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I'm applying for funding for:
Summer 2014
Fall 2014
Spring 2015

By submitting this application, I confirm that, if selected to receive a Chancellor's Award for Excellence in STEM Education, I will:

- ✓ Attend and be recognized at the annual Symposium on STEM Education (fall 2014).
- ✓ Give a brief introduction (~10-15 min) to my project at DBER in fall 2014.
- ✓ Actively engage in the CU-Boulder STEM education community by attending Chancellor's Fellow events.
- ✓ Present my work to the STEM education community by giving at least one DBER seminar, OR, if that is an impossibility, I will give a talk that the CU-Boulder STEM education community is invited to attend.
- ✓ Submit a 1000 to 3000-word report detailing the outcomes of the project at the end of the funding period.

‘Cool Science’: Explaining Antarctic Fieldwork, Polar Science, and the Experience of STEM Research through Live Multimedia Communication, Nonfiction Children’s Literature, and Bilingual Education

Submitted by Alexandra Mass, doctoral student in Department of Civil, Environmental, & Architectural Engineering (CEAE)
Faculty Advisor: Dr. Diane McKnight, Professor in Department of CEAE

A. Program Description

The McMurdo Dry Valleys Long Term Ecological Research Program is an interdisciplinary ecological research site in the mountainous glacial region of Antarctica. While spending three months each season living in a tent in the field and conducting research for her PhD, graduate student Alex Mass has been connecting with classrooms on an international scale in order to describe the experience of applied engineering fieldwork and the conditions of life in Antarctica to young students. This outreach includes visits to local classrooms before and after each field season, skype videoconferencing to classrooms and after-school programs from Antarctica, the creation and maintenance of the Antarctic field blog ‘The Last Degrees’, and photography and video production for concepts in environmental science and engineering. In addition, this classroom engagement is enhanced by promotion and coordination with the illustrated science-education nonfiction children’s book *The Lost Seal* about scientists working in the Dry Valleys region of Antarctica. *The Lost Seal* was created as part of the National Science Foundation- Long Term Ecological Research Program (LTER) Schoolyard book series, describing the exploration history and ecological environment of Antarctica through the real-life story of a group of scientists working in this region. Due to her field experience in the environments where this book takes place, Alex has been promoting the non-profit educational book series and helped to devise a series of lesson plans and activities as a “Teacher’s Complement Guide” to *The Lost Seal,* incorporating goals for the Colorado Standards for K-12 Education in Earth and Life Sciences in order to offer the book series as an option for teachers to incorporate into their science curriculum. After the successful completion of outreach activities during the 2012-13 and 2013-14 Antarctic field seasons, completion of a series of lesson plans for *The Lost Seal* for use in schools, the creation of a Spanish Language edition of *The Lost Seal* for use in bilingual schools and outreach in South American classrooms, and a very positive response to ‘The Last Degrees’ Antarctic field blog, this program now aims to expand with additional projects in the next academic year. Enhancement of this program includes increasing the number of classrooms interacting with Alex and following scientific updates during her next Antarctic field season (November 2014- February 2015), producing additional multimedia projects to describe scientific concepts in the field, and the design and distribution of learning assessments in order to measure the environmental literacy and scientific engagement of students in participating classrooms. After the success of the Spanish-language book translation, we will now work towards the creation of bilingual-English editions of *The Lost Seal* in Spanish, Hawaiian, and te reo Maori for use in bilingual schools in order to introduce scientific concepts from faraway environments while simultaneously embracing and preserving local culture. A short summary of progress since the implementation of this program with the 2012 Chancellor’s Award and the evolution of new program goals is outlined below.

2012 Chancellor's Award goals and outcomes:

i.) ***Work with participating educational professionals to complete a Teacher's Guide to The Lost Seal including a series of lesson plans and laboratory experiments approved by the learning objectives for science and environmental education in the Boulder Valley School District (BVSD), and test-pilot/ implement these activities in BVSD classrooms.***

The Teacher's Complement Guide has been written, reviewed by participating teachers, assessed for appropriate compliance with the Colorado Standards for K-12 Education in Earth and Life Sciences, and formatted for PDF distribution to teachers interested in synchronizing hands-on scientific activities with use of *The Lost Seal* book.

ii.) ***Coordinate the Spanish translation of The Lost Seal for use in bilingual schools.***

The Spanish-language translation has been completed and submitted for editorial review and final publication. Due to the level of interest with this translation, a bilingual Spanish-English edition of *The Lost Seal* has been proposed and is in the early stages of creation. Since the conversion to bilingual books involves significant text revision and generally a large amount of 'cutting' in order to fit two versions of text on the same illustrated pages, this process requires coordination beyond simply merging the existing Spanish edition (see Methodology Goal 2). In addition, interest from the Moorea Coral Reef LTER and the New Zealand Antarctic Program has led to the proposal of a bilingual Hawaiian and te reo Maori-English editions of the book, respectively (see Methodology Goals 2 and 3).

iii.) ***Collaborate with Adrian Howkins on the projects and outreach associated with the Spanish-language edition of The Lost Seal on an international basis during his trip to primary schools in Argentina and Chile.***

Coordination with Adrian Howkins on the South American outreach for 'The Lost Seal' was successful, the book and lesson plans were distributed to participating schools in Argentina and Chile in spring 2013, and a collection of children's artwork was collected and added to the online library of 'Lost Seal Artwork' (an earlier outreach project in the McMurdo Dry Valleys LTER program). Due to the success of this international outreach a similar program to visit schools, introduce concepts in Antarctic science, read from 'The Lost Seal', and collect artwork has been suggested as a means to test-pilot the proposed Hawaiian and te-reo Maori bilingual translations of the book (Methodology Goals 2 and 3).

iv.) ***Meet with participating classes in the Boulder Valley School District to complete activities from the Teacher's Complement Guide and create a relationship and sense of involvement with students ahead of my anticipated return to Antarctica for fieldwork in the Dry Valleys in Fall 2013, enabling participating classes to track my progress as a student in Antarctica through visual media during my time abroad.***

