

APS PROPOSAL FOR FUNDING FROM THE CU SCIENCE EDUCATION INITIATIVE

Douglas Duncan, APS faculty SEI contact.

INTRODUCTION

The Department of Astrophysical and Planetary Sciences (APS) has demonstrated a significant commitment to improving teaching and learning for the large number of major and non-major students we serve, as shown by ongoing department activities the last several years. We also have long-standing teaching and learning goals that we have not been able to address for lack of personnel. We therefore welcome this opportunity to apply for SEI support.

During the last six years APS has developed the largest undergraduate astronomy major in the US, with 190 students now enrolled in two different tracks. Some of these will go to graduate school; some will become high school physics teachers. Each year APS teaches more than 2000 non-science majors. Some of these will become elementary or middle school teachers. For most, it will be one of only a few college science courses they will ever take. The introductory courses for majors and non-majors are the ones we plan to address. The potential impact of SEI-supported improvements is very large.

APS has recently been rated among the top 10 US astronomy departments. It is highly visible, so systemic improvements in teaching made here can potentially serve as models for other departments. Astronomy is a small field, and departments tend to know what other departments are doing. In other words, there is a potential national impact in addition to the immediate impact at CU.

APS was the first department to use learning assistants (LAs) and we use them in a variety of ways. Some work alongside graduate students in labs for our introductory solar system course ASTR 1010. Some lead their own recitations sections, in our introductory stars and galaxies course ASTR 1020. Some help administer lecture-tutorials in classes such as ASTR 1120, the version of introductory stars and galaxies that does not have recitations. Nearly all faculty members, including senior faculty, participate in teaching introductory courses. This variety of teaching approaches makes APS an ideal venue for testing which approaches produce improved student learning.

During the past few years we have supported the first astronomy education research Ph.D. in the Department's history, published research on successful ways to increase the scientific thinking of non-science majors, made major improvements in Fiske planetarium, implemented a highly successful mentoring and career advice seminar for undergraduates, strongly supported the Learning Assistant program, and offered a seminar on "Excellence in Teaching" for graduate students and faculty members. We also hired Instructor Seth Hornstein, and are developing new assessment tools. This means that the department already has considerable familiarity with discipline-based education research, which should make it smoother for us to work with SEI. The final section of the proposal describes these previous actions in more detail.

Our proposal follows the format suggested by SEI: How will we define our goals and insure widespread faculty participation? How will we measure (assess) what students know and can do, before, during, and after teaching "improvements?" What strategies are we contemplating to meet the goals?

MANAGEMENT AND SEQUENCE PLAN

Several members of the APS faculty have regularly attended discipline-based education research (DBER) meetings for the past 5 years. In planning this proposal we discussed with two SEI fellows the details of what worked and what didn't work in their departments. In addition we have read, "Revitalizing Undergraduate Education: Why Some Things Work and Most Don't," by Sheila Tobias. Tobias strongly makes the point that successful departmental change occurs when a large number of people each become a small part of the improvement, rather than a few people making major changes independent of the rest. We are familiar with the work of Henderson and Dancy (Am. J. Phys 76, 79, 2008) on "Barriers to the diffusion of innovation," and the research, "Persuading Professors" by Foertsch et al. at the University of Wisconsin LEAD center. These two papers stress the importance of innovators being flexible and responsive to faculty needs.

We therefore discussed this SEI proposal widely, including at two APS faculty meetings, made changes in response to suggestions, and then held a vote whether to submit. The vote was 20-0-0 in favor. (APS has 22 rostered faculty members.)

The agreed-to process of instructional improvement would be as follows:

1. Two faculty working groups will be formed, one to deal with undergraduate majors, and the other with undergraduate non-majors. Four faculty members and one or two non-faculty members will serve on each working group. On the majors group an outside member will come from Ball or another aerospace company and the other will be Michelle Stachurski, a high school physics and chemistry teacher who studied in APS and is now teaching in Denver city schools. We think this is important and don't know many departments that bring back successful graduates and put them into a group whose task is to determine the best ways to prepare graduates. Each working group will also include a current student. Two SEI fellows will be hired and be part of the working groups. We anticipate hiring expertise in curriculum development and in assessment.

