Thinking Broadly about your NSF Broader Impacts

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Questions we will address:

- **Why do I need to think about broader impacts?**
- **What are some example broader impacts?**
- **Where/How do I integrate broader impacts into my proposal?**

Why do I need to think about Broader Impacts?

“Every NSF grant has the potential to not only advance knowledge, but benefit society -- what we call broader impacts. Just like the kaleidoscopic nature of science, broader impacts come in many forms. No matter the method, however, broader impacts ensure all NSF-funded science works to better our world.”

https://www.nsf.gov/od/oia/special/broaderimpacts/

Why do I need to think about Broader Impacts?

Why do I need to think about Broader Impacts?

NSF PROPOSALS EVALUATION

- ✓ **Intellectual merit: potential to advance knowledge**
- ✓ **Broader Impacts: potential to benefit society and contribute to the achievement of specific, desired societal outcomes**

NSF Review Criteria

1. Potential to benefit society

2. Exploration of creative, original, or potentially transformative concepts

3. A well-reasoned, well-organized plan with a mechanism to assess success

4. Qualification of the individual, team, or organization to conduct the proposed activities

5. Adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities

In NSF Speak:

Broader impacts may be accomplished through:

- ✓**the research itself**
- ✓**through the activities that are directly related to specific research projects**
- ✓**through activities that are supported by, but are complementary to the project.**

In NSF Speak:

Activities that contribute to the achievement of societally relevant outcomes:

- **full participation of women, persons with disabilities, and underrepresented minorities in STEM;**
- **increased public scientific literacy and public engagement with science and technology;**
- **improved well-being of individuals in society;**
- **development of a diverse, globally competitive STEM workforce;**
- **increased partnerships between academia, industry, and others;**
- **improved national security;**
- **increased economic competitiveness of the U.S.;**
- **enhanced infrastructure for research and education.**

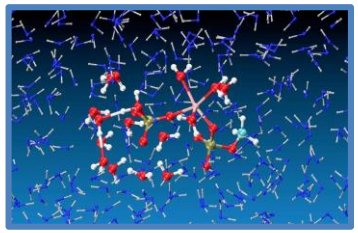
Which BI are in favor changes overtime…

No longer impresses panel reviewers

- **Developing entire courses and having students in your lab**
  - Assumption is that research active faculty should already be incorporating research into their courses and training students
- **Starting a new summer program**
  - The time and resources and cooperation of others is too extensive
- **Publishing your work in your field's journals**
  - Publishing in your field is required

Typical Areas for Broader Impacts

- Build STEM Talent?



- Innovate for the Future?

- Improve Society?

- Reach Beyond Borders?

- Engage a Wider Audience?

https://www.nsf.gov/od/oia/special/broaderimpacts/

What to consider in narrowing in on your BI

- **Audience**
- **Partnerships available to you**
- **Unique and creative options**
- **Evaluation**
- **Budget**

http://coseenow.net/wizard/

https://www.youtube.com/watch?v=EzDocJzeCpo&feature=youtu.be

OK, OK, but how do I do this?

Talent, Future applications, Improve Society, Beyond Borders, Engage wider audience

- **Partner with museums**
- **Partner with nature or visitor centers**
- **Partner with science centers**
- **Partner with community events**

COLORADO SPRINGS COOL science FESTIVAL


E
+
S O
COOL science
HAO
SOLMIRUS
MOBILE EARTH + SPACE OBSERVATORY
CHALLENGER
LEARNING CENTER OF COLORADO

OK, OK, but how do I do this?