After receiving the Chancellor's Award in 2012, I was very fortunate to be invited to spend an austral summer (Nov-Feb) field season at Concordia station on the high Antarctic plateau in 2012-13 a year ahead of my anticipated return to Antarctica. As such this outreach with schools was propelled forward a year and I was able to use my connection with participating teachers to engage with classrooms during my time in the field one year early. This outreach included visits

to classrooms in the Boulder and Denver region both before and after my time in Antarctica, skype videoconferencing with classrooms during the Antarctic season, and the creation of the blog 'The Last Degrees' to describe the experience of applied fieldwork to participating classrooms following along with my progress in the field. This outreach continued as proposed during my 2013-14 field season in the Dry Valleys of Antarctica. As of this writing, in-classroom visits and videoconferencing has reached thirteen classrooms in the Boulder-Denver metro area, seven additional classrooms in the United States, and six classrooms in Australia. In addition, field blog 'The Last Degrees' received over 350,000 visitors after being featured on both Rocky Mountain PBS and website ViralNova this past year. Coordination with Colorado-based classrooms and advertising of this project to local schools was enhanced by cooperation with the Office of University Outreach and its flagship program 'Learn More About Climate'. The continuation and enhancement of this project is described in Methodology Goal 1 below.

B. Methodology

1) ***Continue and enhance communication with participating classrooms through in-classroom visits, Skype videoconferencing from the field, updates in field blog 'The Last Degrees', and creation of multimedia/video projects to explain concepts in environmental science and engineering in Antarctica***

As a graduate student who has now completed three field seasons in different environments of Antarctica, I have seen first-hand how the presence of a student scientist who has *been* to Antarctica can engage young children and enable them to regard science, engineering, and remote fieldwork research as an actual, tangible possibility for their future. I believe that interacting with classrooms and describing not only concepts in science but the experience of *being* a scientist can bridge the gap between 'textbook' concepts and the application of what scientists and engineers currently do in real-world field research situations. In addition, participating teachers share my belief that the ability for a classroom to follow the progress of a specific scientist (particularly a student scientist) that children have already met or had the chance to relate to may enhance the sense of involvement students feel with the scientific research being conducted in a faraway environment. Continuing my relationship with teachers that have been following this program thusfar, promotion from the Office of University Outreach and 'Learn More About Climate' program, and the Institute for Arctic and Alpine Research's community newsletter, I would like to expand the number of classrooms able to participate in both the in-classroom visits and skype videoconferencing during and after the 2014-15 Antarctic field season. I will present a poster describing this outreach and participate in the 4-day exposition hall for the National Science Teachers Association annual conference in Boston, Massachusetts April 2-6 2014 in order to promote this program to a large audience of teachers and increase participation during the next year.

In addition, in-classroom visits or skype videoconferencing are enhanced by a series of updates posted to the field blog 'The Last Degrees' during my time in Antarctica. After positive reviews from both Rocky Mountain PBS and Viralnova, this blog has built up a substantial following and is enhanced by videos, photography, and posts describing the implementation of field research that enable students to envision the experience of polar fieldwork and concepts of environmental and polar science. Due to the success of this blog series, I will take CU courses in video editing, nonfiction essay writing, and science journalism this summer in order to enhance the quality of the blog and strengthen my background towards a career in science communication.

2) ***Collaborate with Amy Rinehart and Taylor Trade/Moonlight Publishing on the creation of a bilingual Spanish-English and Hawaiian-English edition of The Lost Seal and its promotion in bilingual schools***

In this goal I will act as a coordinator between the McMurdo Long Term Ecological Research program, the LTER Schoolyard Book Series, and editor Amy Rinehart with Moonlight Publishing towards the creation of a bilingual Spanish language edition of The Lost Seal. This includes working in a support role to meet the publishing deadlines and needs of this project and seeking out opportunities for outreach such as introduction and lessons executed in participating bilingual schools. In addition, the Moorea Coral Reef LTER representing French Polynesia, Hawaii, and the coral Pacific has successfully translated their *Schoolyard* book '*Kupe and the Corals*' into a bilingual Hawaiian-English edition at the behest of bilingual Hawaiian schools interested in using the book series to help promote and preserve Hawaiian language. Due to our efforts with our own translation, the Moorea Coral Reef LTER has requested a Hawaiian translation of *The Lost Seal* in order to expand on their language preservation goals. This translation will be streamlined by following *Kupe and the Corals* as a predecessor in Hawaiian formatting and incorporated into schools expressing interest after *Kupe*'s success. The Moorea Coral Reef LTER has invited me to visit these Hawaiian-English schools on an outreach trip next spring so that classrooms can meet an Antarctic scientist, ask questions about polar research and the McMurdo Dry Valleys LTER, contribute artwork for the Hawaiian-English edition and participate in learning activities from *The Lost Seal*.

3) ***Coordinate with Moonlight Publishing and the New Zealand Antarctic Program for the te reo Maori-English edition of The Lost Seal for use in bilingual New Zealand Schools***

New Zealand has strong ties to Antarctic research in both geographic and economic means, and concepts of Antarctic science are incorporated into many schools with a sense of national involvement and pride. Following the success of The Lost Seal outreach in primary schools and the Spanish translation of the Lost Seal, Peter West of the National Science Foundation Antarctic Writers and Artists Program and the Antarctic Research and Education Program along with the New Zealand Antarctic Program are interested in creating a te reo Maori-English bilingual edition of The Lost Seal. This translation would tie New Zealand's investment in Antarctic education together with the desire to preserve and promote Maori culture in a dynamic, contemporary manner in bilingual schools, while simultaneously addressing the deficit for indigenous language materials that present scientific rather than simply folkloric content to children.

