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NEW DEGREE PROGRAM REQUEST College of Natural Science & Mathematics
Graduate Certificate in Science Teaching and Outreach

Cover Memorandum

- A. Proposal prepared by:
Richard Boone, Professor, Dept. of Biology and Wildlife
Laura Conner, Research Assistant Professor and Director of CNSM outreach
Sarah Fowell, Associate Professor and Chair of Dept. of Geology and Geophysics
Denise Kind, Instructor, Dept. of Biology and Wildlife
Christa Mulder, Professor and Chair of Dept. of Biology and Wildlife
- B. We hereby propose a new graduate certificate in Science Teaching and Outreach, to be offered at the University of Alaska Fairbanks. Many science graduate students have demonstrated an interest in enhancing their teaching and outreach skills. In response, two courses and a seminar that meet this need have been developed and are currently offered. An additional course on mentoring has previously been offered, but not in the past year. The graduate certificate would package these courses, with the addition of an internship and two 1-credit seminars, to offer a formal credential to science students that are interested in enhancing their teaching skills. The certificate is expected to increase competitive ability in the higher education job market, as well as prepare students to be better communicators of their science.

Program Goals:

- 1) To provide students with a formal credential that documents their efforts towards enhancing their teaching, mentoring, and/or outreach skills
- 2) To better prepare future professionals for careers in science and engineering by increasing skill in teaching, mentoring, and/or community engagement
- 3) To increase student familiarity with pedagogical theory and best practices in teaching

Department Head

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Faculty Senate Curriculum Committee Chair

Chancellor

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President, Faculty Senate

President

Graduate School

9/26/12 TLP

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IDENTIFICATION OF THE PROGRAM

A. Description of the Program

Program title: Graduate Certificate in Science Teaching and Outreach

Credential level of the program: Graduate Certificate (12-29 credits are required for graduate certificates. This certificate will require 12 credits). (Note: This program is NOT related to a state teaching certificate and earning this certificate does not enable the graduate to teach K-12 in a certified position)

Admissions requirements and prerequisites: Applicants must follow the admission requirements of the UAF Graduate School.

The prerequisites are: (1) a bachelor's degree from an accredited institution; (2) admission to a graduate science or engineering degree program at UAF (CNSM, SFOS, SNRAS, CEM), or prior completion of a Master's degree or Ph.D. in the sciences or engineering.

Course descriptions:

Note: We have requested a new designator, STO, for all courses in the certificate (except the two discipline-specific courses in math and physics). This designator reflects the fact that students from multiple disciplines will enroll. The designator obviates the need for multiple cross-listing across departments (for instance, Scientific Teaching is currently cross-listed between BIOL, CHEM and GEOS, although only two of these departments have the main responsibility for teaching the course. We are proposing the course numbers below for all courses in the certificate. See attachment (page 28) for a quick guide to numbering system.

STO 601 Communicating Science (currently BIOL/MSL 694)

2 credits

Offered Spring

Prerequisites: graduate standing or permission of instructor

This highly interactive course allows students to gain hands-on experience with teaching and communicating science to public audiences. Over the course of the semester, students will lead programs in K-12 schools and/or out-of-school settings, develop a presentation and present their own science to peers. Students will also explore pedagogical theory and learn how to use active and inquiry-based teaching strategies.

STO 666 Scientific Teaching (currently BIOL/CHEM/GEOS 666)

2 credits

Offered every other Spring

This course explores methods for teaching science at the university level. Emphasis is placed on methods of teachable unit design, instructional techniques, formative assessment and course management that have been shown by research to improve student learning; the course is taught using these methods. This course is intended for graduate students in the sciences who have an interest in improving their teaching skills. The course format will be a mixture of discussions, workshops and seminars.

STO 602 Mentoring in the Sciences (currently BIOL692)

2 credits

Offered Fall

This course provides a forum for graduate students to develop their mentoring philosophy and build effective mentoring skills. Effective mentoring can be learned, but not taught. Good mentors are normally produced through years of practice, successes and failures, and no two mentoring situations are alike. This course seeks to provide a discussion and learning environment for accelerating the process of learning to be a mentor. Through discussion of case studies, activities and readings provided in course materials, students will consider mentoring philosophy, articulate it, anticipate challenges and practice effective solutions to a variety of mentoring issues.

STO 692 Current Topics in Scientific Teaching (currently BIOL692)

1 credit

Offered every other Fall

Prerequisites: graduate standing

This graduate seminar course will address current pedagogical literature related to best practices in science teaching. The course format will consist of reading and discussion. Students are expected to lead one or more class periods. Course may be repeated twice.

STO 603 Instructional Design

1 credit

Offered Spring

This graduate seminar course will address important components of course planning and instructional design that reflect best practices in science teaching. This course focuses on the overall design of courses, the integration of the various components of a course, the development and implementation of summative assessments and syllabus construction. The course format will consist of reading and discussion, seminars and workshops.

MATH 600 Teaching Seminar

1 credit

Offered Fall

Prerequisites: Graduate standing.

Fundamentals of teaching mathematics in a university setting. Topics may include any aspect of teaching: university regulations, class and lecture organization, testing, book selection, teaching evaluations, etc. Specific topics will vary on the basis of student and instructor interest. Individual classroom visits will also be used for class discussion. May be repeated for credit.

PHYS 605 Physics Teaching Seminar

1 credit

Offered Spring and Fall

Prerequisites: Graduate standing

This course will give science graduate students both lectures and hands on training in dealing with all aspects of teaching (focused on, but not exclusive to, the Teaching

Assistant level and beyond). We will cover topics in teaching pedagogy, preparation strategies, student management, time management and learning assessment. The course will be approximately 50% interactive lecture/ discussion and 50% practical exercises. This course is intended to provide both basic introductory and in-depth science teacher training and guidance at the college level.

STO 604 Scientific Teaching/Outreach Internship

4 credits

Offered: fall, spring

Prerequisites: STO 666 OR STO 601

Under the supervision of a faculty member, students gain professional experience in science teaching or outreach by choosing one focus: 1) higher education, 2) formal K-12 education, or 3) informal education. An internship plan is developed prior to enrollment and agreed upon by instructor of record, faculty mentor, and student.