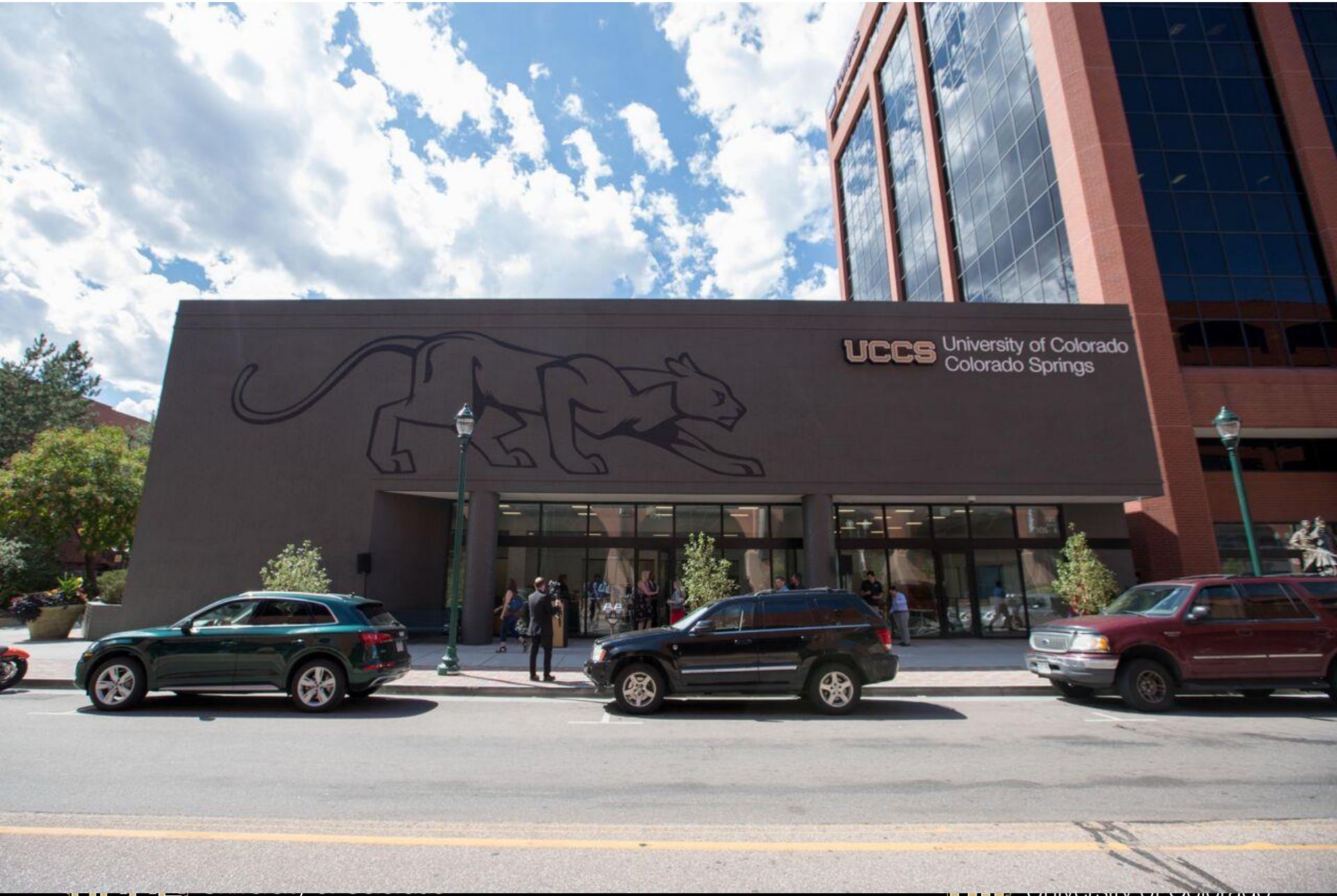
Talent, Future applications, Improve Society, Beyond Borders, Engage wider audience

- **Partner with campus offices, for example:**
  - Faculty Resource Center
  - Center for Student Research
  - Graduate School
  - University Communications
  - Alumni Office
  - Library
  - Mosaic
  - BI Program
  - Advancement – especially Jenifer Furda!

OK, OK, but how do I do this?

Talent, Future applications, Improve Society, Beyond Borders, Engage wider audience

- **Engage underrepresented students on your project team**
- **Hold public lectures and workshops**
- **Create citizen science opportunities***


UCCS University of Colorado
Colorado Springs

OK, OK, but how do I do this?

