MAKING COMPARISONS & EXAMINING EXPERIENCES

A Program Evaluation of the Department of Energy's Student Undergraduate Laboratory Internship (SULI) Program

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ACRONYMS

Acronym	Term
AAAS	American Association for the Advancement of Science
ACC	Academic Competiveness Council
COV	Committee of Visitors
DOE	Department of Energy
EC	Epistemological Congruency
FY	Fiscal Year
GAO	Government Accounting Office
GPA	Grade Point Average
LSAMP	Louis Stokes Alliance for Minority Participation
MARC	Minority Access to Research Careers
MSP	McNair Scholars Program
MTSU	Middle Tennessee State University
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NIGMS	National Institute of General Medical Sciences
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NRSA	Ruth L. Kirschstein National Research Service Awards
NSF	National Science Foundation
PI	Principal investigator
REU	Research Experiences for Undergraduates
REUENG	Research Experiences for Undergraduates in Engineering
STEM	Science, Technology, Engineering, and Mathematics
SULI	Science Undergraduate Laboratory Internships Program
SURE	Survey of Undergraduate Research Experiences
SURF	Summer Undergraduate Research Fellowship
URE	Undergraduate Research Experience
USRP	Undergraduate Student Research Project
U-STAR	Undergraduate Student Training in Academic Research
WDTS	Office of Workforce Development for Teachers and Scientists

DEFINITIONS FOR TERMS USED FREQUENTLY IN THIS REPORT

Term	Definition
Advisor	Some program alumni who responded to the survey use this term to refer to their scientist/mentor
Alumni	A former participant in a URE
Alumni Survey	Survey administered to SULI and SURF alumni by the Vanderbilt Project Team
Applicant	An undergraduate student who is applying for a URE
Co-Curricular and Extra-Curricular Experiences	A construct of the Project Conceptual Model that describes a participant’s experiences related to social and professional experiences; learning that is not curricular or co-curricular
Comparable Program	Generic term for programs that most closely match SULI's scope, based on the Vanderbilt Project Team’s analysis
Curricular Experiences	A construct of the Project Conceptual Model that describes a participant’s experiences related to learning technical skills that are related to the curricular experiences
Entrance into the STEM workforce	Obtaining a job in a STEM field, such as in a national lab
Epistemological Congruency	“the degree of similarity between students’ and faculty members’ beliefs about learning” (Fruge& Ropers-Huilman, 2008, p. 121)
Individual Experiences	A major construct of the Project Conceptual Model that contains three types of participant experiences (curricular, co-curricular and extra-curricular) that are contained within the peer environment
Item	A question on the survey of program alumni
Lab-Based Experiences	A construct of the Project Conceptual Model that describes a participant’s experiences related to the research project
Long-term Outcomes	URE outcome of continued involvement in STEM fields, including obtaining a terminal degree and entrance into the STEM workforce
Mid-term Outcomes	URE outcome of continued involvement in STEM fields post-URE, including obtaining a baccalaureate and (if applicable) a master’s degree in a STEM discipline

Term	Definition
Organizational Context	A major construct of the Project Conceptual Model that represents the features and structures that enable the URE. This contains the program level and the multiple dimensions of the organizational context
Organizational Level	All UREs operate at three organizational levels: the national program level, the local program level, and the individual program level in each lab
Participant	The undergraduate who is participating in the URE
Peer Environment	A major construct of the Project Conceptual Model that represents the environment in which all individual experiences occur and the peer relationships particularly build in the URE
Persistence in the Discipline	Continuing in the STEM academic discipline towards a terminal degree and entrance into the workforce
Pre-program Characteristics and Experiences	The sociodemographic traits, academic preparation/ performance and individual participant disposition that occur mostly prior to the URE experience that affect persistence and acceptance into the URE
Program	The national program level of the URE
Project Conceptual Model	The Reason and Terenzini (2005) conceptual model that Reason (2009) further articulated which was adapted by the Vanderbilt Project Team to describe the URE's role in persistence in the STEM discipline
Research Project	The portion of research assigned to a URE participant; typically supervised by a Scientist/Mentor
Research Team	Scientist/Mentor, staff members, postdocs, graduate students, and other participants who collaborate on the scientists/mentor's research project
Research Team Experiences	A construct of the URE Conceptual Model that describes the participant's individuals experiences with the research team
Scientist/Mentor	The individual who supervises the participant's research project during the URE
Scientist/Mentor Experience	A construct of the URE Conceptual Model that describes the participant's experiences with the scientist/mentor

Term	Definition
Short-term Outcomes	URE outcome to increase participant's interest in the STEM disciplines and fostering a desire to obtain a STEM baccalaureate degree and doctoral degree
Site	The national laboratory or other local program location (such as a college or university) where the URE occurs
Structure	Organizational features or characteristics of the national program, the local program, and the individual program in each lab that foster the development and maintenance of the peer environment and the individual experiences that occur within it
Student	Participant comments often refer to fellow URE participants as "students"
Terminal Degree	A doctoral degree, including the Ph.D., M.D., Ed.D.
Underserved Populations	Female students, and non-Caucasian, non-Asian populations; however, some UREs would classify an individual with a disability as coming from an underserved population
Vanderbilt Project Team	Foltz, Gannon, and Kirschmann

EXECUTIVE SUMMARY

Persistence in the science, technology, engineering and mathematics (STEM) disciplines is a problem of national and economic proportion at a time when the United States is rightfully concerned about maintaining its competitiveness and global technological leadership (Chang, Cerna, Han & Sàenz, 2008). Undergraduate research experiences (URE) are one type of intervention that aims to support persistence in the STEM fields through to a terminal degree and entrance into the STEM workforce by providing participants with real-world experiences that combine lab-based experiences with curricular, co-curricular, and extra-curricular experiences (Buckley, 2008; DePass & Chubin, 2008; Golde, 2006; Jones, Barlow, & Villarejo, 2010; Lopatto, 2007; Reason, 2009; Terenzini & Reason, 2005).

In the US Department of Energy Student Undergraduate Laboratory Internship (SULI) program, participants engage in a realistic, scientific research project in a national laboratory under the supervision of a research scientist/mentor. Participants interact with a variety of scientific professionals and other undergraduates who have similar program entry characteristics. SULI combines individual lab-based, co-curricular, and extra-curricular experiences with experiences in the peer group, research team, and with the scientist/mentor to achieve its outcomes. These outcomes include retention in the program (short-term), persistence to an undergraduate degree in a STEM field (medium-term), and receipt of a terminal degree and subsequent entrance into the STEM workforce (long-term). Specifically this evaluation seeks to answer three questions:

1. What existing federally-funded STEM education/workforce development programs offer comparable experiences? Of those, which are the most comparable to SULI?
2. Are there organizational and programmatic features of undergraduate research experiences that lead to persistence in the discipline and eventual entrance into the

STEM workforce? To what extent do SULI and the identified comparable programs reflect these features?

3. How are the actual experiences and outcomes of SULI alumni and those alumni in comparable programs similar or different?

To answer these questions, the Vanderbilt Project Team reviewed the scholarly literature on UREs and higher education persistence to identify a suitable comprehensive conceptual model that would explain how UREs work. Throughout the project, the Project Conceptual Model proved to be both robust and adaptable in explaining how UREs accomplish program goals and objectives and how participants experience their URE both individually and within larger groups (peer environment, research team, and the scientist/mentor-mentee relationship).

The deliverable for this project is an assessment of the program's strengths and weaknesses to provide WDTS with useful information to improve the program itself, the experience of participants, and, thereby, improve participant outcomes. This project consists of three phases: identification of the comparable programs, document analysis of comparable programs, and the collection and analysis of participant survey data. Each phase addresses a corresponding project question.

After analyzing the collected data, we identified 41 key findings. In its core mission, SULI is a fully-developed STEM URE program exhibiting many features that are both consistent with best practices identified in the literature and comparable to those of the other federally-funded URE programs reviewed in this project. The program is, however, not without a number of areas for improvement, including the lack of decentralization coordination and evaluation occurring within the program. We identified more than 30 recommendations for WDTS and SULI to consider in improving the program, including setting objectives at the national program level, exerting more programmatic and curricular control over the individual project sites, and creating a more uniform experience for participants. Despite the challenges SULI faces, it has a strong foundation on which great improvement can be made.

INTRODUCTION

The US Department of Energy's (DOE) Science Undergraduate Laboratory Internships (SULI) program is one of more than 70 similar federal programs designed to increase the number of both baccalaureate and post-baccalaureate degrees awarded in science, technology, engineering, and math (STEM) disciplines and to improve outcomes for postgraduates in these fields. As part of the DOE's Office of Workforce Development for Teachers and Scientists (WDTS), SULI's mission is to increase the volume of awarded degrees to students in STEM fields. SULI's design contributes to the nation's STEM workforce, decreasing the number of students, graduates, and scientists who are "lost" through leakages and off-ramps in the STEM pipeline. In support of this mission, SULI selected 341 undergraduates in fiscal year (FY) 2009 to join its world-renowned experts in national security, energy, the environment, physics, chemistry, biology, and other basic sciences for hands-on research training through paid internships—often referred to as an undergraduate research experience (URE)—at one of 16 national laboratories or the DOE headquarters (DOE, 2010).

The importance the US places on increasing the graduation rate within the STEM disciplines and the desire for more highly trained workers to enter the STEM workforce is demonstrated in SULI's recent increases in annual funding (more than a 37 percent increase since FY2009). With a $4.15 million budget in its FY2011 Congressional request, SULI is the second highest funded of DOE's six major student programs and currently accounts for more than 18 percent of the DOE's student programming budget. With this increased funding, WDTS projects that the number of SULI participants will grow to 590 in FY2011 (DOE, 2010). This growth, WDTS suggests, will contribute to increases in future innovation and economic development for the nation (DOE, 2010).

Prospective participants select their first and second choice laboratories. Scientists at the laboratories select participants based upon participant preparation and project fit. In this process, “Researchers are looking for someone who is interested in the kind of research they are conducting and who will benefit from their expertise and facilities” (DOE, 2007). Sixteen national laboratories participate in the SULI program and work toward the achievement of key goals, such as encouraging scientific thinking and development while creating a STEM-based career pathway for the student. However, the approach used to achieve these goals may be different at each of the national laboratories. For example, some national labs only allow SULI students during the summer while others accept students in summer, fall, and spring.

In the SULI program, student interns are expected to complete the full 10 or 16 week program, which will likely include more than 40 hours of work each week in research, professional development, and related scientific learning. Participants will also complete entrance and exit surveys, submit a research paper or PowerPoint, and an abstract that describes their research and research findings. Participants must also attend all other scheduled SULI programming, such as lectures, tours, and activities that occur during their program tenure. Beyond the opportunity to work one-on-one with a DOE scientist/mentor while learning about important areas of national security research, the SULI URE provides participants with opportunities to grow through professional development and learn additional skills that will benefit them in their future careers. Participants are given a weekly stipend of approximately $425 plus an additional $125 each week for housing and a lump sum amount of up to $500 to cover travel expenses to and from the national lab.

A Committee of Visitors (COV), which included a number of nationally-recognized faculty members from public and private universities across the nation and the DOE national lab division director, met in 2010 to review the DOE programs administered by the WDTS. In this report, they stressed the SULI program's many significant positive outcomes, including the success stories of Nobel laureates and SULI alumni Thomas Cech and Bill Phillips.By DOE's own accounts, roughly 50 percent of program participants eventually work at a national laboratory (COV, 2010). Although this is an important and laudable achievement, more is needed. In his 2011 State of the Union address, US President Barack Obama emphasized the need to redouble efforts.

> Maintaining our leadership in research technology is crucial to America's success… Our free enterprise system is what drives innovation. But because it's not always profitable for companies to invest in basic research, throughout our history, our government has provided cutting-edge scientists and inventors with the support that they need. That's what planted the seeds for the Internet. That's what helped make possible things like computer chips and GPS. Just think of all the good jobs—from manufacturing to retail—that have come from these breakthroughs (Obama, 2011).

URE programs, like SULI, plant the seeds of this innovation.

The investment SULI makes in undergraduates produces real results; yet, like many federal programs, SULI suffers from "inadequate assessment and evaluation" (COV, 2010, p. 3). Among the recommendations made by the COV was the need for WDTS to improve its evaluation and assessment activities, not only to ensure that programs are fully optimized for success, but also to maintain the alignment between program goals and outcomes. Thus, the purpose of this Capstone Project is two-fold: (1) to identify federally-funded URE programs that are similar to SULI and (2) to conduct an evaluation of SULI and the identified comparable programs.

GENESIS OF THE PROJECT QUESTIONS

The last decade has evidenced an increased interest by the federal government and its agencies in supporting STEM education efforts as they relate to maintaining the nation's ability to compete in an increasingly competitive global economy. The STEM workforce serves to increase the standard of living, ensure our national security, and contribute to the scientific knowledge, technological innovation, and the economic growth of the nation (Ellis, 2007). In so doing, it also provides jobs to a nation with a rising unemployment rate(U.S. Bureau of Labor and Statistics, 2011). Varma and Frehill (2010) note that in the 50 years between 1950 and 2000 occupations in the STEM fields grew at a rate of 669 percent, much faster than other occupations. Hira (2010) suggests that whether or not the US continues to be a leader in addressing critical issues such as global warming, national security, terrorism, and national competitiveness depends on how much it is willing to invest in STEM education programming that supports increases in degree attainment in the STEM fields and the development of a STEM workforce.

STEM education programs recruit and retain students who will persist to graduation, graduate school, and advanced degrees and enter the STEM workforce. These programs are crucial to both national security and US economic competitiveness. In fact, the future of the US economy depends in large part on the success of STEM programs. The 2007 National Academy of Sciences' (NAS) report *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* draws a clear connection between national interests and the number of baccalaureate and post-baccalaureate degrees awarded in the STEM disciplines:

> This nation must prepare with great urgency to preserve its strategic and economic security. Because other nations have, and probably will continue to have, the competitive advantage of a low wage structure, the United States must compete by optimizing its knowledge-based resources, particularly in science and technology, and

> by sustaining the most fertile environment for new and revitalized industries and the well-paying jobs they bring (p. 4)

Unfortunately, the growing concern that US economic competitiveness may be threatened by a lack of STEM-literate citizens is justified by the numbers. Today, barely a third of all bachelor's degrees awarded in the US are in a STEM discipline and more than fifty percent of these are awarded to non-natives. When comparing the proportion of STEM degrees awarded in the US to other leading nations, such as the fifty-three percent in China or the sixty-three percent in Japan, the inadequacy of current US STEM attainment rates becomes clear (National Science Board, 2010). Although the US was once a leader in STEM education outcomes, it has slipped to a current rank of 20th in the proportion of 24-year olds who earn degrees in natural science or engineering (Nata, 2007). While the number of students enrolling in and graduating from STEM baccalaureate programs is on the decline, there are even fewer who persist through graduate school to obtain a master's degree or Ph.D. in a STEM discipline (Center for Institutional Data Exchange and Analysis, 2000).

How can the US maintain its position as a "world leader in scientific and technological innovation" (Government Accountability Office, 2005) if it cannot maintain or increase the percentage of students obtaining degrees in STEM disciplines? Bruce (2003) states that "a successful field of research needs an ongoing flow of individuals through the career pipeline [demanding] sufficient numbers of high school and college students with a developing interest in research … becoming doctoral students and then postdoctoral fellows" (p. 356). Increasing flow begins by going as far back as possible up the pipeline to influence career choices at an early age. "The earlier in the pipeline the trainees are (e.g. high school versus graduate or medical students), the larger the pool of potential trainees, but also the lower the percent yield in terms of long-term retention in the field" (p. 161). Kupfer, Hyman, Schatzberg, Pincus and Reynolds (2002) found that early identification and recruitment was central to long-term success for students, because students who are identified early and successfully earn a baccalaureate degree in a STEM discipline are much more likely to pursue a master's degree or Ph.D. in STEM. Increasing the number of STEM baccalaureates in the immediate future will lead to long-term success in maintaining students in the pipeline through graduate school to a terminal degree and a career in a STEM field (U.S. Department of Education, 2006).

Studies of the dearth of STEM graduates in the pipeline have focused on two main issues: increasing the "flow" of students into the pipeline through inducements and decreasing the "leakages or off-ramps" from the pipeline through interventions (Dunn & Blake, 2003; Gilbert et al., 2006; Jeste, Halpain, Trinidad, Reichstadt & Lebowitz, 2006; Reynolds & Gatz, 2003). To achieve both long- and short-term goals, the US must invest in STEM education programs that serve as either inducements or interventions to reinforce the fragile walls of the STEM pipeline (Chang, Cerna, Han & Sàenz, 2008; Dunn & Blake, 2003; Gilbert et al., 2006; Jeste, et al., 2006; Reynolds & Gatz, 2003). In support of this two-pronged mission, the US has spent more than $2 billion every year during the last decade in direct aid to students in the STEM fields and through both intramural and extramural programs that seek to support students and these long-term STEM outcomes (US Department of Education, 2007; Wellman, 2007). Unfortunately, in a 2005 report, the Government Accounting Office (GAO) painted a lack-luster portrait of federally-funded STEM education programs, finding that these programs suffered from the twin problems of decentralization and lack of coordination that have hampered efforts toward achieving their goals.

In a 2007 follow-up study to the GAO report, the Academic Competiveness Council (ACC) was charged by Congress through the Deficit Reduction Act of 2005 to investigate federally-funded STEM education programs for effectiveness and to identify areas of overlap and duplication among programs (US Department of Education, 2007). They identified 70 programs that target baccalaureate and post-baccalaureate students in the STEM disciplines. The ACC noted that these programs had received more than $2.4 billion from the federal government in FY2006, accounting for more than 75 percent of the total federal outlay for STEM programming across all educational sectors. In its evaluation of program effectiveness, the ACC adds

> Perhaps the most striking finding in undergraduate education is the lack of rigorous evaluation of federal investments due to inadequate mechanisms for the collection of data on long-term student outcomes ... such as success in higher-level courses, retention in a STEM major, or enrollment in a STEM graduate program—are not currently available (p. 24).

With the recent interest from the Republican-controlled Congress in substantially trimming the federal budget, many poorly-coordinated or duplicative federally-funded STEM education programs may lose their funding, especially those without evidence of long-term or even mid-term findings of programmatic success toward stated outcomes or goals (Johnson, Chubin, & Malcom, 2010).

Programs like SULI, which are uniquely designed to improve undergraduate, graduate, and workforce outcomes in the STEM disciplines, face strict scrutiny in the current political and economic climate. In its own program evaluations, which are largely based on entrance and exit surveys, WDTS has validated SULI's short-term program outcomes to increase undergraduate student interest in pursuing a baccalaureate degree and a post-baccalaureate degree. In these evaluations, they have also noted that participants' content knowledge of their STEM field increased because of the URE and specifically the mentored research experience (DOE, 2009). Another WDTS evaluation of more than 600 student research abstracts from the SULI program indicates that the work students engage in is highly technical and that their relationships with program scientists/mentors are effective (DOE, 2010). Despite these efforts, the 2010 COV report finds SULI lacking in its program evaluation when compared to the National Science

Foundation's (NSF) Research Experiences for Undergraduates (REU) program. The COV report was replete with comments, findings, and recommendations suggesting how WDTS should improve its evaluation and assessment efforts in general, and specifically for SULI. Without improved program evaluation, including reporting on long-term outcomes and mid-term program goals, even a distinctive program like SULI could be in jeopardy of losing future federal funding (Johnson, et al., 2010).

The Vanderbilt Project Team conducted *MAKING COMPARISONS & EXAMINING EXPERIENCES* at the request of WDTS to assist in its efforts to better understand the SULI program's outcomes, especially when compared to other, similar federally-funded programs. WDTS enlisted the assistance of three doctoral candidates from the Peabody College of Vanderbilt University to provide consultation in fulfillment of the capstone requirement for their degrees in Higher Education Leadership and Policy. The three graduate students, all serving in leadership positions at institutions of higher learning in Tennessee, selected the SULI program evaluation as their capstone project and worked together to address the project's aims. The students (referred to as the Vanderbilt Project Team) met with WDTS staff members in-person and via teleconference over the course of the nine-month project to develop and implement the project. They presented the final project to WDTS staff in April 2011.

Chief among WDTS's objectives for this project was the development of an accurate portrayal of how SULI compares to other federally-funded STEM URE programs as well as to URE program best practices. In addition to developing a better understanding of their "competitors," WDTS wanted to examine the program's outcomes as they relate to educational attainment and workforce development. The Vanderbilt Project Team engaged in discussions with their WDTS contact, Program Evaluator Sam Held, and reviewed the extant literature to identify the questions that would guide the project:

1. What existing federally-funded STEM education/workforce development programs offer comparable experiences? Of those, which are the most comparable to SULI?
2. Are there organizational and programmatic features of undergraduate research experiences that lead to persistence in the discipline and eventual entrance into the STEM workforce? To what extent do SULI and the identified comparable programs reflect these features?
3. How are the actual experiences and outcomes of SULI alumni and those alumni in comparable programs similar or different?

Mr. Held, the Vanderbilt Project Team and the team's faculty advisor, Professor John Braxton, agreed upon the project questions. They represent the project's scope of work and will be addressed in this project report.

Noting the importance of beginning with outcomes and working backward toward attributes in conducting a program evaluation (Halpern & Hakel, 2003; Wiggins & McTighe, 2005), the Vanderbilt Project Team needed a better understanding of SULI's desired objectives as they relate to the program's expressed goal of increasing college completion and workforce development in the STEM fields before we could begin to address the project questions. The team engaged in multiple conversations with SULI program staff, reviewed SULI, WDTS, DOE reports and websites, and also consulted the scholarly literature in defining the program's short-, medium-, and long-term objectives:

- **Short-term Goals:** increase participant's interest in the STEM disciplines and foster a desire to obtain a STEM baccalaureate degree and doctoral degree

- **Mid-term Goals:** continued alumni involvement in STEM fields, including obtaining a baccalaureate and (if applicable) a master's degree in a STEM discipline
- **Long-term Goals:** continued involvement in STEM fields, including obtaining a terminal degree and entrance into the STEM workforce

The scholarly literature was further used to identify a comprehensive model (Terenzini & Reason, 2005) that the Vanderbilt Project Team adapted to explain how a URE works (or should work) to achieve program goals. This conceptual model is used throughout this report to anchor discussions of the URE program framework and the participant experiences that occur within that framework. It also provides a basis for addressing each of the three project questions. The conceptual model also informs the discussion of the relationship between participant experiences in the URE and the attainment of the URE's short-, mid-, and long-term outcomes. A discussion of the selection and adaptation of the conceptual model is found in the Project Conceptual Model, the following section of this report.

IDENTIFYING A PROJECT CONCEPTUAL MODEL TO ADDRESS THE THREE PROJECT QUESTIONS

Introduction

The Vanderbilt Project Team first sought to identify a comprehensive conceptual model that would aid in explaining how URE programs work to obtain short-, mid-, and long-term goals, and one that would enable us to address all three project questions. Conceptual models enable program evaluators to think broadly about what is involved in a process and how those ingredients interact. Furthermore, conceptual models inform the decision-making process to assist in the determination of which questions to ask, how to analyze the data, and how to make sense of the results (Goes,n.d.). Without a conceptual model for the URE program, inferences and comparisons become strained, if not impossible. Unfortunately, the scholarly literature on URE programs does not provide a comprehensive conceptual model that explains how these programs work to achieve their goals; however, the literature is brimming with descriptions of URE programs, including program inputs, processes, and outcomes (Bauer & Bennett, 2003; Laursen, Hunter, Seymour, Thiry, & Melton, 2010; Lopatto, 2003; NSF, 2008a; Russell, 2006) and the higher education literature is replete with ideas about persistence (Pascarella & Terenzini, 1983; Terenzini & Reason, 2005; Tinto, 1975). These various bodies of literature are contained in Appendix A to this report.

The Project Conceptual Model

After reviewing the scholarly literature on persistence and testing multiple conceptual models **in a process of trial and error using the models to see if they could aid in explaining** the dimensions identified from the URE literature, the Vanderbilt Project Team identified the Terenzini and Reason (2005) model, as revised by Reason (2009), as the most suitable conceptual framework for understanding and promoting retention efforts in the STEM disciplines. The Vanderbilt Project Team adopted this model as the Project Conceptual Model. Complete details of this model can be located in Appendix B. This model was selected from among competing models because it provides a connection to the fundamental core of the persistence literature, including Braxton (2000), Braxton, Hirschy, and McClendon (2004), and Braxton, Jones, Hirschy, and Hartley (2008), Pascarella and Terenzini (1991; 2005), and Tinto (1975; 1993). It also includes both the organizational context and the individual experiences as factors related to student persistence, which is consistent with the URE literature. Furthermore, the Terenzini and Reason (2005) model "offers scholars a comprehensive and detailed conceptual map of both the forces that shape students' success" (p. 14) and "portrays a series of more-or-less linear influences that affect students' experiences and, ultimately, educational outcomes" (p. 13) without implying direct causation. Four main theoretical constructs explain their model:

1. Students arrive at college with a host of entry characteristics that both predispose them to and act as a barrier to certain types of interaction.
2. These characteristics moderate the ways in which the students interact with the institutional environment, which includes peers and faculty members.
3. The college experience includes the peer environment and the students' individual experiences in classroom and curricular settings and through co-curricular experiences.
4. Regardless of the type or level of interaction, all dynamics occur within in institutional environment, which is structured by the institution's own organizational context.

When the qualities of the URE and the constructs related to UREs are framed with the Project Conceptual Model, it begins to depict a pathway to understand how the URE process works. The four theoretical concepts are adapted to explain the model:

1. Participants enter the URE with a host of entry characteristics that both predispose them

to and act as a barrier to certain types of interaction.

2. These characteristics moderate the ways in which the participants interact with the URE environment, which includes peers, research teams, and scientist/mentors.
3. The URE includes the peer environment and the students' individual experiences in the research lab, through activities that support the research lab experience, and through social and professional development experiences.
4. Regardless of the type or level of interaction, all dynamics occur within the URE environment, which is structured by the URE's own organizational context.

It should be noted that through the use of Reason's (2009) later articulation of the Terenzini and Reason (2005) conceptual model for this project, the Vanderbilt Project Team limited the role of other theoretical constructs to explore and explain the URE, specifically the SULI program.

Terenzini and Reason's (2005) conceptual model provides practitioners with a model for understanding student persistence and identifies many locations within the model where suitable interventions could affect student retention. When examined in the larger context of the STEM pipeline, UREs act as interventions, intended to prevent leakages from the pipeline and reduce the likelihood of students taking any off-ramps into other non-STEM programs. They bolster STEM interest by providing participants with lab-based experiences that stimulate students and excite them about the discipline through real-world experiences, gains in knowledge and skills in both curricular and co-curricular/extra-curricular areas, and their interaction with the research team, peers, and especially their mentor. The SULI program is one such intervention, because it focuses on undergraduate students with strong academic potential and provides them with hands-on research experience, career development and mentoring, individual research opportunities, and counseling, as part of a concerted effort to encourage their persistence to the baccalaureate and subsequent enrollment in and successful completion of a STEM graduate program and into the STEM workforce. Students who successfully complete a URE (like SULI) are more likely to persist to not only an undergraduate degree in the discipline but to continue their education so that they, too, may enter the STEM workforce.

Although the URE is itself an intervention that increases the likelihood of persistence for undergraduates majoring in STEM disciplines, there are no established models or frameworks that explain how UREs work to accomplish this task. Nor are there any programs that incorporate all the identified featured that can provide a measuring stick for use in determining whether a program is successful in achieving its goals. There is also a lack of a common language to describe URE program characteristics or a common program evaluation tool for STEM URE programs that can aid policy makers and politicians in determining where cuts can be made in tough budget times. Absent any other theoretical construct, the Project Conceptual Model as adapted by the Vanderbilt Project Team from Terenzini and Reason (2005) and Reason's (2009) later articulation, can be used to accomplish these purposes—providing a better understanding of the nature and function of the URE and addressing how the URE works to support retention, while also providing a model that administrators can use in self- or peer-evaluation, and those in positions of power can make in determining where and how to spend federal STEM education funds. In the final analysis, the Project Conceptual Model includes four factors of influence (pre-program characteristics and experiences, organizational context, peer environment, and individual experiences) that "interact in ways that reinforce or mediate their influence on student persistence. That is, student's interactions with their environments matter" (Reason, 2009, p. 675).

PROJECT RESEARCH DESIGN

Introduction

Because each of the project questions required a different approach, the Vanderbilt Project Team used both traditional qualitative and quantitative methods in a three-step process to collect and analyze data to address the three project questions. The compounding nature of the project questions also made it necessary for the Vanderbilt Project Team to work sequentially, with each strategy in the data collection and analysis process building on the findings of the previous strategy. The project research design utilizes a rubric to address the first project question, a document analysis matrix to address the second question, and an original survey to address the third question.

Project Question 1: *What existing STEM education/workforce development programs offer comparable experiences? Of those, which are the most comparable to SULI?*

Identifying Comparable URE Programs

The first project question was the cornerstone for *MAKING COMPARISONS & EXAMINING EXPERIENCES*. Its answer was essential to the development of the project research design and the subsequent data collection and analysis to address project questions two and three. As such, this question will be fully addressed in this section of the project report. After conducting a general review of the literature on UREs and substantive discussions with the client, the Vanderbilt Project Team created an unweighted rubric to use in the identification of comparable programs. It provided an elegant way to answer the question as “rubrics respond to concerns of subjectivity and unfairness by formalizing the criteria for scoring” (Bresciani et al., 2009, p. 3). The rubric, which was framed by the Project Conceptual Model outlined above and fully described in Appendix B, was used to rate the degree of similarity between the reviewed programs and SULI on eight selected key characteristics that were selected as the most salient:

Pre-Program Characteristics

- Programs are limited to undergraduates.
- Programs target students across STEM disciplines.

Organizational Context

- Payments are limited to a stipend and related expenses.
- Interns work for a limited period of time (not more than the equivalent of one semester).

Peer Environment and Individual Student Experiences

- Programs are focused on hands-on research.
- Experiences are mentored.
- Interns are required to produce a final product.
- The experience includes both co-curricular and extra-curricular opportunities for growth.

The rubric and excluded programs can be found in Appendix C.

Project Question One Findings

The team reviewed the program-specific components of more than 100 different STEM education programs offered by more than 25 federal agencies or departments identified by the ACC (US Department of Education, 2007) and completed the rubric for each. Both intramural and extramural programs were considered because the lab experience at both was anticipated to be similar in nature. Programs that did not meet the criteria established by the Vanderbilt Project Team were eliminated from consideration as a comparable program.

Based on the scored rubrics, the Vanderbilt Project Team ultimately rejected 104 of the 107 reviewed programs and selected three programs, the joint NSF and National Institute of

Standards and Technology (NIST) Summer Undergraduate Research Fellowship (SURF) Program, the NSF's REU program and the National Aeronautics and Space Administration (NASA) Undergraduate Student Research Project (USRP), as comparable to SULI. These findings from Project Question one are the basis for the remainder of the Vanderbilt Project Team's evaluation.

Project Question 2: *Are there organizational and programmatic features of undergraduate research experiences that lead to persistence in the discipline and eventual entrance into the STEM workforce? To what extent do SULI and the identified comparable programs reflect these features?*

Making Comparisons: Addressing Project Question 2

To effectively answer the second project question it was necessary to make comparisons among the identified comparable URE programs as well as between these programs and URE program best practices. The Vanderbilt Project Team utilized a multi-step qualitative document analysis to accomplish this task. As there is no single method for document analysis, the Vanderbilt Project Team began with a review of the scholarly literature on UREs and evaluations of URE programs (Bauer & Bennett, 2003; Boyer Commission, 1998; Hunter, Laursen, & Seymour, 2006; Lane, 1996; NSF, 1989) that discussed features of UREs that lead to long-term persistence in the field and eventual entrance into the STEM workforce. The Vanderbilt Project Team compiled a list of more than 160 features including all of the recommendations identified in these reports as well as those features associated with positive outcomes. A sample matrix is shown in Appendix D.

The Vanderbilt Project Team then used the Project's Conceptual Model (outlined above and presented in detail in Appendix B) to code the features that had been summarized into a profile matrix, which allowed the members of the Project Team to focus on a number of separate but related types of data at the same time. The analysis included (1) a description of each of the three comparable programs and (2) a comparison of the URE programs, to both each other and the URE program best practices as defined in the academic literature. The analytic focus was limited to actual data and did not include any inferences beyond those related to the context of documents reviewed.

When selecting documents to review, the Vanderbilt Project Team looked to the information available on each of the four programs'(SULI, SURF, USRP and REU) websites. The wealth of data available online made reviewing all documents untenable. As a result, the Vanderbilt Project Team chose to use select websites and documents that were highly ranked in Google search results.

When reviewing content, the Vanderbilt Project Team, following Gilgun, Daly and Handel (1992), first skimmed the material for references to qualities identified in the matrix of the URE program best practices. Entries on the matrix were limited to statements about the program under review in relationship to the best practices. Some verbatim quotes were used; however, most entries into the matrices simply paraphrased specific points. Because the Vanderbilt Project Team used its Project Conceptual Model and the scholarly literature on UREs to develop and frame its list of URE program qualities and best practices, team members did not engage in an inductive theory-building process. Data that appeared to be applicable to more than one of the established qualities of URE best practices were coded in multiple locations. In choosing whether to include a piece of data, the team member utilized subjective assessment

(Patton, 2002). Through the literature review, the Vanderbilt Project Team identified three federal programs that, while not comparable to SULI, provided rich examples of best practices. The three federal programs selected included The U.S. Department of Education's McNair Scholars Program (MSP), the NSF Louis Stokes Alliance for Minority Participation (LSAMP), and National Institute of General Medical Sciences (NIGMS) Minority Access to Research Careers (MARC) Undergraduate Student Training in Academic Research (U-STAR) Program. These three programs were also reviewed, in addition to the three programs that were identified as comparable to SULI, to provide a closer look at the best practices employed in other federally-funded URE programs which SULI may consider.

A significant challenge in the document review is the decentralized nature of SULI and the identified comparable programs, which was previously identified by the ACC report (2007). As established by the Project Conceptual Model, both intramural and extramural federally-funded STEM education UREs operate at multiple organizational levels, which include the national program, the local program, and the individual program in each lab. To adequately analyze these programs, the Vanderbilt Project Team would need to review all documents from all three levels in which the programs operate and draw inferences where gaps exist.