All courses labeled with * are currently taught or have been previously taught through CNSM (Current Topics seminar was previously offered as CASE seminar)

Required core courses (6 credits)	Internship/practicum: Choose one focus (4 credits for a semester-long internship. All under same course number, STO 604)	Seminar (2 credits— instructional design is required plus 1 additional seminar)
<p>*STO 666 Scientific Teaching (2 credits) Students learn effective active learning techniques for teaching science at the university level, develop teaching activities, and create components of a teaching portfolio.</p> <p>*STO 601 Communicating Science (2 credits) Students explore hands-on and inquiry based teaching and science communication, then practice these skills in a K-12 or informal setting.</p> <p>*STO 602 Mentoring in the Sciences (2 credits) Students learn research-based methods of effective mentoring and develop a mentoring philosophy.</p>	<p>Higher Education Students are paired with a faculty member who will oversee the development and delivery of lectures during a regular course within the student's discipline. Prerequisite: STO 666 Scientific Teaching</p> <p>Formal K-12 Education Students are paired with a K-12 teacher in the community who oversees development and delivery of classroom teaching activities. Prerequisite: STO 601 Communicating Science</p> <p>Informal Education Students develop and deliver presentations to K-12 audiences or the general public, such as science café-style talks, family science nights, or other formats for informal venues. Prerequisite: STO 601 Communicating Science</p>	<p>STO 603 Instructional Design (1 credit) This seminar explores how to design courses to effectively promote and quantify student learning.</p> <p>*STO 692 Current topics in scientific teaching (1 credit) This seminar focuses on current pedagogical literature related to science teaching.</p> <p>*MATH 600 Teaching Seminar (1 credit) This seminar focuses on skills needed to effectively teach mathematics</p> <p>PHYS 605 Physics teaching seminar (1 credit) This seminar course focuses on the special</p>

		skills needed to effectively teach physics
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3-Year cycle of course offerings:

Course	Spring 14	Fall 14	Spring 15	Fall 15	Spring 16	Fall 16
Scientific Teaching	X				X	
Communicating Science	X		X		X	
Mentoring in the Sciences		X		X		X
Internship		X	X	X	X	X
Current Topics Seminar		X				X
Instructional Design	X		X		X	
Math teaching seminar		X		X		X
Physics teaching seminar	X	X	X	X	X	X

Suggested sequence to complete the certificate in 2 years (starting in an even-year spring):

1 st Spring	Scientific Teaching	
1 st fall	Mentoring in the Sciences	
2 nd Spring	Communicating Science	Instructional Design
2 nd Fall	Internship	Current Topics Seminar*

* Current Topics can be substituted with MATH 600 or PHYS 605, which are offered in additional semesters.

Suggested sequence to complete the certificate in 2 years (starting in an odd-year spring):

1 st Spring	Communicating Science	Instructional Design
1 st fall	Mentoring in the Sciences	Current Topics Seminar*
2 nd Spring	Scientific Teaching	
2 nd Fall	Internship	

* Current Topics can be substituted with MATH 600 or PHYS 605, which are offered in additional semesters.

Note: We are proposing a spring start to the program for sequencing reasons. Both Scientific Teaching and Communicating Science need to be taught in the spring due to current commitments, and the Internship would ideally be completed after both classes have been taken. Other combinations are possible, however. For instance, a student might take MATH 600 or PHYS 605 during the first semester of their enrollment. Students could complete the internship during the summer, or earlier in the sequence, if the prerequisite has been satisfied. It is envisioned that an M.S.

student would need a minimum of 5 semesters of enrollment to complete both M.S. requirements and the certificate requirements.

Proposed general catalog layout copy:

Graduate Certificate in Science Teaching and Outreach

The certificate in science teaching and outreach is a voluntary program that prepares science graduate students for science careers that include teaching and/or communicating science to the public. It does NOT meet the requirements for earning a state teaching certificate and will not allow graduates to apply for certified positions in the K-12 school system. Such training will enhance readiness for college-level teaching by providing hands-on training and familiarity with pedagogical theory. The certificate is expected to increase competitive ability in the higher education job market.

Requirements for the Certificate:

1. Complete the general university requirements
2. Have a Bachelor's Degree from an accredited institution
3. Admission to a graduate science or engineering degree program at UAF (CNSM, SFOS, SNRAS, CEM), or prior completion of a graduate degree in the sciences or engineering.
4. Complete the following:

STO 666- Scientific Teaching	2
STO 601- Communicating Science	2
STO 602- Mentoring in the Sciences	2
STO 603- Instructional Design	1
STO 604- Internship	4

11 credits

5. Complete 1 of the following:

STO 692 – Current Topics in Scientific Teaching	1
MATH 600 – Mathematics Teaching Seminar	1
PHYS 605 – Physics Teaching Seminar	1

1 credit

PROGRAM TOTAL: 12 credits

B. Program Goals

1. Goals, objectives and means for their evaluation (Also see page 19 for detailed program evaluation)

- 1) To provide students with a formal credential that documents their efforts towards enhancing their teaching, mentoring, and/or outreach skills
 - a. Evaluated by tracking number of students that earn the certificate
- 2) To better prepare future faculty for academic careers by increasing skill in teaching, mentoring, and/or community engagement
 - a. Evaluated through pre and post-tests of students that enter and complete the program; and through faculty assessment of teaching portfolios (begun in Scientific Teaching and Communicating Science classes and developed during internship)
- 3) To increase student familiarity with pedagogical theory and best practices in teaching
 - a. Evaluated through pre and post-tests of students that enter and complete the program

2. Relationship of program objectives to "Purposes of the University"

The UAF 2010 Vision statement includes an emphasis on “linking research discoveries with teaching, service, and community engagement.” UAF science graduate students are actively engaged in research, but have few opportunities to explore, understand, and engage in the teaching and service components of faculty workloads. When they do engage in teaching, they are often underprepared to do so. This program will enhance graduate student ability to teach laboratory sections of science courses, thus improving learning opportunities for undergraduates. The internship component of the proposed certificate will allow graduate students to link their research to university-level teaching and/or community engagement. In addition, the Vision 2017 Task Force recommends, among other things, that UAF “significantly expand internships, externships, and practicum opportunities for all students,” and that UAF “emphasize development of career and employability skills throughout the UAF curriculum...” This certificate will allow graduate students to deeply explore and gain hands-on experience with teaching. Earning such a certificate will make graduate students more marketable in the highly competitive job markets they will enter.