In this role I will facilitate between the New Zealand Antarctic Program, the LTER Schoolyard Book Series, Moonlight Publishing, 'Te Kete Ipurangi' (TKI); the New Zealand Ministry of Education curriculum program for teaching te reo Maori in English-medium bilingual schools, and the te reo Maori translators I have contacted through the New Zealand Society of Translators and Interpreters in order to coordinate and support this translation and its introduction into bilingual te reo Maori schools. While this is a novel outreach project, I believe my previous experience supporting the Spanish translation as well as my bachelor's degree in environmental anthropology will be useful to address the cultural and logistic considerations necessary for this work. Above to facilitation of the bilingual translation, this project presents novel opportunities for international outreach that conveniently overlap with some of the travel requirements and existing cooperations for American research in Antarctica. In addition to the positive relationship between the United States and New Zealand Antarctic programs, all United States Antarctic

Program participants travel to New Zealand in order to depart for and return from Antarctica each year. After completing my 2014-15 Antarctic research season in February 2015, I will fly to New Zealand enroute back to the United States. During this time, this project proposes a two-week stay in New Zealand (no additional flights necessary) in order to visit with participating bilingual Maori schools from the TKI program, complete activities from the now-completed *Teacher's Guide to The Lost Seal*, discuss fieldwork in Antarctica, collect feedback from bilingual teachers on the te reo Maori draft of the book, and collect artwork from children that will contribute to the ***Lost Seal Artwork*** collection of international children's artwork published online and adding to the existing interactive collection from the United States, England, Australia, Argentina, and Chile. Feedback from teachers and artwork from students may be incorporated into the final draft of the bilingual te reo Maori book.

4) ***Assess environmental literacy and scientific engagement of students in participating classrooms through the creation and distribution of learning assessments and surveys***

The close interaction with participating classrooms offers a valuable opportunity to assess the environmental empathy and scientific engagement of students at various grade levels involved in this program. Dr. Jane Larson specializes in the external evaluation of primary educational science programs and has previously worked with Diane McKnight on evaluations for ***My Water Comes from the Rocky Mountains***, another book in the LTER Schoolyard series. In addition, I have previous experience in environmental anthropology and ethnography using a modified version of the New Ecological Paradigm (NEP) scale (Dunlap, Van Liere et. al, 2000) to assess the psychological sense of responsibility and belonging individuals feel towards a changing environment; research used in the completion of my bachelor's in environmental anthropology. Instead of simply applying the learning assessments from the Schoolyard series books in our evaluation of the effectiveness of ***The Lost Seal*** and curriculum guide, I will combine the assessments with elements of the New Ecological Paradigm scale so that the combined product disseminated to participating classrooms analyzes ***Lost Seal*** lesson retention (when applicable) along with environmental empathy, perception of ecological resource value, and how each of these parameters affects student interest in STEM fields. These assessments will be disseminated to classes that have completed lessons from ***The Lost Seal*** guide, classrooms that have followed Alex's progress during her fieldwork in the 2014/15 Antarctic season, as well as classrooms that have not included any other aspect of this outreach into their curriculum. Not only will these assessments help to measure the effectiveness of the lesson plans designed for ***The Lost Seal*** (a completed 2012-13 outreach goal), but by varying the method of teaching these lessons by teaching the lesson plans alone, incorporating the history of Antarctic exploration as addressed in ***The Lost Seal***, or including Alex's personal experience by following her field season through skype calls and blog updates, the results of the assessments can be analyzed for both student retention of the scientific material and how each parameter of the outreach program may contribute to its success. The collection of this information as well as the environmental consciousness and engagement measured with the NEP scale will be reviewed by PhD committee member Adrian Howkins and discussed in a chapter of my dissertation addressing this analysis and results.

C. June 2014-May 2015 Fellowship Timeline

Task	June-August 2014	Sept-Nov 2014	Nov 2014-Feb 2015	Feb-May 2015
Current: Increase publicity and network to new teachers/schools by presenting a poster and participating in the activities exposition at the annual National Science Teacher's Conference in Boston, MA in April 2014 in order to network and increase participation for next year's program				
Take CU courses in science journalism, nonfiction essay writing, and video editing in order to enhance the content of field blog 'The Last Degrees' and further prepare towards a career in science communication and outreach	X			
Create learning assessments for implementation in participating schools, utilizing the NEP scale and learning assessments, submitting for approval with the CU Institutional Review Board for Human Subjects Research	X			
Coordinate with Moonlight publishing on the textual revisions necessary for a bilingual Spanish-English and Hawaiian-English editions of 'The Lost Seal'	X	X		
Coordinate with TKI, the New Zealand Antarctic Program, and Moonlight publishing to to begin work on a bilingual te reo Maori translation of 'The Lost Seal' while addressing logistical and cultural considerations by collaboration with TKI	X	X		
Begin new school year engagement with participating classrooms, visit local classrooms, skype with faraway classrooms, and distribute learning assessments to participating schools		X		
Update classrooms with blog updates, skype videoconferencing, photography, and video production from Antarctic fieldsite			X	
Upon arrival in New Zealand following Antarctic fieldwork season, visit bilingual schools for outreach activities, te reo Maori language feedback, and artwork collection. Follow up with Hawaiian visit as invited by the Moorea Coral Reef LTER for the Hawaiian-English edition				X
Continue in-classroom visits upon return to Boulder and complete the blog series and video projects from Antarctic fieldwork				X
Complete necessary coordination for final publication of the Spanish-English, Hawaiian-English, and te reo Maori-English bilingual editions of 'The Lost Seal'				X
Collect final learning assessment forms and analyze data for inclusion in dissertation chapter on environmental empathy and engagement				X
Summary of outreach and learning assessment findings to Chancellor's Award committee, STEM conferences and DBER seminars: throughout and at completion of STEM award	*X*	*X*	*X*	*X*