Education consultant Stephanie Chasteen would be hired as a facilitator to help both working groups get started and stick to their task of defining learning goals and measurable outcomes. APS faculty SEI contact Duncan has experience with facilitated strategic planning meetings. The relatively small investment in a facilitator generally saves a lot of time and increase the chance of success, especially when working with faculty. SEI fellows would then gradually take over organizing the working groups. Faculty members Duncan and Hornstein would serve on the working groups to provide oversight and leadership, but avoid "telling faculty what to do."

Each working group will define a work sequence, but we expect to concentrate on our introductory courses ("solar system" and "stars and galaxies;" see "Goals" below). APS has worked in the past to develop course coherence, and we distribute planning sheets to students. Both majors and non-majors take one semester of "solar system" and one semester of "stars and galaxies." We fight over whether the sun belongs in "solar system" or with "stars." The working groups would certainly add to coherence: not only when to teach the sun, but which courses should teach the background physics about light, spectra, and gravity. Having many faculty members in the working groups together will foster a spirit of coherence and planning that would extend to the future.

The SEI Call for Proposals asks for:

A plan for sequence – which courses are to be addressed, in what order and timeline – and, the logic behind the plan.

Our logic can be stated simply:

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What is the best mix of faculty, TA, and LA resources that creates the best learning gains?

How well does our teaching support the needs of our graduates?

Since we want full discussions and maximum participation in the faculty working groups, we can't and don't want a full plan in advance. However, some needs are so clear from faculty discussions that we can specify them now, and we do so below in the section "Goals for APS-SEI."

2. Each working group will develop a list of core competencies and attitudes we agree that our students should possess. These may be rather different for majors and non-majors. They will include:

- a. What should students learn?
- b. What should they be able to do?
- c. What are student attitudes about (our) science?

...and what is acceptable evidence for a, b, and c? Goals must be measurable.

Item c, student attitudes, is measured less often than learning gains but is important. About 250,000 students nationwide take astronomy each year, and it is usually one of few college science courses they will take. Whether they end up with a lifelong love (or hatred) of science and with understanding (or not) of its importance matters to US society and to our faculty.

3. Working groups will present their results for approval by the entire faculty.
4. SEI fellows will work with faculty members to administer assessments and provide evidence how well the items in #2 are being achieved.
5. SEI fellows and interested faculty members will propose ways of changing our curriculum and teaching that can improve what we are presently achieving. These proposed changes will be presented to the majors and non-majors working groups before being developed; to be sure they are practical and would be used by many faculty members if successful.
6. Changes will be implemented in small amounts during one semester and evaluated as soon as possible. The evaluation feedback will be used as we continue to make successive changes. This process, formative evaluation, is the most effective way to improve educational programs.

The variety of ways we currently teach introductory courses will be part of what is examined. Does having LAs make a difference? Does it matter whether the LAs work alone or alongside graduate students? We teach the solar system with and without a lab: how does this affect learning? Does the substantial investment of resources in the labs produce appropriate gains? How could such investments be best utilized? We teach stars and galaxies with and without LA support. How does this affect learning?

7. Summative evaluation (How did students perform at the end of a changed course?) will be conducted and reported to the faculty working groups.
8. Faculty working groups will report progress to the entire faculty.

We would hire two SEI fellows to begin work in August 2011. The two working groups would be named by May 2011 and also begin work in August. Fall 2011 would be devoted to defining learning goals, core competencies and attitudes we want students to have. SEI fellows and faculty members would then propose ways to measure the goals and have these accepted by the working groups. Spring 2012 would be the first set of "pre" measurements and formative evaluation would be used as we

slowly introduce the changes listed under “Goals” below. We would take “post” measurements in spring 2012. Summer 2012 would be used to review and evaluate year 1 with the working groups, and to plan changes for the 2012/13 academic year. A report to the full faculty would occur in fall 2012. The cycle would then repeat two more years except that with the goals already established more time would be available for curriculum improvement. Four APS faculty members (Burns, Duncan, Hornstein, Schneider) already use nationally-accepted instruments to measure learning gains, and these are available as a baseline. These faculty members also expect to mentor the SEI fellows.