3. Relationship of courses to the program objectives

The majority of the courses required for the certificate in Science Teaching and Outreach are already permanent, taught as trials courses, or taught as special topics courses. One of the goals of this certificate offering is to give graduate students a tangible credential associated with completing several of these classes. Paperwork is appended to formalize and offer these classes on a permanent basis.

PERSONNEL DIRECTLY INVOLVED WITH PROGRAM

A. List of faculty involved in the program including brief statement of duties and qualifications

All of the faculty involved in the program, in addition to their specific credentials listed below, have attended the National Academies Summer Institute on Undergraduate Education, an intensive forum on active learning and best practices in pedagogy. Bios for David Newman and Agatha light, who propose to co-teach PHYS 605, are appended on page 29.

Richard Boone, Professor of Ecosystem Ecology

Boone has been a faculty member in the Department of Biology & Wildlife and the Institute of Arctic Biology since 1995. During that time he has taught Principles of Ecology (BIOL 271), Research Design (BIOL 602), Global Change Biology (BIOL 485), Human Dimensions of Global Change (BIOL 273X), and Fundamentals of Biology II (BIOL 106X) and co-taught the trial offering of Scientific Teaching (BIOL 693). He served as chair of the Department of Biology & Wildlife during 2006-2010 and Associate Dean of the College of Natural Science and Mathematics during 2010-2011. Rich attended the National Academies Summer Institute on Undergraduate Education in Biology in 2007 and received the Usibelli Award for Teaching in 2010. He is now completing a second year as a Program Director in the Division of Graduate Education at the National Science Foundation. Boone would teach STO 603, Instructional Design.

Laura Conner, Research Assistant Professor, Engineering, Science, and Technology Experiment Station, and Director of Outreach, College of Natural Science and Mathematics

Laura Conner received her Ph.D. in Ecology and Evolutionary Biology from the University of Arizona in 2007. She has taught a variety of science courses, labs, and science education courses at the college level for over 9 years, including Communicating Science (BIOL/MSL694, to become STO6XX). She currently serves as PI or Co-PI for NSF and NASA grants that bring science to K-12 and other public audiences. She works closely with K-12 teachers on a regular basis, and has developed and delivered professional development workshops for teachers. Conner also has extensive experience in communicating science to the public through her current position and through past positions as the Director of Public Programs (education and exhibits) for the University of Alaska Museum of the North; as a science journalist; and as Director of the Insect Discovery outreach program at the University of Arizona. For the proposed certificate, Conner would continue to teach the "Communicating Science" course and would also serve as the coordinator for the proposed internship component of the certificate.

Sarah Fowell

Sarah received her PhD in Geology from Columbia University in 1994. She has taught numerous courses at UAF, including introductory Geoscience (GEOS 101 / 112) and Scientific Teaching. She is also a co-instructor for GeoFORCE Alaska, a hands-on, field-based summer geoscience program for high school students from rural Alaskan communities. In 2007 she received a CNSM Outstanding Teacher

Award and attended the National Academies Summer Institute on Undergraduate Education in Biology. Sarah leads annual training sessions for graduate teaching assistants on methods of instruction and holds regular faculty tutorials on the use of automated response systems and design of “clicker questions”. As Chair of the Dept. of Geology & Geophysics, she strongly supports programs that provide opportunities for graduate students develop their pedagogical skills. Sarah will continue to co-teach STO 666, Scientific Teaching.

Denise Kind, Term Instructor, Biology and Wildlife

Denise received her PhD in Population Genetics and Evolutionary Biology from the University of California Irvine in 2005. She has taught several courses since then, including repeated offerings of Biology and Wildlife’s Fundamentals of Biology sequence (BIOL 115X/116X) and Methods in Scientific Teaching (BIOL/CHEM/GEOS 692). She was originally trained in instructional methods during her graduate studies at UCI, and holds a secondary teaching certificate in the State of Alaska. She has participated in and led teaching workshops for faculty and graduate students and has been involved in organizing a non-credit discussion group that is the predecessor of the proposed 1 credit seminar “Current Topics in Scientific Teaching.” As Biology and Wildlife’s Laboratory Coordinator, she works closely with graduate students on a regular basis. Dr. Kind would continue to co-teach STO 666, Scientific Teaching.

Mary Beth Leigh

Mary Beth received her PhD in Microbiology in 2003 from the University of Oklahoma and was a postdoctoral researcher at the Center for Microbial Ecology at Michigan State University and at the Center for Ecology and Hydrology in Oxford. She joined UAF in 2006, and has taught Microbiology (BIOL 342) and Environmental Microbiology (BIOL 457/657) regularly. She attended the National Academies Summer Institute on Undergraduate Education in Biology in 2012 and received a CNSM Outstanding Teacher Award in 2012. Leigh directs a program integrating science with arts and humanities in Alaska (In a Time of Change) and helps lead a national network of Long Term Ecological Research Sites with arts and humanities programs (Ecological Reflections). She would teach STO 602, Mentoring in the Sciences.

Christa Mulder, Professor of Ecology

Christa received her PhD in Biological Sciences from UAF in 1996. She has taught numerous courses at UAF, including introductory Biology (Biol. 105 / 116) and the trial offering of Scientific Teaching (as a co-instructor). Christa attended the National Academies Summer Institute on Undergraduate Education in Biology in 2008 and received a CNSM Outstanding Teacher Award in 2008. Her current research program includes a substantial education / outreach program through training of K-12 teachers in invasive plant and pollination biology, and through the establishment of a citizen science network that monitors plant phenology across the state of Alaska. Christa currently serves as Chair of the Dept. of Biology and Wildlife; in this position she has been working to increase the availability of courses that teach professional skills for graduate students. Mulder would teach STO 692, Current Topics in Scientific Teaching.

B. Administrative and coordinating personnel

Dr. Laura Conner was appointed as Director of Outreach for the College of Natural Science and Mathematics by Dean Paul Layer in 2012. As described above, she would serve as the coordinator for the proposed internship component of the certificate, matching graduate students with appropriate faculty mentors and/or K-12 teachers, as part of her duties as director. This is an FR position, and costs associated with these duties are included under “faculty salaries” elsewhere in this document.

The academic program oversight will be accomplished by means of an interdepartmental committee from CNSM. Initially, this committee will consist of: Denise Kind, Biology and Wildlife; Sarah Hayes, Chemistry and Biochemistry; Sarah Fowell, Geology and Geophysics, David Newman, Physics, and Laura Conner, CNSM/ESTES.