Talent, Future applications, Improve Society, Beyond Borders, Engage wider audience

- **Make a podcast**
- **Publish a toolkit for educators**
- **Present at conferences outside your main field**
- **Make a YouTube movie for research channel**

RESEARCH CHANNEL

https://www.youtube.com/watch?v=nmHxyDCbTkw&t=114s

Lab Report

318 views • Published on Jul 3, 2013

Montana State University
2.51K subscribers

The Mediating Role of Stereotype Threat and Achievement Goals in the Regulation of Scientific Motivation by Eric Deemer, Ph.D. & Jessi L. Smith, Ph.D.

SHOW MORE

Examples from recently funded NSF proposals

Where and how do I integrate Broader Impacts into my NSF proposal?

Everywhere

Cannot be an afterthought.

Where and how do I integrate Broader Impacts into my NSF proposal?

Include broader impacts in the following:

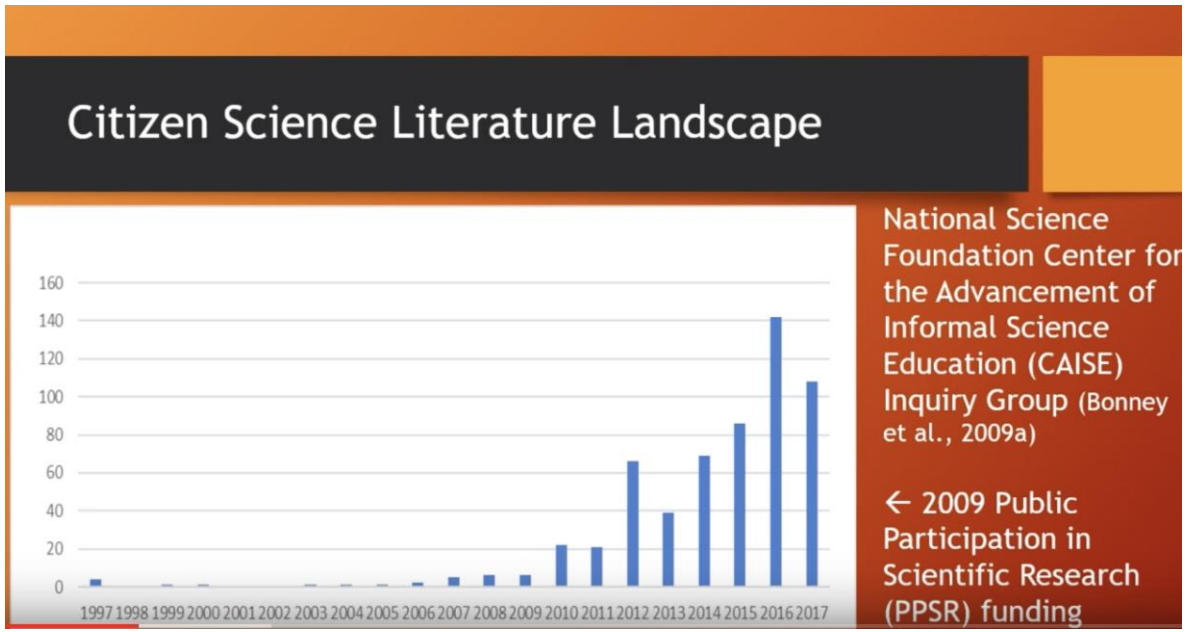
- **Project summary – must have own heading**
- **Project description – must have own heading**
- **Evaluation plan**
- **Results from prior NSF support (include results and a list of up to 5 synergistic activities that demonstrate broader impact)**
- **Annual and final reports**

Don’t Forget:
Assign Resources to Broader Impacts $ $ $

- **Budget**
- **Staff**
- **Partners**
- **Leverage institutional resources**
- **Leverage partner collaborations**

Deep Dive into Citizen Science

Local Expert: Maggie Gaddis, MS, PhD – UCCS Department of Biology



Citizen Science in Colorado Springs

- **Rocky Mountain Field Institute Citizen Science Program**
  - **Ecological restoration monitoring in the Garden of the Gods park**
    - **Erosion mitigation**
    - **Native plant revegetation**
  - **Social compliance in public lands**
  - **Citizen science training research**
- **Broader Impacts**
  - **community involvement**
  - **research application to solve pressing ecological issues in our urban-wildland interface**

