognized “peak” of research excellence. Strengthening these science based disciplines should not happen at the expense of declining excellence in the liberal arts. These fields of study are essential at every research institution and their interdisciplinary efforts should not be ignored. Nurturing interdisciplinary liberal arts programs will provide much needed depth of expertise and breadth of recognition that is essential for any world class university.

***3.3. Identify faculty interested in developing novel interdisciplinary programs and provide needed assistance.***

It will be a painful process for the university to shift from a culture of egalitarian support of all programs to one of selectively supporting programs in areas of emphasis. It is important that faculty in areas outside the “peaks” recognize that they remain important to the overall mission of the university and that opportunities exist to develop new “peaks”. Voluntary, innovative efforts to develop collaborative doctoral programs should be encouraged and developed to the extent that resources allow, especially in support of initial program development and in provision of assistance in quests for external funding support. In some cases, it may be strategically advantageous to combine smaller programs into interdisciplinary degree granting units that will create the critical mass that is essential for excellence.

***3.4. Develop support mechanisms within the Graduate School to enhance the quantity and quality of graduate training grants across the university.***

Acquiring more training grants is recognized as an important component of enhancing interdisciplinary doctoral training by both the WSU Graduate Education Commission (GEC) report<sup>1</sup> and the external review of graduate programs conducted by the Yardley Group.<sup>2</sup> The GEC report recommended that WSU strive to “quadruple the number of training grants in the next decade”. This recommendation was based on the recognition that we currently have three training grants while our peers average fifteen (nine among peers without a medical school).<sup>1</sup> These sentiments were echoed in the Yardley Group report which recommended that “the Provost mandate that the University will win five training grants by the end of AY 2010-11 and that the Dean of the Graduate School, the Vice President for Research, and the Deans of the

Colleges, acting together as an academic initiatives planning committee, be held directly accountable for the achievement of that goal".<sup>2</sup> The interest level of faculty in interdisciplinary training grants such as the IGERT proposals funded by the National Science Foundation is quite high. Preparing a competitive training grant proposal is a daunting task and faculty at this university suffer from a lack of resources to support these efforts. By providing a series of seminars or workshops to assist interested faculty in grant writing approaches specific for training grants, the Graduate School can enhance likelihood of success and reinvigorate grant writing efforts on the part of faculty who have been discouraged by past failures. In addition, the Graduate School should provide administrative support for faculty preparing graduate training grants and ensure that the appropriate database support is available and accessible for preparation of graduate training grants.

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# Appendix

## APPENDIX

### ***What is currently happening with interdisciplinary graduate education at Washington State University?***

#### *American Studies*

The American Studies program is one of the oldest interdisciplinary graduate education programs at WSU. It was founded in 1962 and is housed in the College of Liberal Arts. Its stated goal is the “interdisciplinary analysis” of the United States in a global context. Graduate students combine insights from literature, historical studies, women’s studies, ethnic studies, the fine arts, environmental studies and the social sciences. This program offers undergraduate (BA) and graduate (MA, PhD) degrees. Graduate students choose an emphasis in ethnic studies, feminist studies, history, literature or another discipline. Most graduates of this program enter careers in university and college teaching. The American Studies program has developed an effective administrative structure in which the director reports regularly to the Dean of the College of Liberal Arts. The program has undergone regular review by the Faculty Senate in the same way that any other graduate program within the university would.

The American Studies program has no dedicated faculty FTE. The core faculty, 26 members with regular teaching rotation in the program, is from Comparative Ethnic Studies, Women’s Studies, and English. Approximately 20 adjunct faculty are based in Fine Arts, Philosophy, History, Sociology, Teaching and Learning, Digital Technology and Culture, and Communications. The home department of the program director (currently Dr. T.V. Reed from the Department of English) is compensated by the College of Liberal Arts for the time that the director commits to this effort. Members of American Studies are voted into the program by existing faculty. The faculty meet approximately twice yearly. Faculty subcommittees work on various issues including curriculum. The doctoral program requires that students complete a core sequence of 7 American Studies courses, 15 graded credit hours in an area of emphasis (History, Comparative Ethnic Studies, Women's Studies, English, or another affiliated discipline) and 12 graded credit hours in an area of specialization. The American Studies program has one academic support position that is funded by the College of Liberal Arts.