C. Classified personnel

While this program is interdepartmental, the Biology and Wildlife program will bear responsibility for scheduling course classrooms for the program. This will not result in an increase of duties for the B&W office manager, as many of these courses are currently scheduled through B&W.

ENROLLMENT INFORMATION

A. Projected enrollment/present enrollment

Two of the proposed core courses for the certificate, “Scientific Teaching” and “Communicating Science,” have enjoyed relatively high enrollments for graduate courses since their inception. In the case of Scientific Teaching, which was established in response to student demand, the course enrolled 20 the first time it was offered, 8 the second time it was offered, and 5 the third time it was offered. The declining enrollments appear to be the result of depletion of the current pool of interested students; in the second year it was taught, it received very high IAS scores. We expect that if it is offered every other year, it will have a typical enrollment of 8-12 students. Enrollment for Communicating Science is more complex—the course is currently a requirement for NSF-funded fellows in the GK-12 fellowship program, so some of the enrollment reflects this requirement. In Year 1, the course enrolled 16 students, 10 of whom were required to take the course. In Year 2, the course enrolled 13 students, 10 of whom were required to take the course. The GK-12 program attracts many of the same students that would be likely to enroll in a certificate program, but it is unrealistic to expect that enrollment would be maintained at 13-16 yearly without the requirement. However, 9 out the 13 students currently enrolled report that they would have taken the course even in absence of the GK-12 requirement (determined by anonymous written survey).

In terms of projected enrollment for the certificate program as a whole, comparative numbers from other institutions that offer such certificates are likely the strongest metric. As indicated below in “Need for Program,” a number of certificate programs such as the one proposed are increasingly offered at universities and colleges around the country (data from Grasgreen 2010). For comparative purposes, 386 students were enrolled in the University of Michigan’s certificate program as of 2010. This number represents about 3% of the overall graduate student population. Similarly, 140 students are enrolled in MIT’s certificate program, which represents about 2% of the overall graduate student population. The science graduate student enrollment at UAF breaks down as follows: 295 CNSM graduate students, 52 SNRAS graduate students, and 136 SFOS graduate students. If we assume a 2.5% enrollment in our certificate program across these disciplines, we would see an average of about 12 students enrolled in the program at any one time (Perhaps half this number in Year 1).

B. Minimum enrollments to maintain program for years 1, 2, 3, 4, and 5

The main purpose of the certificate program is to give science graduate students a credential in teaching that signifies a dedication to improving teaching skills, and that may enhance their employment opportunities post-graduation. Because the cost of maintaining the certificate program is negligible (the majority of the courses required are already taught as trials courses or special topics courses), the program could be maintained with very low enrollment, as few as 3 students per year. We anticipate that even under a scenario of low enrollment, the individual courses would continue to enjoy regular subscribership.

C. Maximum enrollment which program can accommodate

Based on a maximum course size of 15-20 students per course, we estimate that the program could enroll as many as 60 students at any one time.

NEED FOR PROGRAM

The need for improvements in how science and engineering graduate students are trained with respect to teaching and mentoring is well-documented (e.g. Committee on Graduate Education, 1998). Despite the multifaceted nature of responsibilities graduate students will have in their careers, most graduate programs in the sciences have not traditionally offered explicit training in teaching and mentoring (Pruitt-Logan et al. 2002). However, this trend is changing—as of 2009, about 45 institutions offered the option of earning a certificate in college teaching to their graduate students (Border and vonHoene, 2010). Some programs focus explicitly on preparing STEM faculty, while other programs are offered across disciplines. Science graduate students at other institutions who have participated in professional development programs related to teaching and learning have reported that their participation resulted in greater knowledge about teaching and learning, and a better understanding of faculty roles, compared to peers who have not had such training (Pruitt-Logan et al. 2002). Such training may enhance a candidate's marketability in higher education and in other science and engineering careers— in a national survey, hiring departments in a broad range of institutions placed high value on teaching readiness, as indicated by college-level teaching credentials (Benassi et al. 2001).

In addition, the certificate will prepare participants (in part) for the service component of faculty and other professional positions by requiring students to work with K-12 and public audiences. This experience should also increase student's ability to create meaningful broader impacts projects for federally funded grant proposals. Finally, participation in the coursework leading to the certificate is expected to have a direct impact on teaching skills in the short term. Because many science graduate students serve as teaching assistants, this is expected to have positive outcomes for undergraduates taking science courses at UAF.

OTHER

For the K-12 track and the informal education track of the proposed internship, graduate students will be placed with the FNSBSD school district, with UAF outreach programs, or with external community groups. In order for this program to be successful, the internship coordinator (Conner) will need to work closely with the school district and other entities. Significant groundwork is in place for this effort. Through the NSF-funded CASE GK-12 program, FNSBSD currently hosts 10 graduate students in K-12 classrooms. Each student works in a classroom for 10 hours per week over the course of a school year. Conner works closely with a cadre of K-12 teachers that are eager and excited about hosting science graduate students in their classrooms. With respect to the informal science track, UAF programs such as the Alaska Summer Research Academy and RAHI already have a track record of placing graduate students within their programs to teach younger students. The UA Museum of the North Department of Education is another potential venue for informal science education experiences.

RESOURCE IMPACT

RESOURCE COMMITMENT TO THE PROPOSED DEGREE PROGRAM

Resources	Existing	New		Total
	College/School	College/School	Others (Specify)	
Regular Faculty (FTE's & dollars)	\$60,800 (loaded salaries) 0.43 FTE			\$60,800 (loaded salaries) 0.43 FTE
Adjunct Faculty (FTE's & dollars)	\$0	\$0		\$0
Teaching Assistants (Headcount)	\$0	\$0		\$0
Instructional Facilities (in dollars and/or sq. footage)	The program will require 3-4 small classrooms per semester.	\$0		The program will require 3-4 small classrooms per semester.
Office Space (Sq. footage)	All faculty and support personnel have existing office space	\$0		All faculty and support personnel have existing office space
Lab Space (Sq. Footage)	\$0	\$0		\$0
Computer & Networking (in dollars)	\$0	\$0		\$0
Research/ Instructional/ office Equipment (in dollars)	\$0	\$0		\$0
Support Staff (FTE's & dollars)	The B&W office manager will schedule courses (<0.05 FTE)	\$0		The B&W office manager will schedule courses (<0.05 FTE)
Supplies (in dollars)	\$0	\$0		\$0
Travel (in dollars)	\$0	\$0		\$0

Signature _____
Dean of College/School Proposing New Degree Program

Date

B. Facilities/space needs

No new facilities are needed for this certificate. All of the courses within the certificate are already taught, have been taught within the past few years, or would have been taught as part of regularly planned programming within the next year (e.g., PHYS 6XX) regardless of whether the certificate exists. These courses can all be accommodated in existing classroom spaces. No lab spaces are needed for these courses. The administrative offices used for the program are already allocated to the Director of CNSM Outreach and the CNSM Outreach Administrative Assistant.