Citizen Scientists at UCCS

- **RMFI-CSP promotion**
  - **RMFI website**
  - **Research blog**
- **UCCS self-recruit to the RMFI-CSP**
  - **More than any other class of recruits**
  - **Other citizen scientists include:**
    - **Community members**
    - **Graduate students from CU-Denver, Regis-Denver, CSU-Ft. Collins**

Caption: My BIOL1000/1060 students participating in authentic research in the Garden of the Gods, assisted by trained citizen scientists, some of whom are also UCCS students

Citizen Science Partnerships and Local Funding

- **City of Colorado Springs**
  - **Funds the RMFI-CSP**
  - **funds my academic research**
- **UCCS Green Action Fund**
  - **To date: 1 UCCS GAF recipient, $ for conference attendance**
  - **In progress: 1 UCCS GAF applicant, proposing novel research of student ideation**
- **Non-profit partners**
  - **CO Native Plant Society**
    - **Statewide calendar with 1000+ circulation**
    - **Lots of research activities around the state**
    - **Connects scholars from different institutions**
    - **Funding for research**
  - **Cheyenne Mountain State Park**
    - **Agency affiliation**
    - **Land access**
  - **Broadmoor Garden Club**
    - **Community impact**
    - **Local funding source**

Let's think broadly together…

Come up with one idea for a broader impact activity relevant to your area of research

- Think for 2 minutes, write down your idea
- Then, pair up with the person next to you
  - Review both ideas
  - Offer ways to improve/expand the ideas
- Finally, share the two revised ideas with the group

Let's Brainstorm Together!

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Example Broader Impacts from Recently Funded Projects

The following examples are excerpts from award abstracts across a range of disciplines and funding types. Before developing an application, investigators should always review abstracts of currently funded projects within their discipline and the specific funding opportunity of interest (https://www.nsf.gov/awardsearch/advancedSearch.jsp), and investigators should always discuss their research and education/outreach plans with the cognizant Program Officer prior to applying. Each Program Officer and review panel has different expectations about the correct way to address broader impacts, and the examples included below may not be appropriate for some applicants and some disciplines.

The first 10 examples reflect diverse projects funded across Colorado. The remaining examples were compiled by Georgia Tech, which has provided targeted support to help faculty develop strong broader impacts within all NSF applications. All the examples included here are notable for going beyond the traditional "inclusion of underrepresented groups" and instead describe activities or impacts tailored to the research and regional (or sometimes global) context.

CAREER: Impacts of Convective and Stratiform Processes on Tropical Cyclone Intensity Change

This study integrates research and education by developing a new graduate radar meteorology course with a digital, interactive textbook, and incorporating mesoscale TC observations into physical meteorology curricula to train and encourage students to test scientific hypotheses using field observations. The open source SAMURAI analysis software and material from the digital radar meteorology textbook will be available to the atmospheric science community to enhance research and education infrastructure. The University of Hawaii at Manoa represents a demographically and geographically unique state in an EPSCoR jurisdiction, and the Principal Investigator is committed to improving diversity by including women and underrepresented minorities such as Pacific Islanders and Native Hawaiians in the project. Improvements in our understanding of TC intensity change can have a significant positive impact on society. The application of the findings from continued research on hurricanes and typhoons can ultimately help to improve our forecast ability and reduce life and property loss throughout the globe.

RCN: Drought-Net: A global network to assess terrestrial ecosystem sensitivity to drought

Drought has social, human health, and economic impacts for people in the United States and around the world. Because climate change may increase the frequency or severity of drought, understanding the effects that droughts have on the sustainability of forests and grasslands is becoming an urgent issue. Drought-Net will focus on establishing international collaborations among researchers who study these challenges. The Distributed Graduate Seminars will train the next generation of global change scientists in collaborative synthetic and network-level research, with emphasis on increasing the involvement of underrepresented groups and geographic regions. Open calls for participation in network events and network-related products (datasets, newsletters, papers, reports, etc.) will be posted on the Drought-Net website, to encourage access by the broader scientific community and the general public. Finally, Drought-Net will partner with the Ask-A-Biologist program at Arizona State University to create articles and companion activities centered around drought impacts on terrestrial ecosystems. With its large Web footprint of 1.5 million visitors per year and links to science educators, broader impacts will be extended into the area of K-12 and life-long learners.