There are currently 40 graduate students in the American Studies program, most of whom are Teaching or Research Assistants. Funds for these stipends are received from state sources and allocated through the College of Liberal Arts and the Graduate School. The program has never had external graduate training grant support. Student recruitment is done through advertising at national conventions, direct mail and through the web site. There is an approximate 10 to 1 ratio of applications to acceptance with approximately 6 or 7 new graduate students accepted into the program each year. The students in this program come from broad international and ethnic backgrounds and tend to be older than graduate students in many other disciplines (age range of 22 to 48).

#### *Biotechnology*

The Center for Integrated Biotechnology at WSU has more than 150 participating faculty with appointments in numerous departments and colleges across the university. The Center primarily functions as a research entity to coordinate core laboratories and centralized services in areas such as bioinformatics, genomics, and proteomics, giving researchers access to services and equipment that may be difficult for individual labs to obtain.

The biotechnology program does not offer a distinct doctoral degree curriculum and is not degree granting. Students enroll in one of six participating doctoral programs and must complete all the graduate training requirements of their home unit. Participating units include biochemistry and biophysics, genetics and cell biology, microbiology, plant physiology, veterinary microbiology and pathology, and chemical engineering. In addition to the requirements of their home department, students accepted into the program must complete courses in proteomics and biochemistry and a unique interdisciplinary graduate course in which teams of students bring a theoretical biotechnology product of their choice through initial development to marketing. Students also participate in a graduate student forum and symposia throughout their doctoral education. These symposia include invited speakers from academia and industry. At the end of their second year in the biotechnology program students participate in an internship experience in a biotechnology or pharmaceutical company or at a national laboratory. Upon successful completion of this program, students receive a certificate in protein biotechnology.

Dr. Raymond Reeves from the College of Sciences is the Principal Investigator for the NIH Biotechnology Training Program. This is a campus-wide Program that includes 31 training faculty in 5 colleges. The program is in its eighteenth year of continuous funding by NIH for training doctoral students in the area of protein biotechnology. NIH funding supports 5 training slots with a stipend of approximately \$21,000 each for two years and funding for internship experiences. Participating units provide support to fund an additional 4 training positions. The program is open, however, to all qualified WSU graduate students even though they may be funded by other sources. After completion of the initial 2 years of their doctoral training funding, student stipends are provided by the major advisor and home department, primarily through RA funding. The Graduate School provides support for recruiting efforts. Administrative support is obtained from the Center for Integrated Biotechnology. Currently there are approximately 32 students in the Biotechnology program. Students who complete their Ph.D degree and successfully fulfill all of the requirements receive a professional 'Certificate of Training in Protein Biotechnology'

### Evolutionary Modeling

The IGERT Program in Evolutionary Modeling (IPEM) is an interdisciplinary doctoral training program in "Model-based Approaches to Biological and Cultural Evolution" funded by the National Science Foundation. IPEM integrates resources at WSU and the University of Washington to provide students in Anthropology and Biology with a common curriculum emphasizing evolutionary processes of adaptation and diversification in genetic, behavioral, and cultural domains, as well as a set of methods (including computational modeling, game theory and phylogenetic analysis) applicable to analyzing evolutionary processes across these domains.

Students enter IPEM through the Department of Anthropology or the School of Biological Sciences at Washington State University, Pullman, or through the Department of Anthropology at the University of Washington, Seattle. Students (Fellows) accepted into the IGERT program begin their training with a weeklong "Math Camp" at the University of Washington to prepare students for advanced courses in statistical methods. Fellows spend at least one term taking courses or pursuing research at the sister institution, and form research teams across these universities and disciplines, allowing them to draw on relevant expertise in either sponsoring university. In addition they have the opportunity to pursue research at partner institutions (the Santa Fe Institute in New Mexico; the Centre for the Evolution of Cultural Diversity, which has branches in England, Scotland, and Canada; Le Centre Universitaire de Recherche et de Documentation en Histoire et Archéologie, Central African Republic; and the University of Costa

Rica). Fellows participate in weekly seminars that are broadcast on the university audio/video network (the Washington Higher Education Telecommunications System or WHETS system).

Fellows are supported for two years—with the possibility of a third year of funding to be competitively determined—at the NSF-mandated rate of \$30,000 per year plus full tuition and an annual supplement for research expenses, competitively granted, of up to \$8,000. Subsequent funding for each student is obtained primarily from RA appointments. The graduate degree is granted from the institution and department of the major professor. IGERT funding began in June 2006 and four doctoral students were accepted into the program at that time. Additional students have been chosen to begin study in 2007 and offers are pending.