C. Credit hour production

Because some courses are taught every other year, and some yearly, the credit hours produced in the program vary slightly from year to year. We anticipate that in Year 1, with 6 students enrolled in the program, 72 credit hours will be produced. In subsequent years, we estimate that this figure would double, for a total of 144 credit hours. These figures exclude credit hours produced from additional individuals taking some of the courses that are not enrolled in the program.

D. Faculty

All of the courses within the certificate are already taught, have been taught within the past few years, or would have been taught as part of regularly planned programming within the next year (e.g., PHYS 605) regardless of whether the certificate exists. Thus, all courses that are part of the certificate will be assigned as a regular part of faculty workloads.

E. Library/Media materials, equipment and services

Karen Jensen, the Library Collection Development Officer, was contacted on August 27th, 2012. We determined that the collections contain sufficient journal subscriptions in science education to support these efforts. In addition, many of the required course books (National Research Council) are freely available as pdf files.

RELATION OF PROGRAM TO OTHER PROGRAMS WITHIN THE SYSTEM

A. Effects on enrollments elsewhere in the system

The courses within the certificate are currently offered with discipline-specific designators, or cross listed between several disciplines. If these designators are kept as they are, it is possible that students may opt to take courses within the certificate program towards the disciplinary degree, which could lower enrollment slightly in other graduate level courses. However, because we plan to convert all proposed courses in the certificate to the STO designator (except MATH 600 and PHYS 605, which are discipline-specific), each department can easily identify the certificate courses and will be able to independently decide how many CNSM credits to allow towards the disciplinary degree. Therefore, we do not anticipate effects on enrollments elsewhere in the system.

B. Does it duplicate/approximate programs anywhere in the system?

No other program offers science graduate students the opportunity to become skilled in science teaching at the college level. This program will offer science graduate students valuable experiences, as well as a credential that will enhance employability post-graduation.

C. How does the program relate to research or service activities?

1. Contributions to research or service

The “Communicating Science” class, a core course in the certificate program, requires students to make presentations or present science to K-12 and /or other public audiences, after training in best practices. Similarly, two of the internship “tracks” would offer students the opportunity to further enhance and practice these skills over the course of a year. These activities are an important component of public service. With respect to research, this program offers a platform for educational research.

2. Benefits from research or service activities

UAF as a whole can benefit from increased collaboration with the community and the local school district. The outcomes any educational research conducted can be used to better inform general training practices for TAs.

IMPLEMENTATION/TERMINATION

- A. Date of implementation**
Spring semester, 2014
- B. Plans for recruiting students**
Students will be recruited internally through targeted emails, flyers, and word-of-mouth. Because faculty support is critical in terms of encouraging/allowing student enrollment, we will also discuss the certificate program at departmental faculty meetings, presenting results from other institutions that have successfully launched such programs.
- C. Plans for phasing out program if it proves unsuccessful**
Should the program prove unsuccessful after five years, we would eliminate the offering. We expect that the courses within the certificate would still be offered regularly. Frequency would depend on student demand.
- D. Assessment of the program** (submitted to Susan Henrichs on 8/23/12)
Program Goals: 1) to provide students with a formal credential that documents their efforts towards enhancing their teaching, mentoring, and/or outreach skills; 2) to better prepare future faculty and other science professionals by increasing skill in teaching, mentoring, and/or community engagement; and 3) to increase student familiarity with pedagogical theory and best practices in teaching.

Intended Outcomes/objectives	Assessment criteria	Implementation procedures (who, what, when)
Graduates will increase their competitive ability on the job market	Alumni survey	Each May, the program coordinator will send an alumni survey to all students who graduated in the previous two years
Graduates will leave the program with enhanced teaching, mentoring, and/or community engagement skills	Pre and post-test of skills Teaching portfolio, which will include <ul style="list-style-type: none">• syllabus• teaching philosophy• mentoring philosophy• teachable unit• evaluation and reflection on implemented teachable unit	The program coordinator will administer a pre-test upon entry into the program, and a post-test upon completion of the program Once a year, the certificate faculty will meet and evaluate teaching portfolios generated by students who are completing the certificate program.
Graduates will leave the program with increased knowledge of best practices in pedagogy	Pre and post-test of knowledge	The program coordinator will administer a pre-test upon entry into the program, and a post-test upon completion of the program



Board of Regents Program Action Request

University of Alaska

Proposal to Add, Change, or Delete a Program of Study

1a. Major Academic Unit (choose one) UAF	1b. School or College CNSM	1c. Department BIOL																																								
2. Complete Program Title: Graduate Certificate in Science Teaching and Outreach																																										
3. Type of Program <div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> Undergraduate Certificate <input type="checkbox"/> Master's </div> <div> <input type="checkbox"/> AA/AAS <input checked="" type="checkbox"/> Graduate Certificate </div> <div> <input type="checkbox"/> Baccalaureate <input type="checkbox"/> Doctorate </div> <div> <input type="checkbox"/> Post-Baccalaureate Certificate </div> </div>																																										
4. Type of Action <input checked="" type="checkbox"/> Add <input type="checkbox"/> Change <input type="checkbox"/> Delete		5. Implementation date (semester, year) Spring, 2014																																								
6. Projected Revenue and Expenditure Summary. Not Required if the requested action is deletion. (Provide information for the 5 th year after program or program change approval if a baccalaureate or doctoral degree program; for the 3 rd year after program approval if a master's or associate degree program; and for the 2 nd year after program approval if a graduate or undergraduate certificate. If information is provided for another year, specify (1st) and explain in the program summary attached). Note that Revenues and Expenditures are not always entirely new; some may be current (see 7d.)																																										
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Page # of attached summary where the budget is discussed, including initial phase-in: 16																																										
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8. Facilities: New or substantially (>\$25,000 cost) renovated facilities will be required. <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, discuss the extent, probable cost, and anticipated funding source(s), in addition to those listed in sections 6 and 7 above.																																										

¹Sometimes the courses required by a new degree or certificate program are already being taught by an MAU, e.g., as a minor requirement. Similarly, other program needs like equipment may already be owned. 100% of the value is indicated even though the course or other resource may be shared.