Enhancing the Value of MOSAiC through Coordination and Outreach

The MCO also provides a framework and products to ensure significant societal impact through outreach and education efforts, and regular, effective media communication, beyond what is possible from individually funded science projects. Modern multimedia content is produced to support the development and dissemination of engaging educational products such as curriculum materials, immersive multimedia experiences, a planetarium show, and an engaging web interface. Graduate students are involved in obtaining and producing outreach content and communications products. The MCO also facilitates outreach activities across the broader MOSAiC community by engaging the participation of many MOSAiC scientists and hosting and disseminating outreach products and content. Products, such as the planetarium show along with its supporting educational curriculum materials, are intended to be distributed for use in local communities by numerous partners across the US and internationally. All activities of the MCO are subject to a rigorous evaluation to assess and maximize their overall impact. Lastly, the MCO's role in overall project co-leadership for MOSAiC science, outreach, and communications maintains a prominent role for the US in this international endeavor and ensures that US objectives are prioritized.

Combining Course-based Undergraduate Research Experiences with Place-based Learning to Increase Student Retention, Civic Engagement, and Self-efficacy

This project will develop and study the impact of course-based undergraduate research experiences that incorporate place-based learning, thus creating community-relevant research opportunities for students. Students will engage in research projects to map the location of apple trees in Boulder County, characterize how these trees interact with the local ecology, identify which genetic varieties are currently growing, and graft the trees to preserve these genetic and cultural resources. It is expected that participation in this research will help students develop a sense of belonging to their local communities and to their scientific communities, will increase their civic engagement and civic efficacy, and will improve institution-community relationships. Both the scientific and educational goals of this project will be assessed to track progress, discover the processes by which students develop into civically-minded scientists, and prepare this model for broad dissemination. Among the broader impacts of this program are its potential to increase the civic engagement of future scientists, improve students' sense of belonging to and persistence in STEM, and enhance how institutions of higher education can serve the broader good.

Collaborative Research: A Teleconnection between the Tropical Madden-Julian Oscillation and Arctic Sudden Stratospheric Warming Events in Warm Climates

The work has broader impacts due to the effects of SSWs on surface weather in the Northern Hemisphere. The warming of tropical SSTs raises the prospect of stronger MJO events, and it is of practical interest to understand how stronger events will affect weather regimes over the US and other countries. Moreover, the slow propagation of the MJO offers some hope for extended-range prediction of extreme weather linked to SSWs, thus research on the MJO-SSW connection has implications for operational weather forecasting. The project has educational broader impacts through summer internships supporting undergraduates and local high school students, who are trained in python programming and atmospheric data analysis. The award also provides support and training to two graduate students, thereby providing for the future workforce in this research area.

Collaborative Research: Topographic Influences on Extreme Warm-Season Precipitation

An important broader goal of this investigation is to determine which of the key ingredients and processes identified for Taiwan extreme rainfall events are also relevant to orographic precipitation in other environments or locations. The team of three early-career female scientists brings a wealth of knowledge of observational field projects and terrain-influenced precipitation studies spanning a variety of global regimes, including warm-season rainfall in the Sierra Madre Occidentals, CMR, Andes, Rockies, and Himalayas, typical trade-wind flow, a tropical cyclone passing over Dominica, and cold-season rainfall over the Olympics. PRECIP will give an opportunity to investigate a wide variety of rain-producing events, both the windward and leeward sides of the mountain range. The findings from this project will have the potential to provide an updated understanding of extreme rainfall globally by building off an ingredients-based framework through unprecedented data collected in a wide variety of heavy rain events.