D. Broader Impacts

Through this project I will participate in science activities in the Boulder Valley School District and year-long engagement with participating classrooms both locally and internationally through the use of skype videoconferencing, video production, and blog updates throughout the Antarctic field season. It will also coordinate the translation, review, and revisions necessary to publish a bilingual Spanish-English and Hawaiian-English edition of *The Lost Seal* for use in bilingual schools, and a novel opportunity to create a bilingual te reo Maori edition of *The Lost Seal* and associated outreach with coordination with the New Zealand Ministry of Education. This is a broad-ranging project including the cooperation of the CU Department of Civil and Environmental Engineering, the Institute for Arctic and Alpine Research, the Antarctic McMurdo Dry Valleys Long Term Ecological Research program, the Office of University Outreach, the CU 'Learn More About Climate Program', the Boulder Valley School District, the National Science Teachers Association, the Moorea Coral Reef LTER, and both the United States and New Zealand Antarctic Programs. The learning assessments created for this project offer both an analysis of lesson retention for the activities designed for educational children's book *The Lost Seal* as well as an analysis of how children's sense of environmental empathy and ecological resource valuation affects their interest in STEM careers; the analysis of which will be included in my dissertation. The outreach, blog posts and design, classroom visits, summer courses in science journalism, video production, and international collaboration will all contribute valuable experience towards my career interest in science communication and outreach. In addition, the creation of supplementary materials, bilingual translations, and outreach activities in both the Boulder Valley School District and through internet communication to a broader audience seek to make the themes of environmental literacy, polar research, and STEM careers more accessible to students of different grade level and linguistic backgrounds on both a local and international scale.

E. Participating Faculty/ Professionals

Adrian Howkins, Professor at Colorado State University and co-Investigator for the McMurdo Dry Valleys Long Term Ecological Research site based out of the Institute for Arctic and Alpine Research at CU

Jane Larson, Science Education Evaluation Specialist, Biological Sciences Curriculum Study (BSCS)

Diane McKnight, Professor of Civil and Environmental Engineering at CU, Fellow at the Institute for Arctic and Alpine Research, and co-Principal Investigator for the McMurdo Dry Valleys Long Term Ecological Research site

Wynn Martens, Assistant Director, Office of University Outreach

Ben Martin, Program Manager, Learn More About Climate Program, Office of University Outreach

The Moorea Coral Reef Long Term Ecological Research (LTER) Program

Amy Rinehart, Long Term Ecological Research 'Schoolyard Series' Book Editor

Cooperation with the United States Antarctic Program for fieldsite communications/ technical support and the New Zealand Antarctic Program and Te Kete Ipurangi (TKI) program for collaboration on Maori translations and extended outreach

ALEXANDRA QUINN MASS
PhD Student- Environmental and Water Resources Engineering, University of Colorado
(631) 428-8889, email alexQmass@gmail.com

EDUCATION

***Current PhD student*, Environmental and Water Resources Engineering**, University of Colorado. Matriculated fall 2011, projected graduation 2016. Concurrent participation and completion of the University of Colorado Hydrologic Sciences graduate certificate program. Research focus on the distribution and degradation of atmospheric pollutants in glacial meltwater, including three seasons of fieldwork in Antarctica.

M.S., Environmental Engineering and Hydrologic Sciences, University of Colorado, expected June 2014. Emphasis on transport, exchange, and degradation of atmospheric pollutants in Antarctic snowpack, glacial water, and ambient air. Data collected from fieldwork project 'Temporal Fluctuations in Ozone, NOx, and Gaseous Elemental Mercury Photochemistry with Snowpack Depth on the Antarctic Plateau' currently resulting in collaborative research manuscripts in review for publication.

M.S., Environmental Toxicology/ Marine Science, University of Georgia, May 2010. MS thesis *Methyl Bromide Utilization in Southern Ocean Sea Ice*- identified the biological degradation and dehalogenation of methyl bromide in sea ice and ocean water, and included austral season fieldwork in Antarctica and onboard the Antarctic Icebreaker Oden. Manuscript in review for publication.

B.S. Biology, Bucknell University, May 2007. 2nd major in Anthropology, minor in Environmental Studies.

Current Graduate Assistantship: *Education and Outreach Coordinator*, McMurdo Dry Valleys Long Term Ecological Research (LTER) Program. Coordinate publicity for the LTER Schoolyard book series and promote environmental literacy for elementary school children, working with primary school teachers and classrooms in the Boulder Valley School District in conjunction with the CU Office of University Outreach and 'Learn More About Climate' program. Coordinated with Diane McKnight for the 2012-13 CU Outreach Award supporting this work. Created outreach blog 'The Last Degrees', (www.thelastdegrees.wordpress.com) recently featured on Rocky Mountain PBS.

TEACHING EXPERIENCE: 14 courses 2005-2012

Primary instructor or lead lecturer for the following courses:

- **Introduction to Marine Science.** (University of Georgia MARS 1010/L laboratory instructor, 3 class sections, Fall 2009.) Responsibilities included independently leading laboratory classes and demonstrating techniques, preparing lab set-up / clean up, meeting with / tutoring students, writing weekly quizzes, and grading all papers and assignments for the laboratory grade.
- **Introduction to Ecology- Field Based.** (University of Georgia ECOL 1000H, May-August 2008 cross-country camping field program.) See description below.
- **Ecology of North America- Field Based.** (University of Georgia ECOL 4160, May-August 2008 cross-country camping field program.) Served as primary ecology lecturer and emergency medical technician on an eight week field program for UGA undergraduates, camping and traveling 11,826 miles throughout twenty one US states in a field-based, hiking environment. Selected course content and devised field-based lectures, assignments and exams.

Teaching assistant for the following courses:

- **Graduate-level Applied Stream Ecology.** (University of Colorado CVEN 5323, Fall 2011.) Responsibilities include laboratory demonstrations, demonstrations of field methodology on fieldtrips, organizing logistics and equipment for student-led field projects, meeting with students, select grading and guest lectures.