9. Projected enrollments (headcount of majors). If this is a program deletion request, project the teach out enrollments.

Year 1: 6

Year 2: 12

Year 3: 12

Year 4: 12

Page number of attached summary where demand for this program is discussed: 12

10. Number* of new TA or faculty hires anticipated (or number of positions eliminated if a program deletion):

Graduate TA	
Adjunct	
Term	
Tenure track	

11. Number* of TAs or faculty to be reassigned:

Graduate TA	
Adjunct	
Term	
Tenure track	

Former assignment of any reassigned faculty:

For more information see page _____ of the attached summary.

12. Other programs affected by the proposed action, including those at other MAUs (please list):

Program Affected	Anticipated Effect	Program Affected	Anticipated Effect

Page number of attached summary where effects on other programs are discussed:

13. Specialized accreditation or other external program certification needed or anticipated. List all that apply or 'none': None

14. Aligns with University or campus mission, goals, core themes, and objectives (list): Linking research with teaching, expanding internship opportunities, development of career skills

Page in attached summary where alignment is discussed: 8

15. State needs met by this program (list):

Page in the attached summary where the state needs to be met are discussed:

16. Program is initially planned to be: (check all that apply)

☒ Available to students attending classes at UAF campus(es).

☐ Available to students via e-learning.

☐ Partially available students via e-learning.

Page # in attached summary where e-learning is discussed:

Submitted by the University of Alaska Fairbanks with the concurrence of its Faculty Senate.

Provost

Date

Chancellor

Date

☐ Recommend Approval

☐ Recommend Disapproval

UA Vice President for Academic Affairs on behalf of
the Statewide Academic Council

Date

☐ Recommend Approval

☐ Recommend Disapproval

Chair, Academic and Student Affairs Committee

Date

<input type="checkbox"/> Recommend Approval <input type="checkbox"/> Recommend Disapproval	_____ UA President	_____ Date
---	-----------------------	---------------

<input type="checkbox"/> Approved <input type="checkbox"/> Disapproved	_____ Chair, Board of Regents	_____ Date
---	----------------------------------	---------------

*Net FTE (full-time equivalents). For example, if a faculty member will be reassigned from another program, but his/her original program will hire a replacement, there is one net new faculty member. Use fractions if appropriate. Graduate TAs are normally 0.5 FTE. The numbers should be consistent with the revenue/expenditure information provided.

Attachments: ☐ Summary of Degree or Certificate Program Proposal ☐ Other (optional)

Draft Prospectus

Prospectus for Graduate Certificate in Science Teaching and Outreach

University of Alaska Fairbanks

A. Mission and Goals:

We hereby propose a new graduate certificate in Science Teaching and Outreach, to be offered at the University of Alaska Fairbanks. Many science graduate students have demonstrated an interest in enhancing their teaching and outreach skills. In response, two courses and an informal seminar that meet this need have been developed and are currently offered. An additional course on mentoring has previously been offered, but not in the past year. The graduate certificate would package these courses, with the addition of an internship, to offer a formal credential to science students that are interested in enhancing their teaching skills. The certificate is expected to increase competitive ability in the higher education job market, as well as prepare students to be better communicators of their science.

Program Goals:

- 1) To provide students with a formal credential that documents their efforts towards enhancing their teaching, mentoring, and/or outreach skills
- 2) To better prepare future professionals for careers in science and engineering by increasing skill in teaching, mentoring, and/or community engagement
- 3) To increase student familiarity with pedagogical theory and best practices in teaching

B. Authorization:

The University of Alaska Fairbanks (UAF) is one of four individually accredited universities within the University of Alaska system. UAF has been continuously accredited since 1934 by the Northwest Commission on Colleges and Universities.

The Constitution of the State of Alaska establishes the University of Alaska as the state university, governed by a Board of Regents appointed by the governor. Alaska Statutes provide for a board of eleven voting members, including one student, with authority to carry out the mission of the university system and its constituent units, including the determination and regulation of the university's course of instruction and the conferring of degrees.

Members of the board have no contractual, employment, or financial interest in the university. The chair is elected from among the board. The board appoints the president of the university system, who in turn appoints the chancellor of UAF. Both officers are full-time employees whose only responsibility is to the institution.

The UAF 2010 Vision statement includes an emphasis on "linking research discoveries with teaching, service, and community engagement." UAF science graduate students are actively engaged in research, but have few opportunities to explore, understand, and engage in the teaching and service components of faculty workloads. When they do engage in teaching, they are often underprepared to do so. This program will enhance graduate student ability to teach laboratory sections of science courses, thus improving learning opportunities for

undergraduates. The internship component of the proposed certificate will allow graduate students to link their research to university-level teaching and/or community engagement. In addition, the Vision 2017 Task Force recommends, among other things, that UAF “significantly expand internships, externships, and practicum opportunities for all students,” and that UAF “emphasize development of career and employability skills throughout the UAF curriculum...” This certificate will allow graduate students to deeply explore and gain hands-on experience with teaching. Earning such a certificate will make graduate students more marketable in the highly competitive job markets they will enter.

C. Educational Offerings:

1. Descriptive information of the educational offering(s):

Graduate Certificate in Science Teaching and Outreach

The certificate in science teaching and outreach is a voluntary program that prepares science graduate students for science careers that include teaching and/or communicating science to the public. It does NOT meet the requirements for earning a state teaching certificate and will not allow graduates to apply for certified positions in the K-12 school system. Such training will enhance readiness for college-level teaching by providing hands-on training and familiarity with pedagogical theory. The certificate is expected to increase competitive ability in the higher education job market.

