CUR Focus

Benjamin A. Pierce
Department of Biology, Southwestern University

Developing a Sustainable Research Program for Tenure

Long-distance runners sometimes employ a training technique called speedplay, in which the runner sprints hard for several hundred yards, then coasts to an easy jog for a mile or so, followed by more sprinting. This pattern of intermittent sprinting and jogging is repeated over and over, until a number of miles have been covered. In theory, speedplay sounds fun—even relaxing—but in practice it is exhausting and painful. The sprint leaves one gasping for air, which never abates before it's time to sprint again.

Speedplay is not unique to running; it's often practiced in academic research. I have seen colleagues sprint when tenure and promotion deadlines loom—working overtime and neglecting other duties to produce the required number of manuscripts and conference papers at the last minute—and then coast from exhaustion until the next deadline approaches. This approach is mentally and physically taxing, hard on personal and family life, and often detrimental to a long-term, sustained program of research.

Through the tenure process, colleges and universities seek to determine if a faculty member is likely to be a valuable contributor to the institution over the long distance of an academic career, potentially for the next 30 to 40 years. Short distance sprints, while successful in meeting immediate goals, are seldom indicative of long-term success. The tenure committees, senior colleagues, and administrators that I have worked with are impressed more by moderate, sustained progress that builds toward a long-term research program than by short-term successes. Consequently, the goal of tenure-track faculty should be to develop life-long practices that will enable them to be productive throughout their careers, along with a set of achievements by the time of tenure that demonstrate acquisition of these skills. It is my belief, based on 27 years of academic experience as both a faculty member and an administrator, that the most successful tenure candidates focus their efforts, not on the six years of their probationary period, but on developing teaching and research programs that will be productive for an entire career.

Much has been written on the value of research for undergraduate students and several recent studies demonstrate that undergraduate research experiences lead to measurable gains for students in a number of educational outcomes (Lopatto, 2004; Russell, Hancock, & McCullough, 2007; Seymour, Hunter, Laursen, & DeAntoni, 2004). Less has been written about undergraduate research from the perspective of the faculty member—its benefits and costs and how to do it (but see Goodwin, Holmes, & Hoagland, 1999 and Neuenschwander & Schwab, 1995). In this paper, I offer nine suggestions for developing a sustainable, long-term research program for tenure. While many of these suggestions are applicable to faculty at a range of institutions, my primary focus is on researchers at predominately undergraduate institutions (PUIs). My own experience in the sciences flavors many of the examples used.

1. Fit your research to the local situation. The long-term success of research at a PUI depends on how well a faculty member negotiates the transition from the research-intensive environment of doctoral and postdoctoral training to the new focus on combined teaching and research at the PUI. As a new faculty member, it is critical to recognize that PUIs are different in many respects from research-intensive institutions. Many PUIs offer great opportunities for developing satisfying and productive research programs, but these will seldom occur at the level or with the resources available at larger institutions. Within the first year of your tenure-track position, carefully evaluate the expectations for tenure at your institution and the resources available to meet them. Develop a research agenda that is realistic in light of these expectations and resources.

My graduate training was in population genetics, applied to amphibians. When I began my first tenure-track position at Connecticut College in 1980, it was clear that I would have difficulty sustaining a research program in the molecular population genetics of my graduate training. I received a total of $2000 for startup expenses, which was not enough to buy even an ultra-cold freezer in which to store samples. Further, the training and knowledge required to carry out projects like those I had completed in graduate school were unrealistic for undergraduate students.

I immediately began to look for possible projects that might fit into my situation. Acid precipitation was attracting a lot of attention—and falling steadily in Connecticut. I realized that little research had been done on the effects of acidity on amphibians. I knew a lot about amphibians, and a colleague introduced me to an experienced

researcher who provided an introduction to methodology. I found that with a little training, undergraduate students were fully capable of carrying out toxicological experiments involving pH. I eventually received a grant from the National Geographic Society and published a total of 12 papers on this topic, most with undergraduate coauthors.