ASSESSMENT

Good assessment is the key to successful educational change because *assessment provides the data on which the science of teaching and learning improvement works*. Without data, it’s not science, and improvement is at best scattershot.

Faculty Contact Duncan has been a strong proponent of formative and summative assessment for 20 years. His recommendation resulted in the hiring of the first assessment person in the education office of the Hubble Telescope, Bonnie Eisenhamer, 15 years ago, when NASA did very little assessment of its education programs. In 2005 the APS Department submitted an NSF proposal, “Modernizing Assessment in Large Introductory Astronomy Classes,” with letters of support from 9 faculty members. The proposal was not funded primarily because it proposed assessment that was new to astronomy but not to the field of assessment. We presume that SEI is looking for good, tested assessment and that is what we will apply if selected as an SEI department.

In almost all cases we prefer mixed-mode assessment that includes both quantitative and qualitative data. Scientists, especially physical scientists, are often leery of qualitative or ethnographic data at first, worrying that it is not precise. But qualitative data is enormously useful in identifying issues that faculty members would not have thought of or never questioned. APS faculty members Dick McCray and Fran Bagenal worked with Elaine Seymour, an outstanding CU ethnographic researcher and the author of *Talking about Leaving*, the landmark study of why women drop out of STEM majors more often than men. Faculty member Duncan worked with SEI Fellow Leilani Arthurs on a study of students’ scientific thinking. They conducted and recorded 52 student interviews, and separately coded them to demonstrate consistency. Ph.D. student Colin Wallace has been conducting undergraduate student interviews for years as part of his thesis work. Faculty member Seth Hornstein has been developing a Solar System Assessment tool. All of this work has familiarized the department with two things: 1) it takes a lot of work and time to do student interviews, and 2) the information they produce is invaluable for improving teaching and learning.

Quantitative data are also essential. Such data are necessary for comparison of changes in learning gains from year to year, and for incorporation in national studies. Astronomy is relatively fortunate in having some good assessment instruments. During the last five years the “Light and Spectra Concept Inventory (LSCI)” has been developed and tested nationally. The lead developer, Ed Prather of the University of Arizona, is a member of Colin Wallace’s thesis committee, and several APS faculty members are familiar with this assessment and use it. The LSCI is a lot like the FCI (Force Concept Inventory) in physics, in that light and spectra are taught in every astronomy course, just as kinematics and dynamics are taught to everyone who studies physics. For more than three years faculty members Seth Hornstein, Fran Bagenal, Nick Schneider, and Doug Duncan have been working to develop a Solar System Concept Inventory. Developing this is a major and important challenge because there has been a fundamental shift in the way the solar system is understood and

taught. Instead of a "botanical taxonomy" of the planets, modern planetary science is concerned with the physical processes that shape all the planets. In some ways solar system astronomy is now more like geology than astrophysics. We need to test how well students understand processes such as cooling, volcanism, the role of atmospheres and the greenhouse effect, as well as how the same processes can produce such different-looking planets. After continuous progress over four years we would greatly welcome the aid that SEI membership would provide in implementing and publishing this instrument, and in using it to improve our own solar system teaching.

GOALS FOR APS-SEI

The goals and strategies to achieve the goals we adopt will be determined by the faculty working groups described under the "Management and Sequence Plan." However, there are some needs that multiple faculty members have identified, sometimes for many years, and it is likely that some of the items below will be addressed, in approximately the sequence below.

1. Improve the effectiveness of Learning Assistants in ASTR1020 by creating student – centered activities for them to use. APS was the first department to use LAs and we strongly support the program. We transformed one of our largest introductory courses, ASTR 1020, "Stars and Galaxies," to have recitation sections led solely by LAs. The faculty members who have taught the course using LAs all strongly suggest that we need more good LA-led activities.

We are aware that better learning takes place when LAs are guiding students through student-centered activities rather than just talking. But we also know that it takes significant effort to develop good activities. We've developed some. One involves measuring the height of Gamow Tower. One involves measuring the circumference of the earth, Eratosthenes-style. Two involve using exhibits at Fiske planetarium. These are much better than "talking" recitations. (The Gamow Tower activity is pictured on the STEM LA web page). However, we only have enough good activities to cover part of the semester. A top priority, therefore, is to develop additional activities for our LAs to use in ASTR1020.