Requirements for the Certificate:

1. Complete the general university requirements
2. Have a Bachelor’s Degree from an accredited institution
3. Admission to a graduate science or engineering degree program at UAF (CNSM, SFOS, SNRAS, CEM), or prior completion of a graduate degree in the sciences or engineering
4. Complete the following:

STO 666- Scientific Teaching	2
STO 601- Communicating Science	2
STO 602- Mentoring in the Sciences.....	2
STO 603- Instructional Design.....	1
STO 604- Internship	4

11 credits

6. Complete 1 of the following:

STO 692 – Current Topics in Scientific Teaching	1
MATH 600 – Mathematics Teaching Seminar.....	1
PHYS 605 – Physics Teaching Seminar	1

PROGRAM TOTAL: 12 credits

2. Evidence of approval by the appropriate academic policy body of the institution:

Senate signature page and BOR approval from the minutes will be provided by the Office of the Provost.

D. Planning:**1. Evidence of need for the change and the students to be served:**

The need for improvements in how science and engineering graduate students are trained with respect to teaching and mentoring is well-documented (e.g. Committee on Graduate Education, 1998). Despite the multifaceted nature of responsibilities graduate students will have in their careers, most graduate programs in the sciences have not traditionally offered explicit training in teaching and mentoring (Pruitt-Logan et al. 2002). However, this trend is changing—as of 2009, about 45 institutions offered the option of earning a certificate in college teaching to their graduate students (Border and vonHoene, 2010). Some programs focus explicitly on preparing STEM faculty, while other programs are offered across disciplines. Science graduate students at other institutions who have participated in professional development programs related to teaching and learning have reported that their participation resulted in greater knowledge about teaching and learning, and a better understanding of faculty roles, compared to peers who have not had such training (Pruitt-Logan et al. 2002). Such training may enhance a candidate's marketability in higher education and in other science and engineering careers— in a national survey, hiring departments in a broad range of institutions placed high value on teaching readiness, as indicated by college-level teaching credentials (Benassi et al. 2001).

In addition, the certificate will prepare participants (in part) for the service component of faculty and other professional positions by requiring students to work with K-12 and public audiences. This experience should also increase student's ability to create meaningful broader impacts projects for federally funded grant proposals. Finally, participation in the coursework leading to the certificate is expected to have a direct impact on teaching skills in the short term. Because many science graduate students serve as teaching assistants, this is expected to have positive outcomes for undergraduates taking science courses at UAF.

2. The procedures used in arriving at the decision to change¹:

The desire for science graduate teaching training at UAF initially came from the graduate students themselves. In order to address the demand for such training, several CNSM departments launched the cross-listed course "Scientific Teaching." This course and its sister course, "Communicating Science," have enjoyed relatively high enrollments for graduate courses since their inception. The demand for such courses, coupled with the desire to remain competitive with other universities that offer such training through a formal certificate, led to interdepartmental conversations among CNSM faculty about the possibility of offering such a certificate at UAF. The idea was discussed among CNSM department chairs and with the dean, all of whom concurred that a certificate offering would be beneficial for our science graduate students.

3. The organizational arrangements that must be made within the institution to accommodate the change²:

The courses that will be part of the certificate are largely already implemented as part of existing faculty workloads. The coordination of the new internship course will fall to Laura Conner as part of her duties as Director of CNSM Outreach. In order for the certificate to be implemented and continued, chairs of individual CNSM departments will need to continue to assign courses to individual faculty workloads.

4. Timetable for implementation³.

We anticipate that the program would be in effect starting Spring of 2014. All of the classes proposed have been, or are currently, offered, with the exception of the internship (STO 604), PHYS 605, and STO 603 (Instructional Design).

E. Budget:

1. The budget projections (revenue and expenditures) for each of the first three years of operation:

Because the program will start in the spring of 2014, which crosses fiscal years, we give projections for the first full 3 fiscal years. We base the figures on in-state graduate tuition.

FY15: Tuition revenue = \$55,152 (based on 6 students enrolled)

FY16: Tuition revenue = \$110,304 (based on 12 students enrolled)

FY17: Tuition revenue = \$110,304 (based on 12 students enrolled)

Expenditures are expected to remain constant and are limited to about 0.43 FTE for faculty salary (est. \$60,800)

2. Revenue and expenditures associated with the change itself:

Please see attached CNSM resource allocation document

3. Institutional financial support to be reallocated to accommodate the change:

Please see attached CNSM resource allocation document

4. The budgetary and financial implication of the change for the entire institution:

Because the majority of the courses in the proposed certificate are already being taught, the financial impact will be relatively small on the institution. Only ~0.5 FTE equivalent, spread across several faculty members, is necessary to implement and sustain the program. There may be a net financial benefit to the institution if enrollment remains high in the program.

F. Student Services:

Student services is concerned with the recruitment, retention, and success of our students. A growing number of universities are offering certificates such as the one proposed here to their graduate students. The certificate could serve as an additional recruitment tool for entering graduate students, and is expected to enhance success in the job market post-graduation.

G. Physical Facilities:

No new spaces are needed for this program. All of the courses within the certificate are already taught, or would have been taught a part of regularly planned programming within the next year (e.g., PHYS 605) regardless of whether the certificate exists. These courses can all be accommodated in existing classroom spaces. No lab spaces are needed for these courses. All faculty and staff associated with the program already have offices, so no new office space is required.

H. Library and Information Resources:

Karen Jensen, the Library Collection Development Officer, was contacted on August 27th, 2012. We determined that the collections contain sufficient journal subscriptions in science education to support these efforts. In addition, many of the required course books (National Research Council) are freely available as pdf files.

I. Faculty and Staff:

No new faculty or staff members are needed to implement this program. All of the courses within the certificate are already taught, or would have been taught as part of regularly planned programming within the next year (e.g., PHYS 605) regardless of whether the certificate exists. Thus, all courses that are part of the certificate will be assigned as a regular part of faculty workloads. The administration of the certificate will be the responsibility of the Office of Outreach in CNSM. This will be part of the regular duties of the Director of CNSM outreach and the outreach administrative assistant.

Quick guide to proposed course numbers and current course status

STO 601 Communicating Science (currently BIOL/MSL 694)

This is currently a trails course. We have attached Format 1 paperwork to make it a permanent course

STO 666 Scientific Teaching (currently BIOL/CHEM/GEOS 666)

This is a permanent course. We are requesting that the designator be changed to STO

STO 602 Mentoring in the Sciences (currently BIOL692)

This was previously offered as a seminar course. We have modified the syllabus and have attached Format 1 paperwork to make it a permanent course.