A key element to many successful, sustained research programs at PUIs is adaptation to the local environment. A chemistry faculty member I know found that the research of her graduate training—using spectroscopy to study molecular-level phenomena—was often too complex for undergraduate research students. A switch to environmental chemistry allowed her to develop a successful research program that resulted in tenure. Another colleague arrived at his first teaching position at a liberal arts college to find that there were no animal facilities for the rats he had used in previous experimental work. A switch to behavioral studies with fish opened up a whole new avenue of experimentation, resulting in a long-term research program that produced over 30 publications and 70 conference presentations, most with undergraduate students (Purdy, 2004).

Success stories such as these abound. Often less successful are researchers who refuse to adapt to the realities of research at a PUI, who continue to attempt to pursue a research program of their graduate training which, though successful in the research-intensive atmosphere of a doctoral-granting university, may be difficult to sustain at a smaller school with limited resources and no graduate students. I am not suggesting that all researchers must change the focus of their research when they accept a position at a PUI; many faculty have successfully adapted the research focus of their graduate training to an PUI environment. Nevertheless, most find that some adaptation is required to successfully transition from a major research university to a PUI.

2. Schedule time for research. Many faculty suggest that they cannot do research because they lack space, instrumentation, travel money, or access to a research library. In reality, the limiting factor is almost always time (Enhancing Research, 2003).

Most faculty members are extremely busy, with more demands on their time than they can accommodate. Many fall into the habit of triage, focusing on the most immediate needs each day. Because research is long-term, without immediate deadlines, it tends to get postponed. Like many activities, research is most successful when you practice it regularly, rather than waiting for large blocks of time that come at infrequent intervals. Faculty I know who are most successful in research work at it constantly, on a weekly basis, even if the amount of time devoted each week is limited.

I believe that the key to finding time for research is scheduling. Research must be scheduled, just like classes, office hours, and committee meetings. Many faculty members work with their chairs or deans to arrange their teaching schedule so that one day of the week can be devoted entirely to research (Pladziewicz, 1984). One of my junior colleagues arranges her teaching duties so that she has no classes on Fridays. She spends the morning writing and doing her own research activities and devotes the afternoon to conducting experiments with students.

Although regular, continuous work on research throughout the year is important, many scholars at PUIs agree that much of the intensive work gets done during the summer (Craig, 1999; Enhancing Research, 2003), when faculty are unencumbered by teaching and administrative duties. A colleague in psychology gets one good experiment completed during the academic year, but she and her students are able to complete four experiments during the summer. Most successful researchers at PUIs find some way to devote much of their summers to research.

One problem sometimes encountered by faculty at PUIs is finding time for research when the primary, and in some cases only, focus is on teaching. One solution is to look for ways to have undergraduate research count as part of the teaching program. Many colleges and universities have independent study courses that students can take for credit, and many faculty at these institutions encourage their research students to enroll in such courses. This often provides a means of receiving some credit for supervising undergraduate research (Nicks, 2000; Purdy, 2005). An added benefit is that students may take research more seriously if a grade is attached to the process. Some departments have gone further and developed research-training courses that provide undergraduate students with the skills they need to successfully undertake a serious research project, as well as initiate students to research projects (Purdy, 2005).

3. Keep student research within your expertise. Students will come to you, eager to work on projects they are excited about, but for which you have limited experience and background. Because I am a population geneticist, I get students wanting to work on the genetics of cancer, genomics, or genetic engineering. I always explain that these

Southwestern University student Jessica Hua collecting tadpoles for her research

Southwestern University student Jessica Hua conducting research

Southwestern University research students Jose Granda and Jessica Hua

areas are outside my expertise, that I have neither the knowledge nor equipment to help with that kind of project. If one of my colleagues has expertise in the topic, I refer the student to them. But I also take time to tell the student about my own area of research and how they might fit into it. Often, students just want the opportunity to work closely with a faculty member, and the topic is less important than the chance to be a part of a research project.