- **Introduction to Environmental Health Science.** (University of Georgia EHSC 3060, 4 class sections from Fall 2007- Spring 2008.)
- **Introduction to Anthropology- Field Based.** (University of Georgia ANTH 1102, May-August 2008 cross-country camping field program.) Assistant and guest lecturer. Additional guest lectures provided for the concurrently-running Honors Introduction to Anthropology- Field Based (ANTH 2120H), and North American Indians- Field Based (ANTH 4020).
- **Cellular and Genetic Biology lab**. (Bucknell University BIOL 121L, 2 class sections Fall 2005, 2006.) Responsibilities same as BIOL 122L below-
- **Ecology and Evolutionary Biology lab**. (Bucknell University BIOL 122L, Spring 2007.) Responsibilities included leading laboratory experiments and demonstrating techniques, preparing lab set-up / clean up, meeting with students, and grading all papers and assignments for the laboratory grade.
- **General biology tutor**, providing individual assistance to students referred by the Bucknell University biology department, including students with cognitive learning disorders. Reviewed lecture material, lab concepts and techniques, tests and lab reports August 2005- May 2007.

ADDITIONAL COMMUNITY OUTREACH

Volunteer Emergency Medical Technician (certified EMT-B) June 2003- present. Additional training provided by the NSF Arctic Field Training Program and the University of Georgia department of Environmental Health Science programs in pharmacology, toxicology, and environmental risk assessment for national disaster response. Reserve (registered) EMT during all Antarctic field deployments.

Foster Trainer and Volunteer, Guide Dog Foundation for the Blind. Participated in the one-year 'puppy foster' program three times to house and train labrador retrievers to become seeing-eye dogs for the Guide Dog Foundation, 2008-2010.

Fundraising volunteer, Polaris Project and 'Not For Sale' 2007-present. Donate 100% of the proceeds from photography website VisualNative.com towards nonprofit organizations to eradicate human trafficking and modern slavery.

Speaker and volunteer, STEM education outreach 2009-present. Give talks/presentations at local schools, skype with classrooms, and maintain field blog 'The Last Degrees' (www.thelastdegrees.wordpress.com) to describe fieldwork science and STEM careers to younger students. Additional outreach for after-school clubs catered to girls in science and outreach events from CU's Society of Women Engineers.

DISTINCTIONS

- CU Outreach Award (under coordination with Diane McKnight), U. Colorado 2013-14
- Chancellor's Award for Excellence in STEM Education, University of Colorado 2012-13
- National Oceanic and Atmospheric Administration Pre-doctoral Fellow, Oceans and Human Health research program, 2008-2009
- Bucknell University Dean's List 2005, 2006
- National Fish and Wildlife Foundation Undergraduate Fellow, 2006.
- Westinghouse / Intel Student Researcher, 2001-2003

REFERENCES

Dr. Diane McKnight	Dr. Adrian Howkins	Dr. Shelly Miller
Professor and current PhD advisor, University of Colorado Diane.McKnight@colorado.edu ph# 303-492-4687	Assistant Professor, Colorado State University Adrian.Howkins@colostate.edu email preferred to office phone	Assistant Professor University of Colorado Shelly.Miller@colorado.edu ph# 303-492-0587

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Adviser's Full Name
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Adviser's Home Department
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By submitting this application, I confirm that, if my advisee is selected to receive a Chancellor's Award for Excellence in STEM Education, I will:

- ✓ Attain a GRA salary match (25% during the academic year, and 50% during the summer) from my own funding sources or from my department.
- ✓ Attend the annual Symposium on STEM Education (fall 2014).
- ✓ Actively engage in the CU-Boulder STEM education community by attending the weekly DBER Seminar Series when possible.

Adviser Application Form

Graduate Chancellor's Award for Excellence in STEM Education

1) Mentoring description

As the principal investigator for the McMurdo Dry Valleys Long-Term Ecological Research project, I have responsibility for carrying out the educational outreach activities of this interdisciplinary project that involves 10 investigators from many other universities. Since 20011, Alex and I have been working together on the outreach activities for this program, along with an environmental historian on the team, Prof. Adrian Howkins from Colorado State University. Alex is currently supported by the project as a graduate research assistant and has completed all her corusework. During the past year, I provided advice as she planned the outreach activities for the field season in Antarctica and worked with her on site as well. In particular, Alex and I worked together as she prepared a poster presentation describing her outreach activities for NSF program managers and a site review team of distinguished scientists. The team and NSF program managers were highly impressed with her work, including her blog, *The Last Degrees*. In addition, while in Antarctica I introduced Alex to others working in educational outreach that I have interacted with previously. Alex has an excellent understanding of the children's fascination with Antarctica and the importance of outreach for all research projects being conducted in Antarctica. I will continue to work with her closely while she is conducting the activities here in Colorado and again next season in Antarctica.

2) Departmental mechanisms for including the results of the research in the student's degree program

The Department of Civil, Environmental and Architectural Engineering has a strong commitment and involvement with expanding engineering education and has carried out a GK-12 Fellowship program supported by NSF to enhance engineering education locally. As part of Alex's outreach activities she has developed a teacher questionnaire with guidance from Dr. Jane Larsen, which she will use to access the student's knowledge gains in association with the outreach activity over the schoolyear. One of the approaches will be to evaluate the importance of interacting with Alex in person prior to and after the trip compared to only interacting through Skype, for example. The results from this study will be included as a chapter in her thesis. This research effort will build upon Alex's undergraduate background in environmental anthropology. Prof. Howkins and Prof. Bielefeldt, a leader from GK-12 program in our department, will be members of her thesis committee

3) Description of the matching funds

The MCMLTER project is a 6-year award funded until 2017 and includes funding for one semester and partial funding for the summer for a graduate research assistant to support the educational outreach activities of the project. These funds have been and will be used to fully match the Chancellor's Award. Alex will work with the teachers and educators throughout the fall semester 2014 and spring semester 2015 on the activities proposed.