Additionally, in conducting the program reviews, it was obvious that there were missing details that the Vanderbilt Project Team did not have access to, such as the number and demographic information for actual SULI participants. There were also instances of missing data for comparable programs and access to program staff members for any of the programs was limited. In these instances, the corresponding cell in the matrix for that program was left empty.

As the final step in addressing project question two, the Vanderbilt Project Team reviewed each program against URE program best practices (Patton, 2002). The data collected and the analyses conducted in the document analysis and added to the profile matrix provide insight into the organizational context of the national URE programs, the individual URE project sites, and the individual research labs within the program sites. The Vanderbilt Project Team also examined the available information for discernable features of the national URE programs and how these structures established at the agency level may influence the participant's experience of the URE in the levels identified in the Project Conceptual Model. Findings are presented in the Making Comparisons section of this report.

Project Question 3: *How are the actual experiences and outcomes of SULI participants and those in comparable programs similar or different?*

Examining Experiences: Addressing Project Question 3

To formulate a response to project question three, the Vanderbilt Project Team collected and analyzed both quantitative and qualitative survey data from URE program alumni, who are the only ones capable of providing information on the actual, individual experiences of the participants in URE programs. The unique perspective of former URE participants can provide rich data in evaluating URE programs' organizational context and peer environments and how they relate to individual experiences and ultimately outcomes. Alumni lab-based, curricular, co-curricular and extra-curricular experiences, along with their interactions with their scientist/mentor and research team, provide great depth to the data collected through the document analysis, which addressed project question two. The alumni surveys also asked respondents about their research activities, education, and occupations following completion of the URE.

The Vanderbilt Project Team contacted program directors for each of the three identified comparable programs (REU, USRP, and SURF) to solicit their participation in conducting the surveys of program alumni. In exchange for their participation, the Vanderbilt Project Team offered to provide each program with an independent program evaluation of the program's outcomes and comparisons with the other identified comparable programs, summary data collected from students and scientist/mentors, and a PowerPoint presentation of the study findings. USRP elected not to participate in the study. SURF Gaithersburg (one of two intramural SURF project sites) agreed to participate in the study. Several unsuccessful attempts were made to work with NSF program staff to enlist the participation of REU in the study. As an extramural program, REU has sites throughout the country. No central repository on data and contact information for REU alumni exist; this data is only available from each of the individual sites. This arrangement precluded the inclusion of REU in the study. Data for this portion of the project was collected through a web-based survey, which was administered to SURF and SULI alumni. No interviews were conducted with program alumni during the course of this study.

Survey development. The alumni survey was developed by the Vanderbilt Project Team for the purpose of this project. The Vanderbilt Project Team reviewed existing literature on the outcomes of UREs, the SURE (Lopatto, 2007), the NSF's Undergraduate Research Opportunities Survey (Russell, 2006), the Bioengineering and Bioinformatics Summer Institutes Program Survey (NSF ENG& the National Institutes of Health, National Institute of Biomedical Imaging and Bioengineering, 2008b), the Undergraduate Research Student Self-Assessment Survey (Hunter, Weston, Thiry, & Laursen, 2009), and Pascarella and Terenzini's (1983) inventory on student persistence. Items from these surveys as well as original items developed by the Vanderbilt Project Team and those items that were conceptualized through the Project Conceptual Model were included in the survey.

The final version of the alumni survey contains 186 items and four questions regarding informed consent and the respondents' assent to participate in the study. The survey included many Likert-style items, dichotomous (yes/no) items, multiple response (select all that apply) items, and a few free-text, open ended response items. Skip-logic was employed so that responses to items caused the survey engine to skip questions that would not be applicable to the respondent. The surveys of program alumni can be found in Appendix E.

Program alumni surveys were administered via SurveyMonkey™, a web-based survey solution. The Vanderbilt Project Team authored an e-mail, which contained a link to the online survey and a note to thank participants for volunteering and explained that this research was conducted by doctoral candidates at Vanderbilt University. The note further encouraged the participants to contact the Vanderbilt Institutional Review Board if they had any questions about the survey. The survey began with the informed consent form, which asked four questions about whether respondents had read the consent, whether it had answered their questions, and if they completed the survey freely and voluntarily. Participants were also provided with a free-text comment field to ask any questions of or provide feedback to the Vanderbilt Project Team. Those who responded affirmatively were also asked to provide an email address if they wished to be informed of the study results, had a comment, or wanted feedback.

Participant selection and survey administration. Because SURF is a summer program, the SULI alumni surveyed for this project were limited to those that participated during a summer term. Two samples of alumni were selected by WDTS to participate in the study. For the initial sample, the participants from summer cohorts 2004, 2005, and 2006 were stratified by lab and randomly selected using a random number generator/sampler software called Research Randomizer©. These alumni were emailed an invitation to participate in the survey on November 23, 2010 and received an initial reminder on December 8, 2010. Because of the low response rate, SULI alumni who were members of the 2001, 2003, and 2007 cohorts were selected in the same manner in the second sample. These were invited to participate in the survey on December 23, 2010. Members of the 2004-2006 cohorts received a second reminder on that same day. Additional email reminders were sent on January 8, 11, and 13, 2011. The survey was closed at midnight on January 15, 2011.

Of the 591 email addresses supplied by SULI, 546 were complete, unduplicated, and determined to be valid by SurveyMonkey™. However, 218 emails were returned as undeliverable. Additionally, twelve respondents were identified as having “opted out” of receiving email from SurveyMonkey™.

Of those that were not returned or blocked, it is possible that 316 email surveys were delivered. Many of the email addresses ended in *.edu* (designating that they were affiliated with a university-distributed email address that the student may have used while enrolled as an undergraduate) and since most participants should have completed college at the time of survey data collection, there was significant risk that the email addresses would be invalid. Further, unlike surveys delivered via the US Postal Service, email is more sensitive to misspellings and data entry errors. Other technical issues can impede email delivery, such as spam filters and full inboxes. In these instances, messages may or may not be returned to sender. Therefore, the number of undeliverable emails may exceed the 218 that were returned. The Vanderbilt Project Team lacks adequate information to determine if all apparent non-respondents should be considered eligible non-respondents and risks underrepresenting the response rate (American Association of Public Opinion Research, 2009).

In the end, 70 SULI alumni partially or fully completed the survey. If all 316 surveys that were not returned or blocked were delivered, this would result in a 22 percent response rate. The Vanderbilt Project Team attempted to improve the response rate using email reminders (Cook, Heath, & Thompson, 2002). Because it was anticipated that many of the alumni could now be government employees who are prohibited from receiving gifts above a small dollar amount, no incentives could be offered for completion. While this response rate may appear low, Sheehan (2001) conducted a study of online surveys that were administered between 1986 and 2000 in which there was an average response rate of 24 percent. Survey length, a reasonable concern in this case, has not been found to influence the response rate (Cook, et al., 2002).

NIST policy prohibits the dissemination of contact information for SURF alumni; however, SURF Director Lisa Fronczek posted a link to the survey on each of the SURF Gaithersburg alumni group pages in Facebook©, including those from the 2001, 2002, 2003, 2006, 2007, 2008, 2009, and 2010 cohorts. The number of Facebook©members per cohort is available in Appendix F. This link was posted within a couple of days of the initial email sent to the first sample of SULI alumni and at least one reminder was posted on each of the SURF alumni group Facebook© pages during the data collection period. The survey was closed at midnight on January 15, 2011. In determining the number of SURF alumni respondents who actually received the survey we faced similar challenges to those experienced with the SULI alumni. Facebook©is a relatively new medium, and there are no references to appropriate response rate in the scholarly literature. In addition to the many technical factors which may have prevented a respondent from receiving the survey link, including whether or not the message was transmitted properly, whether the link to the survey appeared as an update on the user's home page, the Vanderbilt Project Team cannot be sure all of the group members use Facebook©frequently enough to have received the survey link. Again, the Vanderbilt Project Team assumes the risk of underrepresenting the response rate. If it is assumed that all members of the Facebook©group received the survey, the response rate for the SURF sample is 27.2 percent.

Of the 70 SULI alumni who responded to the survey, 52 surveys were completed in full and 18 were partially completed. Of the 135 SURF responses to the survey, 89 were completed in full and 46 were partially completed. SurveyMonkey™ codes a survey as completed in full only when the respondent completes at least one survey item and clicks through each page of the survey to click the "Done" button at the end of the survey. Complete information on the response rates from both tables are shown in Table 1.

Table 1

Response Rates for SULI and SURF surveys

Program	Participants	Addresses	Undelivered emails	Possible contacts	Respondents	Partial Respondents	Response rate
	N	N	N	N	N	N	percent
SULI	2617	546	218	316	70	18	22.1
SURF	940	670	NA	670	135	46	27.2
Total	3557	1216	218	986	205	64	

Descriptive Statistics. SULI respondents were 54 percent female and 46 percent male. Eight percent identified themselves as Hispanic, 12 percent as African-American, and 10 percent as Native American. Fifty percent of SURF respondents identified themselves as female and the other 50 percent as male. Ten percent identified themselves as Hispanic, 2 percent as African-American, 12 percent as Asian-American, and 3.3 percent as Native American. The three most popular disciplines in rank order for SULI respondents were engineering, physics, and computer science. The three most popular for SURF were engineering, physics, and chemistry. Both groups were rather evenly disbursed by class rank, although the number of freshmen in both programs was much smaller (SULI 12 percent, SURF 6 percent). About half of the respondents from both programs had participated in a previous URE. Complete descriptive statistics for all survey participants are available in Appendix G.

Statistical methods. All statistical analyses of thes data were conducted using the IBM® SPSS 19® statistical software package. The codebook developed by the Vanderbilt Project Team to facilitate the analyses of these data can be found in Appendix H.

Scales. A series of nine scales were developed from the 119 Likert-items included in the survey instrument. These scales were directly related to the Project Conceptual Model, including Organizational Context, Peer Environment, Lab-based Experiences, Co-Curricular Experiences, Extra-Curricular Experiences, Scientist/Mentor Experiences, Research Team Experiences, Overall URE Satisfaction, and Continued Research Activity. Items within each scale were developed from a review of the URE literature and the persistence literature. Where necessary, survey items were reverse-coded prior to inclusion on the scale. Cronbach's alphas were calculated for each scale to test the level of internal consistency. In a few cases, items that did not contribute to the scale were eliminated[1]. The mean scores of respondents from SURF and SULI on each of the scales were compared using t-tests of independent means. In addition to comparing the mean responses on each scale for SULI and SURF participants, t-tests of independent means were used to compare the responses on each item composing the scales. Appendix I provides detailed information for all the scales used in this study.

Other statistical tests. A series of dichotomous (yes/no) items were included on the survey instrument. When comparing the responses of SULI and SURF alumni on binary dependent variables, z-tests of proportions were used to determine if the means of each group were significantly different.

The responses of SULI and SURF alumni were compared on the intent to earn a doctoral degree and intent to work in a national lab variables through a 2x2x2 contingency table and by calculating a chi-square statistic. A series of post hoc statistics, the Cochran-Mantel-Haenszel, Mantel-Haenszel, and Breslow-Day, were calculated to allow the Vanderbilt Project Team to control for the effects of other variables .Appendix J provides detailed information on these analyses.

Potential non-response bias. To test for possible non-response bias, late responders were used as a proxy for non-responders, and their responses were compared to the responses of early responders. This method is based on the assumption that survey respondents fall on a continuum of resistance to respond with late responders being more like non-responders than

[1] The item “It was challenging to secure a research position” was removed from the Organizational Context scale.The following items were removed from the Peer Experiences scale: Most of the other participants were the same age as me.Most of the other participants were the same gender as me.Most of the other participants were the same race as me.

early responders (LeHaut, et al., 2003). For the purposes of this project, early responders were defined as respondents from SURF or SULI who completed the survey prior to receipt of the first reminder. Respondents who completed the survey following the receipt of the first or any subsequent reminders were coded as late responders.

The Vanderbilt Project Team found little evidence of response bias when comparing early responders to late responders as shown in Appendix K. SURF respondents were more likely to respond early than were SULI respondents as determined from a contingency table and an obtained chi-square statistic as shown in Table K1. The Vanderbilt Project Team expected this as SULI alumni received more reminders with the intent of increasing sample size. The mean responses from early and late responders on all of the scales used in the study were compared using t-tests of independent means and found to be statistically equivalent on all but the extra-curricular scale as shown in Table K2. As indicated in the data, early and late responders have the same likelihood of seeking a doctoral degree or seeking work in a national lab as shown in Table K3.

Conclusion

In using the research methods described in this section, the Vanderbilt Project Team was able to collect multiple types of data from the national program level about these federally-funded UREs in the STEM fields. They also obtained information from program alumni on their lived experiences in two of the four programs; however, inclusion of quantitative or qualitative data from the perspectives of the scientist/mentor and the program administrator would have bolstered the related findings. In addition to benefitting the URE program evaluation process, the incorporation of both qualitative and quantitative methods has created a rich narrative that adds significantly to the Vanderbilt Project Team's ability to interpret the findings and make recommendations. Future sections of this report will present the findings from the research conducted in addressing project questions two and three as well as the limitations of the project's methods.

MAKING COMPARISONS: FINDINGS FOR PROJECT QUESTION 2

Are there organizational and programmatic features of undergraduate research experiences that lead to persistence in the discipline and eventual entrance into the STEM workforce? To what extent do SULI and the identified comparable programs reflect these features?

Introduction

Having identified three URE programs that are most comparable to SULI (REU, USRP and SURF), the Vanderbilt Project Team was poised to tackle the second project question, which actually asks two questions, (1) if they are to encourage persistence toward both academic completion to a terminal degree and entrance into the STEM workforce, what are best practices UREs can implement to obtain these goals, and (2) to what degree do SULI and the other three selected programs include these best practices as part of their organizational framework? To address project question two, we first consulted the literature on successful STEM URE programs to identify trends and best practices that directly lead to persistence in both academia and the discipline to workforce goals. Next, we used the Project Conceptual Model to organize these best practices and to make comparisons between SULI and the selected comparable UREs. In making these comparisons and contrasts, this section includes an overview of each of the selected programs. The section will later describe some exemplary, but not comparable, federally-funded URE programs to offer a further insights.

The Vanderbilt Project Team retrieved information from innumerable websites to conduct the document analysis and compose this section. All of the websites appear, by program, in Appendix L. Additionally, all of the websites appear as endnotes at the conclusion of this report.

Using Best Practices

To answer the first project question, the Vanderbilt Project Team identified three federally-funded STEM education programs as most comparable to SULI as discussed in the Project Research Design. These included the NSF REU program, the NASA USRP program, and the joint NIST/NSF SURF program. The comparisons and contrasts that follow are rooted in each of these three program's specific organizational context and speak to how each program influences its participants' experiences and outcomes. Inherent in this review is the framework that the organizational context creates for the development and maintenance of the peer environment and individual curricular, co-curricular, and extra-curricular experiences that are central to the programs' short, mid-, and long-term outcomes. This review does not include participants' reflections on their lived experiences. These data are included in the Examining Experiences section. The Vanderbilt Project Team further enriches the understanding of best practices by describing three additional federal programs, The U.S. Department of Education's McNair Scholars Program (MSP), the NSF Louis Stokes Alliance for Minority Participation (LSAMP), and National Institute of General Medical Sciences (NIGMS) Minority Access to Research Careers (MARC) Undergraduate Student Training in Academic Research (U-STAR) Program.

As framed by the Vanderbilt Project Team in the Project Conceptual Model, the URE literature contains many best practices that support undergraduate persistence decisions. This section will detail these best practices, providing supporting literature where appropriate. These best practices are then compared to and contrasted with SULI and the selected programs, based on the Vanderbilt Project Team's document analysis.

Pre-Program Characteristics and Experiences. UREs usually have many more applications than they have funded positions available and must use the pre-program characteristics and experiences of prospective participants and the application review process to establish a degree of selectivity. Because these are functions of organizational context, the treatment of pre-program characteristics and experiences will be discussed in that sub-section.

Organizational Context. The organizational context includes all the internal structures and processes of the UREs that can influence on students' experiences. This includes the three levels of organizational context: (1) the national program level, (2) the local program level, and (3) the individual program level in each lab. SULI and the comparable URE programs depend upon research sites and research labs within these sites to conduct their programs. Each URE program approaches this coordination effort uniquely. The national SULI program provides central guidelines for research sites and allows latitude for individual sites and research teams to operate within this policy framework. REU provides funding to the principal investigator (PI) at a university and allows the PI and research site to make programmatic decisions. SURF provides the guidelines with site variation but delegates some administrative functions to universities. USRP operates like SULI with central guidelines and research site autonomy within those guidelines.

Internal Structures, Policies, and Practices. In addition to examining the broad organizational structure and goals, we also compared the programs' policies and processes for marketing the URE program, the participant application and selection process, and the programs' use of evaluations to inform program outcomes. For each of these areas, we list the best practices and then compare each of the programs to each other and the best practices.

Program Structure. The literature on UREs suggests that effective programs have certain programmatic features that support participant outcome attainment, including:

- **Programs should last at least 10 to 15 weeks** (Lopatto, 2003). Depending on whether the program was offered in the summer or during the spring/fall semesters, each program reviewed lasted between 10 and 15 weeks.
- **Participants should be able to complete multiple immersion experiences in the same program** (Lopatto, 2003). All programs allow participants to complete a second experience; however, REU, SULI, and SURF state that this is an exception and not regular practice.
- **Programs should provide competitive stipends or wages** (Lopatto, 2003). Each of the programs provides a stipend to participants; however, the amount of the stipend varies by program and, in the case of REU, site. Because each sponsoring institution can supplement standard NSF benefits, REU sites have more individual control over the benefits which they can use to attract participants. These benefits range from stipends of approximately $400 per week up to $600 or $800 per student per week. SULI provides participants with a stipend of $425 per week and reimburses participants for travel to/from the national laboratory, up to $500. SURF participants receive $5,000 fellowship and travel awards, which are received and disbursed by the participant's home university. USRP participants receive a $6,000 stipend for the 10-week summer session or a $9,000 stipend for the 15-week spring or fall session. USRP also provides a transportation allowance for selected students.
- **Programs should provide housing allowances for participants while they are involved in the program** (Lopatto, 2003). National laboratories may provide housing, or SULI can provide a housing stipend. SURF participants stay in a pre-arranged, furnished apartment

and share a room with another participant. USRP does not typically provide a housing arrangement or allowance for participants. Housing arrangements for REU vary by site.

- **Programs should work with participants' home institutions so that participants can gain undergraduate credit for the experience** (Lopatto, 2003). Only REU indicated the availability of academic credit for participants. Because REU programs are based at universities, many offer academic credit to program participants. In fact, 16 percent of REU Engineering (REUENG) respondents reported receiving academic credit (NSF, 2008a).
- **Programs should provide travel funding to scholarly conferences that build on and support participant goals or are venues for participants to present research conducted during the URE** (Laursen et al., 2010). No programs include travel funding to present research conducted during the URE. REU does provide limited travel funding for students to attend conferences with their scientist/mentor.
- **Programs should ensure that people from underserved populations are visible leaders in the program and are included as role models** (Laursen, et al., 2010). No programs highlighted their level of diversity of scientist/mentors.
- **Programs should set clear guidelines for eligibility** (Laursen, et al., 2010). Guidelines for the selected UREs vary by program. While SULI requires that participants must have completed at least one semester of undergraduate study at the time of acceptance into the program, SURF students must be enrolled at a university for the following fall or be graduating in the spring semester preceding the program. The USRP program is limited to rising sophomores, juniors, or seniors. REU is the most flexible program, allowing high school students who have been accepted to college but have not yet attended to participate; however, individual sites may establish more restrictive requirements. The required undergraduate major of the participant also varies by program. SULI requires that participants be STEM majors while SURF accepts applicants from most STEM disciplines,

but most participants' majors include physics, material science, chemistry, applied mathematics, computer science, or engineering. USRP is the most restrictive, accepting students majoring (or who have course concentrations) in engineering, mathematics, computer science, or the physical/life sciences. REU is least restrictive, with no undergraduate major requirements for program participants. Only SURF and USRP have grade point average (GPA) requirements for participants, with both requiring a 3.0 on a 4.0 scale. All four programs limit participation to those who are US citizens or permanent residents. SULI and SURF[i] require that participants have their own health insurance.

Program Marketing and Participant Recruiting. In approaching program recruitment and marketing, UREs should:

- **Take a proactive, recruitment-based approach to marketing the program by seeking out specific types of participants** (Laursen et al., 2010). USRP is the only program that clearly demonstrates a proactive, recruitment-based approach in marketing their program. It widely communicates with potential applicants though university career center and co-op office websites, email campaigns to target audiences, virtual career fairs for prospective applicants, university officials, and on-site recruitment at NASA sponsored organizations and educational events. USRP also conducts online meetings, posts recordings of the meetings online, and uploads YouTube videos of previous participants' projects. USRP also used multiple social media including a Facebook© to establish an online presence for prospective applicants. USRP is the only program that indicated that it had asked target-aged individuals to provide feedback about their marketing process, which it used to increase applications by 200 percent in 2008-2009. Thirty one percent of these applications were from minority individuals, and thirty percent were from females.

- **Ensure that program websites are easy to find online** (Laursen et al., 2010). To examine the ease in locating each program's website, we used a website search engine, Google, to search for the program by both name and acronym as well as by entering the search term "undergraduate research experience." In both name searches, the SULI program website was listed on the first page of results. Only REU was listed on the first page of results for "undergraduate research program."

  When we conducted the internet search for "REU," the nsf.gov website that discusses how universities submit grant applications was the first result. Prospective applicants searching for a REU program would need to scroll to the bottom of that page and click "REU information for students" before they could see REU sites. Entering "REU" in conjunction with the name of the project site's university is more rewarding. For example when we conducted a web search to find "Auburn REU" or searched for "REU" on the Auburn website, the web pages were easily found. The search engine did find REU in the first page of results for searches for "undergraduate research experience."

  The SURF program did not appear in the first page of responses; however, a similar program at the California Institute of Technology named "SURF" did appear on the list of choices. The search term "Summer Undergraduate Research Fellowship" did return SURF Gaithersburg at the top of the search results list, but the entire search results list consisted of similar programs with identical names but that were not associated with NIST or SURF. The search engine failed to find SURF in the first page of results for searches for "undergraduate research experience."

  The Vanderbilt Project Team searched for "USRP" utilizing a web search engine. The USRP program appeared fifth in the results. The search term "Undergraduate Student Research Program" did return USRP on the first page of the search results. The search engine failed to find USRP in the first page search results for the search term, “undergraduate research experience.”

- **Create a social media presence to market the program** (Laursen et al., 2010). SULI, does not use social media to market its program, yet USRP deftly uses social media in its marketing efforts. A search in Facebook© located individual REU groups, but NSF’s REU program website for students did not mention social networking and there was no Facebook© group for the national REU program. SURF also maintains Facebook© groups for alumni, but does not use Facebook© or other social media in marketing the program.
- **Use a streamlined, online application process that is easy to understand** (Laursen et al., 2010). SULI utilizes a program-wide centralized application process where applicants can directly apply for one or all sites during the spring or fall semesters or up to two laboratory sites in the summer[ii], while NASA administers all program applications for the USRP through a single system. The SURF program does not allow students to apply directly to its program. The prospective participant’s university must complete the applications, including the individual student’s application, and submit it via grants.gov or on paper. The REU application is the most difficult to navigate as it varies from site to site and may require site-specific paper or electronic processes.
- **Offer assistance to guide prospective participants through the application process** (Laursen et al., 2010). Although SULI and SURF provide answers to frequently asked application questions on their websites and provide contact information for applicants who need assistance, USRP leads the other programs in applicant assistance through the number and kind of resources it makes available, including a detailed video online that explains how to apply for the program, live webinar sessions about the application process, recordings of previous application webinars available online, a forum for applicants to ask

questions via the USRP applicant Facebook© group, and the application portal which allows certain university advisors to access student applications and assist prospective applicants.

*Participant Selection.*The participant selection process is driven in part by the pre-program characteristics of the participants; however, URE programs use program selectivity to admit participants who are most likely to attain the program's short-, medium- and long-term objectives. UREs should also be aware that many students apply to more than one URE (especially for a summer experience) and that the timing of program acceptances may affect whether a prospective participant responds positively. Best practices suggest that UREs should:

- **Have a formal and defined process for applicant selection** (Laursen, et al., 2010). SURF is the only program reviewed that employs a formal review process for program application. In this process, SURF utilizes a review committee of three staff members to rank potential participants and refer successful applications to the corresponding site[iii]. Evaluators weigh academic coursework and GPA, career goals, honors and awards, commitment to working in a laboratory, and interest in pursuing graduate school equally in making their determinations[iv]. The SURF application website places an emphasis on the importance of the personal letter to help the committee members understand why applicants are interested in research and in which disciplines they want to conduct their research.The SURF program director for each site then reviews the application and makes necessary adjustments to the rank order. Admission is awarded in rank order as projects that fit the applicants' disciplines allow[v].
- **Select participants with prior research experience and prior academic achievement and/or those who are motivated to achieve** (Laursen, et al., 2010). REU scientists/mentors indicated that they most commonly select motivated applicants with prior academic achievement, and with a high match for faculty research interests (NSF, 2008a).

The USRP states that it selects participants by comparing applicant knowledge and skills to project requirements.

- **Use race, ethnicity, and gender as plus factors to increase the number of individuals admitted from underserved groups** (Laursen, et al., 2010). Only the REU program indicated that scientists/mentors used a participant's race and/or ethnicity as a factor in selecting program participants; however, 30 percent of all USRP participants in 2008-2009 were female and 21 percent of participants were listed as minorities[vi].
- **Make placements based on a match between the applicants' pre-program characteristics and experiences and the scientist/mentor's background and interests** (Laursen, et al., 2010). While REU scientists/mentors make the ultimate selection of program participants through a selection process that varies by individual project site, acceptance to the SULI program occurs at each national laboratory and is contingent on the number of slots the lab has been allocated. At most sites, the scientist/mentor selects the participants based upon academic coursework, recommendations, scientific interests, and applicant "fit" with the scientist/mentor's research projects and communicates this selection to the national lab's education office, which makes the offer to the student. A second round of matching is conducted if any slots are unfilled after the initial round[vii]. USRP also indicates that the scientist/mentor is heavily involved in the selection process, which would help to ensure the "fit" between the scientist/mentor, participant, and project.
- **Offer early acceptance for exceptional applicants** (Laursen, et al., 2010). USRP is the only program that indicated that it had an early admission process; however, SULI's first round notifications may speed admittance offers to exceptionally qualified applicants.
- **Provide a supportive structure for airing grievances and settling disputes** (Laursen, et al., 2010). None of the programs indicated that there was a process in process in place to allow participants or rejected applicants to air grievances or settle disputes.

Of the four programs we reviewed, USRP appears to be the most selective as evidenced by an 11 percent acceptance rate. USRP had the latest deadline and potentially the latest acceptance date but indicated that exceptionally individuals can be admitted before the deadline. SULI, SURF[viii], and USRP permit certain participants to return which allows the participants to be better able to contribute to the project and make significant individual gains. This may also lower the acceptance rate, depending on how this is calculated.

Program Evaluation. Program evaluations are a central component in ensuring that program goals are met, that the integrity of the URE program is maintained, and in identifying improvements that would enhance participant outcomes. To this end, best practices suggest that UREs should:

- **Utilize pre- and post-program surveys of participants, administrators, and scientists/mentors to identify program strengths and weaknesses** (Laursen, et al., 2010)**.** While SULI, SURF, and USRP all routinely collect pre-program data for program evaluation purposes, only SULI and USRP conduct post-program surveys immediately following the URE to gauge participant satisfaction. SULI's post-program surveys ask participants about career goals and potential future coursework but do not ask about aspiration to earn a doctorate. Because the REU program has no central programmatic oversight, its degree of program evaluation varies from site to site; however, no instances of pre- or post-program surveys were identified. USRP is the only program to solicit feedback from the scientist/mentor after the URE to make program improvements. None of the programs indicated that they collected data from administrators.
- **Utilize objective external evaluators to collect and analyze program data** (Laursen, et al., 2010). REU and SURF are the only programs that indicate use of external evaluators. The NSF uses a third-party to conduct periodic evaluations from both participants and

scientist/mentors (NSF, 2008a) while SURF conducts independent assessments bi-annually to identify alumni outcomes, including alumni program satisfaction, degree aspiration, educational attainment, and current employment status and industry. SULI did have an external review by the COV in 2010, but external review does not appear to be the SULI norm.

- **Assess participant gains from the URE** (Laursen, et al., 2010). While the USRP is the only program to clearly define programmatic goals and measure progress to those goals via their online portal[ix], none of the programs attempt to capture participant learning, professional development, or scientific development gains as a result of the URE.
- **Conduct long-term outcomes by maintaining contact with program alumni** (Laursen, et al., 2010). SULI is only beginning to use social media to stay in touch with program alumni. It recently began using LinkedIn to both network with alumni and gauge long-term, professional, and academic outcomes (Sam Held, personal communication, January 27, 2011); however, there is no evidence that SULI collects long-term outcomes data for participants. Although there are some Facebook groups for specific REU labs, there is no ongoing, over-arching REU alumni engagement process and no obvious attempts to learn about long-term outcomes. While SURF maintains on-going contact with alumni through Facebook©, there is no evidence that this relationship is used by SURF to measure long-term outcomes. USRP encourages alumni to stay connected and to continue professional networking through a proprietary online portal where alumni update their resumes and NASA posts available jobs and educational opportunities[x].

Curricular, Co-Curricular & Extra-Curricular Programs, Policies, and Practices. Beyond the policies, structures and processes that guide URE programs, the organizational context includes the framework in which both individual and peer experiences occur, including the curricular, co-curricular and extra-curricular programmatic aspects. In examining the organizational context that sets the stage for these experiences, the Vanderbilt Project Team compared programs' on-boarding processes, including program orientation, job assignment, and on-site training, as well as the guidelines for scientist/mentor-participant relationships and participant outputs. The available social programs and professional development activities and components designed to support alumni research were also part of our review. Because each program reviewed utilizes a number of project sites, we anticipate that actual curricular, co-curricular and extra-curricular programs, policies, and practices vary by site.

SULI, REU, SURF, and USRP each approach programs, policies, and practices for curricular, co-curricular, and extra-curricular experiences in ways that fit their organizational context and program goals, including the role of the peer environment, the role of the research team, the role of the scientist/mentor, the framework for lab-based, co-curricular and extra-curricular experiences, and the programs' requirements for participants. For each of these areas, we list the best practices and then compare each of the programs against each other and the best practices.

Peer Environment. During the URE, participants will form their own peer environment through the many interactions that will occur on a daily basis; however, the degree of effectiveness and support provided within the peer environment is indicative of the URE program organizational context. Peer environments can be an important source of participant support, assistance, and pleasure. URE programs should be intentional in how they support the formation of the peer environment (Laursen, et al., 2010). Much of the peer environment is established through the on-boarding process for participants at the local program level and the individual program level within each lab, which is central in defining participants' experiences in the program. To this end, to foster a supportive peer environment, UREs should:

- **Group participants into "teams," rather than placing one participant in each individual lab at the local program site** (Lopatto, 2003).Although the programs indicated that some participants worked together on teams in the same lab, this is not part of the programmatic design for any of the UREs reviewed.

- **Conduct a thorough orientation to the URE, the program site, and the individual lab that communicates the cultural norms and expectations of the participants, the scientist/mentor, and the URE** (Lopatto, 2003). URE orientations vary by the site and, for SULI, the number of participants at the site. At larger SULI sites, like Ames, Fermilab, Broookhaven, and Berkley National Laboratories, websites welcome participants and provide specific details regarding orientation. Smaller SULI sites, such as the National Energy Technology Laboratory hosted only two participants and provided no information regarding SULI on its website[xi][xii][xiii]. A 2011 REU in Seismology provides a one-week orientation with a goal to "develop a strong sense of community among interns, provide training in distance collaboration and introduce you to some of the most exciting aspects of modern seismology"[xiv]. By contrast, an REU at Virginia Tech provides a three-day orientation for students going to Ghana, which included both information about Ghana and scientific discovery and the project they would be working on.[xv] At the Virginia Space Consortium participants are oriented to its USRP program including a tour of the facility and library. No information was obtained on the SURF orientation program.

- **Use a formal peer-mentoring program** (Grady, 1998; NSF, 2008; Laursen, et al., 2010; Trent et al., 2003). Each of the four programs indicated that they had a peer mentoring program, which may vary by site and, at least for SULI, by the number of participants at each site.

Research Teams. Because participants will likely learn much from the research teams, the URE literature suggests that project site-based research teams should:

- **Contain a mix of backgrounds and experiences** (NSF, 2008; Russell, Hancock, & McCullough, 2007). No information was available on the components of research teams for any program beyond the individual REU project sites.
- **Meet weekly to solve problems, brainstorm and discuss on-going projects** (Laursen, et al., 2010). Only SULI indicated that weekly research team meetings were required[xvi]. For both SURF and REU there was evidence of weekly meetings at some sites or in some labs; however, there was also evidence that this was not consistent across research teams. No information was available on research team meetings for USRP.
- **Conduct activities that foster collegiality**(Laursen, et al., 2010). No information was available on research team activities for any program.
- **Include a social component, such as team luncheons and get-togethers that foster a "team spirit**" (Laursen, et al., 2010). No information was available on research team social activities for any program.

Role of the Scientist/Mentor. The scientist/mentor is the single-most influential person the participant will interact with in the course of the URE (Laursen, et al., 2010). Scientists/Mentors must therefore be intentional in the development of the participant-mentor relationship (NSF, 2003). Based on the best practices, scientists/mentors should practice the following (discussion on these best practices follows the bulleted list):

- **Set high expectations for participants and provide them some choice in the work they do** (Laursen, et al., 2010).