I learned a number of years ago that directing student research outside your own field can be a huge drain on time—because you must educate yourself about the topic and develop new methodology—and rarely produces substantial results that can be published. This is not to suggest that undergraduate students are incapable of contributing ideas for research projects. After becoming familiar with the methodology and the literature of your area of research, some undergraduates—unfettered by preconceived notions and dogmas—are capable of asking penetrating questions that may move your research in new directions. But, giving a student free reign to pursue any project is unproductive in terms of your own research and, in my experience, rarely results in a good experience for the student.

4. Find a good mentor. Time and time again, I am impressed by the difference a good mentor can make in the success of a junior colleague. Senior faculty who have life-long, sustained research programs provide junior faculty with visible evidence that successful research can be done at a PUI, and they are often invaluable sources of information about negotiating local obstacles.

When I joined the faculty at Connecticut College 27 years ago, Paul Fell in Zoology and the Bill Niering in Botany (now both deceased) were sterling examples of a life-long commitment to teaching and research at a liberal arts college. They carried out their research with little funding, limited equipment, and heavy teaching and administrative duties, regularly publishing and obtaining small grants. Both acquired a national reputation. They did research, not because it was required or even expected, but because they had a passion for it. For me, these individuals proved that research could be done at Connecticut College, and they set a standard I wanted to emulate.

Almost certainly, there are similar faculty at your own institution. Seek these people out and ask their advice. If possible, meet with them regularly. Don't be shy about sharing with them your doubts, disappointments, efforts, and successes.

5. Understand your students. Recognize that many undergraduate students are bright and capable and motivated, but they are not graduate students. They often have multiple competing interests, including classes, social obligations, participation in student groups, and community service; research may not always be their top priority. Most undergraduate students do not have extensive knowledge in the subject of their research, nor do they possess technical skills that may be necessary for research. Developing background knowledge and technical skills requires time and effort and usually considerable one-on-one attention from you. Take these limitations into account as you plan student projects and your own research.

One limitation of working with undergraduate students is the relatively short time they are likely to be involved in your research program. Many undergraduates do not begin research until their junior or senior year and, consequently, are only with you a semester or two before they graduate. One solution is to select research projects that do not require extensive training, so that students can begin collecting data relatively early. However, this is not feasible for all fields.

Alternatively, get students involved in research early, in their first or second year, so that they have more time to devote to the research. One of my colleagues recruits students early by talking about her

Southwestern University research student Shea Spruill

Southwestern University student Jason Burnham examining bacterial colonies for his research

Southwestern University student Bryce Foster conducting research

research in every class she teaches, including introductory courses. She encourages students to join her research group early and consequently, has been successful in having students work in her lab for three or four years.

Undergraduate students are used to the clearly-defined assignments, deadlines, and objectives of their undergraduate courses, which are usually laid out in a syllabus at the beginning of the semester. Many are unaccustomed to independent work, where the student must take initiative and where goals and objectives may be broad and fluid. Many undergraduate students will find helpful a research contract, which clearly outlines the expectations of their work, such as weekly hours in the laboratory or library, and expected products of the experience, such as a paper, presentation, or poster. The contract should clearly explain practices, regulations, and laboratory rules you expect them to follow (Monte, 2001). One of my colleagues requires her students to maintain a computer log of their research activities, which she reviews on a regular basis. This provides an effective way to monitor student time and effort and correct any deficiencies early. Experienced faculty at PUIs comment that a required paper is important to successful research experiences for undergraduate students, as it forces students to summarize their research, including its context and conclusions (Craig, 1999)

Another key element in working with undergraduate students is communication. Develop a method whereby students can meet with you regularly. Weekly research meetings are often a good idea, but also tell students how to communicate with you in between scheduled meetings: Should they email you, drop by your office, or make an appointment to see you? Table 1 contains additional suggestions for working successfully with undergraduate research students.

