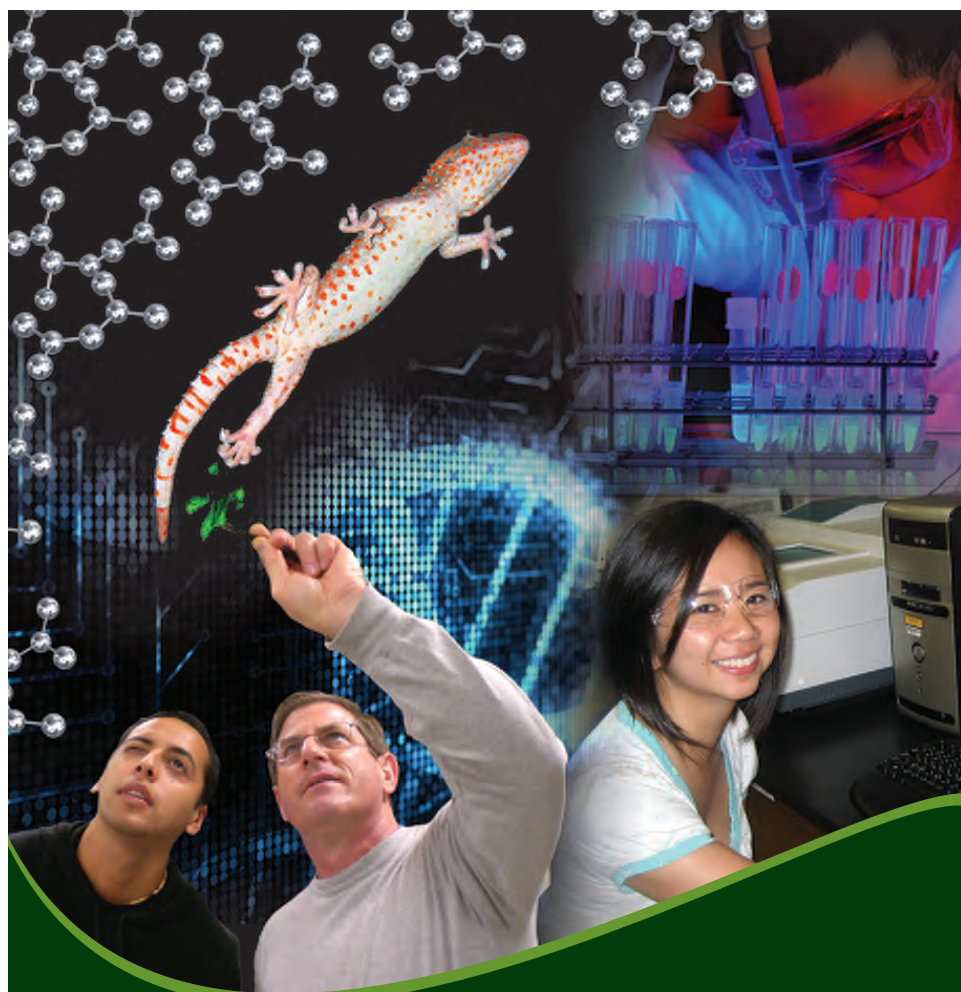


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## Transformative Research at Predominately Undergraduate Institutions

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# **Supporting Potentially Transformative Research: The Administrator's Perspective**

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Faculty members at predominantly undergraduate institutions (PUIs) have won external funding for potentially transformative research projects, and many of them have been remarkably successful in advancing the nation's scientific endeavors. Many of these faculty members, though not all, are at institutions that formally espouse a "teacher-scholar model" for faculty endeavors. From our experiences in contributing and/or supporting such faculty endeavors, we offer the following thoughts and insights.

## **Supporting and Promoting a Scholarly Culture**

To provide the optimal conditions for faculty members at predominantly undergraduate institutions (PUIs) to engage in potentially transformative research and to win funding to support their transformative research, their institutions must create and sustain a culture that embraces and supports deep, ongoing scholarly inquiry by their faculty members and opportunities for intensive and extended student engagement. In short, PUIs must embrace the teacher-scholar faculty model in all of its nuances and richness. In such a culture, faculty members can maintain both high quality (active and engaging) teaching and productive research programs that involve undergraduates. And these faculty members are able to integrate their teaching and research into the fabric of their academic lives.

Engaging undergraduates in authentic scholarly work often provides faculty members fresh insights to research questions. The need to carefully explain research issues to less-expert collaborators and the opportunities to hear students explain them to each other guide faculty members to new understanding. In fact, for many faculty members, undergraduates facilitate the pursuit of research and scholarly questions that allow the faculty members to maintain their professional expertise, enthusiasm, and scholarly engagement. In particular,

many faculty members at PUIs only have opportunities to work as mentors or collaborators when they work with undergraduates. In return, the undergraduate researchers become junior colleagues and scholarly collaborators in the truest sense (Osborn and Karukstis, 2009).