- **Train participants in the most widely used techniques and provide the opportunity to use state of the art equipment** (Lopatto, 2003; NSF, 2008a).
- **Welcome participants and assimilate them into the pre-existing research team as a part of the anticipatory socialization process** (Laursen, et al., 2010; NSF, 2008a).
- **Share personal information, show an interest in students' lives, and provide opportunities for students to approach them for discussion** (Vogt, 2008).
- **Use a mentoring partnership agreement, which defines roles, responsibilities, and expectations** (Lopatto, 2003).
- **Assess participant needs and adjust advising to strike a balance between fostering independence and providing a learning challenge** (Laursen, et al., 2010)
- **Teach the participant and moderate the research experience** (Laursen, et al., 2010)
- **Advise the participant through weekly one-on-one meetings and through "management by walking around"** (Laursen, et al., 2010)
- **Participate in co- and extra-curricular events with participants** (Laursen, et al., 2010)
- **Model appropriate behavior, especially collegiality and collaboration** (Berger& Milam, 2001; Laursen, et al., 2010).
- **Provide academic and career advice** (Laursen, et al., 2010).
- **Normalize risk and uncertainty in the research process** (Laursen, et al., 2010).

Because these are individual characteristics, rather than features of the organizational context, we looked at instances where either the programs or the individual project sites supported scientist/mentor best practices. SULI does not require formal training for scientist/mentors nor does it have standard criteria or guidelines for scientists/mentors; however, individual sites may orchestrate their own training. For example, Fermilab National Lab provides its SULI mentors with specific expectations based on the experiences and exit interviews of former participants. Expectations included the goal of the SULI program, logistic information, training requirements, and the need to identify a co-mentor/colleague who can work with the participant when the scientist/mentor is unavailable. Each REU research site provides the mechanism to select and train mentors/scientists; however, there was no evidence that scientist/mentors were being trained in their roles and responsibilities in the REU program. While a review of SURF program information did not reveal any evidence of criteria or guidelines for scientists/mentors, one USRP site provides scientist/mentor guidelines that describe important characteristics of a good mentor that include patience, planning, and, above all, an investment in the growth of the participant. The guidelines outline what the scientist/mentor can expect as the participant grows in the program.[xvii]Mentoring partnership agreements or internship work plans can be used to formalize some aspect of the scientist/mentor role. Although not required by SULI, many of the national labs require that scientist/mentors and participants develop a scope of work that communicates the goals of the project, the equipment to be used, techniques to use, dates and times of meetings with mentors, and a daily work schedule for the participant[xviii]. Both participants and scientists/mentors must sign the project work plan agreement. There was no evidence that SURF, USRP, or REU used a similar type of partnership agreement.

*Lab-Based Experiences.*Within the lab-based experiences, the URE literature suggests that all the new skills, knowledge, and abilities participants acquire should be built on existing (pre-program) skills and experiences (Laursen, et al., 2010). As training programs, URE programs should ultimately seek to:

- **Help participants master the skills necessary to their research** (Lopatto, 2003). While SULI does not have a standard training program, lab safety was a training topic in a number of national labs. REU participants received training in using specific research tools, such as computer program/language, lab, or field equipment (NSF, 2008a). For SURF, the degree and type of technical training depends on the research team. At USRP, training depends on the site; however, USRP does provide pre-URE online training through the computerized NASA training system.[xix] Participants may also be asked to complete a set of readings before they arrive on site.

- **Build participant's level of scientific thinking** (Sadler, Burgin, McKinney, & Ponjuan, 2010). None of the programs reviewed included information on this objective.
- **Connect the participants' daily work to the "bigger picture"** (NSF, 2008a). None of the programs reviewed included information on this objective.
- **Improve technical skills in experimentation and data collection/analysis** (NSF, 2008a). None of the programs reviewed included information on this objective.
- **Foster participant independence** (Lopatto, 2003; NSF, 2008a). Some scientists/mentors provide SULI participants with pre-program readings related to the research topic.
- **Open doors to participants' creativity and ingenuity** (Lopatto, 2003). None of the programs reviewed included information on this objective.
- **Encourage ownership among participants by making them responsible for some aspects of the project** (Lopatto, 2003). None of the programs reviewed included information on this objective.
- **Develop problem-solving skills in participants by helping them ask good questions** (Laursen, et al., 2010). None of the programs reviewed included information on this objective.
- **Nurture excitement about the research enterprise** (NSF, 2008a). None of the programs reviewed included information on this objective.

Co-Curricular and Extra-Curricular Experiences. In supporting participants' on-going growth and development, URE programs should sponsor a number of both formal and informal activities and events that allow them to interact with other participants, URE scientists, research team members, and outsiders in a professional capacity (Laursen, et al., 2010). Co-curricular and extra-curricular programmatic offerings should include:

- **Field trips to nearby research facilities, including those within and outside of the local program site** (NSF, 2008a). Both SULI and SURF participants are required to attend tours. Some REU sites also include tours, but the NSF does not require that they do so.
- **Lectures/seminars on research ethics** (NSF, 2008a). Both SULI and SURF participants are to attend required lectures; however, there are no required topics. Since the implementation of the America Competes Reauthorization Act of 2010, training in the responsible conduct of research is mandatory for NSF participants.
- **Workshops on academic writing and oral communication and/or presentation skills** (Lopatto, 2003; NSF, 2008a). Both SULI and SURF participants are to attend required lectures; however, there are no required topics. Berkley mentions weekly brown bag lunches and sessions to support poster creation and writing for SULI participants[xxxxi].
- **Conference attendance to network with other undergraduates involved in research** (Lopatto, 2003; NSF, 2008a). None of the programs reviewed provide support for students to attend conferences.
- **Networking events and opportunities** (Laursen, et al., 2010). Only a few SULI sites mentioned formal networking events for participants.
- **Social activities that increase social integration in the peer group** (Laursen, et al., 2010). Peer social experiences vary by program, site, and number of participants at the site.

For example, Ames National Laboratory leisure activities are highlighted on their SULI website, while the Berkeley National Laboratory hosts a barbecue for SULI participants[xxii][xxiii]. The number of social activities within an REU site is determined by the individual scientist/mentor; however, NSF does not allow institutions to use their REU funds to pay for social activities. Although no information was available on SURF-related social activities, the communal housing provided by the program does appear to provide additional opportunities for social interaction among participants as suggested by Braxton et al. (2004). No specific USRP social activities were noted.

Participant Requirements. In addition to lab-based, co-curricular, and extra-curricular experiences, participants should have a required, culminating event that details the research they conducted and their findings (NSF, 2008a; Laursen, et al., 2010; Lopatto, 2003). Berkes (2007) notes that this is important in further developing participant self-efficacy. Participants should be required to:

- **Produce a research paper, abstract, poster presentation or PowerPoint presentation (**Laursen, et al., 2010). SULI requires that participants submit a complete copy of a research paper or PowerPoint (depending upon the laboratory policy) and submit an abstract of research in the required format[xxiv].Each national laboratory can add its supplemental requirements such as participant-created web pages[xxv]. SURF participants are also expected to complete a research abstract at the end of the program. USRP requires that participants submit a paper at the end of the program. No specific deliverables are required by REU, but individual sites may devise their own standards.
- **Conduct an oral presentation of their research** (Berkes, 2007). SURF participants are expected to make an academic talk. USRP notes that participants may be asked to discuss research in public forums, colloquia, workshops, or technology demonstrations[xxvi]. While

SULI does not require an oral presentation, some individual REU sites may make that a program component.

- **Author or co-author a paper for submission to a professional journal** (NSF, 2008a). None of the programs reviewed required authoring a paper.

Model Federally-Funded STEM Education Programs

Though not selected as comparable to SULI, the Vanderbilt Project Team identified three federally-funded STEM education programs that exemplify many of the best practices for STEM URE programs. The U.S. Department of Education's McNair Scholars Program (MSP), the NSF Louis Stokes Alliance for Minority Participation (LSAMP), and the National Institute of General Medical Sciences (NIGMS) Minority Access to Research Careers (MARC) Undergraduate Student Training in Academic Research (U-STAR) Program all seek to address long-term persistence in STEM disciplines for minority undergraduates by combining a highly organized structure, an intentional peer and mentoring environment, and supportive individual experiences in and out of both the classroom and the lab that support students' targeted growth and learning.

MSP and LSAMP. Through the MSP, underrepresented students with strong academic potential are provided with academic and financial aid counseling, mentoring, research opportunities, and counseling to encourage their persistence to the baccalaureate and enrollment in graduate programs (U.S. Department of Education, 2008). While the MSP includes all economically disadvantaged and first-generation students, the LSAMP program only includes racial and ethnic minority STEM students. As extramural programs that are housed with the context of the university administering the local program, both programs support retention by focusing on student research experiences. They also establish strong mentoring relationships, work to connect students socially within their academic disciplines, provide tutoring, and offer both stipends and other funding to include conference travel, posters, books, and other supplies.

Both the MSP and LSAMP programs support student-faculty research projects. Steve Saunders, Interim MSP director at Middle Tennessee State University (MTSU) explains, “What we do is we rely on our faculty members, so if you are majoring in biology, you’ll be working with a biology faculty member who’s got a Ph.D. in biology to help to do an eight-week summer program in research” (Foltz, Gannon, & Kirschmann, 2009). MSP students receive a stipend during the eight weeks and have an opportunity to see how research is done up-close. “They are working with the biology faculty member and that is where they are getting the real knowledge about what it takes to succeed” Saunders added (Foltz, et al., 2009). Programs like LSAMP also put students and faculty members together, as Mrs. Thomas, the MTSULSAMP coordinator explains,

> Students may need extra assistance with tutoring, with an understanding of the components of research, putting together a poster, presenting a poster. They may not understand that is what they’re supposed to do and that this grant [LSAMP] can help them put that together, help them find a research partner, a professor to work with on a project, help them underwrite it. Even if they need to go off-campus to make a presentation for a regional or national conference, we can help underwrite that (in Foltz, et al., 2009).

Foltz, et al. (2009) interviewed students from both programs in their research on minority STEM persistence and found that the experiences these programs offered was integral to the success of the students in obtaining their baccalaureate degree. Like these programs, UREs-as-interventions should be designed, and in many cases redesigned, with a holistic approach to student retention and find ways to improve lab-based experiences and enhance structured curricular, co-curricular, and extra-curricular experiences.

MARC U-STAR. Through the MARC U-STAR grant, underrepresented undergraduate students with strong academic potential are provided with hands-on research experience, a stipend, formal career development and mentoring, individual research opportunities, and counseling to encourage their persistence to the baccalaureate and enrollment in graduate programs (NIGMS, n. d.). The MARC U-STAR program is funded by the NIGMS, one of the National Institutes of Health (NIH) and is part of the Ruth L. Kirschstein National Research Service Awards (NRSA), which focuses on training both pre-doctoral and post-doctoral researchers in behavioral and health sciences.

> The primary objective of the NRSA MARC U-STAR training program is to increase the number of highly trained underrepresented biomedical and behavioral scientists in leadership positions who can significantly impact the health-related research needs of the Nation (NIH Guide for Grants and Contracts, 2010).

MARC U-STAR grants are highly competitive and provide five years of funding to eligible colleges and universities that offer a baccalaureate degree, enabling them to select and provide financial support for underrepresented students in the biomedical and behavioral sciences.

A typical award includes stipends for honors students during their junior and senior years; tuition expenses, school-related activity fees, health insurance, research supplies, travel, and pedagogical and professional development (NIGMS, n.d.). Principal investigators submit a grant proposal and also select the faculty mentors who will collaborate with them to design the training program. Each program establishes unique goals and objectives within the scope of the overall MARC U-STAR program goals. As such, individual institutions are responsible for designing a context-appropriate undergraduate research experience. Program specifics, such as the student selection criteria, the definition of an honors student, and the allocation of staffing and financial resources are developed at the discretion of the awarded institution. Each program is also required to conduct its own self-assessment and design an evaluation plan that facilitates continual improvement, including an assessment of the overall program, comparing baseline numbers and progress toward goal achievement.

Although each MARC U-STAR program is developed to suit its institutional and disciplinary context, all MARC programs must incorporate a summer URE component at another research-university and provide research training opportunities or research instruction opportunities during the fall and/or spring semesters. Each MARC U-STAR program is also expected to include a critical focus on student development. Most include:

- Incorporating quantitative sciences (math, chemistry, physics, engineering, and/or computer science) to study biology for an interdisciplinary mode of learning;
- Implementing innovative teaching strategies to improve learning (examples include: active learning, inquiry-based learning, problem-based learning, and peer collaborative/group assignments);
- Using service-learning as a strategy to integrate community service with instruction;
- Participating in activities that increase the interest in and motivation for biomedical sciences thus increasing the pool of potential MARC trainees;
- Developing student's critical thinking and problem-solving skills;
- Participating in intramural research training (where feasible) or research training through the classroom setting; and
- Presenting research findings at national science meetings in the trainee's field of study (NIH, 2010).

The MARC U-STAR grant also provides institutions with funding to support strengthening science instruction and the pedagogical skills of the faculty.

In a 1995 study of MARC (prior to the development of U-STAR) program outcomes, the NIGMS "found little change in the number of science Ph.D.'s earned by graduates of colleges that received MARC training grants." In this study they found that since the program began in 1977, almost 50 percent of MARC participants went on to graduate school and earned a terminal degree, but only half of those earned Ph.D.'s. Armed with these findings, NIGMS retooled the program to focus on research careers and developed the U-STAR component of the MARC program. Currently, competing MARC U-STAR proposals are submitted to the NIGMS each May and are peer-reviewed according to standard NIH review processes and criteria; however, the MARC U-STAR program has established additional criteria for determining which applications to award. The program theory goals espoused by MARC U-STAR indicate that successful programs should:

1. Improve their record, from the current baseline, of sending students on to science Ph.D.'s;
2. Have overall goal(s) and measurable (quantifiable) objectives of the program that are within the framework of the MARC Branch primary objective;
3. Have evaluation and assessment tools to determine the program's overall effectiveness from its baseline;
4. Have or develop a synergy with and uniqueness from any and all other science URM student training programs at the institution (e.g., MBRS RISE or IMSD, MORE Special Initiatives Bridges or PREP, NIH T32, NSF LSAMP, HHMI, etc.);
5. Have academic training for MARC trainees and other students;

6. Provide research training for MARC trainees; and
7. Have interactions with highly selective graduate institutions, such as those with NIH T32 programs, to send students to competitive science Ph.D. programs.

Carter, Mandell and Maton (2009) conducted a comparative evaluation of the MARC U-STAR and the Meyerhoff Scholarship programs at the University of Maryland, Baltimore County. During their preliminary research they found that “few studies examine the relationship between undergraduate research, in general, and pursuit of a STEM Ph.D., and even fewer consider the relationship between participation in on-campus, academic year research, specifically, and pursuit of a STEM Ph.D.” (p. 446). In this quasi-experimental study that examined 13 cohorts from 1989 to 2001, they found that the MARC U-STAR program had a high level of intensity and a strong structure, and that participants who were exposed to undergraduate research opportunities were more likely to persist and subsequently enroll in advanced STEM graduate level courses. The researchers provide a rigorous analysis of structured research programs for underrepresented students (including the MARC U-STAR) and appropriately do not claim causality with a quasi-experimental design. The sample consists of 441 participants selected non-randomly from the 517 participants. The sample excluded participants who had a missing Ph.D. status (47 cases were eliminated), a missing parental education information (25 cases were eliminated), or had an ethnicity of Hispanic (4 cases were eliminated). Thus, the findings are not generalizable beyond the respondents. The findings suggest that MARC U-STAR has potential to meet its first goal, but the evaluation did not examine any other MARC U-STAR goals.

Each of the three identified programs incorporate many of the best practices indicated in the URE literature as supporting undergraduate persistence, including a strong organizational framework, intentional construction of the peer environment, fostering of positive faculty-student interactions, and a focus on individual student experiences in the lab, in curricular, co-curricular, and in extra-curricular areas.

The Summary of Key Findings and Recommendations sections will further unpack these approaches and provide additional scaffolding in integrating these best practices into existing and evolving URE programs.

Conclusion

Using the Project Conceptual Model and the URE academic literature as guides, the Vanderbilt Project Team identified best practices in organizational context that support participant experiences and the peer environment through URE policies, programs, and practices. The Vanderbilt Project Team also described the policies, program, and practices of SULI and the three comparable URE programs in light of these best practices, drawing conclusions and inferences based on these comparisons. These comparisons cannot, however, provide an in-depth understanding of the participant experience, only the framework that supports it. The next report section, Examining Experiences, provides alumni perspectives on their URE experiences and resulting outcomes.

EXAMINING EXPERIENCES: FINDINGS FOR PROJECT QUESTION 3

How are the actual experiences and outcomes of SULI participants and those in comparable programs similar or different?

Introduction

In order to address the third project question, which asks about differences in URE program participants' experiences and outcomes, the Vanderbilt Project Team utilized a survey instrument to collect both quantitative and qualitative data from SULI and SURF program alumni, as detailed in the Project Research Design section of this report. REU and USRP were also invited to participate in this portion of the study but declined to do so. The aim of the survey was to collect data for use in comparing the experiences of the alumni from both programs that participated in the survey process. Most non-demographic survey questions were arranged by the Vanderbilt Project Team into scales that correspond to constructs within the Project Conceptual Model.

About These Findings

Throughout this section, the terms "agreement" or "agreed" are used to represent those respondents who selected the Likert response "Agree" or "Strongly Agree." In similar fashion, the terms "disagreement" or "disagreed" are used to refer to respondents who selected the Likert response "Disagree" or "Strongly Disagree." This language has been chosen to increase the readability of the report and does not indicate that responses in these two discrete categories were aggregated in the data analysis. Percentages in text reflect the percentage of respondents who selected either "Agree" or "Strongly Agree," unless otherwise identified.

References to “alumni” or “participants” in this section refer to the survey respondents and do not imply generalizability to all alumni or all participants.

A complete description of the data analysis methods utilized can be found in the Project Research Design section of those report. In brief, we utilized the independent t-tests of means to identify statistically significant differences in responses from SULI and SURF alumni on all composite scales and the individual Likert-style items composing those scales. A series of dichotomous (yes/no) items were included on the survey instrument. When comparing the responses of SULI and SURF alumni on binary dependent variables, z-tests of proportions were used to determine if the means of each group were significantly different. In all cases, we used the .05 level of statistical significance to identify significant differences between SULI and SURF alumni. Some survey items asked the respondents to check all of the items that applied to them. When comparing the responses of SURF and SULI alumni on these items, only raw counts have been provided.

The responses of SULI and SURF alumni were compared on the intent to earn a doctoral degree variable through a 2x2x2 contingency table and by calculating a chi-square statistic. A series of post hoc statistics, the Cochran-Mantel-Haenszel, Mantel-Haenszel, and Breslow-Day, were calculated to allow the Vanderbilt Project Team to control for the effects of other variables. Appendix J provides detailed information on these analyses.

The appendices provide the data tables from the statistical analysis, including detailed scalar and item measures in Appendix I. Appendix M provides verbatim respondent comments collected on free-response survey items. Collected survey data also enabled the Vanderbilt

Project Team to make inferences about the programs' effectiveness in achieving their desired short-, mid-, and long-term outcomes. Appendix J summarizes the long-term outcome measures.

Comparing Experiences within the Project Conceptual Model

The survey instrument contained questions from each of the four dominant clusters of influences of the Project Conceptual Model (precollege characteristics and experiences, organizational context, student peer environment and individual student experiences) as well as many of the smaller sub-influences, such as individual lab-based experiences and experiences with the research team. Each construct in the Project Conceptual Model was measured via a scale with the exception of precollege characteristics, which were measured through a series of demographic questions.

Respondent Perceptions of the Organizational Context. The organizational context provides the framework in which the respondent's experiences take place in the URE. The organizational context includes the multiple levels of URE programs: the national program, the local program, and the individual program in each lab. It also incorporates three different types of structures, which include the internal structures, policies, and practices; the curricular and co-curricular programs, policies, and practices; and the scientist/mentor culture. The organizational context scale included items regarding the application process, the importance of housing and stipends, the process of selecting or being assigned a mentor, and the structure of the individual, lab-based research teams. SULI and SURF respondents provided similar responses regarding their experiences with organizational context, $t(91)=0.9$, $p=0.371$. Each item in this scale and responses are shown in Table G1.

The respondent's affiliation with either SURF or SULI began with the application process in which they learned about the programs, gathered the required information, and submitted their applications and supporting documentation. Alumni responses to the survey indicated that they had learned about the programs from multiple sources including the program website, which was the most frequently mentioned resource, as well as from non-program research administrators, current or former program participants, and program brochures. The top four reasons respondents from either program decided to apply for the URE include (1) experiencing "hands-on" research experience, (2) learning more about being a researcher, (3) receiving a stipend, and (4) to have an edge when applying for graduate school. In addition to applying for SULI, thirty seven percent of the SULI respondents also applied to other UREs. About half of the SURF respondents (fifty percent) applied to other UREs in addition to SURF as shown in Table 2.

Table 2

SULI and SURF and Applying for Other UREs

	SULI	N	SURF	N
Did not apply for other programs	63 percent	41	50 percent	62
Applied for other programs	37 percent	24	50 percent	62
Identified one other program	50 percent	12	50 percent	31
Identified more than one program	50 percent	12	50 percent	31

Respondents from both programs indicated on the survey that they finalized their program selection based on the national lab's reputation and its STEM discipline emphasis, URE site location, the timing of their notification of acceptance, and the diversity of experiences they expected. SURF respondents' decisions were also influenced by housing and stipends. Respondent comments to free-response items about program selection appear in Appendix M.

Although the responses of SULI and SURF alumni at the scale level were not statistically different, responses to a single item within the scale were significantly different. The mean perception of the quantity of lab-based interaction with the research team, $t(91)=3.14$, $p=0.002$, with SULI respondents more favorable to this item with a mean response of 3.74 and SURF alumni with a mean response of 3.09.For both program's alumni, responses to this item were the least favorable of any on the scale. A SURF respondent aptly suggested this improvement, "Have the undergraduate participate in team meetings, understand the goals of project and keep them involved in the design, direction, and timeline of the project."

Alumni mean responses for both programs were also low, but not significantly different, in response to the statement that "It was easy to identify a research mentor/supervisor," SULI (3.76) and SURF (3.57). A SULI survey respondent bemoaned the mentor mismatch:

> First, we were not allowed to choose our own mentors, we were chosen by the mentors. I wouldn't do it this way, because they [*sic*] the students, like myself, may end up being chosen for a project they are not interested in. I think the mentors should be chosen wisely. I know that in order for the program to work, willing mentors are needed, but this does NOT mean that the mentors who volunteer will actually effectively mentor.

One SURF respondent also commented, "I would make the mentoring part a bit more structured so that it doesn't feel so overwhelming in the beginning."

Respondent Perceptions of Peer Environment. SULI and SURF respondents reported similar and satisfying peer experiences when measured via the composite scale, $t(133)=0.66$, $p=0.513$. Responses regarding peer experiences include items related to the development of interpersonal relationships and friendships within the lab and whether the respondent felt that he and the other respondents were equally matched in terms of intellect and their URE experience. Respondents from both programs responded favorably to all of the items as shown in Table G2. Responses to the following two items within the scale were significantly associated with the URE in which the respondent participated. The mean SULI response (3.52) was greater than the mean SURF response (3.24) in answer to “The other undergraduates were smarter than me,” $t(101)=1.99$, $p=.049$.SURF participants appear to have more social contact with one another than SULI participants. Thus, the initial stereotypes (that others are smarter then the participant) may change as students get to know each other (Pettigrew, 1988). The mean SURF response (4.38) was more favorable than the mean SULI response (3.88) when asked “While participating in the SURF program I developed close personal relationships with my fellow undergraduates in the lab,” $t(90)=-2.57$, $p=.012$. While SURF provides opportunities for professional interaction among program participants as part of the formal programming in addition to providing group housing for participants, professional interaction among program participants and the provision for participant housing in the SULI program varies by national lab. Respondents’ comments on the survey include descriptions of how housing encouraged or hindered peer interaction. A SULI respondent commented, “I did not receive a housing stipend so I did not feel very close to the other SULI interns who were living together in the same apartment complex.” A SURF respondent expressed positive peer experiences as a function of the housing, “the living arrangements were fantastic and located close to work, which was nice; and the people that I met, particularly the girls that I housed with, are some of the best friends I ever made.”

Peer interaction, as indicated in the literature and Project Conceptual Model, is important in shaping the participants' individual experiences in the URE in all three sub-areas of consequence: lab-based experiences, curricular, and co-curricular/extra-curricular individual experiences. One SULI participant indicated on the survey that he or she craved social connections with peers, recommending "A bit more social interaction, like more meetings for lunch on Friday or something. I thought the research aspect was superb, but I missed out on making friends and connections in my cohort." One SURF survey respondent wanted more lab-based peer experiences:

> I would encourage more collaboration between students—in the SURF program, most students worked on projects individually or with one other student. I think more peer support would help students come up with new ideas and learn about collaboration and would make the projects more interesting.

Another SURF alum suggested that SURF "Put more than one student from the program in each lab group so that the team can bond and discuss their ideas outside of work."

Respondent Perceptions of Lab-Based Experiences. Table 3 provides responses to a series of **prompts** about benefits alumni may have experienced during their participation in SULI or SURF from their participation in lab-based experiences. Respondents were asked to select from the list only those benefits that they had personally experienced. Many selected phrases that describe their URE experience including "engaging in real-world science" and "feeling like a scientist."

Table 3

SULI and SURF Lab-Based Experiences

During my experiences in the program, I…	SURF N	SULI N	Total N
Engaged in real-world science research	43	86	129
Felt like a scientist	43	78	121
Thought creatively about the project	35	70	105
Felt responsible for the project	42	77	119
Worked extra hours because I was excited about the research	30	46	76

SULI and SURF respondents reported similar levels of agreement when asked about various aspects of their lab-based experience on the Curricular Experiences scale, a composite scale that reflects various aspects of the experiences alumni are likely to have encountered in the lab, $t(118)=1.42$, $p=0.16$, as shown in Table G3. Responses to only one item within the scale were statistically different for SULI and SURF respondents. The mean response of SULI alumni (4.21) was significantly higher than the mean response of SURF alumni (3.84) in response to “The research team meetings I attended were beneficial to the development of my research project in the lab,” $t(114)=2.16$, $p=.033$.

Within the context of lab-based experiences, alumni of both programs responded similarly and less favorably to three items, although no significant differences were found between the programs: being able to complete the research project, the presence of intellectually stimulating activities in the lab, and the opportunity to provide input into the design of the research project. The mean SULI response to the item regarding being able to complete research project was 3.81 and the mean SURF response was 3.65. Supplemental comments on the survey reflect the challenges of URE project completion. One SULI alumnus recalled, “One major problem I had was that while I was motivated and wanted to finish, there simply wasn't enough time to for me to complete my project." Similarly, a SURF respondent suggested, "Make sure the project can be reasonably completed in the time allotted, considering time required for training."

Other less favorable responses on this scale came in response to items inquiring about intellectually stimulating activities in the lab (SULI M=3.59, SURF M=3.61) and being able to provide input into the design of the research project (SULI M=3.92, SURF M=3.86). While neither response should be considered negative, it is noteworthy that these items garnered lower scores than other items on the scale from both programs' alumni. Some comments from alumni on the survey indicate that the research project itself may have been problematic. For example, one SULI alum indicated that "I think the program was set up right in trying to have each participant have some finished paper or publication, but only a few actually seemed to do that because the tasks given by mentors were not of that caliber." Another SULI respondent wanted more hands-on time with a specific research project, "I worked on projects, but not actual research projects. While enjoyable and stimulating, some research would have been good, too." A former SURF participant commented "The quality of projects varied greatly and some were not sufficient to make for an interesting experience."

Respondent Perceptions of Co-Curricular Experiences.

Co-Curricular experiences are designed to supplement the lab-based experiences and vary based on the participants' research project, discipline within the STEM fields, and formal program within the program site. SURF and SULI respondents answered similarly to the Co-Curricular Experiences scale as shown in Table G4, $t(62)=1.93$, $p=.06$. Additionally, there were no statistically significant differences in the responses of SULI and SURF alumni to any of the items composing the scale.

SULI respondents provided few comments regarding the curricular experience on the survey. However, SURF respondents expressed a desire to receive early (even pre-programmatic) information regarding their projects and wanted more guidance on how to use laboratory equipment. They also recommended an increased emphasis on laboratory safety.

Respondent Perceptions of Extra-Curricular Experiences. Respondents participated in a variety of extra-curricular experiences during in their URE and reported a similar proportion of affirmative responses on all but two of the items as shown in Table 4. SULI respondents did not report presenting talks or posters to other students and/or faculty members as frequently as SURF respondents.

Table 4

SULI and SURF Participation in Extra-Curricular Activities

Respondents reporting the following as part of their program:	SULI DID	SULI DID NOT	SURF DID	SURF DID NOT	Z	p
I presented a talk or poster to other students or faculty	44	9	93	1	3.34	**.001
I presented a talk or poster at a professional conference	13	40	23	69	-.136	.891
I attended a conference	17	36	27	66	.199	.843
I mentored other students conducting research or led a student research team	5	48	11	81	.193	.847
I wrote or co-wrote a paper that was published in an academic journal	9	44	18	74	.164	.869

*p<=.05 **p<=.01

Table 5 provides responses to a series of prompts describing extra-curricular gains alumni may have experienced during their participation in SULI or SURF from their participation in extra-curricular experiences. Respondents were asked to select from the list only those gains they had experienced. Both SULI and SURF respondents most commonly selected “Explaining my project to people outside my field" from the list of potential extra-curricular gains as shown in Table 5.

Table 5

Gains in Skills Reported from SULI and SURF Respondents

My research skills have improved in the following:	SULI N	SURF N
Explaining my project to people outside my field	48	86
Preparing a scientific poster	31	39
Defending an argument when asked questions	34	58
Writing scientific reports or papers	34	45
Conducting research literature searches	32	48
Understanding journal articles	34	64

*p<=.05 **p<=.01

The extra-curricular experiences scale asked about the professional development opportunities provided during the URE. The responses from SULI and SURF alumni respondents were statistically equivalent on the composite scale, t(42)=-0.891, p=0.378, as shown in Table G5. The responses of SULI and SURF alumni were statistically different on only one item included in the composite scale. The mean response of SULI participants (4.13) was less than the mean response of SURF participants (4.43) when asked about their level of satisfaction with opportunities to participate in social activities, t(94)=-2.13, p=0.036. Respondents from both programs provided the least favorable response on the scale item about professional development programming: the degree of professional stimulation in the activities (SULI M=3.74, SURF M=3.66). The difference between these responses was not statistically significant. Comments on the survey suggested that additional co-curricular and extra-curricular experiences as well as refinements to existing experiences be made in both URE programs.

A variety of potential extra-curricular experiences were recommended by alumni, including paper and abstract writing classes, tours of other labs and research projects, informational seminars, and grant funding courses. One SURF alumni survey respondent commented on an exceptional extra-curricular experience that would benefit other participants:

> My experience was great (not the norm) because I was able to attend conferences both summers outside of the US and present my work. Traveling to another country to present was an eye opener into the rewards of working hard to complete research, and inspired me to work hard throughout the summer.

Another SURF respondent provided this specific suggestion:

> I would have a mid-program research symposium. This way students could share what they're working on in a formal setting, and maybe find other students working on similar projects. Most students don't talk much (if at all) about their work in social settings, so I found it difficult to learn about others' work before the final day of talks in August. Of course by then it's too late for students to learn much from each other that will help each other’s research.

Some respondents also expressed concerns about the quality of existing co-curricular and extra-curricular experiences. One SURF alumni survey respondent commented:

> Weekly seminars for SURFers could be improved. Speakers were consistently either way below or way above the technical understanding of the students. Two shorter talks (20-30 minutes rather than one hour) would have been more appropriate. In half an hour, a speaker can introduce a topic/field/set of experiments to novices without losing them to boredom or lack of understanding. Also, more talks in the course of the summer would introduce interns to more of the exciting research happening at the institution.

Another SURF respondent reflected the trade-off between co-curricular and extra-curricular and curricular or lab-based activities “Don't make certain seminars required. They weren't of interest to me and I could have spent more time on the research I was interested in instead.”

Respondent Perceptions of Scientist/Mentor Experiences. The lab-based, curricular and co-curricular/extra-curricular experiences were all influenced by the relationship and interactions with the scientist/mentor. SURF and SULI respondents reported similar experiences with their scientists/mentors on the composite scale, $t(120)=0$, $p=.987$, and expressed the least agreement on items related to time spent with the scientist/mentor inside and outside of the lab as shown in Table G6. It is notable that items on this scale elicited the least favorable responses on all of the scale items as shown in Appendix I.

Many comments reflect frustration with the scientist/mentor's degree of availability to meet and work with the participant. For example, one SULI respondent noted, "Mine did not once step foot into the lab, which seems backwards when trying to advise someone on research in a lab." Similarly, a SURF respondent wished for "More activities between my adviser and the other professional research staff and I outside of lab—all of our interactions occurred in lab and thus limited our conversations largely to the research at hand."

The responses provided by SULI and SURF respondents were statistically different on only one item included in the composite scale. The mean SURF response (4.34) was greater than the mean SULI response (3.98) when asked about the willingness of the scientist/mentor to provide graduate school advice, $t(85)=-1.99$, $p=0.049$.

Respondent Perceptions of Research Team Experiences. The respondents' experiences with their scientist/mentor experience occurred in conjunction with a research team experience. SULI and SURF respondents had similar experiences with the research team as reflected in the research team scale in response to questions regarding the nature and quality of friendships and collegiality among research team members, $t(80)=0.48$, $p=0.63$, as shown in Table G7. The responses provided by SULI and SURF respondents were statistically different on only one item included in the composite scale. The mean SULI response (4.06) was greater than the mean SURF response (3.51) when asked about whether members of the research team that would be willing to listen to them and/or help them if they had a persona l problem, $t(112)=-2.17$, $p=0.032$. The items that garnered the least agreement concerned the development of close, interpersonal relationship with members of the research team. One SULI respondent contributed, “A lot comes down to individual interactions with one's mentor and research team and there are limits to what program design can do along those lines.”

Examining Respondent Outcomes

URE have a significant role to play in college completion and workforce development in the STEM fields including increasing alumni attainment of the following goals:

- **Short-term Goals:** increase participant’s interest in the STEM disciplines and fostering a desire to obtain a STEM baccalaureate degree and doctoral degree
- **Mid-term Goals:** continued alumni involvement in STEM fields, including obtaining a baccalaureate and (if applicable) a master’s degree in a STEM discipline
- **Long-term Goals:** continued involvement in STEM fields, including obtaining a terminal degree and entrance into the STEM workforce

The Project Conceptual Model was adapted by the Vanderbilt Project Team to explain how a URE works (or should work) to achieve these program goals. The preceding discussion compared SURF and SULI participants’ experiences through the lens of this framework. The conceptual model also informs the discussion of the relationship between participant experiences in the URE and the attainment of the URE’s short-, mid- and long-term outcomes. The following discussion will present the findings of a comparison of SULI and SURF alumni on the short-, mid-, and long-term outcomes stated above.