There are 10 WSU faculty in core support of the IPEM program. Oversight for this graduate training program is mandated by the NSF and includes specific assessment instruments and an external review board. The IGERT director receives one course release credit as compensation for his activities.

### Interdisciplinary Design

The Doctor of Design (D Des) is offered through Interdisciplinary Studies Program at the Interdisciplinary Design Institute, Washington State University Spokane. It is the only degree offered by this program. The program originated as a collaborative effort among the School of Architecture, the Department of Interior Design, and the Department of Horticulture and Landscape Architecture. These academic units reside in two colleges, the College of Engineering and Architecture (CAE) and the College of Agricultural, Human, and Natural Resource Sciences (CAHNRS). The Director of the Interdisciplinary Design Institute (where the Interdisciplinary Program is housed) serves as the Director of the Doctor of Design program. The D Des is a unique doctoral degree, on the same level of intellectual rigor as the PhD, but designed expressly for integrating research towards design applications as well as exploring design as discipline.

The D Des is crafted to encourage rigorous investigation in the pursuit of enhancing the interdisciplinary body of knowledge in design. Students attracted to the program come from diverse academic backgrounds in a variety of design disciplines as well as the social sciences and health. The D Des is primarily supported by faculty whose FTE reside in CAE and CAHNRS, but as the program grows, participation from faculty in more diverse areas is paramount to the success of D Des candidates.

### Materials Science

The Chemical Physics Program at WSU began in the mid-1960s in an attempt to train scientists capable of functioning at the critical interface between Chemistry and Physics. In the 1990's, this program expanded to include faculty from the College of Engineering and Architecture and evolved into the Materials Science Program. The PhD program in Materials Science at WSU is supported by a group of 24 active materials researchers (distributed through Physics, Chemistry, Wood Materials Engineering, Mechanical and Materials Engineering, Electrical Engineering, and Civil Engineering).

The majority of students come from an Engineering background with a significant number from Physics and Chemistry backgrounds. Because of a difference in cultures, most of the Engineering students come in with MS degrees, while most of the science students enter with a BS. Faculty join the program through an election that is held once each year. Emphasis is placed on the probability of active participation in the program. The Materials Science Program

currently has approximately 35 doctoral students currently enrolled. Students are funded entirely with RA support, primarily from faculty research grants.

The chairship of the Materials Science Program rotates through the principal departments on a four year cycle. The program is administered by a program chair, a 0.5 FTE principal assistant, and a graduate studies committee composed of the chair and one representative from Physics, Chemistry, and MME. The program receives some funding from the College of Sciences and from the College of Engineering and Architecture. This pays the principal assistant's salary and leaves a small amount that is used for recruiting. The home college of the Chair usually pays that individual a 1 month summer salary stipend.

### Molecular Biosciences

In 2008, the School of Molecular Biosciences (SMB) at Washington State University will move from offering three PhD degrees (Biochemistry, Genetics and Cell Biology, and Microbiology) to a single interdisciplinary degree in Molecular Biosciences. Trainees, however, will choose one of three discipline-specific tracks (Biochemistry, Microbiology, or Genetics) to ensure that their interdisciplinary training in Molecular, Cellular, and Structural Biology builds on a solid, discipline-specific foundation. SMB graduate students train in the laboratories of 31 faculty with primary appointments in SMB or in the laboratories of Associate Faculty, who hold primary appointments in other departments in other WSU Colleges (Sciences, Veterinary Medicine, Pharmacy, and Agriculture). All Associate Faculty have research expertise in one of the three founding disciplines and in one of four interdisciplinary areas: Molecular Basis of Reproduction, Chromatin and DNA Repair, Gene Regulation, and Infectious Disease. This graduate program was built along the guidelines of NIGMS training programs and has been functioning in this capacity for the last four years.

### Molecular Plant Sciences

Founded in 1984, the Molecular Plant Sciences (MPS) program is unique among current interdisciplinary graduate programs at WSU in that its sole purpose is graduate education. The graduate program in Molecular Plant Sciences is consistently ranked in the top 10 such programs nationally. Faculty in this program come from a diverse group of departments including Crop and Soil Sciences, Biological Sciences, Horticulture and Landscape Architecture, Plant Pathology, Molecular Biosciences and the Institute of Biological Chemistry.