Creating an institutional culture at a PUI that supports scholarly inquiry by both faculty members and students is greatly enhanced and facilitated when senior and junior faculty members and administrators share an understanding of undergraduate research. Several definitions of undergraduate research have been proposed and are variously used throughout academe. A generally accepted definition and one that has been adopted by the Council on Undergraduate Research (CUR) is the following: “Undergraduate research is an inquiry or investigation conducted by an undergraduate in collaboration with a faculty mentor that makes an original intellectual or creative contribution to the discipline” (Wenzel, 1997). This definition encompasses all modes of research from both disciplinary and interdisciplinary fields, recognizes the importance of a teacher-scholar model for participating faculty members, and ensures that both faculty members and students have a vested interest in the research and its outcomes. To expand on the definition cited above, Osborn and Karukstis (2009) have articulated four unifying features that characterize undergraduate research: mentorship, originality, acceptability, and dissemination.

## **Why Should the Faculty at PUIs Engage in Transformative Research?**

The National Science Board (2007) defines transformative research as “research that has the capacity to revolutionize existing fields, create new subfields, cause paradigm shifts, support discovery, and lead to radically new technologies.” The key to promoting transformative research at PUIs involves creating an institutional infrastructure that provides opportunities for high-quality, potentially transformative research to take place. This requires two parallel investments: 1) what institutions do now to ensure that faculty members will be able to secure funding to support their research, and 2) what they need to develop as longer-term strategies that will ensure that they continue to support potentially transformative research in the future.

Faculty members are the central asset of our institutions. Without them the educational enterprise would not exist. A hallmark of a great institution is faculty members who are engaged in successful, innovative scholarly and creative work that complements and enriches their teaching. This work serves to expand knowledge; allows faculty members to develop professionally and engage in their disciplines; educates students at all levels; attracts research funding from government agencies, private foundations, corporate sponsors, and private donors; and increases the stature of the institution through having this work known locally, nationally, and internationally.

For faculty members at PUIs, a significant component of that scholarly and creative work also involves undergraduates. Undergraduate research experiences have long been a component of science programs, especially at PUIs. However, the Boyer Commission’s 1998

report, *Reinventing Undergraduate Education*, helped to bring the values of undergraduate research to national prominence and underscored the importance for undergraduates in all disciplines of becoming “an active part of the audience for research.” Similarly, Project Kaleidoscope highlighted the importance of a research-based curriculum and research experiences as among the best practices in undergraduate science education (Project Kaleidoscope 1991).

More recently, reports from the Association of American Colleges and Universities (2007), the Council on Competitiveness (2005), the Business Roundtable, et al. (2005), and the Business-Higher Education Forum (2003) have called for changes in education that “create life-long learners,” “encourage learning through more interaction and individualization,” “increase the retention rate of undergraduates...” and “promote an innovation-oriented culture while maintaining a commitment to creating new knowledge...” The authors of those reports conclude that student engagement in undergraduate research yields an array of greater educational outcomes in comparison with those of students who do not participate in these experiences. These gains are broadly related to cognitive and intellectual growth, professional growth and advancement, and personal growth (Osborn and Karukstis, 2009). And Osborn and Karukstis (2009) have described specific gains in these areas that are attributed to participation in undergraduate research. For example, an undergraduate research experience has been shown to be an effective tool for enhancing retention (Nagda et al., 1998; Ishiyama, 2002); career preparation (Mogk, 1992; Ishiyama and Hopkins, 2002; Seymour et al., 2004); increasing interest in learning (Lopatto, 2003, 2004, 2006; Tomovic, 1994); and a sign of excellence among academic programs (Doyle, 2000). Moreover, undergraduate research offers high levels of academic challenge, fosters active and collaborative learning, builds from student-faculty interactions, and contributes to a supportive campus environment. All those activities are known to be high-impact educational practices (Kuh, 2008). Therefore, for PUIs, having faculty members who are engaged in potentially revolutionary scholarly work has an even greater impact on undergraduates: strengthening their educational outcomes and in enhancing their motivation to persist and join the next generation of scientists.

## **Administrative Strategies to Promote Transformative Research at PUIs**

### ***Faculty Time***

Nationally, the integration of research into the curriculum has progressed from its beginnings in the mid-1980's. Research-active faculty members have been key players in this curricular change, as their scholarship has served as the engine for innovation. As demonstrated by Karukstis and Elgren (2007), building research-rich/research-supportive curricula makes sense pedagogically. Students learn more about how science is done and practice the critical reasoning skills essential to scientific research, and the learning they do is more engaging and fun. Incorporating authentic research into individual courses and into curricula also makes sense for the faculty members. In particular, developing learning experiences that align with and incorporate the faculty member's scholarship can be

very cost-effective and time-efficient. “Teaching laboratories” are often easier to support (with both financial and staff resources), students learn skills necessary to participate in independent research in the faculty member’s laboratories, and students take over much of the preparation work, which provides the faculty member with needed time to engage in scholarly work and to use for other activities.

The Howard Hughes Medical Institute is currently supporting two multi-institutional initiatives that seek to understand and promote curricular-based research opportunities as a way to enhance learning. These initiatives are the nationwide phage genomics research program and the Classroom Undergraduate Research Experiences (CURE) survey. Thus far, the results from CURE are providing evidence that classroom research-like activities will lead to significant learning gains; as expected, the gains are less pronounced than a full-fledged summer research experience, which was determined from the Summer Undergraduate Research Experiences (SURE) survey. (Lopatto et al., 2008).