4) Benefits: personal development, support STEM education within CEAE, and CU-Boulder community

While I have been an active participant in educational outreach since I joined the faculty at the University of Colorado in 1996, I have much to learn about how to use modern media effectively in educational outreach in the modern era. For example, I have team taught a summer course at the Mountain Research Center entitled Alpine Ecology and Experiential Learning with an expert in environmental education in the early 2000's, when posting of videos was a daunting task, as opposed to the ease of such postings today. Through my interactions with Alex, I have a greater understanding of how to incorporate videos and blogs in supporting the educational use of books in the LTER Schoolyard Book Series, for which I am the Chair of the Editorial Committee.

Last season, Alex's blog from the field in Antarctica had a very impact because it was highlighted by ViralNova as an excellent blog, which resulted in over 400,000 visits, and locally was featured both on the CU website and on the website of Rocky Mountain PBS. The quality of the blog was appreciated by many and set a standard for other graduate students in the CEAE program. Many of these students are engaged in the Engineering for Developing Communities program and thus also work in interesting and remote locations and some are considering preparing blogs about their field activities. The success of Alex's overall project will be an inspiration to these students.

The overall CU community benefits by Alex's sharing the excitement of research in Antarctica with a broad range of people through her educational work. Not only middle school students and their teachers, but also their family and friends will develop a better understanding of how the research conducted at CU is carried out, and of its value in

understanding the natural world. Through this outreach activity many people in Colorado will become more connected to CU.

Professor Diane M. McKnight

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I. EDUCATION

1979, Ph.D., Environmental Engineering, Massachusetts Institute of Technology
1978, M.S., Civil Engineering (Water Resources), Massachusetts Institute of Technology
1975, B.S., Mechanical Engineering, Massachusetts Institute of Technology

II. PROFESSIONAL EXPERIENCE

2012, Director, Center for Water, Earth Science and Technology, University of Colorado
2004-present, Co-Director Hydrologic Sciences Graduate Program, University of Colorado
1999-present, Professor of Civil, Environmental and Architectural Engineering, University of Colorado
1996-present, Fellow of INSTAAR, University of Colorado
1996-2004, Associate Director, Mountain Research Station, University of Colorado
1996-1999, Associate Professor of Civil, Environmental and Architectural Engineering, University of Colorado
1979-1996, Research hydrologist, National Research Program, U. S. Geological Survey
1986-1992, Research Advisor -Ecology, Water Resources Division, U. S. Geological Survey
1979-1980, National Research Council Fellow, U. S. Geological Survey
1975-1979, INCRA Fellow, Massachusetts Institute of Technology

III. HONORS AND SCHOLARLY AWARDS

2012, National Academy of Engineering, member
2009, American Association for the Advancement of Science, Fellow
2008, Honorary Chair, Humic Sciences and Technology Conference XI
2005, American Geophysical Union, Hydrology Section, Langbein Lecturer
2003, American Geophysical Union, Fellow
1995, USGS, Meritorious Service Award
1985, 1993, USGS, Performance Award
1978, Arthur T. Ippen Award, Ralph M. Parsons Laboratory, MIT

IV. RESEARCH INTERESTS:

Limnology, conducting studies of coupled ecological, biogeochemical and hydrologic processes in lakes, streams, and watersheds, primarily in polar and mountain regions. Studies include the response of algae in lakes and streams to climate-driven hydrologic change, the biogeochemistry of natural organic material and ecological interactions in acid mine drainage streams and in arsenic contaminated groundwater. Another aspect of this research is development of reactive solute transport models of biogeochemical and hydrologic processes in stream systems.

V. PROFESSIONAL SERVICE:

American Society of Limnology and Oceanography: Member of Board, 1992-1994, President- elect: 1995, President 1996-1998, Past-President 1998-2000; Steering committee for workshop on Emerging Issues in Limnology, member 2002-2003.

National Research Council: Committee on Climate Change and Water Resources Management, member 1990-1992, Committee on Antarctic Policy and Science, member 1991-1992, Polar Research Board, member 1994-1998, Committee on Inland Aquatic Ecosystems, member, 1994- 1996, Water, Science and Technology Board, member, 2000-2003, Committee to Review Climate Change Science Plan, member, 2003-2004, Committee on Salmon and Water Resources in the Columbia Basin, member 2003-2004, Committee on U.S. Army Corps of Engineers Water Resources, Science, Engineering, and Planning, member 2009-2012, Committee on the Value and Sustainability of Biological Field Stations, Marine Laboratories, and Nature Reserves in 21st Century Science, Education, and Public Outreach, member 2013.

National Science Foundation: Office of Polar Programs Advisory Committee, member 1993-1996, Advisory Committee for Environmental Research and Education, member 2004-2007.

American Geophysical Union: Chair, AGU Committee on Biogeosciences (1998-2000), Acting President of Biogeosciences Section (2000-2002), Editor (founding), Journal of Geophysical Research-Biogeosciences, 2004-2009, AGU Chapman Conference on Lakes and Climate Change, member of steering committee, 2008-2009, AGU Chapman Conference on Organic Matter Fluorescence, member of steering committee, 2008-2010, Biogeosciences Section, Nominations Committee, Chair, 2012.

Long Term Ecological Research Network: Chair, Editorial Committee, Schoolyard Children's Book Series, 2006-present, Principal Investigator, McMurdo Dry Valleys Long-Term Ecological Research project, 2009-present.

Intergovernmental Panel on Climate Change (IPCC): Working Group 2- Impacts, Vulnerability and Adaptability, group 15- North America, member 1998-2001

VI. REFERENCES

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Dieser, M., C. M. Foreman, C. Jaros, , J. T. Lisle, M. Greenwood, J. Laybourn-Parry, P. L. Miller, Y. Chin, D.M. McKnight. 2013. Physicochemical and biological dynamics in a coastal Antarctic lake as it transitions from frozen to open water. Antarctic Science, 25(5): 663-675.