Short-Term Outcome: Overall URE Satisfaction. Respondents answered a number of questions about their overall satisfaction with the URE, which is reflective of how well the URE is achieving its short-term goals. Almost all SULI (ninety four percent) and SURF (ninety seven percent) alumni agreed that attending the program was the right decision for them. The mean responses of SULI and SURF alumni were not significantly different on any item or on the scale as a whole, $t(98)= -.11$, $p=0.91$, as shown in Table G8.

Most survey respondents (from both programs) expressed strong satisfaction with the URE experience; however, only sixty seven percent of respondents indicated that they believed the experience helped them to perform better academically, a factor which indirectly leads to the mid-term goal of academic persistence. Plausible explanations include that the respondents already felt that they were performing well academically before the program or that the knowledge they gained in the URE did not directly correspond with academic requirements.

Respondent Short-Term Outcome: Continued Research Activity. The Research Activity scale measured the respondents' likelihood of participating in a variety of research activities because of their URE experience. As with all of the previous scales, respondents from both programs provided very similar responses, $t(125)=0.198$, $p=0.843$, as shown in Table G9. Respondents indicated that their involvement with research activity would extend beyond the URE. Alumni from both programs indicate that they are likely to deliver an oral presentation about the results of their research (SULI eighty percent, SURF eighty eight percent). No less than sixty six percent of alumni from either program reported that they were likely to participate in research-related field trips to other labs, attend student conferences on research, co-author a paper in a professional journal, or other research activities.

Respondent Long-Term Outcome: Doctoral Intent. The majority of SURF respondents (eighty two percent) and SULI respondents (sixty six percent) reported their intent to obtain a doctoral degree or other terminal degree in a STEM discipline as shown in Table H1. As noted above, the URE attended is significantly associated with this aspiration, χ^2 (1, N=140)= 4.70, p=0.03, Θ=0.18. This association between URE and intent to obtain a doctoral degree is no longer significant when controlled for either gender [χ^2_{CMH}=0.01, 1 d.f., p=0.94] or ethnicity [χ^2_{CMH}=0.00, 1 d.f., p=0.98].

The Vanderbilt Project Team analyzed the characteristics of respondents from both programs to identify associations with intent to earn a doctoral degree. Previous participation in another URE, specified academic discipline before the URE, and undergraduate GPA before the URE are each significantly associated with intent to earn a doctoral degree. The undergraduate level during the program did not have an association with the intent to obtain a doctoral degree, yet only 7.8 percent of respondents who were freshmen when they participated in the URE reported intent to earn a doctoral degree (as compared to those who participated while in other undergraduate levels). Race, gender and ethnicity do not have a significant association with intent to obtain a doctoral or other terminal degree.

Respondent Long-term Outcome: Workforce Intent. When asked if they intended to seek employment at a national lab or institute slightly more SULI alumni (seventy one percent) agreed than SURF alumni (sixty nine percent) as shown in Table H2. The alumni's URE was not significantly associated with intention to seek employment in a national lab or institute, χ^2 (4, N=137)= 2.54, p=0.64, Θ=0.14. Additionally, gender, ethnicity, race, previous participation in another URE, the specified academic discipline before the URE, undergraduate GPA before the URE, and the alumni's undergraduate level when he or she participated in the URE is not significantly associated with the intention to work at a national lab or institute.

Conclusion

With a few exceptions, SULI and SURF alumni who completed the project survey indicated very comparable and favorable URE experiences. As interventions, URE programs seek to keep participants in the STEM pipeline to increase interest in the discipline (short-term), obtain a baccalaureate STEM degree (mid-term), and obtain a doctoral STEM degree and eventually entrance into the STEM workforce (long-term). Findings indicate that nearly if not more than three-quarters of the responding alumni from both programs have been retained in the STEM pipeline and plan to obtain to a doctoral degree and enter the STEM workforce. These findings further support the selection of SURF as a comparable program, in response to Project Question 1, as discussed the Project Research Design section of this report.

PROJECT LIMITATIONS

Despite the best efforts of the Vanderbilt Project Team to reduce and/or eliminate biases and errors in addressing the project questions, several limitations warrant consideration in interpreting the project's findings and recommendations. Some of these limitations are specific to particular methods whereas others are inherent in the client-based nature of the overall project. The limitations fall into four subcategories: (1) client-driven research, (2) design limitations, (3) time and resource constraints, and (4) measurement difficulties and statistical issues.

Client-Driven Research

Chief among these limitations is the inherent nature of the client-driven project. The Vanderbilt Project Team designed and conducted this study on behalf of WDTS, which oversees the SULI program. As such, the project was designed with SULI as the reference point. For example, comparable programs were considered based on their degree of "match" with the SULI program. This orientation and the relationship of the project team with WDTS may introduce bias into the study.

Design Limitations

The project team selected and adapted Reason and Terenzini's (2005) Comprehensive Model of Influences on Student Learning and Persistence to frame their understanding and discussion of the URE. This model also acted as a guide the selection of comparable programs, the identification of URE best practices, comparisons of programs, and as a conceptual framework in the development of the alumni survey. This model was selected because it appeared to fit the

URE; however, selection of this model was influenced by the project team's experience and familiarity with higher education models. The introduction and use of this model may have biased the project team's perspective of what was important in the project.

While the project team attempted to review all potential programs to identify all possible comparison federal programs, it is possible that other comparable programs were not considered for inclusion in this study. The project team developed an original rubric to assist in the identification of comparable programs. Determining which criteria to use in the identification of comparable UREs was a subjective process rooted in the extant literature and the Project Conceptual Model. Assessing the programs for comparability using the rubric may have led to the exclusion of programs that should have been included or the inclusion of programs that are not otherwise comparable.

The project team developed an original matrix to identify the URE best practices. The use of the Project Conceptual Model as a heuristic to guide this process may have limited or distorted the project team's perspective of the extant literature. While the purpose of the matrix was intended to identify elements of the comparable programs that fell within the selected qualities of a URE best practices, there may be other qualities of effective programs that are not included in the matrix. Further, the identification of these best practices is heavily influenced by researcher bias. Both the validity of the comparable programs' selection and the evaluation of each of the programs using the matrix are dependent on the accuracy of the information gleaned from the documents the team reviewed and analyzed, including program websites, many of which were promotional in nature, and federal reports some of which were quite dated. The program websites provide a glimpse of the information available to prospective applicants and provides information that is not otherwise available to us; however, it is important to note that the information provided may not accurately portray what happens at the URE. It is also important to note that the websites varied in their degree of quality. The REU study focused only on engineering which limits is generalizability to all REU program experiences (NSF, 2008a). There is the potential for issues of inter-rater reliability as two members of the project team developed completed matrices for the four programs. The project team also acknowledges that the document analysis may not have identified and analyzed all relevant and salient documents available to review.

Only one of three comparable federal programs elected to participate in the alumni survey, which sought to address the third project question. The Vanderbilt Project Team acknowledges that the survey of program alumni would have been more robust with the inclusion of alumni survey data from additional comparable programs. Unfortunately, it is possible that there was a disincentive for federal agencies, such as NASA, to participate in the evaluation as future funding could be impacted if the Vanderbilt Project Team found that their program was less effective than other comparable programs.

The comparison of the short-, mid-, and long-term outcomes for both SULI and SURF alumni would be improved by the introduction of a counterfactual (Shadish, Cook, & Campbell, 2002). Some research indicates that students may identify science as a career path as early as age six (Klein, et.al, 2007). Given this, it is difficult to know how many of the alumni would have pursued a doctoral degree and joined the STEM workforce without participating in the research experience.

Although the original survey instrument that the project team developed was informed by both the extant literature on expected outcomes of URE and higher education persistence literature, adding to its face and construct validity, it was conceptualized within the URE Project Conceptual Model. There are likely to be additional factors that contribute to an individual's persistence in the discipline and entrance into the STEM workforce that were not identified in this literature or through the Project Conceptual Model and were not measured via the survey.

Time and Resource Constraints

This project was conducted as part of the project team's doctoral degree requirements with a timeline that was couched within an existing academic program. As an executive doctoral program, each of the project team members continued their full-time jobs and completed additional academic classes throughout the duration of the project. Financial resources available to project team were also constrained by Vanderbilt University. For example, the project team had an opportunity to conduct in-person interviews with chief administrators for SULI and the identified comparable programs but was unable to complete these because of limited travel funds.

Time and resource limitations prohibited the project team from pilot testing this study. The NSF (2008) conducted eight pilot administrations of their well-known URE evaluation survey prior to formal use in their study. With the timeline for this project, the Vanderbilt project had only a few months to develop and administer their survey. As such, the Vanderbilt Project Team identified items that were redundant, did not fit with its scales, were poorly worded, should have included an "not applicable" option, did not lend themselves to analysis, and other items that should be improved upon or added prior to future administrations of the survey. The skip-logic within the

SurveyMonkey™ software did not work as intended. The Vanderbilt Project Team was also unable to test test-retest reliability or split-halves reliability to ensure the reliability of the instrument, although internal consistency reliability was assessed with the Cronbach's alpha for each of the scales used in the study. These issues with the survey instrument may have resulted in undetected measurement error.

Additionally, the time and resource constraints imposed on the project team prohibited the team from surveying scientists/mentors or agency administrators who may have been able to provide helpful information that would assist in triangulating program findings in the Making Comparisons and Examining Experiences sections. The addition of these perspectives would have further strengthened the study.

Measurement Difficulties and Statistical Issues

At 186 items, the alumni survey required an investment of as much as 30-40 minutes of respondents' time. Although Cook, Heath, & Thompson (2000) found no relationship between the response rate and the length of a web-based survey, it is possible that the respondents gave less care to the items at the end of the survey or even began to skip some because of survey fatigue. This is suggested by the lower number of respondents on items that occurred close to the end of the survey. This could have resulted in inaccurate measurement and analysis of findings.

The alumni samples provided to the project team by SULI were randomly selected and stratified by national laboratory and can be assumed to be representative of the SULI population for the cohorts they represent, although descriptive statistics of the SULI population are not available and this cannot be confirmed. The SURF surveys were administered via Facebook© groups and had the opportunity to reach a much larger percentage of the SURF population than did the SULI surveys. Further, the cohort years sampled for the two programs were different, complicating the comparison of outcomes between the two groups. This is mitigated to some degree by using intent to obtain a doctoral degree and intent to work in a lab as proxies for the attainment of these goals, however, many of the survey respondents participated in the URE so many years ago that it is possible their long-term outcomes had already been attained.

The Vanderbilt Project Team did not ask respondents to provide the year that they participated in the URE, as such, it cannot be determined if the alumni survey responses may over-represent alumni who participated in more recent cohorts. The alumni email addresses provided to project team by SULI were from participants' original applications. A large number of email addresses from earlier cohorts were inactive and so it is possible that there is heavier representation from participants in the more recent cohorts. If there have been programmatic or other historical changes to the administration of SULI during the last ten years, it is possible that there are factors influencing the alumni of these programs about which the project team is unaware. The more recent SURF cohorts have joined Facebook© groups that are administered by SURF and represent a larger percentage of participants than do the Facebook© groups from the earlier 2000s as shown in Appendix F.

The study samples may over represent alumni who remained within the discipline. Alumni from both SULI and SURF who remain in the discipline and pursue a doctoral or other terminal degree may be more likely to stay connected to their URE program and voluntarily participate in the study than alumni who have sought work in other disciplines. These alumni may look back favorably on their time in the URE and may experience a “halo effect,” remembering all aspects of their URE as favorable (Nisbett & Wilson, 1977). Collins (2003) found that memories of a unique experience are more detailed than memories of a routine experience. Both the presence of a “halo effect” and the memory phenomenon referenced by Collins are suggested by the high multicollinearity of the scales used in this study. Additionally, because of maturation and history effects, alumni may have responded differently immediately following their URE than they did after time has elapsed threatening the internal validity of the study. Alumni who participated in the survey may differ in other important and undetected ways from participants who did not complete the survey that have not been explored by the Vanderbilt Project Team.

The scales used in the study are highly correlated with one another as are each of the individual variables. Because of the small sample size, the project team could not conduct a meaningful multi-layered chi-square test to measure the relationship between each of the individual variables. The small sample size also precluded calculating the homogeneity of the odds ratio and the Mantel-Haenszel Common Odds Ratio. High multicollinearity ruled out factor analysis and precluded the development of a regression model using several independent variables. The results appear favorable to a path analysis approach; however, this approach would require more observations than were obtained in this study.

The Vanderbilt Project Team considered the use of logistic regression to test the nominal dependent variables. This idea was rejected for the following reasons: (1) WDTS was interested in the program’s effects on the long-term outcomes of intent to doctoral degrees and intent to work in a national laboratory. The layered Chi-Square tests did not indicate that the program selection was significantly associated with these long-term outcomes. Therefore, a logistic regression would not serve to further answer the client question. (2) Logistical regression is best suited for data that does not have high multicollinearity, unlike the data used in this study

(Statistics Solutions, 1996-2011). (3) Multiple logistic regression requires at least 10 responses per independent variables—some statisticians recommend 30 (Statistics Solutions, 1996-2011). With intent to earn a doctoral degree, this would only allow, at most, 14 different independent variables. Logistic regression assumes that all needed variables (but no extra) are included (Statistics Solutions, 1996-2011). With only 14 independent variables, the Vanderbilt Project Team would not be able to fully test the hypothesized logistical regression model. At a minimum, the Vanderbilt Project Team would want to test the GPA at the time entering the program, which class the student was in at the time of participation, the seven scalar variables from the Reason model, race, ethnicity, and program. With the dummy-variable coding, this would be 19 variables and exceeds the 14 allowed for a sample of this size. For these reasons, the Vanderbilt Project Team elected not to utilize logistic regression.

These limitations should be considered in the interpretation of the findings of this study. They also provide direction for how studies of this kind can be improved in the future.

SUMMARY OF KEY FINDINGS FOR EACH STUDY QUESTION

In *MAKING COMPARISONS & EXAMINING EXPERIENCES: A Program Evaluation of the Department of Energy's Student Undergraduate Laboratory Internship (SULI) Program*, the Vanderbilt Project Team focused their work around three central, guiding questions. In this section of the report, the findings from each of these guiding questions are summarized.

Project Question 1: *What existing federally-funded STEM education/workforce development programs offer comparable experiences? Of those, which are the most comparable to SULI?*

To answer project question one, the Vanderbilt Project Team used an unweighted rubric to identify three federally-funded STEM education UREs that are comparable to SULI. They looked to both the academic literature on what a STEM URE program is but also looked to the SULI program, listing its features in a rubric so that selected programs would be of a comparable nature.

- **Finding 1.1:** The National Science Foundation Research Experiences for Undergraduates Program is a comparable program to SULI
- **Finding 1.2:** The joint National Institute of Standards and Technology/National Science Foundation Summer Undergraduate Research Fellowship is a comparable program to SULI
- **Finding 1.3:** The National Aeronautics and Space Administration Undergraduate Science Research Projects program is a comparable program to SULI

Project Question 2: *Are there organizational and programmatic features of undergraduate research experiences that lead to persistence in the discipline and eventual entrance into the STEM workforce? To what extent do SULI and the identified comparable programs reflect these features?*

Next the Vanderbilt Project Team conducted a review of the scholarly literature to develop a list of URE best practices. Using the Project Conceptual Model as a point of reference, the Vanderbilt Project Team conducted a document analysis to compare and contrast the four URE programs' organizational contexts in light of the identified best practices. Given the expected variation between sites, these findings are drafted from the "national" program perspective.

- **Finding 2.1:** SULI is a fully-developed program with many features that are consistent with the best practices identified in the literature and that are comparable to the other federally-funded URE programs.
- **Finding 2.2:** SURF is successful in promoting social integration through the provision of communal housing for participants.
- **Finding 2.3:**REU is the only program to use academic credit to attract prospective applicants.
- **Finding 2.4:**None of the programs provide support to alumni in continue their research or make travel funds available so that alumni can present papers based on their URE research.
- **Finding 2.5:**None of the programs make efforts to highlight their diverse scientist/mentors or use diversity in their marketing efforts.
- **Finding 2.6:** All four programs have a web presence and utilize online marketing strategies to some extent; however, the USRP program is the most advanced in its use of web technology to connect with potential participant.
- **Finding 2.7:** Only the SURF program has a formal and defined process for applicant selection; however, each URE uses prior achievement and level of motivation in selecting participant. None have a formal process for airing grievances or reconsidering decisions.

- **Finding 2.8:** Only REU indicated that it used race/ethnicity as a plus factor when making application decisions.
- **Finding 2.9:** All programs appear to make placement matches based on the participant's pre-program characteristics and experiences and the scientist/mentor's research interests.
- **Finding 2.10:** USRP is the only program to make early offers of admission for exceptionally qualified applicants as a way to enroll participants with desired characteristics.
- **Finding 2.11:** Each of the programs collect data from participants; however, how and when this data is collected, who collects it, the type of data collected and the actions taken based on the findings are not always clear. Only USRP solicits feedback from mentors, but none solicit feedback from administrators.
- **Finding 2.12:** None of the programs attempt to measure participant gains from the URE.
- **Finding 2.13:** None of the programs utilize a formal process to collect long-term outcome data from participants.
- **Finding 2.14:** USRP and SURF have been successful in maintaining contact with program alumni by using the internet, including the use of social media.
- **Finding 2.15:** None of the URE programs have a formal process to promote social integration among program participants; most efforts toward social integration were dependent on the site and number of participants at the site.
- **Finding 2.16:** All of the programs neglected to emphasize the role of the research team or even describe the team, with whom the participant will spend the bulk his or her time.
- **Finding 2.17:** Programs lacked clarity and consistency in the role of the scientist/mentor. None of the programs required a formal training or a list of roles, responsibilities, and expectations for mentors.

- **Finding 2.18:** While the Vanderbilt Project Team found limited information in the document analysis on the UREs' scientist/mentor-mentee relationships, it did not find any policies or training materials that emphasized the importance of scientists/mentors providing students assistance with graduate school or career advice.
- **Finding 2.19:** None of the programs consistently used and required a formal mentoring partnership agreement between participants and scientists/mentors that contain a scope of work, a list of responsibilities, and a timeline of activities that should occur in the URE.
- **Finding 2.20:** There was a disparity among URE programs in the information available on lab-based experiences, with most not including information on lab-based learning goals.
- **Finding 2.21:** None of the programs have a prescribed training program for participants; however, some sites require pre-program online training while others send materials in advance for the participant to review.
- **Finding 2.22:** Programs conduct co-curricular and extra-curricular programming; however, there is no uniformity in the type, quality or number of URE co-curricular and/or extra-curricular experiences.
- **Finding 2.23:** No programs appeared to provide consistent and formal opportunities for participants to interact professionally or socially.
- **Finding 2.24:** All programs had defined deliverables participants are expected to produce in their URE; however, none included preparation and submission of a journal-quality article.

Project Question 3: *How are the actual experiences and outcomes of SULI participants and those in comparable programs similar or different?*

Finally, in answering its third project question, the Vanderbilt Project Team developed an original survey tool to explore the actual lived experiences of program participants. The survey was administered to groups of program alumni from both SURF and SULI.

- **Finding 3.1:** In the experiences of participants, the programs were quite similar (as measured by aggregate scales) and generally positive (as measured by survey items within the scales).
- **Finding 3.2:** Respondents' intentions to obtain a doctoral degree or to work in a national lab were independent of the program selected when controlled for gender or ethnicity.
- **Finding 3.3:** Prior research experience, however, was associated with the intent to obtain a doctoral degree.
- **Finding 3.4:** Freshmen students were the least likely to report an intent to earn a doctoral degree or to work in a national laboratory.
- **Finding 3.5:** The top four reasons respondents from either program decided to apply for the URE include (1) experiencing "hands-on" research experience, (2) learning more about being a researcher, (3) receiving a stipend, and (4) to have having an edge when applying for graduate school. In addition to applying for SULI, thirty seven percent of the SULI respondents also applied to other UREs.
- **Finding 3.6:** SULI respondents most commonly selected "website' when asked how they learned about the SULI program
- **Finding 3.7:** Participants frequently applied to more than one URE.

- **Finding 3.8:** SURF respondents listed housing as a reason why they chose SURF over other URE offers.
- **Finding 3.9:** SULI respondents indicated agreement with a variety of mentor qualities, but had less agreement regarding the mentor availability.
- **Finding 3.10:** SULI and SURF alumni survey respondents expressed the lowest agreement on the research team and peer experiences when asked about close, personal relationships.
- **Finding 3.11:** SULI and SURF respondents expressed less satisfaction with the quantity time spent with the research team. SURF was significantly lower than SULI.
- **Finding 3.12:** Alumni of both programs responded similarly and less favorably to three items, although no significant differences were found between the programs: being able to complete the research project, the presence of intellectually stimulating activities in the lab, and the opportunity to provide input into the design of the research project.
- **Finding 3.13:** A variety of potential extra-curricular experiences were recommended by alumni, including paper and abstract writing classes, tours of other labs and research projects, informational seminars, and grant funding courses.
- **Finding 3.14:** Some respondents also expressed concerns about the quality of existing co-curricular and extra-curricular experiences.
- **Finding 3.15:** Alumni from both programs indicate that they are likely to deliver an oral presentation about the results of their research.
- **Finding 3.16:** 66 percent of SULI alumni respondents report their intention to obtain a doctoral or other terminal degree
- **Finding 3.17:** 69 percent intend to seek employment in a national lab or institute.

- **<u>Finding 3.18</u>:** SURF respondents' short-term outcomes were also similar to those indicated by SULI survey respondents.

Using this discussion of findings as a basis, the Vanderbilt Project Team will offer program recommendations in the following report section.

RECOMMENDATIONS AND SUGGESTIONS FOR IMPLEMENTATION

The purpose of this program evaluation was to provide WDTS with an evidence-based understanding of the SULI program's outcomes when compared to other, similar federally-funded undergraduate URE programs in the STEM fields and best practices in the extant literature. Furthermore, WDTS wanted a better understanding of SULI's actual outcomes as they relate to the anticipated outcomes of URE, specifically educational attainment and workforce development. The Vanderbilt Project Team engaged in a four- step process that included traditional qualitative and quantitative methods to address the three interrelated project questions.

1. What existing federally-funded STEM education/workforce development programs offer comparable experiences? Of those, which are the most comparable to SULI?
2. Are there organizational and programmatic features of undergraduate research experiences that lead to persistence in the discipline and eventual entrance into the STEM workforce? To what extent do SULI and the identified comparable programs reflect these features?
3. How are the actual experiences and outcomes of SULI alumni and those alumni in comparable programs similar or different?

Based on the project findings and the academic literature, the Vanderbilt Project Team developed the following recommendations.

<u>Overarching Recommendation</u>

A common weakness of federally-funded STEM education programs as identified by both the GAO (2006) and the ACC (U.S. Department of Education, 2007) is the problem of decentralization in which programs lack central control features that not only ensure consistency in the big things, such as the program attaining its objectives, but also in the smaller areas, such as what should be included in a program orientation. SULI is not immune from this weakness.

Peters and Waterman (1982) make an argument for organizations in which both firm central control and individual autonomy exist, stating that organizations that practice these loose-tight properties are not only successful, but that they create opportunities for creativity and entrepreneurship by providing the individual employee with a great deal of freedom and latitude, despite the seemingly rigid set of basic values and an established organizational culture. For example, the central program office at NIH NRSA MARC U-STAR program, a non-comparable program described in the Making Connections section, mandates that all participating sites conduct a thorough, annual program evaluation according to an established set of criteria. Beyond the demand for an evaluation, the individual programs are free to use their own judgment in developing their relevant criteria.

WDTS should build stronger central control features to manage the expected outcomes, the uniformity of experience and the organizational context while giving individual sites and labs programmatic control within the overall program guidelines.

A More Appealing Program Structure

SULI's program structure is consistent with the programs selected for comparison; however, it would do well to explore and incorporate features of the other programs into its own program structure:

- National labs should explore opportunities to create and support participant social integration through communal housing. For many SURF participants, the housing offered was a deal-maker and for many others, the peer experiences that occurring in this extra-curricular setting were invaluable persistence (Findings 2.2 and 3.7).

- WDTS should facilitate relationships with colleges and universities to offer credit for the URE experience, whether through a practicum, co-operative learning credit, or other acceptable format (Finding 2.3).

<u>Increase Web Presence and Usage of Social Media</u>

- Taking a page out of the USRP playbook, SULI should modernize its website to include the myriad of tools and ways to connect that are found on other URE program sites. WDTS should use effective website marketing including alumni testimonials to better market the program (Findings 2.6 and 3.5).
- SULI should increase its name recognition (COV, 2009) through (1) becoming familiar with the “best” tools to reach its target market, (2) use of loose-tight properties to define social media usage across national labs and outline the ways sites may engage in social media using the SULI brand to ensure that a consistent message is being conveyed, and (3) constant maintenance and updates, which keeps the site higher on the search engine algorithms (Posner, 2011) (Findings 2.6 and 3.5).
- WDTS should highlight its diverse scientists/mentors and the role of the research team in its marketing efforts (Findings 2.5, 2.16, 3.6, 3.8 and 3.16).
- WDTS officials should increase the use of social media and video for recruitment of SULI applicants (Findings 2.6 and 3.5).The use of social networking is increasing in the higher education realm with 82 percent of all admissions officers now utilizing Facebook™ to recruit

students and maintain connections with alumni (Protalinski, 2011). WDTS officials may also explore opportunities to collaboratively advertise SULI on a joint website with other Federal UREs.

Participant Selection Should Be Driven By Outcomes

WDTS should start with the end in mind by selecting participants who will be most likely to be successful and to benefit from the SULI experience.

- SULI program staff and its mentors/scientists should consider prior research experience, including prior SULI experience, in selecting students, because these students are the most likely to benefit from the URE and go on to persist in the discipline (Laursen et al., 2010; NSF, 2008a) (Findings 2.9, 3.3, 3.8 and 3.15).

- Additionally, participants who are better prepared can contribute more to the project and may experience less frustration than underprepared participants. Although this may limit the number of individuals who are able to take part in the SULI URE experience, it provides a deeper experience for the participant, provides a more qualified participant for the program, and will likely increase the program's long-term attainment rate. As a result, SULI may want to limit eligibility to sophomores, juniors and rising seniors (Finding 3.4).

- WDTS should formalize the participant selection process and make it more transparent, including a grievance process (Finding 2.7).

- SULI scientists/mentors should begin the application review process prior to the deadline and offer early admission to exceptionally qualified applicants (Finding 2.10 and 3.10).

Operationalize Objectives and Evaluate Them

Many of the findings in the previous section can be attributed to a lack of overall objectives at all three levels of the program (the national program, the individual national labs/project sites, and the individual scientist/mentor labs). The DOE has established the twin goals of educational advancement and workforce development as key program outcomes of the SULI program. These goals are supported by both the academic literature and the COV (2009) report; however, the Vanderbilt Project Team could not obtain concrete, measurable goals from SULI for use in the program evaluation.

- Objectives should follow SMART principals, in which objectives are specific, measurable, attainable, relevant and time-bound (Doran, 1981). Measurable, realistic goals allow organizations to measure progress towards overall outcomes (W.K.Kellogg Foundation, 2004). Only by spelling out exactly what the goal is can everyone get on the same page.

- Program staff can work backward from the clear and measurable objectives, following from Wiggins and McTighe (2005), to define the programming that will help SULI actually achieve the established goals.

- With the key programmatic components developed with the goal in mind, every activity, every conversation, every decision can pivot on the objective, increasing the likelihood that they will be attained.

SULI/WDTS acknowledges that it has conducted independent assessments in the past, but does not regularly engage in them; however, these are essential for program accountability (COV, 2010; U.S. Department of Education, 2007).

- WDTS should conduct valuable program evaluations that contain actionable feedback for program staff and scientists/mentors (Cannon & Witherspoon, 2005) (Findings 2.11 and 3.11).

- WDTS should supplement its current entrance/exit surveys to solicit feedback from all stakeholders, including scientists/mentors and administrators (W.K. Kellogg Foundation, 2004) (Finding 2.11).

- Survey questions should ask about the participant's intent to obtain a doctoral or other terminal degree and his/her intent work in a national lab. These currently unmeasured intentions may be among the best predictors of alumni long-term outcome (Ajzen, 1991) (Finding 2.11).

- At the end of the URE, participants and scientist/mentors should work collaboratively to complete a checklist of participant gains from the program, including lab-based, co-curricular, and extra-curricular gains (Findings 2.12, 3.8, 3.9, 3.12, and 3.13).

- WDTS should create a social networking presence, using sites like LinkedIn and Facebook© for its SULI participants and alumni to interact and to keep contact information current (Finding 2.14).

- WDTS should engage alumni to maintain up-to-date contact information so that WDTS can track long-term outcomes (Finding 2.13).

Make the On-Boarding Process Consistent Across Project Sites

- URE participants gain important skills in the laboratory (Laursen et al., 2010; Sadler et al., 2010), but making the URE more consistent across all sites requires defining a certain "toolbox" of skills, techniques and understandings that all SULI participants should have when they leave the program. This toolbox should be organized by STEM discipline and sub-discipline and be directly tied to educational attainment and workforce development goals (Findings 2.12, 2.18, 2.19, 2.20, 2.21, 2.22, 3.9 and 3.15).

- WDTS should develop and mandate curriculum goals for SULI participants' orientation which include not only program information, expectations, and opportunities to ask questions, but also time for students to build relationships and interact professionally and socially (Findings 2.15, 2.22 and 3.9).

- Existing on-site research teams should be made aware of the SULI program's purpose and goals prior to the arrival of a participant. They should be made aware of their individual and collective roles in working with and developing the participant through the URE (Findings 2.16, 3.10, and 3.16).

- WDTS should encourage scientists/mentors to communicate program expectations and project educational requirements before the start of the program. Prior to the participant's first day at the national lab, he or she should already be in communication with his or her scientist/mentor and should have received materials outlining in-house training requirements and any background literature that should be read before the start of the URE. Prepared participants can engage with the research more quickly and may better understand how the project fits into the "bigger picture" of science (Findings 2.18, 3.8, 3.11, and 3.15).

Establish Participant Expectations Early On

- WDTS should build shared accountability for mentors, participants, and members of the research team by sharing goals and objectives and tying them to individual goals to build a sense that "we're all in this together" (Findings 2.12, 2.18, 2.19, 2.20, 2.21, 2.22, 3.7, 3.9 and 3.10).

- WDTS should establish work product standards for participant work, whether it be a poster, abstract, PowerPoint or paper. These standards should be clearly communicated to the participant at or before program orientation (Finding 2.24).

- WDTS should develop a mentor/participant contract that can be used in navigating these relationships. The document should include an outline of the grievance processes. The education coordinators at each national lab could work together to share best practices (Findings 2.18, 3.8, 3.9, 3.11, and 3.15).

- National labs/sites should focus more attention on providing a uniform experience, including foundational lab-based, curricular, co-curricular, and extra-curricular experiences that will lead to persistence (Findings 2.12, 2.18, 2.19, 2.20, 2.21, 2.22, 3.12, 3.13, and 3.15).

- WDTS and the Office of Education personnel should jointly construct a scientist/mentor handbook. Certain local program sites have already created scientist/mentor expectation documents. The USRP scientist/mentor information may also prove valuable. The handbook should discuss appropriate project scopes, scientist/mentor curricular expectations (including availability), and expectations encouraging scientists/mentors to share career and graduate school advice. The handbook could draw upon the best practices at each site (Findings 2.18, 2.19, 2.20, 2. 21, 3.8, 3.9, 3.11, and 3.15).

- The Office of Education personnel should jointly construct a research team handbook. This handbook would address team expectations and norms. This handbook could draw upon the best practices from each site (Findings 2.16, 2.18, 2.19, 2.20, 2.21 and 3.10).

- URE program administrators and scientists/mentors should work together to create a trajectory for each STEM discipline represented at its national lab that outlines the path both within the program and beyond, including the take-aways the participant should expect to receive in the URE and how they support the participant's academic and career goals. If the program site offers a variety of co-curricular and extra-curricular activities for participants, then the discipline-based roadmap might highlight those that are most closely related to the participant's interests (Findings 2.18, 2.19, 2.20, 2. 21, 3.7, 3.8 and 3.9).

- Office of Education personnel should establish and maintain uniform guidelines for mentors and research teams (Findings 2.16, 2.18, 2.19, 2.20, 2.21, 3.10, 3.11, and 3.16).

Scientist/Mentor-Participant Interactions Should Be Frequent and Beneficial

While scientist/mentor-participant interactions can take many forms, from one-on-one mentoring sessions and hands-on learning in the lab to social gatherings, scientists/mentors members must be intentional about increasing interaction beyond scheduling a weekly or bi-weekly meeting (Halawah, 2006). Institutions that include higher rates of student-faculty interaction within their organizational context and then work to ensure that individual student experiences include meaningful interactions with faculty both in and out of the classroom will likely see higher levels of persistence in the student body. As Lopatto (2007) notes, faculty mentoring of students improves student-learning outcomes and increases student persistence rates too. If interactions are to occur, they should not only be intentional, but they should also be positive in nature. In college environments, increases in student-faculty interaction have been linked to a host of positive benefits for students, including academic achievement, stronger institutional connection, increased reflexive thinking, academic integration, and increased persistence to completion (Buckley, 2008). The relative gains in a URE should be similar in nature.

Unfortunately, as evidenced in the survey findings and WDTS 2009 Pre- and Post-Survey Summary, there is often very little epistemological congruency (EC) between how the participant understands the role of the scientist/mentor in the URE and the scientist/mentor's understanding. The EC is "the degree of similarity between students' and faculty members' beliefs about learning" (Fruge & Ropers-Huilman, 2008, p. 121). Reaching EC (Tinto, 1993; Treisman, 1992) involves making a match between participant needs, interests, and preferences with those of the organizational context, specifically the scientist/mentor culture. Students who pursue a degree in a STEM field are highly motivated (Foltz, et al., 2009) They also usually have strong encouragement from their families, which in Moore, Hossler, Ziskin and Wakhungu's (2008) study of three institution types was the strongest predictor of persistence. This high level of goal commitment and family encouragement leads to a higher EC for the participant, but it is the scientist/mentor's role to "uphold" the other half of the relationship with a dedication to both the participant and the lab-based learning, and also the curricular, co-curricular, and extra-curricular experiences that reinforce URE retention efforts (Fruge & Ropers-Huilman, 2008).

