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The Teacher–Scholar Fellowship as a Model for Attracting New Faculty to Undergraduate Institutions

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Introduction

I would like to discuss an experiment which was designed to recruit young scientists into faculty positions at undergraduate institutions.* The experiment was based upon the premise that science courses should emphasize the practical aspect of teaching (ie students should *do* science whenever possible and not just read about it). The ultimate goal of the Teacher–Scholar Fellowship is to provide a smooth transition into teaching positions where the fellows can incorporate their research expertise into the curriculum.

Pew Charitable Trusts

The Pew Midstates Science and Mathematics Consortium has funded two rounds of six Pew Teacher–Scholar Postdoctoral Fellowships. Funded by grants from the Pew Charitable Trusts, the Consortium is comprised of ten private liberal arts colleges and two universities. The Teacher–Scholar Fellows were recent recipients of doctoral degrees in biology, chemistry, geology, mathematics, or physics (Table 1). The fellowships were for two years: the first year was spent at either Washington University (St Louis, MO) or the University of Chicago (Chicago, IL); the second year was conducted at one of the ten colleges in the Consortium. Applicants were required to describe their current and future research interests and career goals, select a mentor at either university, and explain the rationale for their mentor selection.

First year

The first year of the fellowship was designed to be a traditional postdoctoral experience. The fellows conducted research full time in an area of their choosing under the auspices of the selected mentor. In addition, the fellows were expected to participate in the annual Pew Undergraduate Research Symposium where students presented their research in poster and oral formats. Finally, each fellow selected the college where the second year was conducted. This required visits to many of the campuses where the fellow gave a seminar to students and faculty, met with the college administration, and explored with the departmental faculty the potential of integrating into the department.

Table 1 To illustrate a Teacher–Scholar's educational background, I give here an annotated outline of my curriculum vitae. The following Table is meant to serve as an example of where the fellows were in their careers when they were selected as Teacher–Scholars

	Number of Years	*Research Topic*
Bachelor's Degree	4	evolutionary implications of conserved anatomy in amphibian hearts
PhD	5	cloning and sequencing of the cDNA encoding the avian sarcoplasmic endoplasmic reticulum Ca^{2+}-ATPase; biochemical and biophysical characterization of three isoforms of the enzyme
Postdoctoral Fellow	0.3	differential distribution of the alternative forms of the sarcoplasmic endoplasmic reticulum Ca^{2+}-ATPase, SERCA2b and SERCA2a, in the avian brain
	2.0 current fellowship	genetic, molecular, and biochemical identification of proteins involved in the mating of the unicellular alga, *Chlamydomonas*

Second year

During the second year, the structure of the fellowship was modified from solely a research position to one of teaching and research in a college setting. In addition to attending the annual Pew Student Symposium, each fellow was expected to carry half the normal teaching load while maintaining a research program involving undergraduates. For some fellows, the second year included a publication (either an abstract presented at a scientific meeting or a paper submitted to a journal) with undergraduates as coauthors. Since the Teacher–Scholar Fellowship was awarded for two year periods, the fellows also searched for 'real jobs' during the second year.

Initial success

The fellows' initial success depended upon two main factors. First, the experimental system being employed by the fellow was chosen in part for its compatibility with undergraduate-based research. For example, my doctoral research required many experiments using mammalian and chicken cells grown in culture — a very expensive

*In the United States, tertiary education is offered by two types of institutions. There are universities where the student body varies from those seeking a bachelor's degree, to doctoral candidates and postdoctoral fellows. The second type of tertiary institution, referred to as 'undergraduate institutions' in this article, tend to be smaller in size and enroll only those students seeking their bachelor's degrees. There are no postgraduate students at undergraduate institutions.

procedure. I have switched systems to *Chlamydomonas*, a unicellular alga, which is easy and very inexpensive to maintain. With this less expensive system, I can still ask fundamental questions using the same molecular and biochemical methods, but have gained the capability of classical genetics as well. The second critical factor was the mentor's contribution. Did he or she support the fellow's interest in becoming a teacher first and researcher second? Was the fellow permitted to take the project away from the mentor's lab? Will the mentor be interested in collaborating in the future? With the mentor as liaison, did the fellow meet the important players in his or her new field?

Interviewing

Visiting the colleges to select the location of the second year had an added benefit of enabling the fellows to practice their interviewing skills. The fellow was provided with several opportunities to present recent results to an undergraduate audience, a new experience for most fellows. By asking questions of faculty members with different subspecialties, a sense of academic life at an undergraduate institution was revealed. Often new faculty members gave helpful advice based upon their recent hiring experiences. More senior faculty members provided constructive criticism of the fellows' *curriculum vitae*. The fellows met the Dean or Provost, normally an intimidating situation, but the Teacher–Scholar Program provided a rare opportunity to interview without having the pressure of trying to get hired for a position. Most importantly, a comparison was made between the different ways each department has answered the question: "How should we teach biology?" Some departments answered the question by stressing the importance of undergraduate research conducted with their faculty members. Others stressed teacher–student interaction, in and out of class, though they have been unable to provide internal research opportunities. There is no single correct answer; both solutions were successful given the composition of institutional facilities, faculty and administration. This juxtaposition of contrasting approaches to teaching biology allowed each fellow to decide which style best suited his or her career goals.

Emphasis on teaching

During the second year, teaching was emphasized over research since the latter was more familiar. The fellows experienced as many aspects of teaching as possible. Therefore, introductory as well as advanced level courses were taught. Whether these were taught solo or as a part of a combined effort depended upon the department's needs and fellow's courage. Either way, the 'sink or swim' aspect of throwing a teacher into a classroom without prior experience or guidance was ameliorated. The fellows learned from more experienced faculty members in order to avoid common mistakes and enhance their teaching skills. The second year also enabled the fellows to ease into research conducted within an undergraduate environment, with its slower pace and more limited resources.