Foreman, C. M.; Cory, R. M.; Morris, C. E.; SanClements, M. D.; Smith, H. J.; Lisle, J. T.; Miller, P. L.; Chin, Y.; McKnight, D. M.. 2013. Microbial growth under humic-free conditions in a supraglacial stream system on the Cotton Glacier, Antarctica. Environmental Research Letters, 8: 3 Article Number: 035022.

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Gooseff, M. N., D. M. McKnight, M. H. Carr and J. Baeseman. 2010. Antarctic McMurdo Dry Valley stream ecosystems as analog to fluvial systems on Mars. in: Doran, P. T., W. B. Lyons and D. M. McKnight, eds., pp. 139-159. Life in Antarctic Deserts and other Cold Dry Environments: Astrobiological Analogs. Cambridge University Press, UK.

Spaulding, S. A., B. Van de Vijer, D. A. Hodgson, D. M. McKnight, E. Verleyen and L. Stanish. 2010. In Smol, J. P. and Stoermer, E.F., eds. Pp. 267-286. The Diatoms: Applications for the Environmental and Earth Sciences. Cambridge University Press, UK.

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McKnight, D.M., Blood, E.R., and O'melia, C.R., 1996, Fundamental Research Questions in inland aquatic ecosystem science, Freshwater Ecosystems: Revitalizing Educational Programs in Limnology, National Academy Press.

Naiman, R.J., Magnuson, J.J., McKnight, D.M., and Stanford, J.A., 1995, The Freshwater Imperative: A Research Agenda, Island Press.

Kimball, B.A., Broshears, R.E., McKnight, D.M., and Bencala, K.E., 1994, Effects of an instream pH modification on transport of sulfide-oxidation products, *in* Alpers, C.N., and Blowes, D.W., eds., Environmental Geochemistry of Sulfide Oxidation, American Chemical Society, p. 224-243.

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McKnight, D.M., 1991, Feedback mechanisms involving humic substances in aquatic ecosystems, *in* Schneider, S.H., and Boston, P.J., eds., Scientists on Gaia: Cambridge, MA, The MIT Press, p. 330-338.

Aiken, G.R., McKnight, D.M., Wershaw, R.L., and Miller, L., 1991, Evidence for the diffusion of aquatic fulvic acids from the sediments of Lake Fryxell, Antarctica, *in* Baker, R.A., ed., Organic substances and sediments in water, Lewis Publishers, p. 75-88.

Ranville, J.F., Hanrish, R.A., and McKnight, D.M., 1991, Particulate and colloidal organic material in Pueblo Reservoir, Colorado: Influence of autochthonous source on chemical composition, *in* Baker, R.A., ed., Organic Substances and Sediments in Water: Volume 1: Humics and Soils, Lewis Publishers, p. 47-73.

Averett, R. A. and McKnight, D.M. (editors) 1987, Chemical Quality of Water and the Hydrologic Cycle: Proceedings of the 8th Rocky Mountain Regional Meeting of the American Chemical Society: Chelsea, MI, Lewis Publishers, Inc, 382 p.

Bencala, K.E., and McKnight, D.M., 1987, Identifying in-stream variability: Sampling iron in an acidic stream, *in* McKnight, R.C.A.a.D.M., ed., Chemical Quality of Water and the Hydrologic Cycle: Chelsea, MI, Lewis Publishers, p. 255-270.

Aiken, G.R., McKnight, D.M., Wershaw, R.L., and MacCarthy, P (editors) 1985, Humic Substances in Soil, Sediment and Water:: New York, John Wiley and Sons, 1092 p.

Aiken, G.R., McKnight, D.M., Wershaw, R.L., and MacCarthy, P., 1985, An introduction to humic substances in soil, sediment, and water, Humic Substances in Soil, Sediment, and Water, John Wiley and Sons, Inc., ed., p. 1-9.

VI. RESEARCH GRANTS AND CONTRACTS

ONR, Humic substances as electron acceptors and electron shuttlers in anaerobic marine sediments, $140,000 total award, 1996-1998.

NSF, McMurdo Dry Valleys Long term Ecological Research: a cold desert ecosystem, $125,000/yr for stream hydrology and ecology, and database management, 1997-2005.

NSF, Niwot Ridge Long term Ecological Research, co-investigator, $25,000/yr for phytoplankton ecology component and $15,000 for educational outreach supplement, 1998-2005.

NSF-OPP, "The effects of dissolved organic matter on the photolysis and bioaccumulation of organic contaminants in Pony Lake, Cape Royds.", $11,000, 1997-1998.

EPA "Manganese photochemistry in mountain streams", with D. Hrncir University of Texas as subcontract, $351,175 total award, 1998-2000.

Trout Unlimited, Summit County, with inkind support from Keystone Resort)- Characterization of stream ecosystems in the Snake River for the Snake River Task Force, $9000, 1999.

ONR, Electron-accepting capacity of humic substances in marine sediments: chemistry of reactive quinone moieties, $285,000, 1999-2001.

EPA, Characterization of stream ecosystems in the Snake River for the Snake River Task Force, sub-contract to Keystone Center, $50,000, 2001-2003.

NSF-EPA, A decision making framework for stream restoration from acid mine drainage, co-PI with Nick Flores (Economics, CCSI), $60,000, 2002-2004.

NSF-OPP, Collaborative research: Direct and indirect photolytic fate of persistent organic pollutants in arctic surface waters. Co-PI with Yo Chinn, Ohio State University, $170,000, 2001-2003.

EPA, Influence of climate-induced alterations in dissolved organic carbon on UV radaition and metal toxicity in high elevation streams, co-PI with W. Clements, Colorado State University, $227,999, 2002-2005.

NSF-OPP, Collaborative Research: Biogeochemistry of Dissolved Organic Matter in Pony Lake, Ross Island. Co-PI with Yo Chin, Penney Miller, Christine Foreman, $ 284,607, 2004-2007.

