

## Physics Department First-Tier Application for the 2005 Department Teaching Award: Summary of Department Activities

### 1. Profile of the Physics Department

The Physics Department's teaching and learning mission is to maintain high quality degree programs at the baccalaureate, masters, and doctoral levels, to teach the principles of physics to large numbers of students from all quarters of the campus, and to participate in significant educational activities outside the University. The 15 or so BSs we graduate per year rank us among the top 10% producers of undergraduate physics majors in America, and, though we comprise less than 2% of the University's faculty, we generate about 5% of its PhD students.

Instruction in Physics at USU is guided by the principle: *research is teaching*. Wherever possible we incorporate research-like, discovery activity in our teaching. We require that all of our undergraduate majors have a capstone research experience. Laboratory and lecture are completely interwoven in our introductory courses. We teach physics to elementary education majors via hands-on exploration. All 500-600 students in our general education astronomy courses get a chance to individually probe the cosmos using telescopes.

Discovery is also the theme of our highly visible educational outreach program. We frequently engage visitors to campus with night sky viewing and interactive demonstrations; our Get Away Special (GAS) Program regularly makes contact with hundreds of grade-schoolers trying to identify by taste test popcorn flown in orbit; and our Physics Day at Lagoon annually attracts 4,000 youngsters from several states to competitions related to the physics of amusement park rides.

Over the years, Physics faculty and staff have accumulated numerous recognitions for excellence in teaching and advising. Among these are a CASE Professorship, a prize from the American Physical Society for research done with undergraduates, two Danforth college teaching fellowships, *nine* University or College of Science Teaching Awards, a Last Lecture, and two awards for advising, including Robins Adviser of the Year.

Our proudest achievement, however, is the personal mentorship we invest in our students. This effort has led to an unparalleled record of student success. In the last five years alone, our students have obtained prestigious fellowships from the Rhodes, Marshall, Goldwater (three), and National Science Foundations. They have gone on to do advanced work at Oxford, Yale, Princeton, UIUC, Rice, and Wisconsin. They have received awards for their scholarly work from the American Geophysical Union, the American Physical Society, NASA, and the Dirac Centennial Commemoration. Four of our students have been selected by the Council on Undergraduate Research to present at the National Posters on the Hill in Washington, DC. And graduates from our program have successfully obtained faculty positions at such distinguished institutions as Whitman and Centre Colleges and the University of Rochester.

### 2. Activities that Establish the Physics Department's Commitment to Learning Excellence

*Physics 4900—Research in Physics* is the centerpiece of our undergraduate program. Each of our majors takes 4900 in the senior year, but many start their research experience much earlier and stick with it for extended periods. (There are currently about 40 undergraduates engaged in collaborative research with faculty in the Department.) Physics 4900 culminates with the student writing an extensive report and making an oral or poster presentation of some kind. Many of our 4900 students communicate their work at professional society meetings and all exhibit posters on campus at Student Showcase. The Department formally celebrates this scholarly activity with a luncheon in late spring, at which time each of that year's student presenters receives public recognition and a commemorative book (made possible by an anonymous faculty donor).

The Department's GAS Program provides another 30 or so undergraduates from various disciplines the opportunity to work as a coherent team to design, build, and fly experiments in space. The GAS Program's more than 20-year history of successful payload missions and K-6 outreach activities make it one of the University's most enduringly prominent academic student organizations.

Other important activities that bear on learning excellence in the Department include textbook writing (10 books at different levels by five different faculty authors), the development of an electronic course on the use of MathCad (by two faculty), and the acquisition of external funding (by five faculty, yielding over \$500,000 in the last seven years) to support curriculum and laboratory development and a summer Research Experiences for Undergraduates program. The Physics Learning Center, staffed by student assistants, is open to anyone needing extra help in any course in physics. We run a weekly seminar for new undergraduates designed to acquaint them with physics as a profession and an informal training session for seniors preparing to take the physics GRE. We are engaged in several physics education research projects: the language of physics and gender bias, the use of simple hands-on exercises to promote discovery, the efficacy of electronic media in laboratory instruction, and the utilization of computer-assisted, interactive homework sets to identify and assist at-risk students early in introductory physics courses.

### **3. Programmatic Assessment and Related Improvements**

We assess our program based on information solicited from various stakeholders. This input includes frequent (mandatory) conversations between our departmental adviser and her advisees, exit interviews of all seniors, student participation at department meetings, alumni surveys, advice from a panel of industrial scientists, responses to our Physics Newsletter, continuing dialogs with the many departments we serve, faculty reports on conferences and NSF review panels dealing with trends in physics textbooks and curricular reform, articulation meetings involving physics faculty from the state's institutions of higher learning, and peer visits to one another's classes.

Through deliberations of our standing curriculum committee and actions taken at Department meetings and retreats, we have responded in the last few years to information from the groups we serve by hiring a full-time academic adviser; introducing computers for problem solving and data acquisition across the curriculum; developing seven undergraduate degree options to enhance our students' career flexibility; reformulating junior level courses to better suit the needs of all our majors (not just those going to graduate school); requiring a capstone research experience; streamlining our graduate requirements to reduce redundancies and to help shorten the time spent to obtain degrees; establishing a Graduate Student Tracking Committee to more carefully monitor graduate student progress; instituting mandatory attendance of graduate students at departmental colloquia; and producing ten new, audience-specific courses to better fit the curricula of the University's various programs. These changes have led to a number of demonstrable outcomes. Enrollments in physics at USU have increased by over 25% in the last few years. More than 90% of our student credit hours now come from other departments (which we interpret as indicating success in responding to others' needs). While, nationally, the number of undergraduate physics majors has declined by 50% in the last decade, our number has risen by 50% in that time. We have produced about 3 PhDs per year for several years—a figure that places us in the top 40% of the Nation's physics PhD programs (despite being one of the 20% smallest).

In summary, the Physics Department's educational program integrates research and teaching at all levels. We help educate numerous students from across the disciplines. Our outreach activities positively impact multitudes of potential students and friends of USU. And the personal attention we devote to our own majors has resulted in a record of scholarly achievement that is unique among the University's departments.