- WDTS should provide clear scientist/mentor expectations for scientist/mentor-participant interactions (Findings 2.17, 3.8, 3.9, 3.11, 3.15 and 3.16).

- WDTS should implement meeting guides for scientist/mentor-participant meetings. For example, when meeting with their scientists/mentors over the course of their URE, participants could plot their course and make informed decisions using a decision tree similar to the one described by Braxton, et al. (2004), such as whether to change minors, take a semester abroad, or apply for an internship (Findings 2.17, 3.8, 3.9, 3.11, and 3.16).

In academic settings, co-curricular experiences would take place in discipline- or department-based clubs, such as the mechanical engineering club or the clinical journal club, which create environments for anticipatory socialization that is not based on lab-based or curricular experiences. Chang, et al. (2008) found that those who joined these academic clubs increased their chances of completion by 130 percent or 150 percent for minority students. Programs that allow students to practice professional skills (such as giving a poster presentations) have been shown to increase student persistence (Astin, 1993; Tinto, 1993). Extra-curricular experiences cannot be ignored because of the important role they play in fostering social integration, building a supportive network and the growth of the peer environment (Braxton, et al., 2004). UREs that are sensitive to participants' needs may offer co- and extra-curricular programming that support a broad range of needs, such as the following: preparation for the Medical College Admission Test, how to write a personal statement for a graduate school application, discipline specific lectures or talks, and providing information on scholarship opportunities or internships that might be of benefit to the participants' futures. Research is at the heart of the undergraduate research experience and for this reason, the recommendation to engage in additional co-curricular and extra-curricular programming is tempered with the realization that these programs could take away from the research experience. As WDTS endeavors to engage participants socially and professionally in co-curricular and extra-curricular activities, the programmatic goals should be carefully considered and integrated in such a way that the co-curricular and extra-curricular activities complement the lab-based and curricular experiences.

- WDTS should utilize Co-Curricular and Extra-Curricular Experiences to supplement the Curricular Experiences (Findings 2.12, 2.16, 2.18, 2.19, 2.20, 2.21, 2.22, 3.9, 3.12 and 3.13).

- National laboratories with few SULI participants should work with other institutions and other federal agencies to deliver the same high-caliber programming and experiences as the sites with the highest yields. This is especially important in co-curricular and extra-curricular programming (Findings 2.12, 2.16, 2.18, 2.19, 2.20, 2.21, 2.22, 3.9, 3.12, and 3.13).

Recent research (Wawrzynski & Jessup-Anger, 2010) has supported the often-touted virtues of living-learning communities, that they increase persistence as well as improve the overall learning environment. By creating shared or communal housing for program participants, URE programs can facilitate a collaborative atmosphere and promote learning across STEM disciplines, networking, and peer learning. The National Study of Living-Learning Programs (Inkelas, 2007) found that female respondents who resided in STEM-based living-learning communities felt more academically supported than in traditional residence halls and the communities eased their transition into college and enhanced their sense of belong.

- SULI should utilize communal housing for all program participants to increase the extra-curricular aspect of the program (Findings 2.2 and 3.7).

<u>Maintain Relationships with Alumni</u>

- WDTS should engage alumni in ongoing research activities to keep them in the STEM pipeline (Laursen, et al., 2010; Lopatto, 2003; NSF, 2008a) (Finding 2.4).

- SULI should allocate a small amount of funding for alumni conference and travel expenses related to presentations of their SULI-based research findings. Allowing alumni to present at national conferences will also act as an advertising mechanism for the program (Finding 3.14).

CLOSING REMARKS

The Vanderbilt Project Team's recommendations are the result of a thorough review of the academic literature on UREs and persistence as well as the findings of the three project questions. The recommendations and findings were written to assist the WDTS in building the SULI program and in addressing concerns noted by the COV; however, most can easily apply to other URE programs, including both federally-funded and institutional and privately-funded URE programs.

Based on the results of this program evaluation, the themes suggested in current literature, and the comparison with other federally-funded URE programs, it is evident that SULI offers its participants an experience that is grounded in many best practices and which assists participants in meeting the outcomes outlined by the DOE. The results of this evaluation highlight the fact that there are additional steps SULI and WDTS can take to be more effective in helping participants achieve the stated short-, medium-, and long-term outcomes while also identifying opportunities for improving its evaluation process. Most importantly, SULI must overcome the problems associated with decentralization, lack of coordination, and incomplete self-evaluation. Ultimately, SULI must develop sound systems for collecting data that will clearly identify and describe participants' gains while in the program and link it to educational and workforce outcomes.

During their work on *MAKING COMPARISONS AND EXAMINING EXPERIENCES*, the Vanderbilt Project Team has enjoyed the opportunity to research and evaluate a federal STEM education program. Of particular satisfaction is the adaptation of the Terenzini and Reason (2005) to the URE context.

The Vanderbilt Project Team is thankful for the encouragement it received through its partnership with the WDTS and would like thank Sam Held for his guidance and support during the project performance period as well as the continued guidance of our advisor Professor John Braxton.

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Appendix A

Review of Literature on the URE and Relevant Higher Education Literature on Persistence

Literature on the URE

To identify a suitable comprehensive conceptual model to frame their discussion and evaluation of SULI and other comparable federally funded STEM education programs, the Vanderbilt Project Team began by reviewing the literature on UREs and how an effective URE works to achieve its short-, mid-, and long-term education and workforce outcomes. As defined in the literature, a prototypical URE meets three criteria:

- A student or student team executes a well-defined research project that is connected to the on-going research of the supervising scientist or the research team;
- Programs fully-immerse students in the research experience for 10 to 15 weeks during the summer or during an academic term; and
- The scientist/mentor provides individualized guidance to the student participant (Laursen et al., 2010, pp. 4).

Implied in this definition is that the participants should be undergraduates. Russell (2006) further specifies that undergraduate research does not include a co-op or internship program[1]. For the purposes of this study, UREs are defined as programs that embody all of these characteristics.

[1] Although SULI is called an "internship" it is in all respects a URE.

The academic literature on STEM undergraduate persistence is very clear about the positive role of the URE in student intellectual gains (Buckley, 2008; DePass & Chubin, 2008; Golde, 2005; Jones, Barlow and Villarejo, 2010). Both mentored and non-mentored UREs have "proved to be the best predictor of student gains in intellectual skills, career and collaboration skills, and research skills" (Buckley, 2008); yet less than one in four STEM students at baccalaureate colleges participate in a research project with a faculty member, while slightly fewer, one in five students at research universities and master's universities engage in faculty research (National Survey of Student Engagement, 2007).

The literature also clearly links UREs with keeping an undergraduate student in the STEM pipeline (Lopatto, 2007). In the Survey of Undergraduate Research Experiences (SURE) Lopatto (2007) found that "undergraduate research enhances the educational experience of science undergraduates, attracts and retains talented students to careers in science, and acts as a pathway for minority students into science careers" (Lopatto, 2007, p. 297). Furthermore, 68% of undergraduate students who engage in faculty research reported an increased interest in STEM-related careers while 83% indicated that they experienced increased confidence in their own research skills.

URE programs typically influence students through both the research experience itself and the student's relationship with a scientist/mentor (Laursen et al., 2010). Buckley (2008) notes that UREs not only foster faculty-student relationships, they also provide an underlying and supportive structure for more meaningful student-faculty interactions. Through these authentic experiences and the opportunity to make real contributions to scientific research, students learn both collaboration and professional skills while also gaining confidence and a sense of pride (Laursen et al., 2010; Sadler, Burgin, McKinney, &

Ponjuan, 2010). Nearly 75% of URE participants in one study (Laursen et al., 2010) describe gains in confidence and in their awareness of their own newly developing capacities. Personal gains experienced through working on research with a faculty member also translate into positive out-of-classroom experiences for students (Laursen et al., 2010).

UREs provide students with a compendium of skills, including gains in specific scientific content and principles, "Students reported gains in their understanding of concepts in science and mathematics: building deeper understanding, connecting ideas within and across fields or topics, and solidifying concepts already learned" (Laursen et al., 2010, p. 49). Students further reported growth in their research skills (formulating hypothesis, designing experiments, collecting data, and analyzing data), technological ability (such as how to use a piece of sophisticated equipment), communication skills (oral and written reports and presentations), computer skills, interpersonal skills (including working on a team) as well as a heightened sense of independence, increased mathematical skills (such as those in statistics), improved writing ability (information retrieval, understanding primary literature), and knowledge of scientific ethics. All of these can advance students' preparedness to be successful in both their academic pursuits and the STEM workforce (Laursen et al., 2010; Sadler et al., 2010).

As a group, STEM majors are generally the most likely to persist—they just may not persist in a STEM discipline (Adelman, 1999; Chang, et al., 2008; Leppel, 2002; Pascarella & Terenzini, 2005). Most freshmen who declare a STEM major will change their major to a non-STEM field by the beginning of their junior year, but nearly all students who start in the STEM fields will persist to graduation (T.J. Cheatham, personal communication, October 2009). Ultimately, the comprehensive conceptual model for this project should inform the evaluation of UREs designed to retain students in the STEM disciplines throughout their baccalaureate and post-baccalaureate educations and into the STEM workforce.

Babbie (2008) suggests that the steps for creating a theory include specifying the topic and the range of phenomena that the theory will address, and identifying major concepts, variables, and their relationships. To select a conceptual model, the Vanderbilt Project Team identified the topic and range of phenomena to capture in their model by examining the inputs, processes, and outcomes that constitute a typical URE, including the pre-program characteristics of the student participants, the activities and interactions during the URE, and the resulting outcomes (W.K.Kellogg Foundation, 2004). The Vanderbilt Project Team next identified major theory constructs, variables, and resulting relationships from the URE literature that spoke to this topic and range of phenomena (Bauer & Bennett, 2003; Laursen, et al., 2010; Lopatto, 2003; NSF, 2008a; Russell, 2006). The resulting dimension of normative statements that were important to the selection of the conceptual framework was refined from the initial findings in the literature to the six statements that follow. STEM URE programs that are effective in promoting and achieving their short-, mid-, and long-term objectives:

- Create organizational structures and policies that support the URE program and its objectives;
- Align program participants' experiences with the organizational mission and the stated program objectives;
- Collaborate with the scientists to foster persistence within the STEM academic discipline to baccalaureate and post-baccalaureate success and workforce goals;

- Use participants' entry characteristics to frame individual experiences and personal relationships within the URE;
- Promote positive peer, scientist/mentor, and research team interactions, both professionally and personally, to provide a critical component of the URE; and
- Prepare participants for ongoing involvement in the discipline through experiences both in and out of the research lab.

With the foundation for the comprehensive conceptual model in place, the Vanderbilt Project Team turned to the academic literature on undergraduate student persistence to identify a model that best represents the URE.

Higher Education Literature on Persistence

Beginning in the 1970s, Tinto (1975) postulated that characteristics that predate the student's collegiate experience as well as the subsequent social and academic integration of that student into the mainstream of the university drive student persistence to the baccalaureate degree. Tinto suggests that this interactional model can explain "the processes of interaction between the individuals and the institution that lead differing individuals to drop out from institutions of higher education" (p. 90). Tinto and many of those who followed him, including Braxton (2000), Braxton, et al., (2004), Pascarella and Terenzini (1983), Terenzini and Reason (2005), and Reason (2009), would agree that these three factors (a student's entry characteristics and the ensuing levels of academic and/or social integration) and the interaction between these dynamic factors are points at which inducements and interventions can be readily applied to alter educational outcomes. Juliano and Oxford (2001) suggest that interventions that come during students' undergraduate years can lead to long-term success in retaining many of the best and brightest students. As noted by Jeste et al. (2006) “potential scientists need to be identified as early as possible in the career pipeline and be provided with rewarding exposure to the field” (p. 160). Despite colleges and universities’ awareness of the need to reduce early departure, “most institutions have not been able to translate what we know about student retention into forms of action that have led to substantial gains in student persistence and graduation” (Tinto, 2006-2007, as cited in Braxton, 2009-2010, p. 5).

A basic model of student persistence typically begins with an examination of student entry characteristics, which are extremely important in predicting one’s likelihood of graduating with a baccalaureate degree. These characteristics include not only a student’s socioeconomic status, but also the student’s demographics, level of academic preparation and performance, and disposition (Reason, 2009). Colleges and universities have very few options to change the fabric of the undergraduate’s life and academic experience, which according to Chang, et al. (2008) predict 60% of the persistence rate, prior to his or her arrival on the campus doorstep. The two dominant theories that seek to explain how student entry characteristics influence educational outcomes are the social capital theory (Bourdieu, 1977; Bowles & Gintis, 1976; Collins, 1977) and theories of social class replication (Feliciano, 2008: Furstenberg & Hughes, 1995: MacLeod, 1995). The role that colleges and universities play related to students’ pre-college experiences is often through enrollment management. These efforts may include the thoughtful use of inducements (such as financial aid), pre-college interventions, and efforts to mitigate these a priori conditions by fully integrating the student into both the social and academic environments within the institution.

A student's entry characteristics include the three most important variables contributing to undergraduate degree completion in the STEM disciplines—the intensity and quality of high school curriculum, high school test scores, and class rank or grade point average (GPA) in high school (American Association for the Advancement of Science, 2001). This supports Weidman's (1989) assertion that background characteristics must be part of the theoretical understanding of student persistence and builds on the importance of social capital and social class replication in student outcomes. In their research on the factors that lead to minority persistence in STEM fields, Foltz, Gannon and Kirschmann (2009) found that most students that persisted to a master's degree in a STEM field had been fully integrated into their academic discipline from a young age.

Beyond the student entry characteristics, an undergraduate's experiences in college also influence their subsequent departure decision. When Tinto (1975) suggested that the more integrated a student is in his or her social and academic experience, the more likely the student is to persist, he opened a new chapter in the examination of student departure decisions. His theory, however, was grounded in the work of others (Durkheim, 1951/1897; Turner, 1969; Van Gennep, 1960) who examined the importance of individual roles in society. Later, Pascarella and Terenzini (1983) would further link a student's degree of social integration to student persistence. They define social integration as the degree to which students believe they have established significant relationships with their peers. Therefore, students who report higher levels of social integration into their campus environments demonstrate higher levels of commitment to both their institutions and the goal of graduation (Drake, Farmer, Foltz, & Treis Rusk, 2009; Pascarella & Terenzini, 1983).

Pascarella and Terenzini (1983) define academic integration as the degree to which the student feels he or she has established a relationship and connection with faculty members. Many researchers confirm these findings and extend the model to incorporate measures of commitment to one's institution (Derby & Watson, 2006; Gannon, Gleason, & O'Berine, 2009; Good & Adams, 2008; Helland, Stallings & Braxton, 2002; LeSure-Lester, 2003). Furthermore, students who report higher levels of on-campus social and academic support—or more extensive social and academic networks—are more likely to persist than students who report low levels of on-campus social support (Drake, et al., 2009; Nicpon, et al., 2006; Thomas, 2000). If institutions accept the premise that students who have high levels of both social and academic integration are more likely to persist to the baccalaureate (Drake, et al., 2009b; Pascarella & Terenzini, 1983), they must take a holistic approach to social and academic interaction across all disciplines and all areas of student life (Grady, 1998; Holmes, Ebbers, Robinson & Mugenda, 2000-2001; Juliano & Oxford, 2001; Pan, Guo, Alikonios & Bai, 2008). Evidence for this approach can be found in Braxton, et al.'s (2004) list of ten exemplary programs that increase persistence by fostering social integration, in which none were without an academic integration component and many coupled elements of both academic and social integration into one program.

In the years since he published his original hypothesis, many of Tinto's (1975;1993) constructs have been tested for validity and reliability. Braxton, et al. (2004) examined persistence across residential and commuter institutions. Although their study did not support Tinto's (1975) original hypothesis that the degree of academic integration was related to the level of subsequent goal commitment to graduate from college, they did find a connection between the degree of academic integration and the level of subsequent institutional commitment at commuter colleges. Braxton, et al. (2004) identify six influences on social integration on which colleges and universities should focus to increase undergraduate persistence. These include the commitment of the institution to student welfare, communal potential, institutional integrity, proactive social adjustment, psychosocial engagement, and the ability to pay. Each factor contributes to this holistic approach to retention, which includes both academic and social integration, such as in the proposition for communal potential: “the more a student perceives the potential of community on campus, the greater the student’s level of social integration” (p. 23). These factors signal that a well-defined organizational context is needed to successfully launch effective retention programs. This notion undergirds the conceptual framework for persistence developed by Terenzini and Reason (2005) and later articulated by Reason (2009) that focuses on the organization’s effect on the student.

The comprehensive conceptual model, as originally conceived by Terenzini and Reason (2005), using Astin’s (1993) inputs-environments-outputs approach as a reference, rests on four factors that influence student outcomes: student entry characteristics, the organizational context, the peer environment, and the individual student’s experiences. This novel approach avoids the “conceptual isolation” addressed by Pascarella and Terenzini (2005) by looking at multiple forces that affect student departure decisions. The main distinction between Terenzini and Reason (2005) and Reason (2009) is that while the original conceptual model stressed that “the framework’s focus on organizational context factors clearly implies that its utility (as presented) will be restricted to multi-institutional studies” (Terenzini & Reason, 2005, p. 26) the new articulation notes that “To fully and effectively address student persistence, any intervention must consider the local organizational context, and the local student peer environment … [that a] student’s decisions about whether to persist are made within, and influenced by, these two proximal contexts”

(Reason, 2009, p. 678).

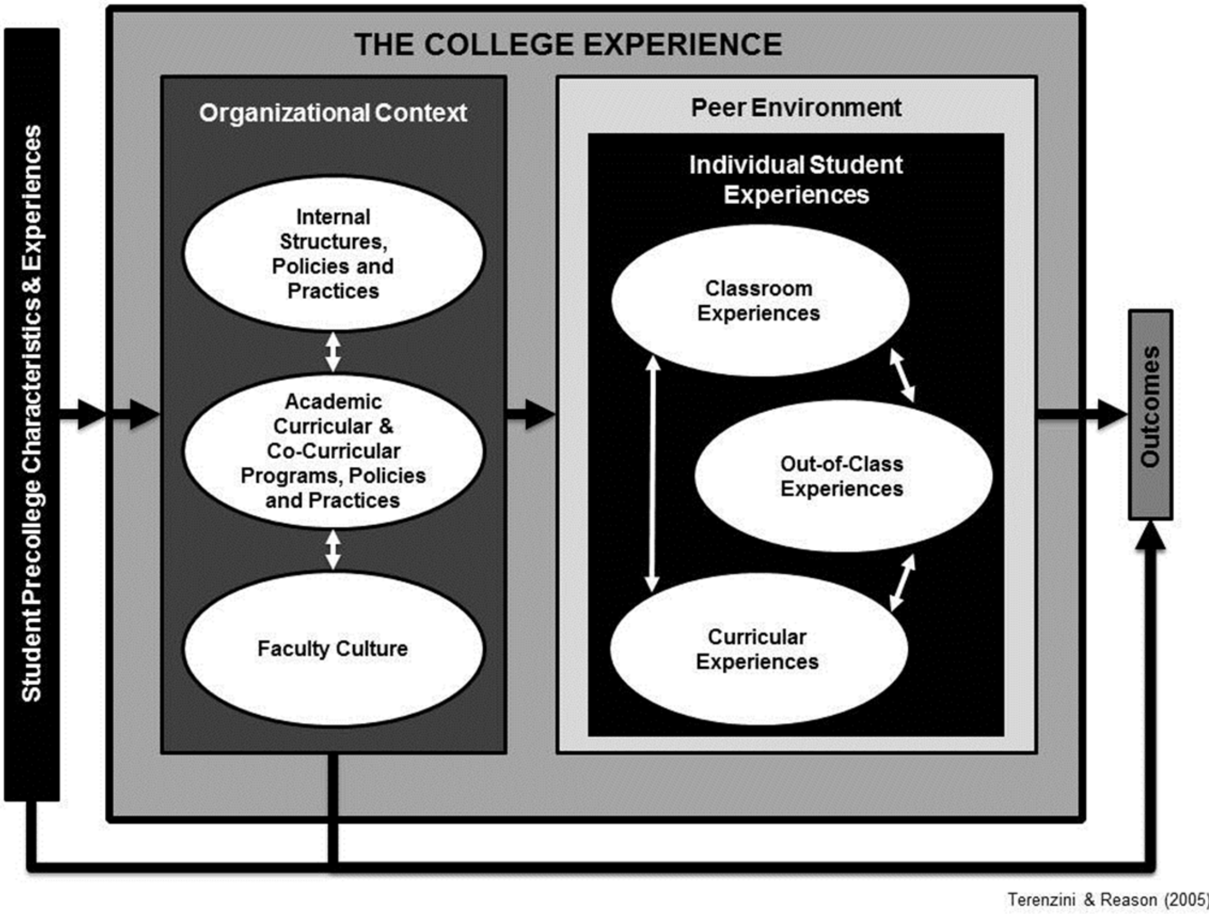


Figure 1. A Comprehensive Model of Influences on Student Learning and Persistence

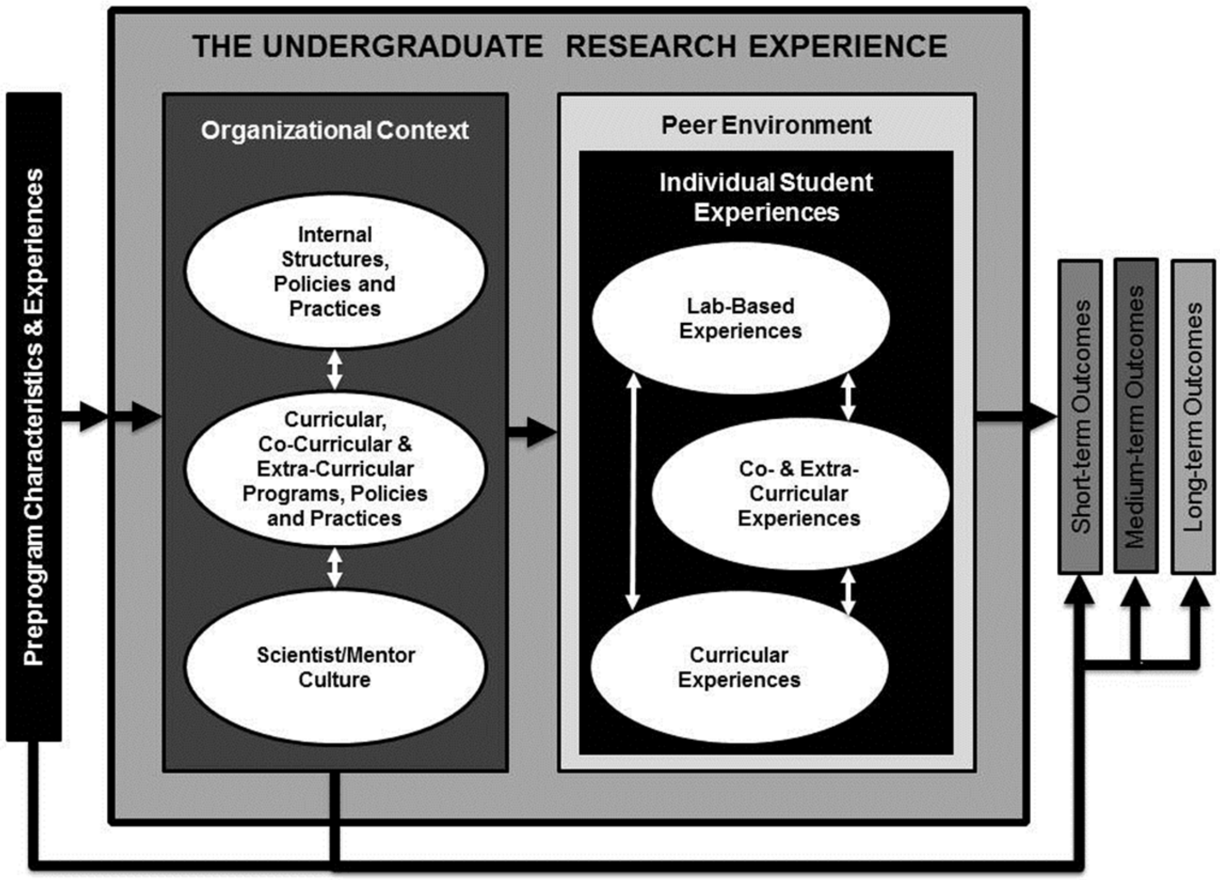
When students arrive at the university with pre-existing characteristics and experiences, they quickly learn that the organization has a life of its own that pre-dates their experience. Most institutions have long-standing and deeply engrained cultures and characteristics that powerfully shape student experiences, most often through administrative and bureaucratic features, which send students messages such as what is expected of them in terms of norms, values and behaviors, the importance of intellectual pursuits and educational aspirations, and the need for social assimilation.

Once messages are sent from the institution, it is both the peer experience and individual student's experiences within the larger peer group that are "the most immediate set of influences shaping student persistence" (Reason, 2009, p. 672). The peer environment includes values, beliefs, attitudes, beliefs, and expectations that are at work within a campus's student body. The effects of the peer environment "are not immediately apparent to the individual student" (Reason, 2009, p. 670); however, they are no less salient, as described in Braxton, et al.'s (2004) findings in support of Tinto's (1975) original premise on the importance of social integration in retention efforts. Within this peer environment are the individual student's experiences, which Terenzini and Reason (2005) divide into three areas of influence: curricular experiences, classroom experiences, and co-curricular experiences.

Curricular experiences include "students' particular coursework patterns, their choice(s) of an academic major field, the nature and extent of students' socialization to the field, and the degree of exposure to other academic experiences [like internships, cooperative education and study abroad] that are part of the general or major field curriculum" (Reason, 2009, p. 672). Classroom experiences include the "pedagogies students encounter in their classrooms" (p. 672). The co-curricular, or out-of-class, experiences are both subtle and complex in the way they affect students and include "where students live while in school, degree of involvement in various co-curricular activities, hours spent studying, family and employment obligations, and family support" (p. 672).

Appendix B

Unpacking the Project Conceptual Model



Adapted from Terenzini & Reason (2005) and Reason (2009)

Pre-Program Characteristics and Experiences. The participant's pre-program characteristics and experiences are the starting point in the Project Conceptual Model. In the Terenzini and Reason (2005) model, this cluster of personal traits is referred to as student precollege characteristics and includes a student's sociodemographic traits, academic preparation and performance, and disposition or "academic goals, academic self-efficacy, and … sense of academic skills" (Reason, 2009, p. 665). In the application of the Project Conceptual Model to the URE, participant pre-program characteristics and experiences still include sociodemographic traits, academic preparation, and performance. Participant disposition, then, refers to the individual's motivation in applying for the URE, the rigor of the research he or she proposes, his or her academic and career goals and finally, the degree of self-efficacy possessed by the prospective participant.

Organizational Context. Terenzini and Reason's (2005) model of the college experience includes the organizational context of the institution and the peer environment, which they state are "both more specific and more immediate to the student experience" (p. 8). Wedded to the organizational context is that "specific internal organizational structures, practices, and policies, compared to overall institutional features, are more likely (at least indirectly, perhaps also directly) to influence student outcomes through the kind of experiences and values they promote or discourage" (p. 8). The organizational context includes seven dimensions: the internal structures, policies, and practices; the academic and co-curricular programs, policies and practices; and the faculty culture. In extending the Terenzini and Reason (2005) comprehensive conceptual model to explore and explain the URE, it is necessary to redefine several of the original dimensions.

Internal Structures, Policies, and Practices. These refer to the "rich variety of internal organizational structures and processes that can have some influence on students' experiences" (p. 8). As conceptualized by the Vanderbilt Project Team, internal structures, policies, and practices are manifested at three levels: the overall or national URE, the individual URE program site, and the individual research laboratory within the project site. The three dimensions of structures, policies, and practices suggest the following questions about the URE: Is the program managed and coordinated, both horizontally and vertically, to achieve the program goals? What kinds of support staff are present at all levels in support of these goals? Is the program's budget sufficient to achieve its goals? What are the requirements for acceptance into the program? What is the level of collaboration between the program administrators, program staff, and the scientists/mentors? How and to what degree does the program communicate its mission, history, values, standards, and expectations to prospective participants, among others? Does the program target specific groups or types of students? To what extent does the program evaluate outcomes and make adjustments accordingly? What decision-making models are used by the program's administration?

Lab-Based, Curricular, Co-Curricular & Extra-Curricular Programs, Policies, and Practices. These refer to the policies and practices that structure "both the 'intended' curriculum (the curricular and classroom experiences the institution formally seeks to deliver) and the 'enacted' curriculum (what is, in fact, offered to students)" (Terenzini and Reason, 2005, p. 8). The national URE, the individual URE project site, and the individual research laboratory within the project site all have an active role in molding the curricular and co-curricular programs. As conceptualized by the Vanderbilt Project Team, the URE is also responsible for creating the context for participants' extra-curricular experiences. The three dimensions of programs, policies, and practices in the individual lab-based, curricular, co-curricular, and extra-curricular experiences suggest the following questions about the URE: Does the URE have a formal, common set of requirements across all project sites and individual research labs within project sites? Are the lab-based experiences, co-curricular, and extra-curricular experiences specifically designed to provide opportunities for participants to achieve the overall goals of the program? Are the mentoring programs effective? Are the teaching pedagogies active and collaborative? How is the orientation program structured? Are participants truly socialized to the URE, including the lab-based experiences, co-curricular, and extra-curricular aspects of the URE?

Scientist/Mentor Culture. This seventh dimension points to the pool of scientists/mentors at the individual URE project site and those within each individual research laboratory at project sites who constitute what Terenzini and Reason (2005) called the *faculty culture*. This dimension is made up of the "'deeply embedded and enduring patterns of behavior, perceptions, assumptions, beliefs, attitudes, ideologies, and values about the nature of the organization and its functioning that are held and maintained by [faculty] members'" (Berger & Milem, 2000, as cited in Terenzini & Reason, 2009, p. 274,). In the URE, the influence of the organizational culture on the scientist/mentor can be seen in how the scientists/mentors view their role in the URE, as well as in how they explain what it means to be a scientist/mentor in the URE. Is the scientist/mentor committed to increasing participants' knowledge and skills in research? Are scientists/mentors in the URE learning- or student-centered? Do they use assessment techniques that address gaps in participant expertise? Is the scientist/mentor available to the participant—what Wilson, Wood and Gaff, (1974) call "social-psychological accessibility" (p.74). Are scientists/mentors engaged in co-curricular and extra-curricular activities within the URE?

Peer Environment and Individual Experiences. The URE's organizational context, which includes the internal structures, policies, and practices; the lab-based, curricular, and co-curricular/extra-curricular programs, policies, and practices; and the scientist/mentor culture, clearly set the stage for both the peer environment and the individual experience that occur within the URE. The organizational context is directly linked to participant persistence toward the URE's short-, mid-, and long-term goals. Some overarching elements of the organizational context include the daily patterns and decision-making stratagem of the multiple levels within the URE. They also include the program and sponsoring federal agency's culture, the nature of the source of support, the program’s size, its mission and its degree of selectivity in selecting participants (Reason, 2009). When assembled together, these elements of the organizational context can easily be the pivot points upon which a participant makes a decision to either pursue a lifelong career in STEM or change majors upon exiting the URE.

The other major component in Terenzini and Reason’s (2005) concept of the college experience is the peer environment, which Reason (2009) defines as embodying the “system of dominant and normative beliefs, attitudes, and expectations that characterize a campus student environment” (p. 670) and includes social integration. Theories of social integration suggest that factors within the peer environment both directly and indirectly influence a URE participant’s persistence decision. This “broader, more general, and subtle set of influences that are more easily sensed than measured” (Terenzini & Reason, 2005, p. 11) acts in a similar fashion to the organizational context, in that both continuously mold and shape the framework in which the participant’s individual experiences occur.

While the organizational context sends the participant signals about what is important in the URE (following the established norms, values and behaviors, and the importance of his or her intellectual pursuits), the peer environment “conveys to students what others value and expect behaviorally, in the social and academic world” (p. 670). These two spheres actually work together to support and add meaning to the individual experiences that further determine a college student's degree of social and academic integration. From Terenzini and Reason's (2005) perspective, students share the common peer environment and organizational context of the college campus, in which their individual experiences occur. They write that there can be

> no doubt that students' experiences during their college years influence a wide spectrum of student outcomes … however [they] are often treated conceptually and empirically in a highly segmented and often discrete fashion, as if certain experiences (or sets of experiences) were the *only* factors at work shaping student learning, change, or persistence. Such studies produce only a partial picture of the forces at work (p. 12)

Only when viewed both separately and together can these individual experiences of students, or participants in UREs, provide a more coherent picture of how the different types of participants' experiences occur in different settings are directly linked to long-term persistence in the discipline. The individual experiences of URE program participants revolve around three types of experiences: research lab experiences, curricular experiences, and co-curricular/extra-curricular experiences.

Research-Lab Experiences. These are to the URE what classroom experiences are the original Terenzini and Reason (2005) conceptual model. Just as in classroom experiences, all too often there is no plan or evaluation of the participants' research-lab experiences. The direct relationship between good teaching, in which participants are both active learners and collaborators, and persistence in the discipline includes both direct and indirect pathways to increase the likelihood that a student will decide to stay in that STEM field. Research-lab experiences do not just include the hands-on activities, but also the pedagogies students are exposed to, the types and quantity of discussions with the scientist/mentor, and the amount of feedback the participant receives from the scientist/mentor.