2. Make more effective use of Night Observing Sessions: CU has darker skies than most universities, and an excellent facility in Sommers Bausch Observatory (SBO). Astronomy classes at CU should have good nighttime labs based on authentic observation of the sky. Before the advent of LAs, night labs were run in ASTR 1010 because this class has the graduate student TAs who could run telescopes. But most of what is observed is stars, star clusters, and nebulae, the subject matter of ASTR1020. Part of the activities developed for ASTR1020 (Item #1) would be night observing sessions, allowing us to put them in a more logical sequence as part of ASTR1020 instead of 1010. We would also experiment with bussing students to the Mountain Research Station.

**3. Track career success of the undergraduate program;
Institutionalize "Beyond Boulder" career mentoring**

The APS undergraduate major is now the largest such program in the US with over 190 students. We offer two tracks, one leading to graduate school and one leading to careers in K-12 teaching, museums, science journalism, or other science-related careers. It seems very important to start to track the post-graduation careers of our students and use the feedback to improve our major. We would use a small amount of SEI support for developing an appropriate exit survey and gathering and processing such data.

Beyond Boulder is a mentoring and career development program for undergraduate physics and APS majors. The feedback from the many undergraduate students who take part in it has been highly favorable. “Beyond Boulder” meets weekly for discussions, seminars, Q&A panels, and workshops related to life after graduation, whether it is career or graduate school. It was developed and is currently administered by APS postdoc Makenzie Lystrup, as part of her NSF Fellowship. Beyond Boulder serves over 150 students per year, about 50 from APS. Six APS faculty members participated this year, and speakers were also brought in from government labs, research institutions such as LASP and NIST, and aerospace companies. Topics discussed include careers in academia, careers in research, careers in industry, careers in teaching, alternate careers, choosing grad schools, and women in physics and astrophysics.

We know from the student comments as well as studies such as *Talking About Leaving* (Seymour and Hewitt; Westview, 1997) how critical mentoring can be to student success. APS faculty members widely share the mentoring of our undergraduate majors. However, Beyond Boulder provides more extensive advice. If the data we gather on career success indicates that Beyond Boulder helps our majors succeed, we would institutionalize it. We would ask our SEI fellows to help continue Beyond Boulder while we evaluate it.

4. Recruitment of minorities.

Several APS graduate students formulated a plan to recruit more minority students to attend CU, and to recruit more CU minority students to study (astro)physics. They have signed up 10 graduate students who are willing to mentor minority students. After joining with APS faculty members Erica Ellingson and Douglas Duncan, the group is seeking funding to support such mentoring. Like Beyond Boulder, the costs involved are not large. A tentative strategy involves two recruitment parties at Fiske Planetarium, one for high school students, to convince them to apply to CU, and a later one once students are admitted to CU.

Astronomy colleague Linnea Avalone is the Director of the Miramontes Arts & Sciences Program (MASP- formerly the Minority Arts & Sciences Program). She contributes, “I would love to help with the recruitment of minority students (to any area of science, but especially physical sciences). You can definitely say that our students and/or staff would be available to help with your programs. We could certainly collaborate on visiting schools, talking to students, and mentoring students!”

The Department will donate the use of Fiske Planetarium for recruitment events. Fiske is the only planetarium in the US regularly producing programs in both Spanish and English. Fiske Manager Tito Salas is bilingual in scientific Spanish as well as being Chancellor’s Employee of the Year last year. He is an important resource to help attract and retain Hispanic students.

Michelle Stachurski was an LA in APS and now teaches in a 90% Hispanic high school in Boulder. She is an outstanding, energetic young teacher who has accompanied Prof. Valerie Otero to NSF. Shelly has brought her students to CU and to Fiske, and we hope to make several planetarium volunteers this summer. This is a personal connection we could use to recruit students. A member of the Board of the Denver School of Science and Technology, who has previously worked with APS faculty member Mike Shull has asked the APS Department to associate itself with this school in a mentoring role. This is another highly Hispanic school where we have a direct connection to recruit good students to CU.