6. Limit the number of your research students. I once had an early-career colleague who would accept 10 to 12 undergraduate students to work in his laboratory every semester, each working on a different project. His doctoral and postdoctoral training had been in large laboratories, where the senior scientist supported several postdoctoral fellows, five to ten graduate students, three or four undergraduate students, and a couple of technicians. My junior colleague was attempting to emulate his graduate mentor. His idea of directing undergraduate research was to assign projects and troubleshoot. He assumed that each student would complete his or her project on their own, analyze the data, and write up the results as a manuscript that could be submitted for publication, with his name as co-author. Obviously, this approach didn't work. None of the students finished their projects, much less wrote a publication-quality paper that my colleague could submit to a professional journal.

Trying to emulate a large laboratory environment with undergraduate students rarely works. Most students require considerable one-on-one guidance, as least initially. Your research program will be more productive if you spend much quality time with a few students rather than limited time with many.

7. Ask for what you need. Faculty members sometimes assume that chairs and deans will be annoyed by requests for additional resources. My experience has been the opposite: I find that most chairs and deans want their faculty to be successful and will do all they can to help faculty succeed. This does not mean that they are always flush with cash, nor if they have it that they are willing to spend it on trivial or undocumented requests. But most are receptive to carefully explained, reasonable requests to assist faculty with their scholarship. Even if they aren't able to meet your request immediately, knowledge of your needs may help them procure the resources in the future. Also, don't assume that administrators can read your mind and will automatically know what you need. You have to ask and justify the request.

Although you should ask for what you need, don't wait for requested resources to get started. Studies of scholarship at PUIs note that successful researchers often begin with limited resources; their success generates additional resources, which produces more successes, followed by more resources (Doyle, 2000; Enhancing Research, 2003).

8. Collaborate! Collaborations—with researchers at other institutions or those in other disciplines at your own institution—are often the secret to successful research programs at PUIs. Some scholars believe that collaboration is easier to develop and more successful at PUIs because departments and faculties are often small and the lack of administrative structure facilitates interaction with colleagues (Enhancing Research 2003). Regardless of their ease or difficulty, collaborations provide many potential benefits for faculty at PUIs and, indeed, at all types of institutions. Collaborative research is often more productive than research carried out by single investigators; a recent study documents that collaborative research is becoming increasingly common in almost all fields and that team-based research accounts for more high-impact research (Wuchty, Jones, & Uzzi, 2007). For more information on the value of collaboration, see Haase and Fisk in this issue.

While collaborations can contribute to an independent research program by providing efficiency, ideas, and access to advanced instrumentation, early-career faculty should avoid collaborations in which their only role is to contribute to another colleague's research agenda. A common expectation of tenure is the development of a sustainable, *independent* research program. Effective collaborations involve a true partnership by all parties.

9. Pace yourself. Perhaps the most important key to long-term success in research is pace. Speedplay, alternatively sprinting and coasting, rarely results in a successful long-term program. Sprinting causes exhaustion and cannot be maintained long-term. Coasting between sprints leads to loss of momentum and requires continual re-initiation of the research program, which is costly in terms of time and effort. Regular, continuous research is almost always more successful in the long run.

In reviewing applications for tenure and promotion, I pay particular attention to the pace of the research productivity. Candidates who demonstrate continuous, steady output of research are, in my view, more likely to be doing research 10 or 20 years into the future than are candidates whose research comes in spurts. In most fields, reinitiating a research program, even after a hiatus of just a few years, can be extremely difficult. One must resurvey the literature, reacquire a sense of the direction of the field, and reestablish contacts with other researchers. Faculty sometimes intend to take a short-term break from research, to catch their breath and later pick up where they left off, but with the heavy and continuous demands of teaching, advising, and committee work at a PUI, many wind up ending their research careers altogether.

How does one maintain a sustainable pace? One aid is to develop a strategic plan that includes short and long-term goals. It is important that the goals be reasonable and that you evaluate them on a regular basis. For many faculty members, this will be a regular and required part of the pre-tenure and promotion processes and of performance reviews thereafter. See Nordell Pearson in this issue for more information about developing a strategic plan.