Development and Testing of a Global Quasi-3-D Multi-scale Modeling Framework

The work has broader impacts for the research community because it develops a new atmospheric model which is applicable to a range of research areas related to the impact of clouds on large-scale weather and climate phenomena. To ensure accessibility to the broader research community, the Q3D MMF will be constructed using a version of CAM (the spectral element version) as the GCM component. CAM is freely available, well supported and documented, and widely used, thereby maximizing accessibility. In addition, CAM is the atmospheric component model of the Community Earth System Model, which is used for projections of future climate change that inform decision makers concerned with climate impacts on natural and human systems.

Collaborative Research: Broadening Use of Modern Geodetic Methods in Earth Science Field Courses

This project specifically aims to broaden access of undergraduate students to the geodetic technologies of GPS, Structure from Motion (SfM), and Terrestrial Laser Scanning (TLS). To increase student engagement and learning in geodetics, the project will create short courses for instructors. These short courses will help instructors identify societally-relevant geoscience research questions that will provide relevance and context for students to learn and apply geodetic technologies. More than 100 instructors will participate in these short courses, resulting in more than 1500 students who will learn to use geodetic field methods over the course of the grant. The project aims to develop sustainable changes in college instruction that could reach even more students in the future. The project will examine the efficacy and adoption of teaching materials produced through 1-day and 2.5-day short courses, as well as through more intensive, smaller cohort groups. These data will contribute to the body of educational research, particularly research on the impact of faculty professional development in improving field education. The teaching materials developed by the project participants will continue to be evaluated by and disseminated through the website of the Science Education Resource Center (SERC), which has 5 million visitors per year (serc.carleton.edu/getsi). This project responds to community needs and has the potential to contribute to the critical need for a diverse, Earth Science-ready STEM workforce. This project is supported by the NSF IUSE: EHR Program, which supports research and development projects to improve the effectiveness of STEM education for all students. This project is in the Engaged Student Learning track and Development and Implementation tier; it

builds on work of an earlier IUSE-funded Exploration and Design tier project. Through the Engaged Student Learning track, the program supports the creation, exploration, and implementation of promising practices and tools.

Collaborative Research: Colorado-Washington Security Scholars Program

CWSSP will advance cybersecurity research and education by promoting collaboration and resource sharing in cybersecurity and actively involving governmental agencies. To advance cybersecurity education, CWSSP will introduce a cross-campus curriculum and incorporate unique team-based approach to cybersecurity education and deliver effective mechanisms to incorporate teams and conferences/workshops in formal education. The CWSSP program will also have strong outreach to external organizations in cybersecurity by getting them involved in the CWSSP teams and the CWSSP conferences. By extending the collaborations outside of the host institutions, CWSSP will drive the student scholars to make connections with the cybersecurity professionals in the government sector and work/research on the cybersecurity problems which can have stronger real-world impacts in the protection of the nation's information infrastructure. The CWSSP graduates will be equipped with the cybersecurity knowledge and understanding, relevant technical skills, and teamwork and collaboration skills to help ensure their readiness to participate in the government's cybersecurity workforce.

Nonlinear and Non-local Models in Social and Ecological Systems

RAD systems are the focus of this research; their use will help to gain insight into complex social and ecological systems where there is a need to understand macroscopic patterns. In this framework the PI will work on incorporating real-world data to extract objective information that will help shed light into what are the most influential factors leading to the complex patterns which are observed in ecology and sociology. Associated to this research project is a mentoring plan focused on advising underrepresented minority students at University of Colorado Boulder majoring in a STEM field. This will mainly be done through the initiation of a Society of Chicanos and Native Americans in the Science chapter. The aim is to provide these students with a network that can help them succeed in STEM.