Miranda Tafoya who is one of our fall graduates will be the first person in her family to finish college. She has good ideas about mentoring Hispanic/Latino students in coming to college and majoring in astrophysics. Susan Ramirez Armstrong is APS Administrative Assistant, and her father is a retired faculty/administrator from CU Boulder. Both are very interested in taking part in efforts to recruit and mentor. We would make the recruitment of minority students an official part of our initiative if it is funded, and seek permanent way to support this (see “Sustainability”).

5. Institutionalize a Graduate Student Seminar on “Excellence in Teaching.”

We would offer a one hour per week, semester-long seminar on “Excellence in Teaching,” in which graduate students learn strategies for increasing student learning, the same way that undergraduate Learning Assistants do in their weekly seminar. Faculty members Duncan, Hornstein, and Schneider would teach the seminar on a voluntary basis, working with the two SEI fellows. Duncan and Schneider have already taught such a seminar once, also on a voluntary basis.

Evidence increasingly shows that implementation is critical to educational improvement. Some lab sections in ASTR1010 are rated as good by students and some as poor. This is the same curriculum but taught by two different graduate students who may or may not have received instruction on how to teach. Some who use clickers use them well; some poorly or even fail. Colin Wallace’s thesis work shows that while his tutorials achieve spectacular learning gains on average there is a wide range in success among different classes that use them. There is no sense in SEI spending a lot of money on developing new curriculum without supporting guidance on how to use it. For that reason we will institutionalize the “Excellence in Teaching” seminar if APS is selected as an SEI department, committing to offering it every other year. (APS classes are offered in a two year cycle.)

EFFORTS ALREADY UNDERWAY TO IMPROVE TEACHING AND LEARNING

We think that the accomplishments already achieved in APS during the last several years demonstrate serious APS faculty time commitment. They should increase confidence that if APS is selected as the new SEI department we will deliver substantial results.

1. Collin Wallace Ph. D: Three years ago the APS faculty unanimously approved the first-ever departmental Ph.D. in astronomy education research. To insure high quality as well as profit from the more extensive experience in physics, we invited professor Noah Finkelstein to be part of the committee. Wallace’s thesis is a study of student conceptions of cosmology and dark matter, and the creation of “tutorials” to address student misconceptions. Wallace has been extremely industrious in gathering funding and in recruiting faculty to try his tutorials, so far gathering a sample of 1700 students throughout the US. The improvements in student learning produced by his tutorials work are striking:

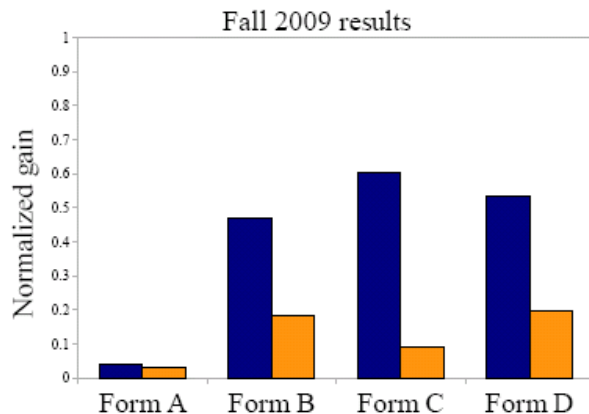


Figure 1. Normalized learning gains for students who did (blue) and did not (gold) use tutorials on four different subject in cosmology (Forms A-D).

Support of a discipline-based education research thesis is a major step for any department to take, and the results in APS have been very positive.

2. A Successful Strategy to Improve Student's "Scientific Thinking." Duncan and SEI Fellow Leilani Arthurs have a paper in press (*Astronomy Education Review*) that demonstrates success in improving the confidence of non-science majors that they can make good scientific decisions for themselves. The instructional strategy involves assignments that send students to the www and YouTube, ask them to judge whether the science is good, and to explain to classmates how they decide. Students' confidence builds with practice and at the semester's end they are quite different from students taught in a conventional class used as a control group. (As measured by 52 interviews and hundreds of responses to questions such as in Fig. 2.)