STO 692 Current Topics in Scientific Teaching (currently BIOL692)

This course is currently offered as a seminar course. The content will change slightly depending on student interests, so we are requesting that it stays a seminar course with a STO 692 designator. Format 1 paperwork is attached.

STO 603 Instructional Design

This is a new course (Scientific Teaching, STO 666, was originally a 3-credit course during the trials stage. It is now a 2-credit course, and the content that was eliminated is now covered through STO 603). Format 1 paperwork is attached.

MATH 600 Teaching Seminar

This is a permanent course.

PHYS 605 Physics Teaching Seminar

This is a new course. Format 1 paperwork is attached.

STO 604 Scientific Teaching/Outreach Internship

This is a new course. Format 1 paperwork is attached.

Instructors for Physics 605
Physics Teaching Seminar

Instructors:
David Newman
Agatha Light

Bio for David Newman:

David E. Newman
University of Alaska Fairbanks
Physics Department
P.O. Box 755920
Fairbanks, AK 99775-5920
USA
Phone: (907) 474-7858
Fax: (907) 474-6130
Email: ffden@uaf.edu or bhattman@mosquitonet.com
URL: <http://ffden-2.phys.uaf.edu/newman2.html>

EDUCATION

Ph.D., Physics (August 1993)
University of Wisconsin, Madison, WI.

- Investigated the nonlinear dynamics of interacting nonlinearities in turbulent plasma systems.
- Distributed Minor in Physics (Space Physics, Dynamical Systems, and Fluid Dynamics)
- Adviser: Dr. Paul Terry

B.S., Physics and Mathematics (August 1983)
University of Pittsburgh, Pittsburgh, PA.

PROFESSIONAL EXPERIENCE

Director Center for Complex Systems Studies UAF (2006-present)
Professor at University of Alaska- Fairbanks (July 2005 – Present)
Associate Professor at University of Alaska- Fairbanks (July 2001 – 2005)
Assistant Professor at University of Alaska- Fairbanks (November 1998 – July 2001)

RESEARCH

- Research as Assistant then Associate Professor then Full Professor at University of Alaska-Fairbanks (November 1998 – Present)
 - Very extensive proposal writing followed by research planning, implementation, and presentation.
- Research Scientist at Oak Ridge National Laboratory (Sept. 1995 – Oct. 1998)
 - Researcher in the Theory Section of the Fusion Energy Division
 - **Grant writing:** plasma processing investigation (funded Oct. 1994 -Sept. 1995), atomistic flows in carbon nanotubes (funded Oct. 1997 - Sept. 1998)

- **Supervisory Role:** Directed undergraduates through summer internship program, graduate students through Ph.D. program and post doctoral fellow in carbon nanotube project. Additionally, guided visiting faculty collaboration.
- Wigner Fellow at ORNL in the Fusion Energy Division (Sept. 1993 - Sept. 1995)
- Research Assistant U.W. Madison, January 1989 - Sept. 1993

TEACHING

Assistant, Associate then Full Professor at University of Alaska- Fairbanks (November 1998 – Present)

- Prepared and taught ~2 courses each semester since Spring 1999 (a total of 12 different classes).
- Supervised undergraduate independent studies and interns
- Coordinator for the General science program (2000 – present)

New grad student Teaching Assistant training (1999 - present)

- Developed, supervised and presented training courses for new graduate students.

Teaching Assistant Training (1987 - 1993) and 1997-present

- Developed, supervised and presented one week training courses for new graduate students.
- Developed evaluation criterion and methodology for assessing training.
- Served on departmental teacher evaluation committee.

Teaching Assistant Sept. 1986 - December 1988

- Taught introductory physics for engineers and physics majors and advanced physics laboratory.
- Served on departmental graduate and undergraduate program development committees.

Secondary School Teacher - (Jan. 1984 - Dec. 1985 as U.S. Peace Corps Volunteer)

- Taught Physics and English at Sochoi Secondary School, Lessos, Kenya.

Bio for Agatha Light:

Agatha S. Light
University of Alaska Fairbanks
Physics Department
P.O. Box 755920
Fairbanks, AK 99775-5920
USA
Phone: (907) 474-7857
Fax: (907) 474-6130
Email: aslight@alaska.edu

EDUCATION

M.S., Atmospheric Sciences (December 2009)
University of Alaska Fairbanks, Fairbanks AK

- Concentrations: Lidar methods, aeronomy, spectroscopy
- Dissertation: Theoretical and Experimental Studies of Resonance Fluorescence Lidar for Measurements of N_2^+ in the Auroral Atmosphere

B.A., Physics with Astronomy Option (May 2006)
University of Montana, Missoula, MT

PROFESSIONAL EXPERIENCE

- Laboratory Supervisor, University of Alaska Fairbanks (August 2010-present)
- Outreach Coordinator, spectrUM (May 2006-August 2007)
- Adjunct Faculty, Dept. of Physics and Astronomy, University of Montana (August 2006-May 2007)

RESEARCH

- Graduate Research Assistant, Lidar Research Laboratory (August 2007-December 2009)
 - Remote processing, data processing and analysis
 - Developmental of experimental methods and computer models
- Undergraduate Research Assistant, Dr. Maureen McGraw, (May 2005-May 2006)
 - Conducted sensitive measurements
 - Reduced, input and analyzed data

TEACHING

Laboratory Supervisor, University of Alaska Fairbanks (August 2010-present)

- Developed and coordinated lab program for 8 undergraduate physics courses
- Supervised, trained, and mentored 10-12 graduate teaching assistants per semester
- Trained and coordinated 6-7 undergraduate paper graders per semester.
- Faculty advisor for Society of Physics Students, Fall 2012

New grad student Teaching Assistant training, Physics Dept., University of Alaska Fairbanks (August 2010 - present)

- Assisted with development and presentation of training courses for new Teaching Assistants

Outreach Coordinator, spectrUM (May 2006-August 2007)

- Developed and delivered hands-on science experiences for learners of all ages
- Trained docents, prepared educational materials

Adjunct Faculty, Dept. of Physics and Astronomy, University of Montana (August 2006-May 2007)

- Taught physics and astronomy laboratory courses
- Taught general physical and chemical science laboratory and discussion

Teaching Assistant, Department of Physics and Astronomy, University of Montana (January 2004-May 2005)

- Taught introductory physics laboratories
- Assisted with operations and public relations at astronomical observatory