Students enrolled in this degree-granting program complete core course work offered by existing departments and by the MPS program. A core 24 hours of graded credit is required from courses offered by the MPS program and by Molecular Biosciences. A variety of supporting course work is available from these and other departmental sources to complete the university requirements for graduation. Funding for students is obtained predominantly from the individual faculty research programs, with smaller inputs from the MPS program or from the administering academic unit of the major professor. In the past, the program has obtained two externally-funded training grants, the Plant Biochemistry Research Training Grant (PBRTC) and a McKnight award. These programs funded more than 30 graduate students. Seven MPS students have also been recipients of fellowships from the NIH Protein Biotechnology Training Program.

The MPS program is governed by a director who is appointed for an indefinite term, a Steering Committee and a Recruitment Committee, who together make administrative decisions. The Steering and Recruitment Committees are made up of representatives from all participating programs. The director is currently uncompensated for the time spent in this role and does not evaluate faculty participation within the program. Decisions affecting curriculum or major

directions are decided by the full faculty. The MPS faculty meet when the director calls a meeting. Although the program has never been asked to develop a strategic plan, they have done so. The program has approximately 45% of one administrative support position, which is funded by CAHNRS.

One of the major challenges MPS faculty members face is the difficulty in recruiting students in specialized areas, e.g. bioinformatics, plant biochemistry, plant metabolomics, structural biology etc. (As MPS and other programs on campus have expanded, their faculty interests have broadened. This is good for 'integrative' approaches, but bad for achieving focus in particular areas of strength.) The program is addressing this issue by forming 'clusters' of strength within MPS. These clusters will have access to new funds and resources to 'rebrand' themselves and thus gain recognition in particular areas. This will allow these groups to attract students with interests and skills in these areas. In addition, the program will initiate special topics courses (e.g. journal clubs) for the upper level students in each cluster, to allow them to focus their education in specific areas.

### Neuroscience

The Neuroscience program at WSU is a degree granting doctoral program. Although considered an interdisciplinary program, it is currently housed almost entirely within the Department of Veterinary Comparative Anatomy, Pharmacology, and Physiology (VCAPP) and reports to the chair of that department.

### Pharmacology and Toxicology

The Pharmacology and Toxicology program at WSU is a degree granting doctoral program. It is currently housed primarily within the Department of Pharmaceutical Sciences but also includes faculty from Veterinary Comparative Anatomy Pharmacology and Physiology, Entomology, Psychology, Molecular Biosciences, Small Animal Medicine, and Chemistry.

## ***What new interdisciplinary graduate education programs are being considered at WSU?***

### Bioengineering

Bioengineering is an academic discipline that combines engineering with biology in diverse ways. The proposed graduate program in Bioengineering (BE) will be a university-wide program, initiated primarily by the School of Chemical Engineering and Bioengineering (ChEBE) in the College of Engineering and Architecture; the Department of Pharmaceutical Sciences in the College of Pharmacy; and the Department of VCAPP in the College of Veterinary Medicine, all located on the Pullman campus. Faculty of many other departments may participate in the BE graduate program by teaching core or elective courses and mentoring graduate students.

Students from diverse undergraduate backgrounds will take courses in mathematics, biological sciences and different engineering disciplines, including but not limited to, core courses in Bioengineering. Electives may be taken in a variety of areas that meet the student's needs. Students will conduct Bioengineering research and be mentored by faculty from many different programs and colleges at WSU. A flexible Bioengineering graduate program – with minimal core requirements – will allow students to take courses and perform research in the diverse interdisciplinary research areas covered by BE faculty as well as other faculty performing bioengineering-related research within the CEA. Flexibility will also help accommodate the specific, related interests of other faculty across campus – most specifically within the Departments of Pharmaceutical Sciences and VCAPP.

The Department of Pharmaceutical Sciences is interested in developing a Pharmaceutical Bioengineering track under the umbrella of a Bioengineering graduate program to train engineering students in the area of “Translational Research” – science related to advanced drug product delivery systems. The discipline within this track is intended to integrate pharmaceutical sciences, engineering, biology, and chemistry to discover new therapeutic agents, identify drug targets, and develop novel delivery systems to address issues important to human and animal health.

The Department of VCAPP would like to see students with interests in engineering, neuroscience and biophysics, to apply advanced technologies to areas such as muscle physiology, protein engineering, brain imaging, and molecular mechanisms of disease. More generally, teaching and research activities are targeted to achieve the goal of “integrative biomedical science,” which means understanding the interactions among distributed structural and functional elements of biological systems and how these interactions allow the emergence of complex system functions and behavioral features.