Goals of the program

Now that the Teacher–Scholar Program has been described, there are two fundamental questions which must be addressed. Is the goal reasonable and is it successful? Whether undergraduate faculty should continue to conduct undergraduate based research as an integral part of the curriculum depends upon the value an institution and department sees in 'hands-on' learning. The Pew Teacher–Scholar Program is based upon the following reasoning. Increasingly, colleges in the United States believe that active learning, such as research and investigative laboratory courses, is the key to generating excitement in students.[1,2] In their 'cone of learning', Bruce Hyland and Edgar Dale have graphically illustrated how well people retain information when presented in different formats. Students remember 10% of what they read, 50% of what they see demonstrated and 90% of what they do.[3] Several funding organizations in the United States have recognized the value of active learning through research at undergraduate institutions and have directed a part of their resources towards undergraduate research. For example, the National Science Foundation supports students conducting research both within their college (Research in Undergraduate Institutions) and on other campuses (Research Experiences for Undergraduates). Funds are also available to upgrade lab equipment within departments (Instructional Laboratory Improvement Program). Likewise, for many years, the Howard Hughes Medical Institute has supported undergraduates conducting research at their institutions. However, funding is not the limiting factor in discovery based learning.

Doing science

Even with limited budgets, students learn science best by *doing* science. Once they have been taught basic techniques, students need to be confronted by unknowns that they can solve by designing and conducting experiments. Beginning with their first biology class, students need to share in the excitement of asking and then answering biological questions. Once they have chosen biology as their major, they need to have a choice of courses which will challenge them, including labs where students can learn actively from first hand knowledge of experimental methods and interpretation of results. Furthermore, biology majors should be nurtured in a science community which allows them to discuss, among themselves and with faculty, their own results as well as recently published research papers. The number of biology majors will increase when students see, throughout their college years, the seductive aspect of science by performing 'hands-on' problem solving. As a result, more college graduates will be better prepared for their eventual careers, in or out of science. They will be more confident in their problem-solving abilities. Therefore, if the

students are to be taught how to learn through discovery, then who is better prepared to share the excitement of discovery than a trained scientist who still actively pursues his or her research?

Conclusions

Is the Pew Teacher–Scholar Program successful? Of the six Pew Teacher–Scholar who have completed their fellowships, four have become members of faculties at undergraduate institutions while the other two decided to return to more research oriented positions. The second and final group of Pew Fellows will apply for teaching positions which begin in the 1994 academic year. The Pew Teacher–Scholar Program was designed as a pilot experiment to test a model. If it is judged to be successful, then others might try to emulate the program with modifications to suit their needs and long term interests. I have heard discussions of new Teacher–Scholar programs that would have different formats to achieve similar goals. One agency is considering the funding of a three-year fellowship, with the first two to be spent doing research and the third teaching. Another approach has been initiated by an undergraduate biology department that has adapted the Teacher–Scholar model to meet its needs for sabbatical leave replacements. This department has advertised for a two-year position where the tenured faculty member taking a sabbatical would teach half his normal load while conducting research in collaboration with the temporary hire, who would also teach half a normal course load. This would allow the Teacher–Scholar to conduct research with undergraduates for two years while getting two years of teaching experience.

The Pew Teacher–Scholar Program has provided opportunities for a small group of aspiring science faculty to make smoother than normal transitions from intense research positions to ones which emphasize teaching. During both years of the fellowship, the Teacher–Scholars were apprenticed to seasoned practitioners of the teaching craft. Under such supervision, the fellows began using their training as researchers as a pedagogical tool. Therefore, it seems that the Teacher–Scholar model is an effective mechanism for recruiting and training the next generation of science faculty.

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Programs from the School of Medicine, National University of Mexico, to Enhance the Development of Biochemistry*

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Introduction

I am going to present the main institutional activities that the directive group of the School of Medicine from the National University of Mexico is actively supporting with the aim of improving the amount, and specifically the quality, of biomedical research activities performed by the personnel of the School of Medicine.

Before that, I shall emphasize the important role played by the School of Medicine at the National University of Mexico in the initial development of biomedical research work, particularly for biochemistry, in Mexico. The Mexican Society of Biochemistry was founded in 1957 with 15 members: 7 of them were MDs, at that time 9 of them were professors in the School of Medicine at UNAM and 3 more were professors in other schools of medicine in Mexico. In 1957, 60% of the biochemists were working in teaching activities and 40% were working in health institutions. The papers published at that time were related to the medical field, in particular, nutrition.

The Instituto de Estudios Médicos y Biológicos at UNAM was derived from the School of Medicine. The first generation of students for the PhD program came from the School of Medicine. The first and the second meetings from this Biochemistry Society were carried out in the rooms of the School of Medicine at UNAM. Thus, in Mexico, biochemistry was born under the auspices of medicine, and particularly, under the protection of the School of Medicine at UNAM.

I shall now describe the following institutional programs — what they are, what are their main objectives and how far they are going. (1) Quality student groups, (2) Promotion and support of research by undergraduate medical students, (3) PhD, (4) MD-PhD, (5) Postdoctoral, (6) Repatriation, (7) Physical facilities, (8) Attendance of special professors to scientific meetings.

Quality student groups program

This program is devoted to medical students. From 1000 students entering the School of Medicine each year, 60, selected on the basis of rigorous testing, and are invited to form two groups, along with selected teachers, to receive special lectures and laboratory exercises in order to improve the quality of teaching and learning. The experience of the School of Medicine 30 years ago, with the then-called 'pilot groups' from Laguna and co-workers,

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