Curricular Experiences. These support students' in-class experiences in the Terenzini and Reason (2005) model and refer to "students' general education coursework, their choice(s) of an academic major field, the nature and extent of students' socialization to that field … and the degree of exposure to other academic experiences that are part of the general or major field curriculum" (p. 12). Reason (2009) extended the definition of the term to include a student's "acquisition of academic skills" (p. 672). These experiences include learning study skills, supplemental instruction, and even developmental and remedial programs. In the Project Conceptual Model, curricular experiences directly support the lab-based experiences of URE participants, by both preparing students for those experiences and by extending or informing them. Curricular experiences in the URE include skill-based training such as how to use a piece of equipment, run a computer program, or handle an animal research subject. Knowledge-based training, such as how a particular protein works, would also be included in the curricular experiences necessary to support lab-based experiences. Curricular experiences also include any compliance or safety training needed to work in the lab and any education in the responsible conduct of research.

Co-Curricular and Extra-Curricular Experiences. In the original Terenzini and Reason (2005) model co-curricular and extra-curricular experiences were called out-of-class experiences. In the URE, these experiences include activities that add value to the overall URE but do not directly support the lab-based experiences, such as professional development learning opportunities and social activities. As Terenzini and Reason (2005) write, "out-of-class experiences shape [students'] cognitive, psychosocial, attitudinal, and occupational learning outcomes in subtle and complex ways" (p. 12). Reason (2009) extends this stating "co-curricular activities that serve to increase student involvement in educationally purposeful activities (e.g., student academic groups, service organizations) tend to increase the likelihood of persistence” (p. 675). Co-curricular and extra-curricular experiences occur through the organized professional development activities, such as how to conduct a database search of the literature, how to give an effective presentation, or through giving a poster presentation and through events at which participants can engage with their peers, mentors and others on a professional level, such as through guest lectures, formal receptions, and conferences. The social aspects of the URE often leave participants to their own devices; however, many UREs assign participants to peer-mentors, arrange roommates, and schedule social activities that engage the participant in the “life” aspects of the experience.

Appendix C

Federal Programs Considered but Eliminated as Comparable Programs for SULI

Program	Federal Agency	No Federal Stipend	Not STEM	Not UR	Duration not Within	No Stipend	Larger scholarship	Niche Program	Comments	Source
Energy Resource Development Tribal Internship Program	BIA							X	Professional development	http://www.dep.anl.gov/p_undergrad/TribalInternships/
Federal Career Intern Program	BLM			X					Research is not focus	http://www.blm.gov/wo/st/en/res/blm_jobs/students_and_recent/fcip/fcip__how_do_i_apply.html
Gulf of Mexico Region	BOEMRE			X					Research is not focus	http://www.gomr.boemre.gov
Pacific Region	BOEMRE			X					Youth temporary workers	http://www.boemre.gov/omm/pacific/interns/intern.htm
Youth Initiative	BOR			X					temporary workers	http://www.usbr.gov/youth/employ.html
Research Participation at the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry	CDC/DOE				X				One month to one year with renewals, up to four years maximum	http://see.orau.org/ProgramDescription.aspx?Program=10110
Program and Policy Intern	DHHS			X		X			Policy rather than research opportunities	http://www.hhs.gov/fbci/about/volunteer/fbci-intern.html
DHS - HSTEM	DHS				X				Allows students to return for second year	http://www.orau.gov/dhsinternships/
Federal Cyber Service: Scholarship For Service Program	DHS						X		Part of larger scholarship program for student	https://www.sfs.opm.gov/
Federal Law Enforcement Training Center (FLETC) College Intern Program	DHS			X					Not research	http://www.fletc.gov/student-information/college-intern-program

Headquarters Student Summer Employment Program	DHS	X					Research is not focus	http://www.dhs.gov/xabout/careers/gc_1168032414916.shtm
Headquarters Volunteer Fellows Program	DHS	X		X			Research is not focus	http://www.dhs.gov/xabout/careers/gc_1248728267762.shtm
Mathematics Summer Employment Program (MSEP)	DHS	X				X	Mathematics focus	http://www.dhs.gov/xabout/careers/gc_1168032414916.shtm
National Security Internship	DHS	X					Research is not focus	http://www.nationalsecurityinternship.com/
Office of Health Affairs Volunteer Scholars Program	DHS			X			Unpaid	http://www.dhs.gov/xabout/careers/gc_1269375808755.shtm
Office of Policy Internship	DHS	X					Research is not focus	http://www.dhs.gov/xabout/careers/gc_1260804199821.shtm
Presidential Management Fellows (PMF)	DHS	X					Research is not focus	https://www.pmf.opm.gov/JobSearch/results.aspx
Scholarship and Fellowship Program	DHS		X		X		Part of larger scholarship program for student	http://www.orau.gov/dhsed/newpages/scholarship.html
Student Career Experience Program (SCEP)	DHS	X					Research is not focus	http://www.usajobs.opm.gov/EI/studentcareerexperience.asp
Student Temporary Employment Program (STEP)	DHS	X					Research is not focus	http://www.usajobs.opm.gov/EI/studentcareerexperience.asp
Summer Law Intern Program	DHS	X					Law School	http://www.dhs.gov/xabout/careers/gc_1287065109250.shtm
Transportation Security Laboratory Visiting Scientist Program	DHS	X					Undergraduate and graduate student interns, recent graduates including postdoctoral fellows, faculty researchers, and other visiting scientists	http://www.orau.gov/dhs-tslvissciprog/awarddesc.html
U.S. Customs and Border Protection	DHS	X					Research is not focus	http://www.cbp.gov/xp/cgov/careers/students_grads/
U.S. Department of Homeland Security Scholarship and Fellowship Program	DHS				X		Part of larger scholarship program for student	http://www.orau.gov/dhsed/
U.S. Immigration and Customs Enforcement ICE Student Volunteer Program	DHS	X		X			Unpaid	http://www.ice.gov/careers/internships/index.htm

U.S. Secret Service Student Volunteer Internship	DHS		X					Research is not focus	http://www.secretservice.gov/opportunities_interns.shtml
Educational Partnership Program with Minority Serving Institutions	DOC					X		Part of larger scholarship program	http://www.epp.noaa.gov/
Ernest F. Hollings Scholarship Program	DOC					X		Part of larger scholarship program	http://www.oesd.noaa.gov/Hollings_info.html
Internship for Post Secondary Students	DOC	X	X					Not just science-lab orientation	http://see.orau.org/ProgramDescription.aspx?Program=10038
Volunteer Legal Intern	DOC				X			Volunteer	http://www.ogc.doc.gov/internships.html
DoD Centralized Intern Program	DOD	X	X					Not research experience focused	http://www.godefense.com/dod_page.html
Science, Mathematics and Research for Transformation (SMART)	DOD					X		Part of a larger scholarship program	http://smart.asee.org
DOE Scholars: Undergrad, grad, post-grad research internships, summer or other times	DOE		X					Internship rather than Research Experience	http://orise.orau.gov/doescholars/faq/default.htm
Energy Resource Development Tribal Internship Program	DOE						X	Specialty focus (Tribal Universities)/Less than 50	http://www.dep.anl.gov/p_undergrad/TribalInternships/
Faculty and Student Teams Program	DOE						X	Community college focus	http://www.scied.science.doe.gov/scied/fast/about.html
National Energy Technology Laboratory Professional Internship Program	DOE			X				Three to 24 consecutive months	http://see.orau.org/ProgramDescription.aspx?Program=10046
Pre-service Teacher Internships	DOE		X					Teacher preparation	http://www.scied.science.doe.gov/scied/pst/about.htm
Savannah River Site	DOE			X				Undergraduates have four year appointments	http://www.srs.gov/general/outreach/edoutrch/intern.htm
Summer Faculty and Student Research Team Program for MSI	DOE		X				X	Serves faculty, graduates, and undergraduates/ Specialized for minority serving institutions/Less than 50	http://see.orau.org/ProgramDescription.aspx?Program=10187

Plum Island Animal Disease Center Research Participation Program	DOE/USDA/DHS			X				Longer program length	http://www.orau.gov/piadc/
Student Interns	DOI		X					Research is not focus	http://www.doi.gov/whatwedo/youth/Student-Internship-Opportunities.cfm
Federal Aviation Administration Minority Serving Institutions Internship Program	DOT		X					Research is not focus	http://www.faa.gov/about/office_org/headquarters_offices/ahr/jobs_careers/student_programs/minority/index.cfm
Federal Highway Administration Student Transportation Internship Program for Diverse Groups	DOT		X					Research is not focus	http://www.fhwa.dot.gov/education/stipdg.htm
Research and Special Programs Administration, John A. Volpe Transportation Internship	DOT		X					Research is not focus	http://www.volpe.dot.gov/career/intrnshp.html
Student Intern	DOT				X			Volunteer	http://careers.dot.gov/stu_intern.html
Department of Ed Internships	ED	X	X					Not research experience focused	http://www2.ed.gov/students/prep/job/intern/index.html
National Network for Environmental Management Studies (NNEMS)	EPA	X				X	X	Not STEM, Less than 50 participants	http://www.epa.gov/enviroed/NNEMS/2010summary.html
Student Career Experience Program (SCEP)	EPA		X					Various employment	http://www.epa.gov/careers/stuopp.html
Student Services Contracting Authority	EPA		X					Employment focus rather than summer research experience focus	http://www.epa.gov/ord/orma/ssa-faqs.htm
The Greater Research Opportunities (GRO) Fellowship Program	EPA					X		Part of a larger scholarship program	http://www.epa.gov/ncer/fellow/
Research Participation/Internship Program for the U.S. Environmental Protection Agency	EPA/DOE			X				One month to one year with renewals, up to four years maximum	http://see.orau.org/ProgramDescription.aspx?Program=10182

Research Participation Program at the Federal Bureau of Investigation	FBI			X				One month to one year with renewals, up to four years maximum	http://see.orau.org/ProgramDescription.aspx?Program=10063
Summer Student Research Program at the National Center for Toxicological Research	FDA/DOE						X	20 Participants	http://see.orau.org/ProgramDescription.aspx?Program=10137,http://www.fda.gov/AboutFDA/CentersOffices/NCTR/WhatWeDo/NCTRPublications/ucm218529.htm
Student and Career Internship Opportunities	FWS		X					temporary workers	http://www.fws.gov/humancapital/HR/exc_svc_opp.html
Student Positions	FWS		X					Research is not focus	http://www.fws.gov/jobs/wwd_student.html
Youth in Conservation Careers	FWS		X					Various employment	http://www.fws.gov/jobs/wwd_student.html
Research Participation Program for the Joint POW/MIA Accounting Command/Central Identification Laboratory (JPAC-CIL)	JPAC/DOE	X	X					Anthropology	http://www.jpac.pacom.mil/Downloads/ORISE_position_historian_FEB09.pdf
Achieving Competence in Computing, Engineering and Space Science	NASA		X			X		Participants are students with disabilities who work in offices	http://www.nasa.gov/offices/education/programs/descriptions/Achieving_Competence.html
Applied Physics Laboratory Internship Project	NASA		X					Undergraduate to PhD	http://www.nasa.gov/offices/education/programs/descriptions/Applied_Physics_Laboratory_Internship_Project.html
Consortium for Undergraduate Research Experience	NASA					X		Underrepresented and underserved California community college students	http://www.nasa.gov/offices/education/programs/descriptions/Consortium_for_Undergraduate_Research_Experience.html
Lewis' Educational & Research Collaborative Internship Project	NASA	X	X					High School Students, College Students, Secondary School Teachers, and NASA Scholars, Many disciplines other than science	http://www.nasa.gov/centers/glenn/education/LERCIP_GRC.html

Marshall Robotics Academy	NASA		X					Includes graduate students, combines research with understanding of how NASA operates	http://robotics.msfc.nasa.gov/program_description.html
Motivating Undergraduates in Science and Technology	NASA					X		Part of larger scholarship program for student	http://www.nasa.gov/offices/education/programs/descriptions/Motivating_Undergraduates_Science_Technology.html
NASA Aeronautics Scholarship Program	NASA					X		Part of larger scholarship program for student	http://nasa.asee.org/
NASA Independent Verification and Validation Internship Project	NASA		X			X		Computer science and data assurance focus	http://www.nasa.gov/offices/education/programs/descriptions/Independent_Validation_Verification_Project.html
Space and Aeronautics Internship Project	NASA	X	X					Small and companies select students	http://www.nasa.gov/offices/education/programs/descriptions/Space_Internship_Project.html
Student Independent Research Internship	NASA			X	X			Part time and not paid	http://www.nasa.gov/offices/education/programs/descriptions/Student_Independent_Research_Internship.html
Student Internship Project	NASA						X	46 Participants (small program)	http://www.nasa.gov/offices/education/programs/descriptions/Student_Internship_Project.html
Summer Aerospace Workforce Development Research Internship Project	NASA		X				X	Fewer than 50 participants/try out employment opportunities	http://www.nasa.gov/offices/education/programs/descriptions/Summer_Aerospace_Workforce_Dev.html
Tribal Colleges and University Project -- Native American Internships	NASA						X	Less than 50 participants/Tribal College Focus	http://www.nasa.gov/offices/education/programs/descriptions/Tribal_Colleges_University_Project_Internships.html
Visiting Scientist Program for the National Geospatial-Intelligence Agency (NGA), InnoVision Basic and Applied Research Division	NGA			X				Current students, postdoctoral researchers and faculty members for full-time residency appointments	http://see.orau.org/ProgramDescription.aspx?Program=10198

Summer Internship Program	NIH			X			High school, undergraduate, graduate, and professional students	http://usrp.usra.edu/news/archive/2010/061410Award.shtml
Research Participation Program for the Navy and Marine Corps Public Health Center (NMCPHC)	NMC					X	Military Program	http://see.orau.org/ProgramDescription.aspx?Program=10199
NOAA/Hollings Undergraduate Scholarship	NOAA				X		Part of larger scholarship program for student	http://www.oesd.noaa.gov/Hollings_info.html
Jobs for Students	NPS		X				Research is not focus	http://www.nps.gov/aboutus/jobsforstudents.htm
Youth Conservation Corps	NPS		X				Research is not focus	https://pwrcms.nps.gov/gettinginvolved/youthprograms/ycc.htm
BBSI	NSF			X			Two consecutive years of participation	http://bbsi.erc-assoc.org/
Higher Education Research Experiences at Oak Ridge National Laboratory (HERE at ORNL)	ORNL	X						http://www.orau.gov/hereatornl/about.htm
ORNL Nuclear Engineering Science Laboratory Synthesis	ORNL	X					Not federal program	http://www.ornl.gov/sci/nsed/outreach/internship_nesls.shtml
Watershed Intern Program	OSM		X				trainee type arrangements	https://pwrcms.nps.gov/gettinginvolved/youthprograms/ycc.htm
Research Participation Program for the U.S. Army Aeromedical Research Laboratory (USAARL)	USA /DOE					X	Military Program	http://see.orau.org/ProgramDescription.aspx?Program=10185
Research Participation Program for the U.S. Army -Various	USA/DOE					X	Military Program	http://see.orau.org/ProgramDescription.aspx?Program=10084
Research Participation Program for the U.S. Army Corp of Engineers	USACE/DOE					X	Military Program	http://see.orau.org/ProgramDescription.aspx?Program=10209
Research Participation Program for the U.S. Air Force Research Laboratory (USAFRL)	USAF					X	Military Program	http://see.orau.org/ProgramDescription.aspx?Program=10065

Research Participation Program for the U.S. Air Force School of Aerospace Medicine (USAFSAM)	USAF/DOE						X	Military Program	http://see.orau.org/ProgramDescription.aspx?Program=10065
Agricultural Intern Program (Washington DC)	USDA	X						USDA Mission areas and agencies	http://www.fas.usda.gov/admin/student/program.asp
ARS Internship Program	USDA		X					Managers hire students	http://www.ars.usda.gov/careers/docs.htm?docid=1345
Federal Career Intern program	USDA		X	X				Two year program, employment focused	http://www.dm.usda.gov/employ/CareerInternQuestionsandAnswers.htm
Foreign Agricultural Service International Internship Program	USDA		X				X	A few international internships	http://www.fas.usda.gov/admin/student/program.asp
Hispanic Association of College and Universities Internship Program	USDA	X	X				X	Fall, Spring, Summer, Opportunities for HSI	http://www.aphis.usda.gov/civil_rights/hacu.shtml
Law School Civil Rights Interns	USDA	X	X					For law school students	http://watt.house.gov/uploads/Internship_Opportunities_20101.pdf
Passport to Work	USDA						X	Washington D.C. Youth	http://www.apfo.usda.gov/FSA/hrdapp?area=home&subject=nwem&topic=stf
Presidential Management Fellows	USDA		X					Graduate students, employment focused	http://www.fs.fed.us/fsjobs/pmf.shtml
Public Service Leadership Scholars	USDA					X		Part of a larger scholarship program	http://www.usdascholarships.com/applications/
Scholarship for Service	USDA		X					Part of a larger scholarship program	http://www.ehow.com/about_7499560_usda-forest-service-scholarships.html
Student Host Assignments (Free and not-free)	USDA	X	X					Paid by third parties	http://www.iwebfolio.com/downloads/TvjHqPTcUeE/Internships_DC.pdf?id=TvjHqPTcUeE
Student Volunteers	USDA		X		X			Not paid	http://www.afm.ars.usda.gov/ppweb/pdf/413-08.pdf
USDA 1890 Scholars Program	USDA	X	X			X	X	Seniors in high school to attend HB1890 institutions	http://www.aphis.usda.gov/about_aphis/programs_offices/veterinary_services/downloads/1890_program.pdf

USDA Sumer Intern Program (SIP)	USDA		X					Employment focus rather than summer research experience focus	http://www.dm.usda.gov/employ/SIPIntro.htm
Washington Internships for Native Students (WINS)	USDA	X	X				X	Native American - builds leadership and professional skills	http://www.aphis.usda.gov/civil_rights/wins_program.shtml
Workforce Recruitment Program for College Students with Disabilities	USDA		X				X	Mission is to assist students w/disabilities gain federal employment	http://www.dm.usda.gov/employ/WRP.htm
Research Participation at the National Center for Toxicological Research	USFDA/ DOE			X				One month to one year with renewals, up to four years maximum	http://see.orau.org/ProgramDescription.aspx?Program=10112
Research Participation at the U.S. Food and Drug Administration	USFDA/ DOE			X				One month to one year with renewals, up to four years maximum	http://see.orau.org/ProgramDescription.aspx?Program=10105
Student Employment	USGS		X					Various employment	http://www.usgs.gov/ohr/student/index.html

Appendix D

IDEAL PROGRAMS ARE STRUCTURED TO …	THE URE PROGRAM IS STRUCTURED TO …	COMPARATIVE ANALYSIS			
		STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Last an entire semester or summer (10-15 weeks)					
Allow multi-year appointments for participants					
Provide stipends or wages for participants					
Provide a housing allowance for participants					
Provide conference travel funding for participants					
Offer class credit for participation					
Gather information on prospective participants					
Actively recruit participants					
Streamline the application process					
Guide prospective participants through the application process					
Require references from faculty members at students' home institution					
Limit the number of younger participants					
Select participants with prior research experience					
Select participants based on prior academic achievement					
Select participants who will benefit most from the experience					
Use student motivation as a selection criterion					
Make selection preferences using race, ethnicity and gender as plus factors					
Offer early entry/acceptance for qualified students					
Match mentors with participants' backgrounds and interests					
Conduct routine program evaluations					
Gather information through entrance and exit interviews					
Ensure that people of color are visible leaders and role models					
IDEAL PROGRAM SITES …		**STRENGTHS**	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
Communicate norms and culture to participants through orientation activities					
Set high expectations for participants					
Provide state-of-the-art equipment					
Provide choices for both participants and mentors					
Build student teams with a mix of backgrounds and experiences					
Link programmatic offerings to participants' majors					
Create a supportive structure for participants (including a grievance process)					
Gather information through entrance and exit interviews					
Conduct routine program evaluations					
Ensure that people of color are visible leaders and role models					
IDEAL PROGRAM MENTORS …	**URE'S MENTORS …**	**COMPARATIVE ANALYSIS**			
		STRENGTHS	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
Communicate norms and culture to participants					
Set and uphold high expectations					
Ensure the program is authentic by working in the lab with the participants					
Assess participants' abilities					
Adjust approaches to meet participants' abilities					
Model professional behavior and a respectful attitude					
Model collegiality and is a role model					
Foster social integration in lab, among research team					
Set a relaxed, informal and approachable tone					
Allow participants to encounter them as people					
Promote a collaborative culture by encouraging participants to give/receive help as needed					
Solicit participants' input in research design and data interpretation					
Are involved in project decisions with participants					
Use problem solving as a pedagogy					

Normalize risk and uncertainty					
Teach technical skills, such as record keeping					
Teach professional skills such as presentation skills, how to write scholarly papers					
Foster participant independence					
Monitor participant progress through weekly meetings					
Encourage the use of multiple mentors					
Provide advice on career issues					
IDEAL RESEARCH TEAMS …	**URE'S RESEARCH TEAMS …**	**COMPARATIVE ANALYSIS**			
		STRENGTHS	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
Meet weekly to problem solve, brainstorm and discuss problems					
Have frequent interaction with participants (including postdocs and graduate students)					
Foster collegiality and collaboration					
Provide opportunities for both teamwork and independent work					
IDEAL PEER ENVIRONMENTS …	**URE'S PEER ENVIRONMENT …**	**COMPARATIVE ANALYSIS**			
		STRENGTHS	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
Provide frequent support and assistance (such as through peer mentoring)					
Include peer mentoring					
Provide opportunities for peers to interact professionally through seminars, leadership training and other events					
Include organized social events and opportunities					
IDEAL CURRICULAR EXPERIENCES …	**URE'S CURRICULAR EXPERIENCES …**	**COMPARATIVE ANALYSIS**			
		STRENGTHS	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
Allow participants to build on existing skills while learning new skills					
Foster participant independence					
Open doors to participant creativity and ingenuity					
Educate participants in how to write a research proposal					
Give participants primary responsibility for some aspects of the project and allow participants to feel ownership for the project					
Encourage participants to ask questions as well as problem-solve on their own					
Learn how research works day-to-day, including the normal setbacks and difficulties					
Give participants a choice in their research project or assignment					
Provide participants with a scope that can be accomplished in the program tenure					
Do not push participants to go beyond what they are comfortable with (morally, ethically)					
Encourage enthusiasm about the research enterprise					
Connect the daily work of participants to the "bigger picture"					
IDEAL CO-CURRICULAR EXPERIENCES …	**URE'S CO-CURRICULAR EXPERIENCES …**	**COMPARATIVE ANALYSIS**			
		STRENGTHS	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
Allow participants to master the techniques necessary to their research					
Include experiential opportunities beyond the participants' lab					
Provide training in research tools, such a computer programs, lab or field equipment					
Include lectures/seminars on research ethics					
Training in safety issues in the lab and the careful reproduction of lab techniques					
Build on existing technical skills and encourage participants to learn new ones that they can master during the program					
Foster participant independence in their use of techniques					
Allow participants the opportunity to help decide which techniques					

IDEAL EXTRA-CURRICULAR EXPERIENCES …	URE'S EXTRA-CURRICULAR EXPERIENCES …	COMPARATIVE ANALYSIS			
		STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Help participants make gains on multiple personal, professional and career dimensions					
Allow participants to develop professional peer relationships and					
Require participants to make oral presentations of scientific work (such as a PowerPoint or poster presentations)					
Provide opportunities for participants to attend professional conferences					
Require participants to engage in formal academic writing (such as preparing a final written report or authoring a journal article)					
Encourage participants to continue their research back at their home institutions					
Provide academic and career advice for participants					
Ensure that participants have opportunities to interact professionally with others at the institution, such as in seminars, or through leadership training and other events					
IDEAL EVALUATIONS…	**URE's EVALUATIONS**	**COMPARATIVE ANALYSIS**			
		STRENGTHS	**WEAKNESSES**	**OPPORTUNITIES**	**THREATS**
Capture short-term outcomes of student learning gains					
Capture short-term outcomes of student degree aspirations					
Capture short-term outcomes of student professional and scientific development					
Capture short-term outcomes of curricular reform based upon student experiences					
Capture short-term outcomes of intent to participate in future research activities					
Capture medium-term outcomes of student graduation from STEM majors					
Capture medium-term outcomes of research conferences					
Capture medium-term outcomes of research publications					
Capture long-term outcomes including attainment of terminal STEM degree					
Capture long-term outcomes including career outcomes					
Are conducted independently					
Seek scientist/mentor input					

References: Lopatto, 2003, Laursen et. al, 2010, Hancock and Russell, 2008, Russell, 2006, Hossler et. al 2008, Bauer and Bennett,

Appendix E
Alumni Surveys

SULI student

1. Informed Consent

Evaluating Outcomes in Federally-Funded Summer Undergraduate Research Experience Programs in STEM Field

Informed Consent Document for This Research Survey

Principal Investigators: Laura Foltz, Sam Gannon & Stephanie Kirschmann,Vanderbilt University

The following information is provided to inform you about this research project and your participation in it. Please read this form carefully and feel free to submit any questions you may have about this study (via the email link) and your questions will be answered as soon as possible. You may print a copy of this consent notice.
You participation in this research survey is voluntary.

You are also free to end the survey at any time.

1. Purpose of the study
The principal investigators are doctoral candidates at Vanderbilt University. You are being asked to participate in a research study in order to help them learn about the effectiveness of federally-funded summer undergraduate research experience programs in the STEM disciplines. The resulting tool will allow researchers to make comparisons within and among STEM programs.

2. Procedures to be followed and approximate duration of the study
The survey will take approximately 15-30 minutes depending on the survey you complete. You will be asked to answer a number of questions (exact number is dependent on your answers). Once you have completed all the questions, you may close the survey.

3. Expected costs
There is no cost to take the survey.

4. Description of the discomforts, inconveniences, and/or risks that can be reasonably expected as a result of participation in this study
The approximately 15-30 minutes you spend taking the survey may be an inconvenience.

5. Anticipated benefits from this study
The anticipated benefit to mankind from this study is increased general knowledge; however, there are no direct benefits to you for participating in this study.

6. Compensation for participation
None

7. What happens if you choose to withdraw from study participation?
There is no penalty for choosing not to complete the survey.

8. Contact information
If you should have any questions about this research study or possible injury, please feel free to contact:
• Sam Gannon (615/484-1801) or via email sam.gannon@vanderbilt.edu
For additional information about giving consent or your rights as a participant in this study, please feel free to contact the Vanderbilt
University Institutional Review Board Office at (615) 322-2918 or toll free at (866) 224-8273.

9. Confidentiality statement
Although the questions will not collect personal information that can identify you, all reasonable efforts will be made to keep the information in your research record private and confidential, but absolute confidentiality cannot be guaranteed. Your information may be shared with institutional and/or governmental authorities, such as the Vanderbilt University

SULI student

Institutional Review Board, if you or someone else is in danger, or if we are required to do so by law.

10. Data Maintenance
Data will be stored online until the data collection phase ends. Once all data has been collected, data will be converted to an Excel spreadsheet, which will be used in data analysis. Only the principal investigators will have access to the data, which will be stored on a secure, encrypted password enabled server at Vanderbilt University Medical Center.

*** 1. Have you read this informed consent document and the material contained in it?**

- No
- Yes

2.

*** 1. Did this informed consent document answer all your questions about the study?**

- No
- Yes

3.

1. Please enter your first name, email address and/or phone number and your question and we will provide answers to all your questions so that you may freely and voluntarily give your informed consent to participate in this study.

4.

*** 1. Do you freely and voluntarily choose to participate in the study?**

- No
- Yes

5. Default Section

SULI student

* 1. Which of the following best describes your chosen academic major prior to your involvement in the SULI program?

- ◯ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc.
- ◯ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc.
- ◯ Business, including accounting, finance, management, marketing, etc.
- ◯ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc.
- ◯ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc.
- ◯ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc.
- ◯ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc.
- ◯ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc.
- ◯ Pre-law
- ◯ Mathematical sciences, including applied mathematics, mathematics, statistics, etc.
- ◯ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc.
- ◯ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc.
- ◯ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc.
- ◯ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

Other (please specify)

[ ]

* 2. Did you have (non-classroom based) undergraduate hands-on research experience prior to your participation in the SULI program?

- ◯ No
- ◯ Yes

6. Other Undergraduate Hands-On Research Experiences

SULI student

*** 1. Was most of the prior hands-on research you did as an undergraduate in the same general academic field as your major?**

- No
- Yes

*** 2. Which of the following best describes the hands-on research experience:**

- Summer research, other than intern or co-op program. A full-time hands-on research project for the summer with a professor or researcher.
- Hands-on research with a professor during one or more academic terms, while enrolled in classes.
- Intern or co-op program that involved hands-on research as its main component. Usually, a company or other organization pays you for working on a research project at their site. Sometimes you receive academic credit at your school for this research. May happen any time of year.
- A junior or senior thesis that involves hands-on research (other than library research) as its main component.

Other (please specify)

*** 3. Did you receive academic credit for any of your undergraduate research activities?**

- No
- Yes

*** 4. Did you receive any of the following for your prior hands-on undergraduate research experience?**

	No	Yes
Stipend		
Tuition and/or fees paid		
Housing or housing allowance		
Budget/allowance for lab supplies		
Travel to conferences and/or opportunities to present research at conferences		

Other (please specify)

SULI student

* 5. Was your previous undergraduate hands-on experience any of the following?

- [ ] Department of Education McNair Scholars Program
- [ ] Department of Energy
- [ ] Have no idea
- [ ] Institutional (from your undergraduate school)
- [ ] NASA
- [ ] NIH
- [ ] None
- [ ] Not sure which NSF program
- [ ] NSF HBCU-UP program
- [ ] NSF LS-AMP program
- [ ] NSF REU program
- [ ] NSF RUI program
- [ ] Other federal government program/agency
- [ ] Other NSF program
- [ ] With an outside company

Other (please specify)

* 6. Was the program geographically located

- ○ At your undergraduate institution?
- ○ 50 miles or less from your undergraduate institution?
- ○ 51 to 100 miles from your undergraduate institution
- ○ 100 to 150 miles from your undergraduate institution
- ○ More than 150 miles from your undergraduate institution
- ○ Do not know

SULI student

* **7. Was the program geographically located**

- 50 miles or less from your home
- 51 to 100 miles from your home
- 100 to 150 miles from your home
- More than 150 miles from your home
- Do not know

* **8. Did any of your undergraduate research activities take place in another country (outside the United States)?**

- No
- Yes

7. International Experience

* **1. In what country or countries did your hands-on undergraduate research take place?**

8. Selecting the SULI Program

* **1. Before you applied for the SULI undergraduate research experience, from which sources did you obtain information about the program?**

- The program director, coordinator, or other administrator
- Program faculty/researchers
- Current or former Program students
- Non-Program faculty/researchers
- Program brochure
- Conference
- Program Website
- University Website

Other (please specify)

SULI student

*** 2. How important was each of the following in your decision to apply to the Program? (Check all that apply)**

- [ ] Interdisciplinary coursework offered by Program
- [ ] Opportunity to find out if [Program research field] was for you
- [ ] Research projects of Program faculty
- [ ] Research seminars offered by Program
- [ ] Opportunity for a "hands-on" research experience
- [ ] Opportunity to learn more about what it's like to be a researcher
- [ ] Opportunity to find out if going to graduate school was for you
- [ ] Opportunity to fulfill your school's research requirements
- [ ] Opportunity to fulfill your scholarship's requirements for research
- [ ] Opportunity to earn academic credit for doing research in the summer
- [ ] Opportunity for an experience that might help you get into graduate school
- [ ] Opportunity for an experience that might help you get a job
- [ ] Reputation of the host lab/institution
- [ ] Geographic location of the host lab/institution
- [ ] Availability of transportation to and from host site
- [ ] Stipend
- [ ] Housing stipend
- [ ] Living arrangements
- [ ] Social/cultural activities

Other (please specify)

*** 3. Did you apply to any other research programs/projects/summer institutes or for any internships for the same summer you participated in SULI?**

- ◯ No
- ◯ Yes

9. Other Program

SULI student

*** 1. Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer.**

- [ ] Another laboratory/institution in the SULI program
- [ ] Research Experience for Undergraduates (REU) program
- [ ] NIH Summer Research Program
- [ ] University research assistantship
- [ ] Federal work-study
- [ ] Internship (in government, industry, non-profit organization)

Other summer research program (please specify)

*** 2. If you were accepted to another program, why did you select SULI over that program?**

5
6

10. SULI Program Internal Structure

*** 1. What is your level of agreement with each of the following statements about the SULI program?**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
The application process for the undergraduate research experience (URE) program was straightforward	○	○	○	○	○	○
There was sufficient program information available to help me choose a URE research project	○	○	○	○	○	○
It was easy to identify a research mentor/supervisor	○	○	○	○	○	○
It was challenging to secure a research position	○	○	○	○	○	○
There was a lack of program orientation	○	○	○	○	○	○
The guidance I received in navigating the administrative process of getting started in my URE was lacking	○	○	○	○	○	○
I am happy with the support I received from the program/administrative staff	○	○	○	○	○	○
I am dissatisfied with the guidance I received from the program/administrative staff	○	○	○	○	○	○
The financial support I received from the SULI program was sufficient to meet my living expenses while I was in the program	○	○	○	○	○	○

11. Research Mentor/Supervisor

SULI student

* 1. Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
My lab-based interactions with my research mentor/supervisor have had a positive influence on my research skills	◯	◯	◯	◯	◯	◯
My lab-based interactions with my research mentor/supervisor have had a positive influence on my interest in the discipline	◯	◯	◯	◯	◯	◯
My lab-based interactions with my research mentor/supervisor have had a positive influence on my career aspirations	◯	◯	◯	◯	◯	◯
I had a great deal of lab-based interaction with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
While participating in the SULI program, I was able to work in the lab with leading scientists/researchers	◯	◯	◯	◯	◯	◯
I am happy with the support/guidance I received in the lab from my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I had little contact with my research mentor/supervisor in the lab	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally interested in developing my research lab skills	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally an outstanding teacher	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was involved in developing my research skills	◯	◯	◯	◯	◯	◯

SULI student

*** 2. Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
My non-lab interactions with my research mentor/supervisor have had a positive influence on my personal growth, values, and attitudes	◯	◯	◯	◯	◯	◯
My non-lab interactions with my research mentor/supervisor have had a positive influence on my intellectual growth and interest in discipline	◯	◯	◯	◯	◯	◯
My non-lab interactions with my research mentor/supervisor have had a positive influence on my career goals and aspirations	◯	◯	◯	◯	◯	◯
While participating in the SULI program I developed a close, personal relationship with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I am satisfied with the opportunities I had to interact informally with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I am happy with the overall experience with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I had little contact with my research mentor/supervisor outside the lab	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally interested in developing my career	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally an outstanding professional mentor	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was willing to spend time outside of class to discuss professional development issues that were important to me	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was willing to provide me with graduate school advice	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was willing to provide me with career advice	◯	◯	◯	◯	◯	◯