A phylogenetic and functional understanding of microbial sulfur cycling in oxygen minimum zones

Marine science research will be used as a platform for enhancing science education across multiple academic levels. A Summer Workshop in Marine Science (SWIMS) will be developed in collaboration with K-12 educators and teacher-development experts at Georgia Tech. The 5-day SWIMS program, which includes 2 days at the Skidaway Institute of Oceanography, will engage graduate students and Georgia Tech researchers in training local teachers to merge key topics in marine science with new national standards in middle school Earth Science education. In addition, through a partnership with Morehouse and Spelman Colleges, this project funds summer internships to enhance representation of minority students in undergraduate marine science and bioinformatics research. A PI-graduate student working group is to be established at Georgia Tech to develop and implement new guidelines for training in the cross-disciplinary field of marine genomics. A new course will be created at Georgia Tech, Writing for Scientists, to enhance the professional development of graduate students. It will use structured, peer-driven exercises to equip students with the critical writing and speaking skills necessary for success in science - such

a course is critically lacking at Georgia Tech. Through the activities outlined above, this CAREER project will not only establish a research group dedicated to characterizing an ecologically significant, but cryptic, component of the marine microbial ecosystem, but will also develop a strong foundation through which the PI can use the results of his work to train and motivate future generations of marine scientists.

Interactions and Entanglement in Electronic Nanostructures

Educational and outreach activities are proposed that seek to interest and educate physics students at various levels and the general public in areas of nanoscience. A new graduate course will be developed that exploits the general appeal of nanoscience in an effort to attract students to theoretical condensed matter physics. Undergraduate students will be addressed by integration of aspects of modern condensed matter research into undergraduate teaching. The PI will reach out to the general public through a summer program at Georgia Tech that allows him to involve a K-12 teacher in the research supported by this award. The participating teacher will take new knowledge and fascination for nanoscience back to the classroom with metro-Atlanta K-12 students. The PI will cultivate this interaction through tours of the local research facilities for the students of the participating teacher. Educational diversity is another goal pursued with this career plan, drawing on existing infrastructure at Georgia Tech.

Hyaluronan-Protein Networks in Solution and in the Polymer Coat of Cells

As part of the outreach program and working closely with a designated teacher in a rural, socioeconomically-disadvantaged community, this research project will be integrated into the Direct to Discovery (D2D) program at Georgia Institute of Technology that provides seamless video conferencing between researchers and classrooms using Georgia's Peach Net high-speed internet infrastructure. Modules will be designed to combine the teacher's lecture material with (virtual) visits to the PIs Lab using D2D technology, giving students an opportunity to explore cell culture, study viscoelastic properties of materials, and use of different experimental tools - all the while reaching educational goals to learn topics such as the structure and function of cells, nature of matter, and conceptual laws of forces.

Theoretical and Experimental Analysis of Fluid Injection into Granular Media-Failure and Flow Patterns

Results from the research will be published in scholarly journals, disseminated through collaboration with industry, and integrated into undergraduate and graduate courses. Encouraging women to pursue engineering will be the main focus of undergraduate education and outreach activities. The PI will actively recruit women undergraduate students to gain research experiences. Hands-on experiments will be developed for summer camps organized for middle school girls by Georgia Tech's Women in Engineering Program. In addition, the PI will host a local high school teacher, through the Georgia Tech Center for Education Integrating Science, Mathematics, and Technology, to conduct summer research and to develop a geomechanics/geotechnical engineering based software module to be used in the new Environmental Science and Earth Systems courses, to improve the performance standards in K-12 education in Georgia. The software will be disseminated through the Georgia Science Teachers Association conference. The process of fluid injection into granular media is relevant to many engineering applications, as cited above. However, the pattern of flow and eventual fate of

the injected fluids is poorly understood, leading to significant safety concerns in many situations. This research will lead to a clearer understanding of these issues, as well as safer engineering practices that are no longer based primarily on empirical data. Industrial collaborators from [various companies] will help translate the research findings into engineering practice.

CAREER: Systematic Understanding and Control of the Mechanical Properties of Functionalized Nanoporous Metals

The project will generate crucial insights into the deformation mechanisms governing mechanical properties of hierarchical nanoporous metals, thus providing a basic scientific knowledge necessary for controlling and optimizing their properties and bringing closer wider adaptation of this class of materials. Research activities are closely integrated with education and outreach efforts: both graduate and undergraduate students will work on the project, thus gaining cutting-edge skills and expertise in nanotechnology and science; the PI will work with high school teachers and students in the Atlanta area through Georgia Intern Fellowship for Teachers program and through Georgia Tech's Women in Engineering summer camps; some of the results will be introduced in engineering courses at Georgia Tech as case studies; the PI will participate in Tech to Teaching program that inspires students to choose a teaching career.