A cooperative administrative structure is envisioned where leadership from SChEBE, DPS, and VCAPP form a steering committee to work with a Director of the program. This will ensure good communication and a cooperative venue to apportion financial support fairly across the participating units. It will also create a platform for coordinated and united requests for program support through budget requests within the colleges and through the graduate school.

#### Environmental and Natural Resource Sciences

The PhD in Environmental and Natural Resource Sciences currently exists at WSU as an interdepartmental degree program sponsored by the School of Earth and Environmental Sciences (SEES) and the Department of Natural Resource Sciences. The program in Environmental and Natural Resource Sciences focuses on factors related to the understanding and management of the environment. The PhD program provides opportunities for doctoral study that involve integration and interaction among various fields of science with the goal of addressing complicated physical, biological, social, and political issues in environmental and natural resource management. As environmental and resource problems are common to many countries (e.g. long-range transport of pollutants, waste management, deforestation of tropics, misuse of rangelands, conservation of wildlife, species, growth management), it is expected that a significant international dimension of the program will develop. This program is already broadly interdisciplinary and actively encourages the participation of faculty from other academic units, across several colleges, by providing those faculty with affiliate and adjunct status. Other approaches to broadening the participation in this program are being actively explored. In particular, discussions with the Department of Community and Rural Sociology have been initiated to consider ways in which their interests in the human dimensions of sustainability might be integrated into the current degree program.

#### Life Sciences

Recently, the Graduate School at WSU charged an interdisciplinary committee of faculty to review current doctoral programs in the broad field of Life Sciences and make recommendations for enhancements. The committee has now produced a document describing changes in admissions and training structure with the goals of increasing the quality of applicants, enhancing ability to match students with appropriate programs and mentors, and provide the best possible training for students after arrival at WSU. These faculty envision an umbrella of

Life Sciences Graduate Training to coordinate recruitment, admissions and interdisciplinary activities. These changes are designed to maximize the ability to identify and admit highly qualified students to the appropriate programs and laboratories and to create the flexibility needed to pursue the interdisciplinary training that is increasingly defining Life Sciences research in the early 21<sup>st</sup> century. The key to success in this endeavor is increased course-work flexibility in individual graduate programs as well as graduate school course load requirements.

This program will be administered through a steering committee of relevant chairs, deans and program directors that reports to the Graduate School. An external advisory board is recommended for each life sciences Training Groups to evaluate the programs and function to facilitate training grant activities. Training Groups will be populated by faculty from varying departments and colleges. Faculty will be eligible, depending on their research and professional interests, to join one or more Training Groups. Students in an individual faculty mentor's laboratory may be enrolled in differing training programs depending on their interests and aptitudes. This program will supplement or replace current departmental-based graduate programs in the life sciences. Students may be admitted to the general program without specifying a mentor or definitive research interest. These students will progress through a basic core curriculum with up to four laboratory rotations until an appropriate major professor is selected by the end of the first year of study. Students may also be recruited to work with a specific faculty mentor; they will begin their research activities as soon as possible and will not participate in traditional laboratory rotations. Students applying for Life Sciences graduate study at WSU will be allowed to select multiple training groups and sub-programs of interest with a priority listing so that if more than one program admits the student, their highest priority is honored. It is proposed that all students receive the first year of support from Graduate School funds or Teaching Assistant funds administered provided by participating colleges. The Graduate School and each department will be expected to contribute funding to annual recruitment activities.

### Physical Biosciences

Many of the greatest advances in understanding basic biology are now occurring at the interface of the physical and biological sciences with the application of mathematical and computational analysis to biological problems. Graduate students in this discipline require core strengths in mathematics, physical sciences, computational analysis, and biology. These broad strengths are uncommon in the typical US undergraduate. Interested faculty have produced the broad outline of a doctoral training program that would recruit students from either physical/quantitative or biological science backgrounds. Students trained in life sciences will enroll in courses that enhance quantitative skills while students with a background in physical science will complete graduate course work that enhances understanding of biological processes. The physical biosciences major will have options of focus areas that include mathematical biology, biophysics, computational biochemistry and chemical biology. Interdisciplinary course work will be established to cover the overlapping areas of mathematics, physics, chemistry, biophysics, engineering, computer science and biology. By necessity, this program will require extensive interdisciplinary collaboration between faculty from several colleges and departments across campus. An example of the type of classes that might be offered is *Biological Physics*, *Physics 466/566*. This class explores fundamental physics and thermodynamics of the cell. Biosciences students in the class are given extra material to enhance skills in physics and mathematics while physics and engineering students study additional information related to cell physiology and physical biochemistry.