Administrators can support faculty members’ efforts to realize the teacher-scholar model by proactively encouraging them to efficiently utilize their academic time (e.g., number of office hours, open-door policies, number and type of course assignments, number and type of committee service, etc.), thereby ensuring that the faculty members have regular time to actively engage in research, preferably that which involves undergraduates. A number of useful strategies for effective time management for the teacher-scholar model were published in the June 2004 issue of the Council on Undergraduate Research’s *CUR Quarterly*, which focused on “Creating Time for Research.”

### ***Tenure and Promotion Criteria***

One of the most important components of a tenure-track faculty member’s first few years is preparing for formal evaluation process. The standards for evaluating faculty performance are typically outlined in an institution’s reappointment, tenure, and promotion criteria. Those criteria guide the way that faculty members should approach their scholarship, teaching, and other key facets of academic work (e.g., academic advising, service, etc.). Most tenure and promotion criteria are either included within faculty handbooks or exist as stand-alone documents, and the criteria are usually articulated to prospective faculty members as they progress through the interview and appointment processes and the criteria are usually revisited as new faculty members begin their tenure-track appointments. Many PUI’s have tenure and promotion criteria that stress excellence in teaching, balanced with excellence in some form of peer-reviewed scholarship; often service is required as well. The range of acceptable scholarship varies from institution to institution, but the most common expectation is that faculty members will contribute actively to the broader intellectual community. Those contributions necessarily involve the “sharing of results with the professional community” (Illinois Wesleyan University Faculty Handbook), which is often done in the form of peer-reviewed publications. Typically, faculty members must show active engagement within their discipline or field in order to “extend the boundaries and/or refine the subtleties of interpretation,” as the Illinois Wesleyan handbook also puts it. According to many

faculty members navigating the processes toward tenure, an important difficulty with their institutions' tenure and promotion criteria is that many criteria do not specifically define the desired number and/or significance of publications, including the journals or other venues that are deemed "acceptable" by departments and/or tenure and promotion committees. This leaves the pre-tenure faculty members, departments, and/or tenure and promotion committees with the task of interpreting institutional standards on a case-by-case basis. Most tenure and promotion criteria do not explicitly address how to evaluate scholarship that would be defined as high-risk, and high impact, which might lead to fewer publications in the short run, causing many early-career faculty members to feel that a "safer" research program that results in multiple publications by the time of the tenure review is the only acceptable path for their research plan. Thus, many early-career faculty members conduct low-risk, "traditional" research that will have greater productivity as measured by publication in respectable peer-reviewed journals. This often discourages these faculty members, who are in highly productive and creative years of their careers, and it deters them from pursuing potentially transformative research questions, which usually have higher risk and lower measurable productivity in terms of publications, at least at first.

One of the most important aspects, then, of providing pre-tenure faculty members with the option of pursuing transformative research is to ensure that tenure and promotion criteria support high-risk, but potentially high-impact, research. Many institutions already have criteria that are quite broad; however, they need to be more explicit about supporting high-risk research as a type of scholarship allowable for attaining tenure and promotion.

If institutional administrators want to foster opportunities for potentially transformative research, especially for pre-tenure faculty members, then administrators must facilitate the discussion and revision of the tenure and promotion processes and criteria to include avenues for early-career faculty members to pursue high-risk research. This includes leading faculty discussions and adopting policies that broaden institutional processes and tenure and promotion criteria. In particular, processes and criteria need to be modified to recognize and reward the following: 1) non-traditional funding sources, 2) non-standard dissemination venues, 3) interdisciplinary scholarship, 4) mentoring of pre-tenure and pre-promotion faculty members, and 5) education of departments and tenure and promotion committees about effective mechanisms to evaluate faculty members conducting transformative research. We discuss each of these topics below.

*Non-traditional Funding Sources.* One issue that arises with pre-tenure faculty members working on any scholarly project, including those that are high-risk, is finding financial support for high-quality research. Indeed, as a first step, institutions need to do a better job of assisting all faculty members, including early-career faculty, in becoming more effective in procuring external funding and in disseminating the results of the resulting research in appropriate peer-reviewed venues. Much has already been written about ways of supporting faculty efforts to obtain external grants from government agencies, private foundations, and alumni (see, for example, Bolek and Forsythe, 2008; Graham and Johnson, 2004; Watson, 2004; Zack and Dickinson, 2004; Giese, 2004; and Kinnard, 2004). However, external



funding for potentially transformative research may need to come from entities that have not been traditional sources for a particular institution or department. In particular, funding may need to be sought from for-profit entities, including corporations, venture capital investors, and even from individuals. Administrators need to make sure each faculty member understands the necessity and importance of working with their institution's advancement or development office as they plan to approach non-traditional funding sources. Development personnel can provide invaluable support in identifying potential donors who might be interested in funding a project not yet recognized by federal funding agencies. Likewise, personnel in the development office are knowledgeable about local, state, and regional private foundations, corporations, and economic-development initiatives that might be fruitful sources of funding for potentially high-risk projects. It is important, however, to understand ahead of time that these funding sources may insist on establishing non-disclosure agreements that may restrict reporting of results or funding amounts, which may be important to faculty members' ability to include such work in their tenure files.