*** 3. My research mentor/supervisor is ...**

	False	True
The same ethnicity as me	◯	◯
The same race as me	◯	◯
The same sex as me	◯	◯

12. Research Team

SULI student

*** 1. Select your level of agreement with the following statements about your lab-based interactions with the research team**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
My lab-based interactions with members of the research team have had a positive influence on my research skills	○	○	○	○	○	○
My lab-based interactions with members of the research team have had a positive influence on my interest in the discipline	○	○	○	○	○	○
My lab-based interactions with members of the research team have had a positive influence on my career aspirations	○	○	○	○	○	○
I had a great deal of lab-based interaction with members of the research team	○	○	○	○	○	○
I had little lab-based contact with other members of the research team	○	○	○	○	○	○
I am happy with the overall experience of working in the lab with the research team	○	○	○	○	○	○

*** 2. Select your level of agreement with the following statements about interactions outside the lab with the research team**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
While participating in the undergraduate research experience (URE) I developed close personal relationships with members of the research team	○	○	○	○	○	○
The friendships I developed with members of the research team while participating in the URE have been personally satisfying	○	○	○	○	○	○
My interpersonal relationships with members of the research team had a positive influence on my personal growth, attitudes, and values	○	○	○	○	○	○
My interpersonal relationships with members of the research team have had a positive influence on my intellectual growth and interest in the discipline	○	○	○	○	○	○
It was difficult for me to meet and make friends with members of the research team while in the summer URE	○	○	○	○	○	○
Few of the members of the research team I met while in the summer URE would be willing to listen to me and/or help me if I had a personal problem	○	○	○	○	○	○
Most of members of the research team in this URE have values and/or attitudes different from my own	○	○	○	○	○	○
The experience with members of the research team overall was excellent	○	○	○	○	○	○
I had little contact outside the lab with other members of the research team	○	○	○	○	○	○
I am happy with the overall experience of spending time with members of the research team outside of the lab	○	○	○	○	○	○

SULI student

*** 3. Most of the members of the research team are ...**

	False	True
The same ethnicity as me	◯	◯
The same race as me	◯	◯
The same sex as me	◯	◯

13. Peer Environment

1. Were there other undergraduates working in the same lab or at the same site as you?

◯ No

◯ Yes

*** 2. Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the SULI program.**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
While participating in the SULI program I developed close personal relationships with fellow undergraduates lab	◯	◯	◯	◯	◯	◯
The friendships I developed with fellow undergraduates while participating in the SULI program have been personally satisfying	◯	◯	◯	◯	◯	◯
My interpersonal relationships with fellow undergraduates had a positive influence on my personal growth, attitudes, and values	◯	◯	◯	◯	◯	◯
My interpersonal relationships with fellow undergraduates have had a positive influence on my intellectual growth and interest in the discipline	◯	◯	◯	◯	◯	◯
It was difficult for me to meet and make friends with fellow undergraduates while in the SULI program	◯	◯	◯	◯	◯	◯
Few of the other undergraduates while in the SULI program would be willing to listen to me and help me if I had a personal problem	◯	◯	◯	◯	◯	◯
Most of my fellow undergraduates who worked have values and attitudes different from my own	◯	◯	◯	◯	◯	◯
I had very little interaction with fellow undergraduates who worked	◯	◯	◯	◯	◯	◯
I received very little support/guidance from fellow undergraduates	◯	◯	◯	◯	◯	◯
Most of the other undergraduates were the same sex as me	◯	◯	◯	◯	◯	◯
Most of the other undergraduates were the same ethnicity as me	◯	◯	◯	◯	◯	◯
Most of the other undergraduates were the same race as me	◯	◯	◯	◯	◯	◯

SULI student

*** 3. Indicate your level of agreement with each of the following.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
The other undergraduates were smarter than me	○	○	○	○	○	○
The other undergraduates had a better mentor than me	○	○	○	○	○	○
The other undergraduates had a better experience overall than me	○	○	○	○	○	○
Other undergraduates had less professional development opportunities than I did	○	○	○	○	○	○
Other undergraduates gained less technical expertise than I did	○	○	○	○	○	○

14. Research Lab Experiences

1. During my experiences in the SULI program, I ...

- ☐ Engaged in real-world science research
- ☐ Felt like a scientist
- ☐ Thought creatively about the project
- ☐ Tried out new ideas or procedures on your own
- ☐ Felt responsible for the project
- ☐ Worked extra hours because I was excited about the research

SULI student

* 2. Indicate your level of agreement with each of the following.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
I am satisfied with the extent of my experiences in research lab	○	○	○	○	○	○
My research lab experience has had a positive influence on my intellectual growth and interest in the discipline	○	○	○	○	○	○
My interest in the discipline has increased as a result of the research lab experience	○	○	○	○	○	○
I am more likely to engage in work in a research lab now than I was before my experiences in this research lab	○	○	○	○	○	○
I learned as much as I anticipated I would in the research lab experience	○	○	○	○	○	○
Few of my activities in the research lab have been intellectually stimulating	○	○	○	○	○	○
The time (and amount of time) I spent working in the research lab was meaningful	○	○	○	○	○	○
I am satisfied with my level of responsibility on my undergraduate research experience (URE) project	○	○	○	○	○	○
I am satisfied with the input I gave in designing the research project	○	○	○	○	○	○
I did little or nothing that seemed like real research	○	○	○	○	○	○
I was able to complete my research project	○	○	○	○	○	○
I am happy with the research experience overall	○	○	○	○	○	○
I am satisfied with the amount of time I spent in the research lab	○	○	○	○	○	○
I am satisfied with the amount of support/guidance I received in my research experiences in the lab	○	○	○	○	○	○
The URE contributed to increasing my awareness of the relevance of research to my coursework	○	○	○	○	○	○
The research team meetings I attended were beneficial to the development of my research project in the lab	○	○	○	○	○	○

* 3. As a result of the SULI program, my lab-based skills have improved in:

☐ Identifying limitations of research designs

☐ Understanding the concepts guiding my research project

15. Social/Professional Development

SULI student

* 1. Indicate your level of agreement with each of the following.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
I am satisfied with the extent of my professional experiences in the SULI program	○	○	○	○	○	○
I attended most of the professional development activities that were offered during my SULI program	○	○	○	○	○	○
I received adequate professional support/guidance during my SULI	○	○	○	○	○	○
My experiences outside the lab in the SULI program have had a positive influence on my professional growth and interest in the discipline	○	○	○	○	○	○
My interest in the discipline has increased as a result of my professional experiences in the SULI program	○	○	○	○	○	○
I am more likely to engage in professional activities now than I was before my experiences in the SULI program	○	○	○	○	○	○
I learned as much as I anticipated I would from the professional experiences in the SULI program	○	○	○	○	○	○
Few of my activities in the SULI program have been professionally stimulating	○	○	○	○	○	○
I am satisfied with the professional and social experiences in the SULI program overall	○	○	○	○	○	○
I am satisfied with my living/residence arrangement during the SULI program	○	○	○	○	○	○
I am satisfied with the opportunities to participate in social activities during the SULI program	○	○	○	○	○	○
The SULI program increased my awareness of the many career paths for scientists	○	○	○	○	○	○
The research team meetings I attended were beneficial to my professional development in the discipline	○	○	○	○	○	○
The group social activities that took place during the program helped me feel like a part of the team	○	○	○	○	○	○

* 2. As part of my SULI program

	I did this	I didn't do this
I presented a talk or poster to other students or faculty	○	○
I presented a talk or poster at a professional conference	○	○
I attended a conference	○	○
I mentored other students conducting research or led a student research team	○	○
I wrote or co-wrote a paper that was published in an academic journal	○	○
I wrote or co-wrote a paper that was published in an undergraduate research journal	○	○

SULI student

*** 3. As a result of the SULI program, my research skills have improved in:**

- ☐ Explaining my project to people outside my field
- ☐ Preparing a scientific poster
- ☐ Defending an argument when asked questions
- ☐ Writing scientific reports or papers
- ☐ Conducting research literature searches
- ☐ Understanding journal articles

16. Curricular Experiences

*** 1. Indicate your level of agreement with each of the following about improvement in your research skills as a result of the SULI program.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
Taking greater care in conducting lab procedures	○	○	○	○	○	○
Making oral presentations	○	○	○	○	○	○
Supporting assertions with evidence	○	○	○	○	○	○
Keeping a detailed lab notebook	○	○	○	○	○	○
Calibrating instruments needed for measurement	○	○	○	○	○	○

*** 2. During the SULI program, did you attend (check all that apply)**

	Yes, it was required	Yes, it was intellectually stimulating	Yes, it had direct bearing on my research
Skill-based human subjects training	☐	☐	☐
Ethics education/training	☐	☐	☐
Animal-subjects training	☐	☐	☐
Safety training	☐	☐	☐

SULI student

*** 3. Indicate your level of agreement with each of the following.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
I am satisfied with the extent of my skill-based experiences in the SULI program	◯	◯	◯	◯	◯	◯
My skill-based training in the SULI program has had a positive influence on my professional growth	◯	◯	◯	◯	◯	◯
My interest in the discipline has increased as a result of my skill-based training in the SULI program	◯	◯	◯	◯	◯	◯
I am more likely to engage in other skill-based training activities now than I was before my experiences in the SULI program	◯	◯	◯	◯	◯	◯
I learned as much as I anticipated I would from the skill-based training of the SULI program	◯	◯	◯	◯	◯	◯
Few of my skill-based training activities in the SULI program have been stimulating	◯	◯	◯	◯	◯	◯
The SULI program contributed to increasing my awareness of connections among scientific disciplines	◯	◯	◯	◯	◯	◯
The information provided to me on how to use the lab equipment was sufficient	◯	◯	◯	◯	◯	◯

17. Outcomes

*** 1. Indicate your level of agreement with each of the following related to the SULI program.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
It was important for me to complete this program	◯	◯	◯	◯	◯	◯
I am confident that I made the right decision in choosing to participate in this program	◯	◯	◯	◯	◯	◯
I understand how my work in this program contributes to the “bigger picture” of research	◯	◯	◯	◯	◯	◯
This program made me feel like a part of the scientific community	◯	◯	◯	◯	◯	◯
I am satisfied with the extent of my intellectual development during the undergraduate research experience (URE)	◯	◯	◯	◯	◯	◯
My interest in the discipline has increased as a result of the URE	◯	◯	◯	◯	◯	◯
My participation in this program helped me perform better academically	◯	◯	◯	◯	◯	◯
The field trips that I took while in the program benefitted my progress overall	◯	◯	◯	◯	◯	◯

SULI student

*** 2. Reflecting on my SULI experience, overall it: (Check all that apply)**

- [ ] Helped me to be self-motivated
- [ ] Taught me that I have the ability to be a competent researcher
- [ ] Taught me how to work effectively with others
- [ ] Was one of the best experiences of my life
- [ ] Taught me how to apply concepts that I had learned in the classroom to a real situation
- [ ] Taught me what it takes to be a successful graduate student
- [ ] Increased my knowledge and understanding of my discipline
- [ ] Showed me that research is not for me
- [ ] Gave me an understanding of what the “world” of research is like
- [ ] Helped equip me to better tackle complex problems
- [ ] Showed me that I would like to continue research as a career in a field similar in my discipline
- [ ] Taught me that you have to have patience in research
- [ ] Taught me that there are different skills required for classroom success and research success
- [ ] Helped me see that doing research can help me get better grades
- [ ] Showed me that "real" research is much different from experience gained in lab classes
- [ ] Helped me to be more dependable
- [ ] Realized that I can do things I didn't think I could do
- [ ] Showed me that I like research better than I expected I would
- [ ] Helped me decide that I am more interested in medical school than graduate school
- [ ] Taught me how to figure out for myself things that I needed to know
- [ ] Taught me that I can do what I set out to do even if there are setbacks along the way
- [ ] Helped me see my personal strengths and/or weaknesses
- [ ] Taught me better time management skills
- [ ] Introduced me to a career that I had never known existed
- [ ] Showed me that I am a good problem solver
- [ ] Taught me that I do not have the patience for research
- [ ] Made me want to go for a PhD

SULI student

3. If you were designing undergraduate research programs, how would you make them better than the programs in which you participated?

* **4. Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the SULI program.**

	Quite likely	Likely	Neutral	Not likely	Quite unlikely	Not applicable
Mentor other students conducting research or leading a student research team	◯	◯	◯	◯	◯	◯
Participate in research-related field trips to other labs	◯	◯	◯	◯	◯	◯
Attend student conferences on research (that include students from other colleges)	◯	◯	◯	◯	◯	◯
Attend discipline-specific conferences (conferences not specifically for students)	◯	◯	◯	◯	◯	◯
Prepare and present a poster describing my research	◯	◯	◯	◯	◯	◯
Prepare written research papers describing my research and results	◯	◯	◯	◯	◯	◯
Deliver an oral presentation describing my research and results	◯	◯	◯	◯	◯	◯
Author or co-author a paper that is published in a professional journal in this discipline	◯	◯	◯	◯	◯	◯
Become a faculty member at a research university	◯	◯	◯	◯	◯	◯
Seek employment in a national lab or institute	◯	◯	◯	◯	◯	◯
Enroll in medical or dental school	◯	◯	◯	◯	◯	◯
Obtain both an MD and a PhD	◯	◯	◯	◯	◯	◯
Pursue certification as a teacher	◯	◯	◯	◯	◯	◯

18. Post-SULI Major

* **1. Did you change your major at any time following the SULI experience?**

◯ No

◯ Yes

19. Post-SULI Major

SULI student

*** 1. Which of the following best describes your major after SULI?**

- Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc
- Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc
- Business, including accounting, finance, management, marketing, etc
- Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc
- Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc
- Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc
- Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc
- Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc
- Pre-law
- Mathematical sciences, including applied mathematics, mathematics, statistics, etc
- Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc
- Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc
- Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc
- Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

20. Master's Degree

*** 1. I intend to complete/or have already completed a master’s degree**

- No
- Yes

21. Master's Degree

SULI student

*** 1. Which of the following best describes the field or fields of your master's degree**

- Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc
- Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc
- Business, including accounting, finance, management, marketing, etc
- Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc
- Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc
- Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc
- Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc
- Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc
- Law
- Mathematical sciences, including applied mathematics, mathematics, statistics, etc
- Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc
- Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc
- Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc
- Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

22. Doctoral Degree

*** 1. I intend to complete a doctoral degree**

- No
- Yes

23. Doctoral Degree

SULI student

* 1. Which of the following best describes the field or fields of your doctoral degree

- ◯ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc
- ◯ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc
- ◯ Business, including accounting, finance, management, marketing, etc
- ◯ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc
- ◯ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc
- ◯ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc
- ◯ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc
- ◯ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc
- ◯ Law
- ◯ Mathematical sciences, including applied mathematics, mathematics, statistics, etc
- ◯ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc
- ◯ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc
- ◯ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc
- ◯ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

24. Demographics

* 1. Your sex

- ◯ Female
- ◯ Male

* 2. Are you Hispanic or Latino?

- ◯ No
- ◯ Yes

SULI student

* 3. What is your racial background?

- ◯ African American or Black
- ◯ Asian or Asian American
- ◯ Cacasian or White
- ◯ Native American or Alaska Native
- ◯ Native Hawaiian or Pacific Islander
- ◯ More than one race

Other (please specify)

* 4. What was your family/household income when you were involved in the SULI program?

- ◯ Less than $20,000
- ◯ $20,001 - $30,000
- ◯ $30,001-$40,000
- ◯ $40,001-$50,000
- ◯ $50,001-$60,000
- ◯ $60,001-$70,000
- ◯ $70,001-$80,000
- ◯ $80,001-$90,000
- ◯ $90,001-$100,000
- ◯ More than $100,000

* 5. Undergraduate level at the time of participation in SULI

- ◯ Freshman
- ◯ Sophomore
- ◯ Junior
- ◯ Senior
- ◯ Already achieved baccalaureate degree

SULI student

*** 6. Level in school (now)**

- ◯ Freshman
- ◯ Sophomore
- ◯ Junior
- ◯ Senior
- ◯ Graduated

Other (please specify)

25. Education

*** 1. Are you currently ...**

- ◯ Working toward an undergraduate degree
- ◯ In grad school for master's degree
- ◯ Graduated from grad school (no longer attending)
- ◯ Pursuing a PhD or other doctoral degree

Other (please specify)

26. Educational Attainment

*** 1. Father's highest level of educational attainment**

- ◯ Some high school
- ◯ High school diploma
- ◯ Some college
- ◯ Associate degree
- ◯ Bachelor's degree
- ◯ Some graduate or professional education
- ◯ Graduate or professional degree (M.A., M.S., M.D., J.D., Psy.D., etc.)
- ◯ Doctoral degree (Ed.D., Ph.D.)

Other (please specify)

SULI student

* 2. Mother's highest level of educational attainment

- ◯ Some high school
- ◯ High school diploma
- ◯ Some college
- ◯ Associate degree
- ◯ Bachelor's degree
- ◯ Some graduate or professional education
- ◯ Graduate or professional degree (M.A., M.S., M.D., J.D., Psy.D., etc.)
- ◯ Doctoral degree (Ed.D., Ph.D.)

Other (please specify)

* 3. What was your position in your high school graduating class?

- ◯ Top 5%
- ◯ Top 6-10%
- ◯ Top 11-15%
- ◯ Top 16-20%
- ◯ Greater than top 20%
- ◯ I do not know or my high school did not calculate rank

SULI student

* **4. During your undergraduate career, have you received any of the following? (check primary source)**

- ◯ Student loan
- ◯ Scholarship
- ◯ Internship
- ◯ Pell Grant
- ◯ Direct Loan
- ◯ Merit Aid
- ◯ Federal Tax Credit
- ◯ Lottery Scholarship

Any others (please specify)

* **5. What was you cumulative undergraduate GPA in the semester prior to your participation in SULI? (based on a rounded four-point scale)**

- ◯ Less than 3.5
- ◯ 3.5 to 3.75
- ◯ 3.76 to 3.8
- ◯ 3.9 or higher
- ◯ Have no idea

Other calculation (please specify)

SULI student

* 6. Chosen discipline/major prior to SULI program

- ○ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc.
- ○ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc.
- ○ Business, including accounting, finance, management, marketing, etc.
- ○ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc.
- ○ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc.
- ○ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc.
- ○ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc.
- ○ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc.
- ○ Pre-law
- ○ Mathematical sciences, including applied mathematics, mathematics, statistics, etc.
- ○ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc.
- ○ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc.
- ○ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc.
- ○ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

27. Thank you!

SURF student

1. Informed Consent

Evaluating Outcomes in Federally-Funded Summer Undergraduate Research Experience Programs in STEM Field

Informed Consent Document for This Research Survey

Principal Investigators: Laura Foltz, Sam Gannon & Stephanie Kirschmann,Vanderbilt University

The following information is provided to inform you about this research project and your participation in it. Please read this form carefully and feel free to submit any questions you may have about this study (via the email link) and your questions will be answered as soon as possible. You may print a copy of this consent notice.
You participation in this research survey is voluntary.

You are also free to end the survey at any time.

1. Purpose of the study
The principal investigators are doctoral candidates at Vanderbilt University. You are being asked to participate in a research study in order to help them learn about the effectiveness of federally-funded summer undergraduate research experience programs in the STEM disciplines. The resulting tool will allow researchers to make comparisons within and among STEM programs.

2. Procedures to be followed and approximate duration of the study
The survey will take approximately 15-30 minutes depending on the survey you complete. You will be asked to answer a number of questions (exact number is dependent on your answers). Once you have completed all the questions, you may close the survey.

3. Expected costs
There is no cost to take the survey.

4. Description of the discomforts, inconveniences, and/or risks that can be reasonably expected as a result of participation in this study
The approximately 15-30 minutes you spend taking the survey may be an inconvenience.

5. Anticipated benefits from this study
The anticipated benefit to mankind from this study is increased general knowledge; however, there are no direct benefits to you for participating in this study.

6. Compensation for participation
None

7. What happens if you choose to withdraw from study participation?
There is no penalty for choosing not to complete the survey.

8. Contact information
If you should have any questions about this research study or possible injury, please feel free to contact:
• Sam Gannon (615/484-1801) or via email sam.gannon@vanderbilt.edu
For additional information about giving consent or your rights as a participant in this study, please feel free to contact the Vanderbilt
University Institutional Review Board Office at (615) 322-2918 or toll free at (866) 224-8273.

9. Confidentiality statement
Although the questions will not collect personal information that can identify you, all reasonable efforts will be made to keep the information in your research record private and confidential, but absolute confidentiality cannot be guaranteed. Your information may be shared with institutional and/or governmental authorities, such as the Vanderbilt University

SURF student

Institutional Review Board, if you or someone else is in danger, or if we are required to do so by law.

10. Data Maintenance
Data will be stored online until the data collection phase ends. Once all data has been collected, data will be converted to an Excel spreadsheet, which will be used in data analysis. Only the principal investigators will have access to the data, which will be stored on a secure, encrypted password enabled server at Vanderbilt University Medical Center.

*** 1. Have you read this informed consent document and the material contained in it?**

- No
- Yes

2.

*** 1. Did this informed consent document answer all your questions about the study?**

- No
- Yes

3. Need more information?

1. Please enter your first name, email address and/or phone number and your question and we will provide answers to all your questions so that you may freely and voluntarily give your informed consent to participate in this study.

4.

*** 1. Do you freely and voluntarily choose to participate in the study?**

- No
- Yes

5. Default Section

SURF student

*** 1. Which of the following best describes your chosen academic major prior to your involvement in the SURF program?**

- ○ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc.
- ○ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc.
- ○ Business, including accounting, finance, management, marketing, etc.
- ○ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc.
- ○ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc.
- ○ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc.
- ○ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc.
- ○ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc.
- ○ Pre-law
- ○ Mathematical sciences, including applied mathematics, mathematics, statistics, etc.
- ○ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc.
- ○ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc.
- ○ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc.
- ○ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

Other (please specify)

*** 2. Did you have (non-classroom based) undergraduate hands-on research experience prior to your participation in the SURF program?**

- ○ No
- ○ Yes

6. Other Undergraduate Hands-On Research Experiences

SURF student

* 1. Was most of the prior hands-on research you did as an undergraduate in the same general academic field as your major?

- No
- Yes

* 2. Which of the following best describes the hands-on research experience:

- Summer research, other than intern or co-op program. A full-time hands-on research project for the summer with a professor or researcher.
- Hands-on research with a professor during one or more academic terms, while enrolled in classes.
- Intern or co-op program that involved hands-on research as its main component. Usually, a company or other organization pays you for working on a research project at their site. Sometimes you receive academic credit at your school for this research. May happen any time of year.
- A junior or senior thesis that involves hands-on research (other than library research) as its main component.

Other (please specify)

* 3. Did you receive academic credit for any of your undergraduate research activities?

- No
- Yes

* 4. Did you receive any of the following for your prior hands-on undergraduate research experience?

	No	Yes
Stipend	○	○
Tuition and/or fees paid	○	○
Housing or housing allowance	○	○
Budget/allowance for lab supplies	○	○
Travel to conferences and/or opportunities to present research at conferences	○	○

Other (please specify)

SURF student

* 5. Was your previous undergraduate hands-on experience any of the following?

- [ ] Department of Education McNair Scholars Program
- [ ] Department of Energy
- [ ] Have no idea
- [ ] Institutional (from your undergraduate school)
- [ ] NASA
- [ ] NIH
- [ ] None
- [ ] Not sure which NSF program
- [ ] NSF HBCU-UP program
- [ ] NSF LS-AMP program
- [ ] NSF REU program
- [ ] NSF RUI program
- [ ] Other federal government program/agency
- [ ] Other NSF program
- [ ] With an outside company

Other (please specify)

* 6. Was the program geographically located

- ○ At your undergraduate institution?
- ○ 50 miles or less from your undergraduate institution?
- ○ 51 to 100 miles from your undergraduate institution
- ○ 100 to 150 miles from your undergraduate institution
- ○ More than 150 miles from your undergraduate institution
- ○ Do not know

SURF student

*** 7. Was the program geographically located**

- ◯ 50 miles or less from your home
- ◯ 51 to 100 miles from your home
- ◯ 100 to 150 miles from your home
- ◯ More than 150 miles from your home
- ◯ Do not know

*** 8. Did any of your undergraduate research activities take place in another country (outside the United States)?**

- ◯ No
- ◯ Yes

7. International Experience

*** 1. In what country or countries did your hands-on undergraduate research take place?**

____

8. Selecting the SURF Program

*** 1. Before you applied for the SURF undergraduate research experience, from which sources did you obtain information about the program?**

- ☐ The program director, coordinator, or other administrator
- ☐ Program faculty/researchers
- ☐ Current or former Program students
- ☐ Non-Program faculty/researchers
- ☐ Program brochure
- ☐ Conference
- ☐ Program Website
- ☐ University Website

Other (please specify)

____

SURF student

*** 2. How important was each of the following in your decision to apply to the Program? (Check all that apply)**

- ☐ Interdisciplinary coursework offered by Program
- ☐ Opportunity to find out if [Program research field] was for you
- ☐ Research projects of Program faculty
- ☐ Research seminars offered by Program
- ☐ Opportunity for a "hands-on" research experience
- ☐ Opportunity to learn more about what it's like to be a researcher
- ☐ Opportunity to find out if going to graduate school was for you
- ☐ Opportunity to fulfill your school's research requirements
- ☐ Opportunity to fulfill your scholarship's requirements for research
- ☐ Opportunity to earn academic credit for doing research in the summer
- ☐ Opportunity for an experience that might help you get into graduate school
- ☐ Opportunity for an experience that might help you get a job
- ☐ Reputation of the host lab/institution
- ☐ Geographic location of the host lab/institution
- ☐ Availability of transportation to and from host site
- ☐ Stipend
- ☐ Housing stipend
- ☐ Living arrangements
- ☐ Social/cultural activities

Other (please specify)

*** 3. Did you apply to any other research programs/projects/summer institutes or for any internships for the same summer you participated in your undergraduate research experience?**

- ○ No
- ○ Yes

9. Other Program

SURF student

* 1. Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer.

- [ ] Another laboratory/institution in the SURF program
- [ ] Research Experience for Undergraduates (REU) program
- [ ] NIH Summer Research Program
- [ ] University research assistantship
- [ ] Federal work-study
- [ ] Internship (in government, industry, non-profit organization)

Other summer research program (please specify)

* 2. If you were accepted to another program, why did you select SURF over that program?

10. SURF Program Internal Structure

* 1. What is your level of agreement with each of the following statements about the SURF program?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
The application process for the undergraduate research experience (URE) program was straightforward	○	○	○	○	○	○
There was sufficient program information available to help me choose a URE research project	○	○	○	○	○	○
It was easy to identify a research mentor/supervisor	○	○	○	○	○	○
It was challenging to secure a research position	○	○	○	○	○	○
There was a lack of program orientation	○	○	○	○	○	○
The guidance I received in navigating the administrative process of getting started in my URE was lacking	○	○	○	○	○	○
I am happy with the support I received from the program/administrative staff	○	○	○	○	○	○
I am dissatisfied with the guidance I received from the program/administrative staff	○	○	○	○	○	○
The financial support I received from the SURF program was sufficient to meet my living expenses while I was in the program	○	○	○	○	○	○

11. Research Mentor/Supervisor

SURF student

*** 1. Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
My lab-based interactions with my research mentor/supervisor have had a positive influence on my research skills	◯	◯	◯	◯	◯	◯
My lab-based interactions with my research mentor/supervisor have had a positive influence on my interest in the discipline	◯	◯	◯	◯	◯	◯
My lab-based interactions with my research mentor/supervisor have had a positive influence on my career aspirations	◯	◯	◯	◯	◯	◯
I had a great deal of lab-based interaction with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
While participating in the SURF program, I was able to work in the lab with leading scientists/researchers	◯	◯	◯	◯	◯	◯
I am happy with the support/guidance I received in the lab from my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I had little contact with my research mentor/supervisor in the lab	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally interested in developing my research lab skills	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally an outstanding teacher	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was involved in developing my research skills	◯	◯	◯	◯	◯	◯

SURF student

*** 2. Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
My non-lab interactions with my research mentor/supervisor have had a positive influence on my personal growth, values, and attitudes	◯	◯	◯	◯	◯	◯
My non-lab interactions with my research mentor/supervisor have had a positive influence on my intellectual growth and interest in discipline	◯	◯	◯	◯	◯	◯
My non-lab interactions with my research mentor/supervisor have had a positive influence on my career goals and aspirations	◯	◯	◯	◯	◯	◯
While participating in the SURF program I developed a close, personal relationship with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I am satisfied with the opportunities I had to interact informally with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I am happy with the overall experience with my research mentor/supervisor	◯	◯	◯	◯	◯	◯
I had little contact with my research mentor/supervisor outside the lab	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally interested in developing my career	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was generally an outstanding professional mentor	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was willing to spend time outside of class to discuss professional development issues that were important to me	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was willing to provide me with graduate school advice	◯	◯	◯	◯	◯	◯
My research mentor/sponsor was willing to provide me with career advice	◯	◯	◯	◯	◯	◯

*** 3. My research mentor/supervisor is ...**

	False	True
The same ethnicity as me	◯	◯
The same race as me	◯	◯
The same sex as me	◯	◯

12. Research Team

SURF student

* 1. Select your level of agreement with the following statements about your lab-based interactions with the research team

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
My lab-based interactions with members of the research team have had a positive influence on my research skills	○	○	○	○	○	○
My lab-based interactions with members of the research team have had a positive influence on my interest in the discipline	○	○	○	○	○	○
My lab-based interactions with members of the research team have had a positive influence on my career aspirations	○	○	○	○	○	○
I had a great deal of lab-based interaction with members of the research team	○	○	○	○	○	○
I had little lab-based contact with other members of the research team	○	○	○	○	○	○
I am happy with the overall experience of working in the lab with the research team	○	○	○	○	○	○

* 2. Select your level of agreement with the following statements about interactions outside the lab with the research team

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
While participating in the undergraduate research experience (URE) I developed close personal relationships with members of the research team	○	○	○	○	○	○
The friendships I developed with members of the research team while participating in the URE have been personally satisfying	○	○	○	○	○	○
My interpersonal relationships with members of the research team had a positive influence on my personal growth, attitudes, and values	○	○	○	○	○	○
My interpersonal relationships with members of the research team have had a positive influence on my intellectual growth and interest in the discipline	○	○	○	○	○	○
It was difficult for me to meet and make friends with members of the research team while in the summer URE	○	○	○	○	○	○
Few of the members of the research team I met while in the summer URE would be willing to listen to me and/or help me if I had a personal problem	○	○	○	○	○	○
Most of members of the research team in this URE have values and/or attitudes different from my own	○	○	○	○	○	○
The experience with members of the research team overall was excellent	○	○	○	○	○	○
I had little contact outside the lab with other members of the research team	○	○	○	○	○	○
I am happy with the overall experience of spending time with members of the research team outside of the lab	○	○	○	○	○	○

SURF student

*** 3. Most of the members of the research team are ...**

	False	True
The same ethnicity as me	◯	◯
The same race as me	◯	◯
The same sex as me	◯	◯

13. Peer Environment

1. Were there other undergraduates working in the same lab or at the same site as you?

◯ No

◯ Yes

*** 2. Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the SURF program.**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
While participating in the SURF program I developed close personal relationships with fellow undergraduates lab	◯	◯	◯	◯	◯	◯
The friendships I developed with fellow undergraduates while participating in the SURF program have been personally satisfying	◯	◯	◯	◯	◯	◯
My interpersonal relationships with fellow undergraduates had a positive influence on my personal growth, attitudes, and values	◯	◯	◯	◯	◯	◯
My interpersonal relationships with fellow undergraduates have had a positive influence on my intellectual growth and interest in the discipline	◯	◯	◯	◯	◯	◯
It was difficult for me to meet and make friends with fellow undergraduates while in the SURF program	◯	◯	◯	◯	◯	◯
Few of the other undergraduates while in the SURF program would be willing to listen to me and help me if I had a personal problem	◯	◯	◯	◯	◯	◯
Most of my fellow undergraduates who worked have values and attitudes different from my own	◯	◯	◯	◯	◯	◯
I had very little interaction with fellow undergraduates who worked	◯	◯	◯	◯	◯	◯
I received very little support/guidance from fellow undergraduates	◯	◯	◯	◯	◯	◯
Most of the other undergraduates were the same sex as me	◯	◯	◯	◯	◯	◯
Most of the other undergraduates were the same ethnicity as me	◯	◯	◯	◯	◯	◯
Most of the other undergraduates were the same race as me	◯	◯	◯	◯	◯	◯

SURF student

*** 3. Indicate your level of agreement with each of the following.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
The other undergraduates were smarter than me	◯	◯	◯	◯	◯	◯
The other undergraduates had a better mentor than me	◯	◯	◯	◯	◯	◯
The other undergraduates had a better experience overall than me	◯	◯	◯	◯	◯	◯
Other undergraduates had less professional development opportunities than I did	◯	◯	◯	◯	◯	◯
Other undergraduates gained less technical expertise than I did	◯	◯	◯	◯	◯	◯

14. Research Lab Experiences

1. During my experiences in the SURF program, I ...

- ☐ Engaged in real-world science research
- ☐ Felt like a scientist
- ☐ Thought creatively about the project
- ☐ Tried out new ideas or procedures on your own
- ☐ Felt responsible for the project
- ☐ Worked extra hours because I was excited about the research