### STEM Education

The nation suffers from its inability to educate a diverse population to use science, technology, engineering and mathematics (STEM) to address technical issues in life. The STEM Education doctoral degree emphasizes research and educate the next generation of educational research scholars to improve the educational success in STEM disciplines along the K-20 educational pipeline. This program will integrate educational disciplines of teaching, learning, and assessment with technical disciplines of mathematics, science, engineering, and technology to discover, implement, test, and disseminate proven practices that transform students' attitudes, literacy, skills, and conceptual understanding in STEM subjects. Graduates of this doctoral program will be prepared to elevate retention, academic success, and graduation rates of students in graduate and undergraduate STEM education and teacher preparation programs locally and across the nation. Scholars in STEM Education will produce an empowering synergy between research and teaching that revitalize collaboration across the university.

The STEM Education doctoral degree is interdisciplinary by virtue of its collaborators, course content, and research model. The program is being developed by faculty from colleges of Education, Sciences, and Engineering and Architecture. Faculty leading the effort have a history of collaboration on research grants, graduate student advising, course offerings, and seminar offerings. Core courses identified for the degree program will integrate concepts and methods of education and the relevant technical fields. Research within the program will engage diverse teams of students from STEM areas working in mentor-mentee relationships to address complex issues surrounding education in STEM fields. Two centerpieces of the program are a STEM Education Research Laboratory and a STEM Education Teaching Laboratory. In the former, students in mentor-mentee relationships produce scholarly research publications reporting discoveries and guiding application of knowledge about educational practices for improved student learning in STEM classes. In the latter, graduate students apply educational research to the teaching of disciplinary subjects in a STEM area.

A steering committee, with funding from an Office of Research Initiation of Collaboration grant, is developing a proposal to establish the STEM Education doctoral degree.



Program	Year of Inception	Degrees Granted	Major Participating Units	Number of Students Currently Enrolled	Funding for Student Stipends	Comments
American Studies	1968	PhD	College of Liberal Arts <ul style="list-style-type: none"> <li>• Comparative Ethnic Studies</li> <li>• Women's Studies</li> <li>• English</li> </ul>	40	State funded TA and RA positions	
Biotechnology	1989	Graduate Certificate in Protein Chemistry	Colleges of: <ul style="list-style-type: none"> <li>• Agric., Human, and Nat. Res. Sciences</li> <li>• Veterinary Medicine</li> <li>• Pharmacy</li> <li>• Engineering and Architecture</li> <li>• Sciences</li> </ul>	18	NIH training grant (5 slots/year) Unit funding (4 slots/year)	Funds each student for 2 years; remainder of study funded as RA or TA for home department.
Evolutionary Modeling	2006	None	College of Liberal Arts (Department of Anthropology) College of Sciences (School of Biological Sciences) University of Washington	8	IGERT grant from National Science Foundation	Funds each student for 2 years; remainder of study funded as RA or TA for home department.
Interdisciplinary Design		PhD	College of Engineering and Architecture Dept. of Interior Design Dept. of Horticulture and Landscape Architecture			
Materials Science	mid-1990s	PhD	College of Engineering and Architecture College of Sciences	35	RA funding from faculty research grants	Currently 5 state funded RA positions
Molecular Biosciences	2008	PhD	College of Sciences		TA and RA support from the School of Molecular Biosciences	Combining 3 disciplines into one degree with 4 interdisciplinary research areas
Molecular Plant Sciences	1984	PhD	College of Agricultural, Human and Natural Resources College of Sciences		RA funding from faculty research grants	Currently 5 state funded RA positions
Neuroscience		PhD	College of Veterinary Medicine, Dept. of VCAPP		TA and RA funding from VCAPP; RA funding from faculty research grants; some individual predoctoral awards	

Pharmacology /toxicology	1982	PhD	College of Pharmacy, VCAPP, SMB, COS	13	TA and RA mostly from pharmacy	Although the current program was created in 1982, predecessor programs began in 1931
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Table 1. Summary of current interdisciplinary doctoral programs at Washington State University.