Administrators also need to be vigilant in their efforts to provide faculty members with key resources for grant-writing. Such resources include:

- Having a person on staff who assists faculty members in developing (and in some cases writing) grant proposals (e.g., an office of sponsored research);
- Providing a set of databases available to faculty members that allows them to search for funding opportunities;
- Offering proposal-writing workshops on-campus, and/or providing support for faculty members to attend off-campus workshops;
- Allowing buy-out of some of the normal teaching responsibilities with grant funding;
- Developing institutional indirect-cost policies that encourage grant-writing;
- Using indirect funds in support of faculty research;
- Recognizing peer-reviewed grants and well-reviewed grant proposals (even when not funded) as one part of the suite of faculty work that is counted for tenure and promotion; and
- Appointing as department chairs faculty members who embrace the teacher-scholar model and who present strong records of research and grantsmanship.

Those are just a few ways to provide grant-proposal-writing support for faculty members. Administrators can also acknowledge faculty members who have been successful in obtaining external funding in a public manner, whether on the university Web page, to trustees, to other faculty members, or by hosting recognition receptions. Only after a campus has established a culture that encourages and rewards pursuit of external research funding can that institution can take the next step of recognizing and rewarding non-traditional forms of funding.

*Acknowledge Non-standard Dissemination Venues.* Another major obstacle for pre-tenure faculty members who pursue high-risk research is that no precise or standard methods have been established for evaluating either funding obtained from non-traditional sources or research results disseminated in non-standard venues. Thus, in addition to establish-

ing a culture of active faculty scholarship, which includes successful grant seeking and production of peer-reviewed journal articles, institutions will need to determine methods of evaluating and measuring scholarly success via non-standard venues. Even though the ultimate goal must remain the generation of peer-reviewed publications, research that is asking potentially transformative questions may initially result in dissemination in such venues as the following:.

- A report to a funding source or a regulatory group;
- Contributing to (and perhaps even organizing) a summit or symposium that results in a proceedings or edited volume;
- Publication in the “gray literature/venues,” such as open access, online-only journals, influential blog sites, etc.; and
- Publication of “null” results.

The methods of evaluating a faculty member's scholarly work must be determined by each institution, reflecting the culture and expectations at that institution. However, so that the standards for tenure and promotion remain robust, the methods established for evaluating non-traditional work should follow methods similar to those used to review more “traditional” faculty productivity, and the methods should be based on fundamental principles that characterize any form of high-quality research. {For example, a tenure candidate may have been contributing to an influential blog site, and the candidate's entries may have included original results, as well as robust contextual synthesis; and the blog entries have attracted the top scholars in the field, who have provided vibrant peer-review and feedback on the candidate's work, which have in turn drawn the attention of many more scholars to the site. As a consequence, this outlet has brought significant recognition to the candidate's scholarly work and to the institution.}

Additional review and validation of research that is disseminated in new, non-traditional venues could be added to the reappointment, tenure, and promotion process. Here, a set of external reviewers could be used to evaluate non-traditional forms of funding and dissemination. Many institutions already rely on a set of letters from independent, external evaluators for the summative tenure and promotion reviews. Such external reviewers could also be used in the intermediate years to provide formative feedback. As an institution develops these methods, pre-tenure faculty members who indicate that they will be pursuing high-risk research will need to work with their departments and the central administration regarding the methods that will be used to evaluate their work. Furthermore, tenure and promotion committees will need to understand the collaborative nature of scholarship that often occurs in high-risk research. As for traditional faculty scholarship, publications with multiple authors should “count” the same as single-authored work. This may mean that pre-tenure faculty members and their collaborators will need to describe their contributions to each publication. However, meaningful collaborations are vital to much of the research currently being pursued in the sciences.

Many of the same suggestions discussed above regarding administrative support for securing external resources can be used to encourage publication of scholarly work. Does an



institution have faculty-development funds to support research leading to publications? Are there pre-tenure leave options that allow faculty members to spend one or two semesters pursuing their own scholarship (in addition to regular sabbatical leaves for tenured faculty members)? Is the scholarship of pre-tenure faculty members recognized in a public manner (such as at a faculty scholarship recognition event)?

*Interdisciplinary Research.* In many cases, potentially transformative research will involve interdisciplinary or multidisciplinary collaboration. Historically, in fact, significant developments have come from collaborations among investigators working in seemingly disparate fields. For example, the harnessing of atomic energy in the late 1930s and 1940s occurred as a result of physicists, materials scientists, and engineers working together. More recently, the field of bioinformatics has grown out of the human genome project and has brought together molecular biologists, mathematicians, and computer scientists. Nanotechnology has grown from knowledge about carbon buckeyballs and is a relatively new discipline that embraces chemistry, materials science, and molecular biology, among other fields.

Clearly, there have been many attempts by governmental and private agencies and organizations over the past 15 to 20 years to steer the academy toward preparing scientists for the future by “encouraging” changes in the academic culture to foster collaborations and promote interdisciplinary training (e.g., National Research Council, 2003; National Institutes of Health, 2004; National Science Foundation, 2009; Association of American Medical Colleges and Howard Hughes Medical Institute, 2009).