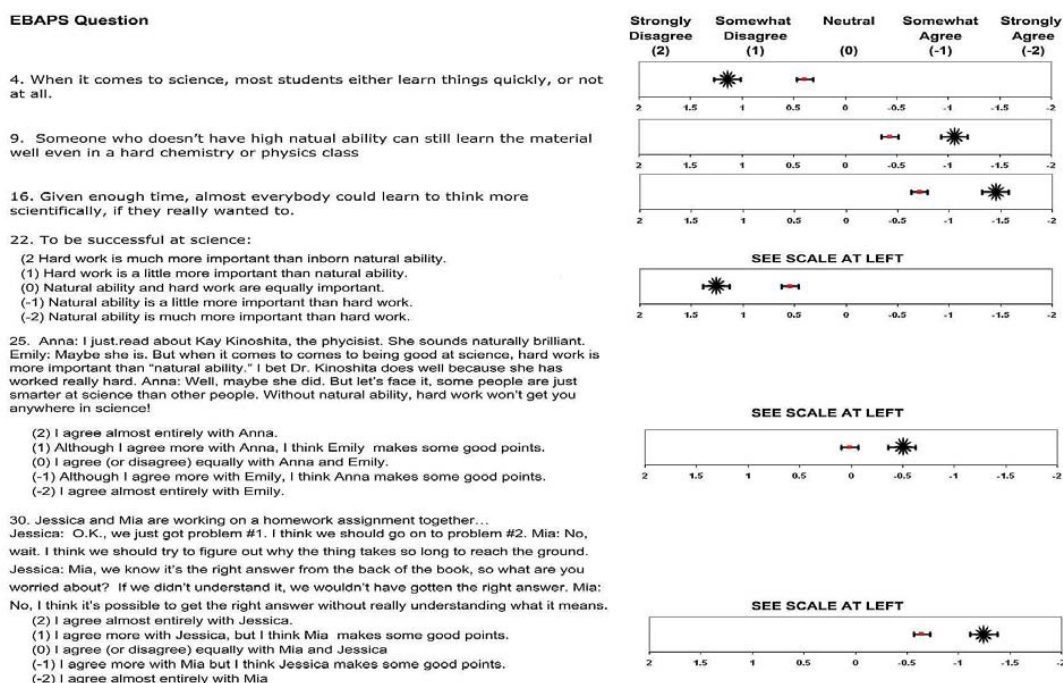


Fig 2. Every EBAPS question that dealt with "Who can do science?" or "How does one learn science?" differed significantly between the Test class: stars; and the Control Class: squares.

3. Seth Hornstein developing a Solar System Assessment Instrument. For more than three years, APS faculty members Hornstein, Fran Bagenal, Nick Schneider, and Doug Duncan have been working to develop a Solar System Assessment. In this effort 4 faculty members are actively involved, each doing part of the work, though Hornstein is doing the most. As mentioned above, an SEI fellow would be a very helpful addition to help complete, test, and spread this assessment, which would be used by more than 1,000 students who take Introductory Astronomy: Solar System at CU each year. It would be used nationally as well because there is no instrument available that deals with the solar system (stars: yes, spectra: yes, sky motions: yes, planets: no!).

4. Offering an "Excellence in Teaching" Seminar for graduate students. LAs in all departments receive ongoing, excellent preparation for teaching in their Wed. seminar. Unfortunately graduate students often don't. Two years ago APS faculty members Nick Schneider and Doug Duncan offered a one hour per week seminar on "Excellence in Teaching." It covered such topics as: Are good teachers born or made? How to "Avoid Doing Harm" when teaching; Characteristics of the best and worst teachers; Five components of effective teaching; *Six Ways to*

Discourage Learning -- the most common mistakes made in “lecture mode;” The importance of formalizing teaching goals. The scholarship of discipline-based educational research of your subject, your students, and how they learn; Metacognition -What does it *mean* to learn a science? What do your students think it means? Bloom’s Taxonomy; The challenge of *A Private Universe* and *Minds of our Own*; Common misconceptions in astronomy; Motivating students; What can be better than a “Good, Clear Lecture? Assessment Techniques such as the *Astronomy Diagnostic Test* and the need for new ones.