NSF, Niwot Ridge Long term Ecological Research, co-investigator, $25,000/yr for phytoplankton ecology component and $15,000-$40,000/yr for educational outreach supplement, 2005-2011.

NSF, McMurdo Dry Valleys Long Term Ecological Research: a cold desert ecosystem, $60,000/yr for stream hydrology and ecology, 2005-2011.

NSF-DEB, Development of the LTER Schoolyard Book Series, $78,000, 2007-2008.

NSF-GEO, Collaborative research: Stream-Sediment Bed Exchange of Colloids and Colloid-Associated Metals in Acid Mine Drainage Environments, $427,628, 2006-2009

NSF-GEO, Collaborative Research: Humics and Iron Redox Reactions in Bangladesh Aquifer, $388,063, 2008–2011.

NSF-OPP, Collaborative Research: The Biogeochemical Evolution of Dissolved Organic Matter in a Fluvial System on the Cotton Glacier, Antarctica, $329,535.00, 2009-2011.

NSF-OPP, Collaborative Research: Stream Ecosystem "Harshness" and Microbial, $452,230.00, 2009-2011.

NSF-OPP, Increased Connectivity in a Polar Desert Resulting from Climate Warming: McMurdo Dry Valley LTER Program, $ 5,640,000, 2011-2017.

VII. GRADUATE STUDENTS ADVISED

Ph. D.
1. Sarah Spaulding (co-adviser with D.Wall) 1997
2. Dev Niyogi (co-advisor with Prof. William Lewis in Environmental, Population and Organismic Biology) 1999
3. Michael Gooseff, 2001
4. Durelle Scott, 2001
5. Natalie Mladenov, 2004
6. Andrew Todd, 2005 (fall)
7. Rose Cory, 2005 (fall)
8. Anne Hickey, 2006 (spring)
9. Matt Miller, 2008 (summer)
10. Karen Cozzetto, 2009 (summer)
11. Joshua Koch, 2010 (fall)
12. Lee Stanish, 2011 (fall)
13. Kaelin Cawley, 2010 (spring)
14. Sabre Duren, 2013 (fall)
15. Rachel Gabor, 2013 (fall)
16. James Duncan Cullis, 2011 (fall)
17. Tyler Kohler
18. Alex Mass
19. Travis Drake
20. Jessica Ebert
21. Alia Khan

M. S.
1. Arne Bomblies, 1999
2. Summer Waters, 1999
3. Laura Belanger, 2002
4. Durelle Scott, 2001
5. Alexandra Brown, 2001
6. Lisa Klapper, 2001
7. Eric August, 2001
8. Ethan Chatfield, 2001
9. Erin Van Matre, 2002
10. Matt Miller, 2004
11. Christopher Jaros, 2003
12. Eileen Gardner, 2003
13. Sabre Duren, 2004
14. Marcy Appel, 2004
15. Justin Joslin, 2005
16. Chi Yang, 2005 (spring)
17. Jeffrey Wong, 2006 (spring)
18. Colleen Flanagan, 2007 (spring)
19. Lindsay Weber, 2008 (spring)
20. Tisza Bell, 2009 (fall)
21. Rachel McLoughlin, 2009 (spring)
22. Aimee McLaughlin, 2009 (fall)
23. Bailey Simone, 2010 (summer)
23. Caitlin Crouch, 2011 (summer)
24. Jessica Ebert, 2012 (fall)
25. Alia Khan, 2012 (summer)
26. Deena Garland, 2013 (spring)
27. Garrett Rue
28. Aneilya Sakaeva

VIII. SUMMARY OF COURSES TAUGHT

Natural Organic Material in Water (Spring 1997)
Applied Stream Ecology (1997-present)
Surface Water Quality Modeling (1998-1999)
Alpine Ecology and Experiential Learning (summer 1998-2004)
Introduction to Applied Ecology (spring 2000-present)
Advanced Aquatic Chemistry (spring 2003, Spring 2008)
Environmental Engineering Chemistry (fall 2005, 2008)

IX. UNIVERSITY SERVICE

Departmental Committees:

- CEAE Curriculum Committee (member 1997-1999, 2005-2006, 2014)
- CEAE Executive Committee (member 2001-2004)

Local committees and public outreach activities:

- Boulder Creek Watershed Initiative, member Board of Directors (1997-present).
- Snake River Watershed Task Force, member, 1999-present.

X. PROFESSIONAL SOCIETIES

- Ecological Society of America
- American Society of Limnology and Oceanography
- American Chemical Society
- American Geophysical Union
- International Humic Substances Society
- Phycological Society of America
- North American Benthological Society
- Sigma Xi

XII. REVIEWER

Journals:

Ecosystems
Antarctic Science
Archiv of Hydrobiologie
Chemical Geology
Environmental Science and Technology
Geochimica Cosmochimica Acta
Hydrologic Processes
Journal of Arctic, Antarctic and Alpine Research
Journal of Soil Science Society of America
Limnology and Oceanography
Nature
Polar Biology
Water Research
Water Resources Research

Books:

MIT Press

Proposals:

NSF (Ecology and Ecosystems in DEB, Polar Programs, Hydrology)
Dept. of Agriculture
Department of Energy

Current and pending support

NSF, ANT, " Increased Connectivity in a Polar Desert Resulting from Climate Warming: McMurdo Dry Valley LTER Program", 04/01/11 - 03/31/17, $5,684,000 total, about $200,000/yr at the University of Colorado.

NSF, DEB, “The Niwot Ridge Long-Term Ecological Research Program 2011-2016: Tipping Points in High-Elevation Ecosystems in Response to Changes in Climate.” $100,000 for aquatic ecology research, 01/01/11 - 01/01/17.

NSF, DEB, “A continental scale assessment of the linkages between soil organic matter stabilization mechanisms, controls and vulnerability, 02/01/14 - 01/31/19, $186,679 in 2016 and 2017.