While interdisciplinary research has attracted much attention and has been growing, institutional cultures and tenure and promotion processes have been slow to change (e.g., Hurtado and Sharkness, 2008; NSF, 2009). The NSF’s 2003 *Characteristics of Doctoral Scientists and Engineers in the United States* indicated that between 42 and 51 percent of those employed in the biological and natural sciences were over 50 years old and that between 34 and 44 percent were more than 20 years past receiving their doctorates. These data indicate that the academy may see a large turnover of science faculty members within the next decade and a half (NSF, 2006). What will our new colleagues want in an institutional home? In recent years, new faculty members have wanted facilities that will allow them to continue the types of work they have done in the past, collaborations with new colleagues, and opportunities to teach upper-level courses within their disciplinary and interdisciplinary specialty areas. They also want these efforts to be recognized and rewarded. Meeting these desires will require PUIs to provide modern research spaces that afford opportunities for the cross-fertilization of ideas from multiple disciplines; on-site collaborations both within and across disciplines; the ability to teach cross-disciplinarily; and tenure and promotion processes and criteria that clearly recognize interdisciplinarity. These approaches are not currently found in the majority of PUIs, which still predominantly feature a departmental-silo culture. Administrators must encourage and facilitate the creation of new cross-disciplinary collaborations for both research and teaching if PUIs are to attract and retain excellent faculty members in the future.

How can administrators encourage and facilitate the creation of new cross-disciplinary collaborations for both teaching and research? Key ingredients are time, opportunity, and incentives to push interactions toward collaborations. Time is self-explanatory, in that people need time to exchange ideas, learn to speak a common language, and develop collaborative projects or courses. Opportunity will require changes in facilities design since many of our institutions are still organized around departments that are segregated from one another, with chemistry on one floor, biology on another, and perhaps math and computer science in a separate building across campus. Industrial labs are typically designed to keep the exchange of ideas flowing among researchers with varied interests, for example, through open labs, common library space, huddle rooms, breakout spaces, spaces for small conferences, etc. While many of our campus buildings do not incorporate these concepts, it is possible to create areas that foster collaborations by grouping faculty members by areas of interest. For example, a neuroscience area might include cognitive scientists, cell and molecular biologists, biochemists, psychologists, etc. Or faculty members might be grouped based on their needs for the same types of instrumentation (for example, gas chromatographs with or without new spectrometer facilities— would be needed by plant biologists, environmental toxicologists, chemists, biochemists, etc). By placing people with different backgrounds in close proximity (and ensuring that they have the time to interact), daily communications will ultimately lead to new ideas for investigation. Likewise, these interactions will lead to novel teaching approaches that integrate fields, thus helping to better prepare our students for what they will encounter in graduate and professional schools and the workplace.

Incentives also can encourage these interactions. Effective ways of encouraging and promoting the importance of cross-disciplinary work include administrative support for mini-grants to provide funds for supplies needed to collect preliminary data; a rotating semester-long reduction of teaching or service tied to expected outcomes, such as a grant proposal or a new cross-disciplinary course to be taught the next semester; dinner meetings to encourage cross-disciplinary discussions; or a cross-disciplinary speakers series to excite faculty members and students about potential areas of investigation. For more information and suggestions concerning ways to bring about more collaboration, see Kezar and Lester (2009).

*Mentoring.* One of the most important responsibilities of an institution (and the responsibilities of department chairs, deans, and chief academic officers) is mentoring pre-tenure faculty members. Many institutions hold workshops on the tenure and promotion process for pre-tenure faculty members and their supervisors. These workshops describe the criteria for tenure and promotion and include opportunities for faculty members and their supervisors to ask questions. An advantage of being on the faculty at a PUI is that pre-tenure faculty members are often the center of attention of department chairs, deans, and provosts. Pre-tenure faculty members at most PUIs receive several forms of feedback from multiple evaluations (at both the departmental and institutional levels) during the years leading up to the summative tenure-review year. Each pre-tenure faculty member should be encouraged to develop a plan and general timeline for strategically advancing an overall scholarly program, whether the faculty member is engaged in high-risk, potentially transformative

research or in more traditional research. In particular, a pre-tenure faculty member interested in pursuing high-risk research needs to be encouraged to follow that line of research, but each faculty member also needs to hear the message, if it is required by institutional culture, that in addition, the research program should include some projects that are more likely to lead to the type of peer-reviewed publications commonly recognized by their departments and by the promotion and tenure committees. It is good advice for any pre-tenure faculty member to have multiple threads (or projects) that comprise an overall research program. This strategy mitigates problems that may arise from “putting all of your eggs in one basket,” especially important for those engaging in high-risk research. However, with multiple projects under way, there is also a risk of pre-tenure faculty members becoming “spread too thin” and not bringing any of the research to fruition in peer-reviewed venues. The message about what is required to achieve tenure and about the different research strategies can be shared in informal mentoring sessions with senior faculty members or through more formal letters from the department, tenure and promotion committee, or an administrator during the evaluation process in the early years of a faculty member’s probationary period. The message also should be included in the institution’s tenure and promotion standards.