The nine suggestions discussed above are not the only elements of successful research programs, but they are practices employed by many successful researchers at PUIs and their use can, I believe, increase the chances that you will experience long-term success in your research.

References

Craig NC. The joys and trials of doing research with undergraduates. *J Chem Res*. 1999;76:595-597.

Doyle MP, ed. *Academic Excellence: The Role of Research in the Physical Sciences at Undergraduate Institutions.* Tucson, AZ: Research Corporation; 2000.

Enhancing Research in the Chemical Sciences at Predominantly Undergraduate Institutions, A report from the Undergraduate Research Summit at Bates College, Lewiston, Maine, August 2-4, 2003. Available at http://abacus.bates.edu/acad/depts/chemistry/twenzel/finalsummitreport.pdf Accessed November 9, 2007.

Goodwin T, Holmes B, Hoagland KE. *How To Get Started in Research. 2nd Ed.* Washington, DC: Council on Undergraduate Research; 1999.

Lopatto D. Survey of undergraduate research experiences (SURE): first findings. *Cell Biol Ed*. 2004;3:270-277.

Monte A. Mentor expectations and student responsibilities in undergraduate research. *CUR Quarterly*. 2001;22:66-71.

Neuenschwander DE, Schwab TM. *How to Involve Undergraduates in Research: A Field Guide for Faculty*. College Park, MD: American Institute of Physics; 1995.

Nicks SD. Undergraduate research opportunities for students attending small colleges and universities. *Eye on Psi Chi.* 2000;4:38-39.

Pladziewicz JP. Factors important to the maintenance of undergraduate research programs. *J Chem Ed.* 1984;61:515-516.

Purdy JE. Conducting behavioral research with animals in smaller institutions: a case study. In Panicker S, Akins C, eds. *The Basics for Teaching and Research with Laboratory Animals.* Washington, DC: American Psychological Association; 2004:87-111.

Purdy JE. Promoting the purpose and mission of Psi Chi through undergraduate research. *Eye on Psi Chi.* 2005;9:20-23.

Russell SH, Hancock MP, McCullough J. The pipeline: benefits of undergraduate research experiences. *Science.* 2007;316:548-549.

Seymour E, Hunter A, Laursen SL, DeAntoni T. Establishing the benefits of research experiences for undergraduates in the sciences: first findings from a three-year study. *Sci Ed.* 2004;88:493-534.

Wuchty S, Jones BF, Uzzi B. The increasing dominance of teams in production of knowledge. *Science.* 2007;316:1036-1039.

Table 1. Keys to Success in Working With Undergraduate Research Students

1.	Maintain high standards.
2.	Be available.
3.	Convey enthusiasm.
4.	Celebrate successes large and small.
5.	Allow mistakes.
6.	Explain the big picture.
7.	Require a written report.
8.	Use a research contract.
9.	Be an example of good research practices.
10.	Share credit.

Benjamin A. Pierce
Professor of Biology and holder of the Lillian Nelson Pratt Chair
Department of Biology, Southwestern University,
Georgetown, Texas 78626
EM: pierceb@southwestern.edu

Benjamin Pierce is Professor of Biology and holder of the Lillian Nelson Pratt Chair at Southwestern University in Georgetown, Texas. Ben previously taught at Connecticut College and Baylor University. At Baylor University, he served as Associate Dean for Sciences for six years; he is currently chair of the Natural Sciences Division at Southwestern University. Ben is a population geneticist who conducts ecological and evolutionary research on amphibians. He has authored 33 articles in research journals and three books, including The Family Genetics Sourcebook, a guide to genetics for the layperson and Genetics: A Conceptual Approach, a widely used general genetics textbook. He has received grants from the National Science Foundation, the W. M. Keck Foundation, the 3M Foundation, the National Park Service, and the National Geographic Society.