BRIGE Exploiting crystalline framework flexibility to enable energy efficient entropically selective separations

A primary goal of this project is to introduce young women and under-represented minorities to STEM fields in an effort to increase inclination to join these fields. The PI will achieve this goal through a combination of outreach at local inner city middle and high schools in Atlanta, and by leveraging existing programs at Georgia Tech. The BRIGE award will allow the PI to implement his educational outreach plans, which aim to achieve these goals. The PI’s comprehensive plan for outreach and retention of women and under-represented minorities has three primary facets: i) Outreach through in-class demonstrations and lectures at inner city Atlanta middle and high schools and active participation in Georgia Tech’s Summer Engineering Institute, ii) use BRIGE support for female and under-represented minority research assistants, and iii) leveraging existing programs at Georgia Tech to engage in mentoring, guidance and professional development of female and under-represented minorities both in and out of the laboratory. The PI will periodically assess the success of his outreach efforts and adjust his program according to feedback from teachers, students, and research assistants.

Nonlinear and Adaptive Acoustic Metamaterials for Novel Wave-Based Devices

If successful, the results of this research will significantly advance knowledge and understanding in the general area of tunable and adaptive nonlinear metamaterials. This understanding will be important for the development of innovative devices for use in communication systems (mobile phones, GPS units, etc.), noise isolation, energy redirection, and acoustic filters, logic ports and switches. Advances from the research topics will be disseminated widely through academic courses on wave mechanics at Georgia Tech and in undergraduate research opportunities. Broadening of participation will be achieved by specifically working with underrepresented students through ongoing programs available at Georgia Tech. In addition, educational laboratory activities and classroom modules, developed in partnership with the GIFT program at Georgia Tech, will expose high school and middle school underrepresented students to basic results of

the research and to underlying wave mechanics principles.

CAREER: 3D Heterogeneous Integration for Power Reduction in Embedded Systems: Application to Wireless Image Sensing and Transport

The educational plan of the project includes creating a new undergraduate course, Physics of Computation, a visual VLSI learning tool, and a toy-sensor chip design project for undergraduate courses; and fostering undergraduate research. This plan develops the pedagogical methods and tools for delivering an integrative learning of VLSI, instead of isolated skills in device, circuits, and systems, to next generation students. The outreach activities include engagement with the Summer Undergraduate Research in Engineering/Science program at Georgia Tech; recruiting under-represented students through the Facilitating Academic Careers in Engineering and Science for African-American students program; and participation in the First Lego League for the middle school students in the State of Georgia, hosted by ECE, Georgia Tech.

Polymer Nanostructures as Thermal Interface Materials

The success of this project could enable cost-effective materials for thermal management of advanced electronic systems and devices leading to new technologies and applications in the computing, communications, electronics, aerospace and defense industries. New discoveries will be disseminated through patents, technical publications and potential technology transfer to a start-up company through Georgia Tech's Advanced Technology Development Center (ATDC). ADTC is located in close proximity to the PIs labs and provides seed funding and technology incubation space to member companies. Integration of research, teaching, and outreach programs across multiple disciplines, including polymer science and nanotechnology, will impact the education and training of a diverse student body covering the undergraduate, graduate and post-graduate level at Georgia Tech. Finally, the PIs will engage high school teachers and students from Dekalb County in outreach activities involving hands-on exposure to advanced materials and thermal technologies.

Regional Industrial Structure, Economic Resilience and Energy Consumption: Comparative Evaluation, Historical Analysis and Pathway towards a More Sustainable Economy

To broaden the impact of the research, a participatory game for students will be developed anchored in rich scenario-based narratives and underpinned by a simplified version of the CGE model. Additionally, workshops will be held for African American high school students in collaboration with Georgia Tech's Center for Education Integrating Science, Mathematics, and Computing, and involve African American undergraduate research assistants (RAs) will be involved in the project and encouraged to participate as RAs in the field of sustainability.