*Educating Tenure and Promotion Committees.* Administrators can also play a leading role in educating departmental and institutional tenure and promotion committees about the value and the unique aspects of transformative research. Tenure and promotion committees also should be made aware of the challenges associated with high-risk, potentially transformative research—such as delay in publishable results, non-traditional funding sources, and dissemination of results through non-standard publications and presentation venues. Faculty members who engage in potentially transformative research will need to carefully describe the progress they are making relative to their scholarly agendas and they must provide evidence of their progress, such as industry reports, a description of scholarly presentations, patents, and other relevant documents. It is particularly important that pre-tenure faculty members understand the expectations for appropriate materials and documentation to include in their dossiers as they progress through the tenure and promotion process. The tenure and promotion committee should regularly provide clear feedback to the pre-tenure faculty member regarding progress toward tenure and promotion. This feedback allows the faculty member to make modifications to the research agenda and/or to provide further evidence of the progress unfolding as the tenure evaluation approaches. Finally, if a pre-tenure faculty member describes high-risk research that may not produce results by the time of the tenure review, which normally occurs in the sixth year of employment, administrators might want to initiate discussions about options for extending the tenure clock. These options need to be considered carefully to ensure that national standards are being followed (e.g., those of the American Association of University Professors).

Finally, administrators have great responsibility for supporting and guiding pre-tenure faculty members as they progress through the reappointment and tenure process. Administrators can use their positions of leadership to promote potentially transformative research by early-career faculty members through support for individuals and mentoring of the promo-

tion and tenure committees. Administrators also need to reduce the anxiety of the early-career faculty members and provide opportunities that allow these faculty members to be successful scholars. Colleges and universities can expect great results if these suggestions are followed as these faculty members become permanent members of the scholarly community.

### ***Merit Considerations for Mid-Career and Senior Faculty Members***

Mid-career and senior faculty members often have much more freedom to pursue non-traditional forms of scholarship, since attaining tenure and promotion often relaxes the intense pressure to publish quickly. This allows these faculty members to pursue lines of research that may not have the same impact or immediate results required for the tenure decision. However, since many tenured faculty members face post-tenure reviews and merit-pay considerations that include evaluation of their scholarly work according to standards and criteria similar to those used for tenure decisions, steps should be taken to ensure that these reviews also do not inhibit innovation and high-risk, potentially transformative research. Mid-career and senior faculty members should be rewarded for pursuing high-risk research, as well as for more traditional lines of research. Many of the resources for supporting transformative research discussed in the previous section also can be applied to mid-career and senior faculty members conducting high-risk research (e.g., determining mechanisms to evaluate high-risk research, encouraging faculty members to concurrently pursue traditional and high-risk research, and providing an environment that encourages and supports scholarship and grant seeking).

Administrators have many ways to encourage and support mid-career and senior faculty members who choose to pursue high-risk, high-impact research. One way is by providing seed money for projects that are not yet ready for external support. A number of external funding sources provide start-up grants for early-career faculty members, but those same opportunities are not available for mid-career and senior faculty members. Seed money can come from a number of sources, such as institutional faculty-development funds, money donated to support pilot projects, or indirect funds generated by funded research grants. Institutional support for new avenues of scholarship by mid-career and senior faculty members can lead to projects that have potential for external funding.

Another important step in promoting high-risk research is to encourage mentoring and collaborative relationships among early-career and mid-career or senior faculty members. The energy and creativity of new faculty members often can be infectious. Encouraging faculty members to team-teach courses on “big ideas” can lead to stimulating discussions beyond the classroom and to links among faculty members that might not otherwise have occurred. Creating an atmosphere of intellectual stimulation and risk-taking in the classroom can often translate into fruitful scholarly collaborations. Other information about ways to nurture collaborations among faculty members has already been discussed. The end result of creating an environment supportive of successful mid-career and senior faculty scholars is that the institution becomes a thriving intellectual center.

## Promoting Entrepreneurial Approaches to Fundraising

Most would agree that an underlying goal of any academic institution is to educate students in such a manner as to inspire a passion for knowledge that will enable them to enrich and transform their chosen disciplines. It is the responsibility of academic institutions to prepare students for leadership in a global society, and thus our new generation of scientific researchers must be well versed in new technologies. This is not an easy task when we are currently experiencing static or declining federal research funding from large agencies such as the National Institutes of Health and the National Science Foundation, along with rapidly changing technology, declining student interest in scientific fields, and growing outsourcing of jobs from the United States. Thus the role of an administrator must include finding alternative ways to fund STEM (science, technology, engineering, mathematics) fields. One way to accomplish this task is to make the pursuit of STEM education and research more fun, exciting, and relevant to commercial entities. To do this, administrators should support and encourage potentially transformative research by creating environments that promote excellence in applied, as well as basic, research; they should empower faculty members to pursue promising new programs and funding initiatives from private as well as public sponsors.

If administrators expect that an area of potentially transformative research might lead to scientific and technical applications, they need to encourage and support development of policies and arrangements to manage the intellectual property rights that will be a natural outgrowth of inventions and discoveries from this research.