This seminar was given once and regular attendance was 14, including several faculty members and postdocs. One faculty member has taught at CU for 30 years and this was the first teaching seminar he’s attended. If selected as an SEI department, APS would institutionalize this seminar, offering it every other year. Graduate students are very busy, as is our seminar schedule, so this is an important departmental commitment.

5. Fiske Planetarium moving to more student-active teaching. About 10 APS faculty members teach courses that use Fiske planetarium. Although planetariums can be very passive by nature, ours encourages active learning by including peer instruction and clicker use in programs, as well as interactive exhibits and “Science on a Sphere” (now used with clickers). Fiske instituted clickers years ago using infrared clickers, supported by a grant from faculty member Jason Glenn.

6. Nils Halverson experimenting with peer instruction in graduate classes. One of our most recent faculty hires, Nils holds a joint appointment in physics and has already begun making the graduate class he teaches more active and student-centered, including using peer instruction and clickers. In spring 2011 he will be teaching undergraduates and using LAs for the first time, and he has a strong interest in using them effectively. All of this is part of Halverson’s NSF Career Grant. As a future leader in APS his participation can have a major impact now and in future years.

SUSTAINABILITY AND DEPARTMENT COMMITMENT

The previous section demonstrates that there is already commitment from many department members to improve teaching and learning. The reward for faculty members will be the resources from SEI (SEI Fellows) that enable them to achieve things in teaching that they want but don’t have resources to do themselves. For the faculty members specifically interested in recruiting more minorities, and those interested in tracking the success of our graduates, the SEI initiative would provide student employee hours to collect data and arrange activities. The reward is the ability to conduct programs faculty members want to see accomplished. The strong faculty participation in meetings discussing this proposal is a sign of commitment that will contribute to sustainability.

The Department currently provides support for two LAs, for two semesters each year (\$6,000 support). We will continue to do so.

APS has previously spent departmental money on creating two labs at Sommers Bausch Observatory suitable for the kind of teaching SEI encourages. One has tables designed for group activities. The other is a multi-use computer lab. The department recently voted to commit \$22,600 to improve these labs for 2011.

We will hold two fundraisers each year at Fiske planetarium, to raise money to support programs that need miscellaneous funds, such as the proposed recruitment and mentoring.

The department already holds semi-regular meetings of faculty members involved with undergraduate teaching. We will regularize these the way that “brown bag” lunches are held in physics and chemistry, involving the SEI fellows and using the lunches to keep everyone apprised of progress and opportunities.

CIRTL (Laura Border) has offered APS support for improving the “Teaching Excellence” Seminar.

Faculty contact Duncan will commit 2 months each year directly to the SEI programs and remain committed to DBER and teaching improvement at the end of the SEI period. It will be his responsibility to be sure the promised activities take place on schedule.

BUDGET

A. Salaries and Wages	Year 1	Year 2	Year 3
Postdoctoral Science Education Fellow			
Postdoctoral Science Education Fellow			
Faculty Contact: D. Duncan - 1 month			
Faculty member Seth Hornstein - 1 month			
Student employees: \$10/hr, 20 hrs/wk x 40 wks plus 10 weeks, 40 hrs/wk in summer			
Total Salaries and Wages	122347	124794	127291
B. Fringe Benefits			
Postdoctoral Science Education Fellow			
Postdoctoral Science Education Fellow			
D. Duncan: 26.8%			
S. Hornstein 26.8%			
Student employees 1.1%			
Total Fringe Benefits	29617	30210	30814
D. Travel			
Postdocs attend one scientific conference/yr EACH			
air travel:			
\$600 RT coach airfare: \$600 per trip	1200	1224	1248
meals Meals/Lodging: \$185/day x 3 days	555	566	577
registration Ground transportation: \$100	350	357	364
local transportation	100	102	104
Bus to Mtn. Res. Station (4 busses/yr)	1200	1200	1200
Total Travel	3405	3449	3493
E. Other Direct Costs			
consultant S. Chasteen 30 hrs@\$75/hr	2250		
publication costs	2000	2040	2081
E. Total Direct Costs	157369	160493	163679
Total amount requested for project:	481541		