Let us first review the differences and similarities between academic and commercial intellectual property arrangements. In employment law, the relevant statutes say that work produced by employees as part of their employment is the property of the employer (the so-called “work for hire” statutes). In industrial or other commercial employment settings, the discoveries of a scientist and the relevant patents devolve to the employer, who might arrange for certain rights or incentives to be provided to employees as partial supplemental compensation for their creative contributions. However, in academia, it is a long-standing principle that scholarly work produced by faculty members will remain the intellectual property of the faculty member; hence it is the faculty member, not the institution, that typically is asked to sign copyright agreements with publishers for books and articles. Most institutions implicitly, if not explicitly, assign the intellectual property of such printed products as books, articles, class syllabi, class Web sites, class assignments, and personal (professional) Web pages to the faculty member, while reserving the intellectual property rights to policy materials, departmental documents, the results of committee work, or the administrative work for the department or institution.

Most institutions concede that institutional investments during the academic year, intervening summers, and during sabbaticals, do not merit retaining rights to commercially successful textbooks or monographs. In simpler days, institutions retained intellectual property rights to the outcomes of academic research only for products benefitting from substantial *institutional* investment and likely to bring substantial returns from commercialization. This approach once applied largely to products with viable patent possibilities,

but in some cases this approach now also applies to software with commercial possibilities. Further, institutions investing in online courses for revenue purposes often retain the rights to those online instructional products. Since all of this has become more complex, it behooves each institution to assess its priorities and to clearly state in advance its interests in the results of the academic work of its employees. And while this may seem oppressive in the normally free and open academic environment, it is commonplace, and employers' rights to work-for-hire are the default under law. Hence institutions can establish a broad sense of good will and shared enterprise with their faculty members by affirming in their intellectual property policies that the traditional instructional and scholarly work products of faculty members are retained by the faculty members (by stating that the institution relinquishes its rights to those products).

Having an invention and patent policy ensures that discoveries and inventions created by members of the university community (including but not limited to faculty members, staff members, and student employees) are shared, utilized and disseminated effectively. It is the responsibility of the institution as the employer to assist its faculty members and staff members in properly disclosing their scholarly work to ensure that commercial benefits are not lost and to ensure that the commercial benefits are shared in an equitable manner, such that the outcomes benefit and recognize the contributions of both the inventor and the college or university. An Intellectual Property policy (IPP) can be a valuable resource for creating a culture poised for transformative research. When correctly instituted, an IPP creates an environment of cooperation and trust. The goal of an IPP would be to offer a system of support for the development of innovative materials that benefits both the inventor and the institution with fair and equitable distributions. An IPP should be viewed by faculty members and the institution as a tool of empowerment.

### ***Developing an Intellectual Property Policy Agreement (IPP)***

When instituting an IPP, it is imperative that close attention be given to the structure and content of the policy. Of first importance is to clearly define what constitutes an invention or intellectual property of mutual interest to a faculty member and the institution; who is responsible for administering the policy; and to whom this policy is applicable.

In terms of intellectual property, inventions may include such things as ideas, programs, discoveries, processes, and more, whether patentable or unpatentable. Thus, it is necessary to clearly define the institution's definition of invention. Secondly, research and discovery at an academic institution may involve an array of participants that includes students, staff members, postdoctoral fellows, tenured and pre-tenure faculty members, and visiting faculty members. It is beneficial to all participants involved if the institution's IPP clearly defines the audience for which the policy is applicable. For example, if a visiting professor is conducting research at an institution other than her home institution and makes a discovery, is she subject to the IPP of the institution that she is visiting or to the policy of her home institution? Does this decision change depending on whether she is receiving any financial support from the institution being visited? To avoid unpleasant disagreements or



unwelcome surprises, an IPP should include an explanation of the applicability of the intellectual property policy.

Once the institution has determined what constitutes an invention, and which people and activities would be subject to its IPP, it is important to define who is responsible for administering this policy. This administrative group or committee should include representation from key areas in order to best aid the college and the researcher in maximizing the potential of an invention. The goals of the committee would include evaluating the patentability and commercial value of the patent, as well as aiding in determining a course of action for commercialization of the invention. The committee should also be utilized to oversee the commercialization of the invention in order to ensure just financial rewards for the college and the inventor. With these goals in mind, it is advantageous for this committee to report to either the president or provost (chief academic officer) of the institution. The committee itself should include a senior academic administrator such as the provost or vice president for academic affairs, a senior financial administrator such as the chief financial officer, and the dean of the relevant academic unit, as well as any other members of the college administration with experience or training relating to invention and innovation. To build confidence that it will protect faculty interests as well as institutional interests, the committee should also have senior faculty representatives. In order for the IPP to be viewed as empowering, it is important that the policy, as well as the process, be supported at the upper levels of administration, including the provost, president, and the board of trustees and by senior faculty members and faculty committees. Lastly, it is imperative that this committee has access to an experienced intellectual-property attorney for consultation on all legal matters pertaining to the policy.

*Ownership.* Ownership is key in the application of an intellectual property policy and this should be clearly defined. Scientific discovery usually comes about through the merging of many resources. These resources might include the intellect and work of the inventor, work of a collaborator(s) at another institution, work of students or other employees of the inventor and the college, the financial resources of the college (either directly or through use of space and instrumentation), and, often, financial funding from the public and/or private sector. Thus, it is important for these varied contributions to be considered and for ownership to be clearly defined before the work begins. The IPP of an institution should clearly address the issue of ownership in relation to all conceivable scenarios of multiple contributors to the outcome.

*Reporting.* If the goal of an IPP is to assist faculty members and staff members in disclosing their scholarly work, and to ensure that the commercial benefits are recognized and shared in an equitable manner that benefits and recognizes the contribution of both the inventor and the institution, a clearly delineated process for reporting an invention is necessary. Timeliness plays a large role in the marketability and commercialization of an invention. It is important that the invention be promptly reported through patent disclosures and patent applications as well as publications, hence the institutional committee process the invention in a timely manner. The time frame for this process should be defined, in

order to ensure that all parties involved act within an appropriate and judicious time frame that would allow maximizing the commercialization potential of the invention. Outlining a specific time frame and process for reporting and developing the invention will have a large impact on the potential commercial rewards of the invention.

*Financial Considerations.* Legal expenses and distribution of income are often difficult considerations related to the application of an IPP. It is essential that the institution has legal resources and expertise readily available for the evaluation of the potential for commercialization of the invention. Because the goal of potentially transformative research is to transform, the institution must be prepared to aid in the process of commercializing the research so that it can be readily used and the benefits of the innovation are accessible. Thus, academic institutions should have ready access to patent attorneys and IPA experts. Institutions should also provide resources of time and money to enable the inventor(s) to reasonably document the discoveries and to develop the patent disclosure. It would be beneficial for the institution to use legal experts to create generic contract agreements, non-disclosure and confidentiality agreements, and material-transfer agreements in order to encourage the initial processes of innovation. To aid in developing templates for these documents, institutions should research and study the Web sites of other colleges and universities, because many examples of such policies, agreements, and contracts are available.

The process of commercializing an invention or innovation should be defined, and the responsibilities for the financial expenses that will be incurred should be clearly delineated. There must be a clear commitment from the institution to see the project through its development, and this plan must also include an exit strategy. Having a clearly delineated process and ready access to needed expert resources encourages faculty members and the institution to pursue commercialization. Again, there are many examples of excellent IPPs available on the Internet, and they are useful starting points from which institutions can begin to develop their own institutional Intellectual Property policies.

Perhaps the most-discussed consideration for an IPP is distribution of income. The goals of an IPP would be to provide a simple, fair, and equitable distribution of income. Consideration should be given to expenses incurred by the academic institution. Furthermore, after considering the expenses to the institution, any income should be distributed so that the inventor(s), the department, the division, and the institution receive fair financial shares. It is expected that the outcome of a successful innovation or invention would financially benefit both the inventor and the institution. One very important consideration is that an IPP should be a tool that encourages faculty members to pursue formal protection of valuable intellectual property. Hence, as a way to entice faculty members to protect the shared intellectual property, it is common for IPPs to define the distribution of income so that a large percentage of revenue is credited to the inventor(s) when the profit is small; as the level of profit increases, the percentage of revenue credited to the institution may increase.

Nonetheless, efforts devoted to protection of intellectual property and patent rights may slow the disclosure of the related academic work, reducing the normally available indi-

cators of productive scholarly research. Institutions should have clear procedures for reviewing the research of faculty members who generate results that need such caution and protection.

While research universities have vested interests in asserting and protecting the value of the intellectual discoveries of their faculty members, PUIs with less of a research focus have alternatives, including alternative interests. Of greatest interest to a PUI is sustaining positive and productive relationships with its most effective teacher-scholars. Since these relationships may be strained by working out the details of agreements on particular discoveries, an alternative to asserting patent rights is for the institution to waive its rights to discoveries and to support faculty members in gaining independent advice on patents and patent protection.

A further threat from the commercialization of a faculty member's discoveries is that patent efforts or venture-capital investments can be a major distraction from the normal mix of activities of a teacher-scholar. A supportive administrator might want to offer reassigned time (perhaps purchased with venture-capital funding) to a faculty member for a period of time, providing a reduced teaching load to offset the heavy demands of pursuing a patent or commercialization project. Some colleges have even decided to invest (effectively providing venture capital) in faculty members' small-business endeavors as a sign of support and respect for innovative faculty colleagues.

In cases such as those, institutions place a premium on the relationships they build and maintain with their most innovative and creative faculty colleagues; almost without exception, investments such as those are rewarded with long-term loyalty from the faculty members the institutions most want to keep. Whether that premium is expressed through supportive IPP arrangements, relinquishing intellectual-property rights to the faculty member, or investing in commercialization endeavors, the administrators who make these commitments express an undeniable value system for the institution. While there might be financial return on investments such as these, the resulting goodwill from key faculty members may be the greatest and best reward.

## **Conclusion**

In this chapter, we have outlined several ways that academic administrators at PUIs can support research-rich environments. Academic administrators can encourage the professional growth and development of their faculty members and establish an environment that supports potentially transformative research projects. Indeed, one of the most important responsibilities of academic administrators is supporting all aspects of the professional development of faculty members, who are the most important assets of our colleges and universities. Faculty members at PUIs have been successful at producing scholarship that is transformative and that advances the nation's scientific endeavors. With the assistance of administrators, more of this type of fundamental scientific research can be completed at PUIs, resulting in engaged and productive faculty members and a highly qualified future generation of scientists.

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