SURF student

* 2. Indicate your level of agreement with each of the following.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
I am satisfied with the extent of my experiences in research lab	◯	◯	◯	◯	◯	◯
My research lab experience has had a positive influence on my intellectual growth and interest in the discipline	◯	◯	◯	◯	◯	◯
My interest in the discipline has increased as a result of the research lab experience	◯	◯	◯	◯	◯	◯
I am more likely to engage in work in a research lab now than I was before my experiences in this research lab	◯	◯	◯	◯	◯	◯
I learned as much as I anticipated I would in the research lab experience	◯	◯	◯	◯	◯	◯
Few of my activities in the research lab have been intellectually stimulating	◯	◯	◯	◯	◯	◯
The time (and amount of time) I spent working in the research lab was meaningful	◯	◯	◯	◯	◯	◯
I am satisfied with my level of responsibility on my undergraduate research experience (URE) project	◯	◯	◯	◯	◯	◯
I am satisfied with the input I gave in designing the research project	◯	◯	◯	◯	◯	◯
I did little or nothing that seemed like real research	◯	◯	◯	◯	◯	◯
I was able to complete my research project	◯	◯	◯	◯	◯	◯
I am happy with the research experience overall	◯	◯	◯	◯	◯	◯
I am satisfied with the amount of time I spent in the research lab	◯	◯	◯	◯	◯	◯
I am satisfied with the amount of support/guidance I received in my research experiences in the lab	◯	◯	◯	◯	◯	◯
The URE contributed to increasing my awareness of the relevance of research to my coursework	◯	◯	◯	◯	◯	◯
The research team meetings I attended were beneficial to the development of my research project in the lab	◯	◯	◯	◯	◯	◯

* 3. As a result of the SURF program, my lab-based skills have improved in:

- ☐ Identifying limitations of research designs
- ☐ Understanding the concepts guiding my research project

15. Social/Professional Development

SURF student

* 1. Indicate your level of agreement with each of the following.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
I am satisfied with the extent of my professional experiences in the SURF program	◯	◯	◯	◯	◯	◯
I attended most of the professional development activities that were offered during my SURF program	◯	◯	◯	◯	◯	◯
I received adequate professional support/guidance during my SURF	◯	◯	◯	◯	◯	◯
My experiences outside the lab in the SURF program have had a positive influence on my professional growth and interest in the discipline	◯	◯	◯	◯	◯	◯
My interest in the discipline has increased as a result of my professional experiences in the SURF program	◯	◯	◯	◯	◯	◯
I am more likely to engage in professional activities now than I was before my experiences in the SURF program	◯	◯	◯	◯	◯	◯
I learned as much as I anticipated I would from the professional experiences in the SURF program	◯	◯	◯	◯	◯	◯
Few of my activities in the SURF program have been professionally stimulating	◯	◯	◯	◯	◯	◯
I am satisfied with the professional and social experiences in the SURF program overall	◯	◯	◯	◯	◯	◯
I am satisfied with my living/residence arrangement during the SURF program	◯	◯	◯	◯	◯	◯
I am satisfied with the opportunities to participate in social activities during the SURF program	◯	◯	◯	◯	◯	◯
The SURF program increased my awareness of the many career paths for scientists	◯	◯	◯	◯	◯	◯
The research team meetings I attended were beneficial to my professional development in the discipline	◯	◯	◯	◯	◯	◯
The group social activities that took place during the program helped me feel like a part of the team	◯	◯	◯	◯	◯	◯

* 2. As part of my SURF program

	I did this	I didn't do this
I presented a talk or poster to other students or faculty	◯	◯
I presented a talk or poster at a professional conference	◯	◯
I attended a conference	◯	◯
I mentored other students conducting research or led a student research team	◯	◯
I wrote or co-wrote a paper that was published in an academic journal	◯	◯
I wrote or co-wrote a paper that was published in an undergraduate research journal	◯	◯

SURF student

*** 3. As a result of the SURF program, my research skills have improved in:**

- [ ] Explaining my project to people outside my field
- [ ] Preparing a scientific poster
- [ ] Defending an argument when asked questions
- [ ] Writing scientific reports or papers
- [ ] Conducting research literature searches
- [ ] Understanding journal articles

16. Curricular Experiences

*** 1. Indicate your level of agreement with each of the following about improvement in your research skills as a result of the SURF program.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
Taking greater care in conducting lab procedures	○	○	○	○	○	○
Making oral presentations	○	○	○	○	○	○
Supporting assertions with evidence	○	○	○	○	○	○
Keeping a detailed lab notebook	○	○	○	○	○	○
Calibrating instruments needed for measurement	○	○	○	○	○	○

*** 2. During the SURF program, did you attend (check all that apply)**

	Yes, it was required	Yes, it was intellectually stimulating	Yes, it had direct bearing on my research
Skill-based human subjects training	☐	☐	☐
Ethics education/training	☐	☐	☐
Animal-subjects training	☐	☐	☐
Safety training	☐	☐	☐

SURF student

*** 3. Indicate your level of agreement with each of the following.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
I am satisfied with the extent of my skill-based experiences in the SURF program	◯	◯	◯	◯	◯	◯
My skill-based training in the SURF program has had a positive influence on my professional growth	◯	◯	◯	◯	◯	◯
My interest in the discipline has increased as a result of my skill-based training in the SURF program	◯	◯	◯	◯	◯	◯
I am more likely to engage in other skill-based training activities now than I was before my experiences in the SURF program	◯	◯	◯	◯	◯	◯
I learned as much as I anticipated I would from the skill-based training of the SURF program	◯	◯	◯	◯	◯	◯
Few of my skill-based training activities in the SURF program have been stimulating	◯	◯	◯	◯	◯	◯
The SURF program contributed to increasing my awareness of connections among scientific disciplines	◯	◯	◯	◯	◯	◯
The information provided to me on how to use the lab equipment was sufficient	◯	◯	◯	◯	◯	◯

17. Outcomes

*** 1. Indicate your level of agreement with each of the following related to the SURF program.**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
It was important for me to complete this program	◯	◯	◯	◯	◯	◯
I am confident that I made the right decision in choosing to participate in this program	◯	◯	◯	◯	◯	◯
I understand how my work in this program contributes to the “bigger picture” of research	◯	◯	◯	◯	◯	◯
This program made me feel like a part of the scientific community	◯	◯	◯	◯	◯	◯
I am satisfied with the extent of my intellectual development during the undergraduate research experience (URE)	◯	◯	◯	◯	◯	◯
My interest in the discipline has increased as a result of the URE	◯	◯	◯	◯	◯	◯
My participation in this program helped me perform better academically	◯	◯	◯	◯	◯	◯
The field trips that I took while in the program benefitted my progress overall	◯	◯	◯	◯	◯	◯

SURF student

* 2. Reflecting on my SURF experience, overall it: (Check all that apply)

- [ ] Helped me to be self-motivated
- [ ] Taught me that I have the ability to be a competent researcher
- [ ] Taught me how to work effectively with others
- [ ] Was one of the best experiences of my life
- [ ] Taught me how to apply concepts that I had learned in the classroom to a real situation
- [ ] Taught me what it takes to be a successful graduate student
- [ ] Increased my knowledge and understanding of my discipline
- [ ] Showed me that research is not for me
- [ ] Gave me an understanding of what the “world” of research is like
- [ ] Helped equip me to better tackle complex problems
- [ ] Showed me that I would like to continue research as a career in a field similar in my discipline
- [ ] Taught me that you have to have patience in research
- [ ] Taught me that there are different skills required for classroom success and research success
- [ ] Helped me see that doing research can help me get better grades
- [ ] Showed me that "real" research is much different from experience gained in lab classes
- [ ] Helped me to be more dependable
- [ ] Realized that I can do things I didn't think I could do
- [ ] Showed me that I like research better than I expected I would
- [ ] Helped me decide that I am more interested in medical school than graduate school
- [ ] Taught me how to figure out for myself things that I needed to know
- [ ] Taught me that I can do what I set out to do even if there are setbacks along the way
- [ ] Helped me see my personal strengths and/or weaknesses
- [ ] Taught me better time management skills
- [ ] Introduced me to a career that I had never known existed
- [ ] Showed me that I am a good problem solver
- [ ] Taught me that I do not have the patience for research
- [ ] Made me want to go for a PhD

SURF student

3. If you were designing undergraduate research programs, how would you make them better than the programs in which you participated?

*** 4. Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the SURF program.**

	Quite likely	Likely	Neutral	Not likely	Quite unlikely	Not applicable
Mentor other students conducting research or leading a student research team	◯	◯	◯	◯	◯	◯
Participate in research-related field trips to other labs	◯	◯	◯	◯	◯	◯
Attend student conferences on research (that include students from other colleges)	◯	◯	◯	◯	◯	◯
Attend discipline-specific conferences (conferences not specifically for students)	◯	◯	◯	◯	◯	◯
Prepare and present a poster describing my research	◯	◯	◯	◯	◯	◯
Prepare written research papers describing my research and results	◯	◯	◯	◯	◯	◯
Deliver an oral presentation describing my research and results	◯	◯	◯	◯	◯	◯
Author or co-author a paper that is published in a professional journal in this discipline	◯	◯	◯	◯	◯	◯
Become a faculty member at a research university	◯	◯	◯	◯	◯	◯
Seek employment in a national lab or institute	◯	◯	◯	◯	◯	◯
Enroll in medical or dental school	◯	◯	◯	◯	◯	◯
Obtain both an MD and a PhD	◯	◯	◯	◯	◯	◯
Pursue certification as a teacher	◯	◯	◯	◯	◯	◯

18. Post-SURF Major

*** 1. Did you change your major at any time following the SURF experience?**

◯ No

◯ Yes

19. Post-SURF Major

SURF student

* 1. Which of the following best describes your major after SURF?

- ◯ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc
- ◯ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc
- ◯ Business, including accounting, finance, management, marketing, etc
- ◯ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc
- ◯ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc
- ◯ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc
- ◯ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc
- ◯ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc
- ◯ Pre-law
- ◯ Mathematical sciences, including applied mathematics, mathematics, statistics, etc
- ◯ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc
- ◯ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc
- ◯ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc
- ◯ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

20. Master's Degree

* 1. I intend to complete/or have already completed a master’s degree

- ◯ No
- ◯ Yes

21. Master's Degree

SURF student

*** 1. Which of the following best describes the field or fields of your master's degree**

- ◯ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc
- ◯ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc
- ◯ Business, including accounting, finance, management, marketing, etc
- ◯ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc
- ◯ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc
- ◯ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc
- ◯ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc
- ◯ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc
- ◯ Law
- ◯ Mathematical sciences, including applied mathematics, mathematics, statistics, etc
- ◯ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc
- ◯ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc
- ◯ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc
- ◯ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

22. Doctoral Degree

*** 1. I intend to complete a doctoral degree**

- ◯ No
- ◯ Yes

23. Doctoral Degree

SURF student

*** 1. Which of the following best describes the field or fields of your doctoral degree**

- ◯ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc
- ◯ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc
- ◯ Business, including accounting, finance, management, marketing, etc
- ◯ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc
- ◯ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc
- ◯ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc
- ◯ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc
- ◯ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc
- ◯ Law
- ◯ Mathematical sciences, including applied mathematics, mathematics, statistics, etc
- ◯ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc
- ◯ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc
- ◯ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc
- ◯ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

24. Demographics

*** 1. Your sex**

- ◯ Female
- ◯ Male

*** 2. Are you Hispanic or Latino?**

- ◯ No
- ◯ Yes

SURF student

* 3. What is your racial background?

- African American or Black
- Asian or Asian American
- Cacasian or White
- Native American or Alaska Native
- Native Hawaiian or Pacific Islander
- More than one race

Other (please specify)

* 4. What was your family/household income when you were involved in the SURF program?

- Less than $20,000
- $20,001 - $30,000
- $30,001-$40,000
- $40,001-$50,000
- $50,001-$60,000
- $60,001-$70,000
- $70,001-$80,000
- $80,001-$90,000
- $90,001-$100,000
- More than $100,000

* 5. Undergraduate level at the time of participation in SURF

- Freshman
- Sophomore
- Junior
- Senior
- Already achieved baccalaureate degree

SURF student

*** 6. Level in school (now)**

- Freshman
- Sophomore
- Junior
- Senior
- Graduated

Other (please specify)

25. Education

*** 1. Are you currently ...**

- Working toward my undergraduate degree
- In grad school for master's degree
- Graduated from grad school (no longer attending)
- Pursuing a PhD or other doctoral degree

Other (please specify)

26. Educational Attainment

*** 1. Father’s highest level of educational attainment**

- Some high school
- High school diploma
- Some college
- Associate degree
- Bachelor’s degree
- Some graduate or professional education
- Graduate or professional degree (M.A., M.S., M.D., J.D., Psy.D., etc.)
- Doctoral degree (Ed.D., Ph.D.)

Other (please specify)

SURF student

* 2. Mother's highest level of educational attainment

- Some high school
- High school diploma
- Some college
- Associate degree
- Bachelor's degree
- Some graduate or professional education
- Graduate or professional degree (M.A., M.S., M.D., J.D., Psy.D., etc.)
- Doctoral degree (Ed.D., Ph.D.)

Other (please specify)

* 3. What was your position in your high school graduating class?

- Top 5%
- Top 6-10%
- Top 11-15%
- Top 16-20%
- Greater than top 20%
- I do not know or my high school did not calculate rank

SURF student

*** 4. During your undergraduate career, have you received any of the following? (check primary source)**

- Student loan
- Scholarship
- Internship
- Pell Grant
- Direct Loan
- Merit Aid
- Federal Tax Credit
- Lottery Scholarship

Any others (please specify)

*** 5. What was you cumulative undergraduate GPA in the semester prior to your participation in SURF? (based on a rounded four-point scale)**

- Less than 3.5
- 3.5 to 3.75
- 3.76 to 3.8
- 3.9 or higher
- Have no idea

Other calculation (please specify)

SURF student

* 6. Chosen discipline/major prior to SURF program

- ◯ Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc.
- ◯ Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc.
- ◯ Business, including accounting, finance, management, marketing, etc.
- ◯ Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc.
- ◯ Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc.
- ◯ Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc.
- ◯ Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc.
- ◯ Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc.
- ◯ Pre-law
- ◯ Mathematical sciences, including applied mathematics, mathematics, statistics, etc.
- ◯ Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc.
- ◯ Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc.
- ◯ Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc.
- ◯ Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories

27. Thank you!

Appendix F

SURF Cohort Enrollment Totals and Corresponding Participants in Facebook Groups

Cohort	Population	Facebook Group Members
2001	60	13
2002	103	21
2003	114	27
2006	112	93
2007	134	117
2008	131	123
2009	151	145
2010	135	131
Total	940	670

Appendix G
Descriptive Statistics

Participant Characteristics as a Percentage of the Sample

Characteristic	SULI (n=50)	SURF (n=90)
Gender		
Male	54%	50%
Female	46%	50%
Ethnicity		
Hispanic	8%	10%
Non-Hispanic	92%	90%
Race		
African-American/Black	12%	2%
Asian American	0%	12%
Caucasian	78%	82%
Native American	10%	3.3%

Participant Discipline Before the URE as a Percentage of the Sample

Discipline	SULI (n=67)	SURF (n=128)
Earth Sciences	3%	0%
Biology	9%	5%
Chemistry	10%	13%
Computer Science	12%	11%
Engineering	28%	39%
Health/Medical Science	5%	2%
Mathematical Sciences	3%	5%
Physics	25%	20%
Physical Sciences other than Physics	0%	1%
Social or Behavioral Sciences	2%	0%
Interdisciplinary Sciences/Math/Engineering	3%	4%

Undergraduate Level at Time of Participation in URE

UG Level	SULI (n=50)	SURF (n=90)
Freshman	12%	6%
Sophomore	32%	24%
Junior	28%	42%
Senior	22%	20%
Received Baccalaureate	6%	8%

Cumulative Undergraduate GPA

GPA	SULI (n=50)	SURF (n=88)
3.9 +	24%	38%
3.76 - 3.8	16%	21%
3.5 - 3.75	26%	21%
Less than 3.5	28%	16%
Don't Know	6%	6%

Participants with Prior URE Experiences

Prior URE	SULI (n=50)	SURF (n=90)
No	51%	48%
Yes	49%	52%

Appendix H

Code Book

Item Number	Variable Code	Description/Definition	Response Values
1	Program	Survey generated response based upon link chosen for program	SULI, SURF
2	Cohort	Years of participation for SULI participants	2001, 2003, 2004, 2006, 2007, 99 (missing)
3	EndDate	Computer generated date that survey ended	Date
4	LATE_RESPOND	Did the individual responde before the first reminder for his/her group? Calculated based upon survey end date.	0= NO (Early) 1=YES (Late)
5	RCAcadMajorBefore	Which of the following best describes your chosen academic major prior to your involvement in the program?	1 = Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc. 2 = Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc. 3 = Business, including accounting, finance, management, marketing, etc. 4 = Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc. 5 = Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc. 6 = Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc. 7 = Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc. 8 = Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc. 9 = Pre-law

			10 = Mathematical sciences, including applied mathematics, mathematics, statistics, etc. 11 = Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc. 12 = Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc. 13 = Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc. 14 = Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories 15 = Other (please specify) 99 = Missing
6	Didyouhavenonclassroombasedundergraduatehandsonresearchexperienc	Did you have (non-classroom based) undergraduate hands-on research experience prior to your participation in the program?	0 = No 1 = Yes 99 = Missing
7	Wasmostofthepriorhandsonresearchyoudidasanundergraduateinthesame	Was most of the prior hands-on research you did as an undergraduate in the same general academic field as your major?	0 = No 1 = Yes 99 = Missing
8	Whichofthefollowingbestdescribesthehandsonresearchexperience	Which of the following best describes the hands-on research experience:	1 = Summer research, other than intern or co-op program. A full-time hands-on research project for the summer with a professor or researcher. 2 = Hands-on research with a professor during one or more academic terms, while enrolled in classes. 3 = Intern or co-op program that involved hands-on research as its main component. Usually, a company or other organization pays you for working on a research project at their site. Sometimes you receive academic credit at your school for this research. May happen any time of year. 4 = A junior or senior thesis that involves hands-on research (other than library research) as its main component. 5 = Other (please specify) 6 = Multiple (with details in the next column) 98 = Not applicable, answered “No” to question 6 99 = Missing

9	Didyoureceiveacademiccreditforanyofyourundergraduateresearchacti	Did you receive academic credit for any of your undergraduate research activities?	0 = No 1 = Yes 98 = Not applicable, answered “No” to question 6 99 = Missing
10	Didyoureceiveanyofthefollowingforyourpriorhandsonundergraduatere	Did you receive any of the following for your prior hands-on undergraduate research experience? - Stipend	0 = No 1 = Yes 98 = Not applicable, answered “No” to question 6 99 = Missing
11	Didyoureceiveanyofthefollowingforyourpriorhandsonundergraduate_A	Did you receive any of the following for your prior hands-on undergraduate research experience? - Tuition and/or fees paid	0 = No 1 = Yes 98 = Not applicable, answered “No” to question 6 99 = Missing
12	Didyoureceiveanyofthefollowingforyourpriorhandsonundergraduate_B	Did you receive any of the following for your prior hands-on undergraduate research experience? - Housing or housing allowance	0 = No 1 = Yes 98 = Not applicable, answered “No” to question 6 99 = Missing
13	Didyoureceiveanyofthefollowingforyourpriorhandsonundergraduate_C	Did you receive any of the following for your prior hands-on undergraduate research experience? - Budget/allowance for lab supplies	0 = No 1 = Yes 98 = Not applicable, answered “No” to question 6 99 = Missing
14	Didyoureceiveanyofthefollowingforyourpriorhandsonundergraduate_D	Did you receive any of the following for your prior hands-on undergraduate research experience? - Travel to conferences and/or opportunities to present research at conferences	0 = No 1 = Yes 98 = Not applicable, answered “No” to question 6 99 = Missing

15	PriorHandsOnResearchExperience	Was your previous undergraduate hands-on experience any of the following?	1 = Department of Education McNair Scholars Program 2 = Department of Energy 3 = Have no idea 4 = Institutional (from your undergraduate school) 5 = NASA 6 = NIH 7 = None 8 = Not sure which NSF program 9 = NSF HBCU-UP program 10 = NSF LS-AMP program 11 = NSF REU program 12 = NSF RUI program 13 = Other federal government program/agency 14 = Other NSF program 15 = With an outside company 16 = Other (please specify) 17 = Multiple 98 = Not applicable, answered “No” to question 6 99 = Missing
16	Wastheprogramgeographicallylocated	Was the program geographically located	1 = At your undergraduate institution? 2 = 50 miles or less from your undergraduate institution? 3 = 51 to 100 miles from your undergraduate institution 4 = 100 to 150 miles from your undergraduate institution 5 = More than 150 miles from your undergraduate institution 6 = Do not know 98 = Not applicable, answered “No” to question 6 99 = Missing
17	Wastheprogramgeographicallylocated_A	Was the program geographically located	1 = 50 miles or less from your home 2 = 51 to 100 miles from your home 3 = 100 to 150 miles from your home 4 = More than 150 miles from your home 5 = Do not know 98 = Not applicable, answered “No” to question 6 99 = Missing

18	Didanyofyourundergraduateresearchactivitiestakeplaceinanothercou	Did any of your undergraduate research activities take place in another country (outside the United States)?	0 = No 1 = Yes 98 = Not applicable, answered “No” to question 6 99 = Missing
19	Inwhatcountryorcountriesdidyourhandsonundergraduateresearchtakep	In what country or countries did your hands-on undergraduate research take place? - Open-Ended Response	Open-ended response
20	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromwhi	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - The program director, coordinator, or other administrator	1 = Checked 97 = Not checked
21	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_A	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - Program faculty/researchers	1 = Checked 97 = Not checked
22	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_B	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - Current or former Program students	1 = Checked 97 = Not checked
23	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_C	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - Non-Program	1 = Checked 97 = Not checked

		faculty/researchers	
24	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_D	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - Program brochure	1 = Checked 97 = Not checked
25	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_E	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - Conference	1 = Checked 97 = Not checked
26	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_F	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - Program Website	1 = Checked 97 = Not checked
27	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_G	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - University Website	1 = Checked 97 = Not checked
28	BeforeyouappliedfortheSURFundergraduateresearchexperiencefromw_H	Before you applied for the undergraduate research experience, from which sources did you obtain information about the program? - Other	1 = Checked 97 = Not checked
29	DetailsofOther	Details of Other	Open-ended response

30	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Progr	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Interdisciplinary coursework offered by Program	1 = Checked 97 = Not checked
31	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_A	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity to find out if [Program research field] was for you	1 = Checked 97 = Not checked
32	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_B	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Research projects of Program faculty	1 = Checked 97 = Not checked
33	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_C	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Research seminars offered by Program	1 = Checked 97 = Not checked
34	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_D	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity for a "hands-on" research experience	1 = Checked 97 = Not checked
35	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_E	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity to learn more about what it's like to be a researcher	1 = Checked 97 = Not checked

36	Howimportantwaseac hofthefollowinginyour decisiontoapplytothe Pro_F	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity to find out if going to graduate school was for you	1 = Checked 97 = Not checked
37	Howimportantwaseac hofthefollowinginyour decisiontoapplytothe Pro_G	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity to fulfill your school's research requirements	1 = Checked 97 = Not checked
38	Howimportantwaseac hofthefollowinginyour decisiontoapplytothe Pro_H	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity to fulfill your scholarship's requirements for research	1 = Checked 97 = Not checked
39	Howimportantwaseac hofthefollowinginyour decisiontoapplytothe Pro_I	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity to earn academic credit for doing research in the summer	1 = Checked 97 = Not checked
40	Howimportantwaseac hofthefollowinginyour decisiontoapplytothe Pro_J	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Opportunity for an experience that might help you get into graduate school	1 = Checked 97 = Not checked
41	Howimportantwaseac hofthefollowinginyour decisiontoapplytothe Pro_K	How important was each of the following in your decision to apply to the Program? (Check all that apply) -	1 = Checked 97 = Not checked

		Opportunity for an experience that might help you get a job	
42	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_L	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Reputation of the host lab/institution	1 = Checked 97 = Not checked
43	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_M	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Geographic location of the host lab/institution	1 = Checked 97 = Not checked
44	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_N	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Availability of transportation to and from host site	1 = Checked 97 = Not checked
45	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_O	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Stipend	1 = Checked 97 = Not checked
46	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_P	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Housing stipend	1 = Checked 97 = Not checked
47	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_Q	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Living arrangements	1 = Checked 97 = Not checked

48	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_R	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Social/cultural activities	1 = Checked 97 = Not checked
49	Howimportantwaseachofthefollowinginyourdecisiontoapplytothe Pro_S	How important was each of the following in your decision to apply to the Program? (Check all that apply) - Other (please specify)	1 = Checked 97 = Not checked
50	Didyouapplytoanyotherresearchprogramsprojectssummerinstitutesorf	Did you apply to any other research programs/projects/summer institutes or for any internships for the same summer you participated in your undergraduate research experience?	0 = No 1 = Yes 99 = Missing
51	Pleaseindicatethetypesofresearchprogramsprojectssummerinstitutes	Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer. - Another laboratory/institution in the program	0 = No 1 = Yes 97 = Not checked 98 = Not applicable, answered “No” to question 51
52	Pleaseindicatethetypesofresearchprogramsprojectssummerinstitut_A	Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer. - Research Experience for Undergraduates (REU) program	0 = No 1 = Yes 97 = Not checked 98 = Not applicable, answered “No” to question 51

53	Pleaseindicatethetypesofresearchprogramsprojectssummerinstitut_B	Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer. - NIH Summer Research Program	0 = No 1 = Yes 97 = Not checked 98 = Not applicable, answered "No" to question 51
54	Pleaseindicatethetypesofresearchprogramsprojectssummerinstitut_C	Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer. - University research assistantship	0 = No 1 = Yes 97 = Not checked 98 = Not applicable, answered "No" to question 51
55	Pleaseindicatethetypesofresearchprogramsprojectssummerinstitut_D	Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer. - Federal work-study	0 = No 1 = Yes 97 = Not checked 98 = Not applicable, answered "No" to question 51
56	Pleaseindicatethetypesofresearchprogramsprojectssummerinstitut_E	Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer. - Internship (in government, industry, non-profit organization)	0 = No 1 = Yes 97 = Not checked 98 = Not applicable, answered "No" to question 51
57	Pleaseindicatethetypesofresearchprogramsprojectssummerinstitut_F	Please indicate the types of research programs/projects/summer institutes or internships to which you applied for that summer. - Other summer research program (please specify)	0 = No 1 = Yes 97 = Not checked 98 = Not applicable, answered "No" to question 51
58	MultipleDetailsofType	Multiple Details of Type	Open-ended response

59	Whatisyourlevelofagreementwitheachofthefollowingstatementsaboutt	What is your level of agreement with each of the following statements about the program? - The application process for the undergraduate research experience (URE) program was straightforward	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
60	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_A	What is your level of agreement with each of the following statements about the program? - There was sufficient program information available to help me choose a URE research project	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
61	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_B	What is your level of agreement with each of the following statements about the program? - It was easy to identify a research mentor/supervisor	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
62	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_C	What is your level of agreement with each of the following statements about the program? - It was challenging to secure a research position	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

63	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_D	What is your level of agreement with each of the following statements about the program? - There was a lack of program orientation	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
64	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_E	What is your level of agreement with each of the following statements about the program? - The guidance I received in navigating the administrative process of getting started in my URE was lacking	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
65	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_F	What is your level of agreement with each of the following statements about the program? - I am happy with the support I received from the program/administrative staff	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
66	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_G	What is your level of agreement with each of the following statements about the program? - I am dissatisfied with the guidance I received from the program/administrative staff	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

67	Whatisyourlevelofagreementwitheachofthefollowingstatementsabou_H	What is your level of agreement with each of the following statements about the program? - The financial support I received from the program was sufficient to meet my living expenses while I was in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
68	Selectyourlevelofagreementwiththefollowingstatementsaboutyourlab	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - My lab-based interactions with my research mentor/supervisor have had a positive influence on my research skills	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
69	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_A	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - My lab-based interactions with my research mentor/supervisor have had a positive influence on my interest in the discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
70	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_B	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - My lab-based interactions with my research mentor/supervisor have had a positive influence on my career aspirations	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

71	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_C	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - I had a great deal of lab-based interaction with my research mentor/supervisor	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
72	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_D	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - While participating in the program, I was able to work in the lab with leading scientists/researchers	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
73	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_E	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - I am happy with the support/guidance I received in the lab from my research mentor/supervisor	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
74	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_F	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - I had little contact with my research mentor/supervisor in the lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

75	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_G	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - My research mentor/sponsor was generally interested in developing my research lab skills	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
76	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_H	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - My research mentor/sponsor was generally an outstanding teacher	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
77	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_I	Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor - My research mentor/sponsor was involved in developing my research skills	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
78	Selectyourlevelofagreementwiththefollowingstatementsaboutinterac	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My non-lab interactions with my research mentor/supervisor have had a positive influence on my personal growth, values, and attitudes	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

79	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_A	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My non-lab interactions with my research mentor/supervisor have had a positive influence on my intellectual growth and interest in discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
80	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_B	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My non-lab interactions with my research mentor/supervisor have had a positive influence on my career goals and aspirations	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
81	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_C	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - While participating in the program I developed a close, personal relationship with my research mentor/supervisor	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
82	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_D	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - I am satisfied with the opportunities I had to interact informally with my research mentor/supervisor	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

83	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_E	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - I am happy with the overall experience with my research mentor/supervisor	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
84	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_F	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - I had little contact with my research mentor/supervisor outside the lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
85	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_G	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My research mentor/sponsor was generally interested in developing my career	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
86	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_H	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My research mentor/sponsor was generally an outstanding professional mentor	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

87	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_I	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My research mentor/sponsor was willing to spend time outside of class to discuss professional development issues that were important to me	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
88	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_J	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My research mentor/sponsor was willing to provide me with graduate school advice	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
89	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_K	Select your level of agreement with the following statements about interactions outside the lab with your research mentor/supervisor - My research mentor/sponsor was willing to provide me with career advice	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
90	Myresearchmentorsupervisoris...Thesameethnicityasme	My research mentor/supervisor is ... - The same ethnicity as me	0 = No 1 = Yes 99 = Missing
91	Myresearchmentorsupervisoris...Thesameraceasme	My research mentor/supervisor is ... - The same race as me	0 = No 1 = Yes 99 = Missing
92	Myresearchmentorsupervisoris...Thesamesexasme	My research mentor/supervisor is ... - The same sex as me	0 = No 1 = Yes 99 = Missing

93	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_J	Select your level of agreement with the following statements about your lab-based interactions with the research team - My lab-based interactions with members of the research team have had a positive influence on my research skills	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
94	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_K	Select your level of agreement with the following statements about your lab-based interactions with the research team - My lab-based interactions with members of the research team have had a positive influence on my interest in the discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
95	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_L	Select your level of agreement with the following statements about your lab-based interactions with the research team - My lab-based interactions with members of the research team have had a positive influence on my career aspirations	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
96	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_M	Select your level of agreement with the following statements about your lab-based interactions with the research team - I had a great deal of lab-based interaction with members of the research team	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

97	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_N	Select your level of agreement with the following statements about your lab-based interactions with the research team - I had little lab-based contact with other members of the research team	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
98	Selectyourlevelofagreementwiththefollowingstatementsaboutyourl_O	Select your level of agreement with the following statements about your lab-based interactions with the research team - I am happy with the overall experience of working in the lab with the research team	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
99	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_L	Select your level of agreement with the following statements about interactions outside the lab with the research team - While participating in the undergraduate research experience (URE) I developed close personal relationships with members of the research team	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
100	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_M	Select your level of agreement with the following statements about interactions outside the lab with the research team - The friendships I developed with members of the research team while participating in the URE have been personally satisfying	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

101	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_N	Select your level of agreement with the following statements about interactions outside the lab with the research team - My interpersonal relationships with members of the research team had a positive influence on my personal growth, attitudes, and values	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
102	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_O	Select your level of agreement with the following statements about interactions outside the lab with the research team - My interpersonal relationships with members of the research team have had a positive influence on my intellectual growth and interest in the discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
103	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_P	Select your level of agreement with the following statements about interactions outside the lab with the research team - It was difficult for me to meet and make friends with members of the research team while in the summer URE	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
104	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_Q	Select your level of agreement with the following statements about interactions outside the lab with the research team - Few of the members of the research team I met while in the summer URE would be willing to listen to me and/or help me if I had a personal problem	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

105	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_R	Select your level of agreement with the following statements about interactions outside the lab with the research team - Most of members of the research team in this URE have values and/or attitudes different from my own	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
106	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_S	Select your level of agreement with the following statements about interactions outside the lab with the research team - The experience with members of the research team overall was excellent	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
107	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_T	Select your level of agreement with the following statements about interactions outside the lab with the research team - I had little contact outside the lab with other members of the research team	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
108	Selectyourlevelofagreementwiththefollowingstatementsaboutinter_U	Select your level of agreement with the following statements about interactions outside the lab with the research team - I am happy with the overall experience of spending time with members of the research team outside of the lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
109	Mostofthemembersoftheresearchteamare...Thesameethnicityasme	Most of the members of the research team are ... - The same ethnicity as me	0 = No 1 = Yes 99 = Missing

110	Mostofthemembersoftheresearchteamare...Thesameraceasme	Most of the members of the research team are ... - The same race as me	0 = No 1 = Yes 99 = Missing
111	Mostofthemembersoftheresearchteamare...Thesamesexasme	Most of the members of the research team are ... - The same sex as me	0 = No 1 = Yes 99 = Missing
112	Werethereotherundergraduatesworkinginthesamelaboratthesamesiteas	Were there other undergraduates working in the same lab or at the same site as you?	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
113	Indicatethedegreetowhichyouagreewitheachofthefollowingstatements	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - While participating in the program I developed close personal relationships with fellow undergraduates lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
114	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_A	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - The friendships I developed with fellow undergraduates while participating in the program have been personally satisfying	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

115	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_B	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - My interpersonal relationships with fellow undergraduates had a positive influence on my personal growth, attitudes, and values	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
116	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_C	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - My interpersonal relationships with fellow undergraduates have had a positive influence on my intellectual growth and interest in the discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
117	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_D	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - It was difficult for me to meet and make friends with fellow undergraduates while in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

118	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_E	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - Few of the other undergraduates while in the program would be willing to listen to me and help me if I had a personal problem	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
119	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_F	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - Most of my fellow undergraduates who worked have values and attitudes different from my own	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
120	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_G	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - I had very little interaction with fellow undergraduates who worked	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
121	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_H	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - I received very little support/guidance from fellow undergraduates	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

122	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_I	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - Most of the other undergraduates were the same sex as me	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
123	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_J	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - Most of the other undergraduates were the same ethnicity as me	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
124	Indicatethedegreetowhichyouagreewitheachofthefollowingstatemen_K	Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program. - Most of the other undergraduates were the same race as me	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
125	Indicateyourlevelofagreementwitheachofthefollowing.Theotherunder	Indicate your level of agreement with each of the following. - The other undergraduates were smarter than me	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

126	Indicateyourlevelofagreementwitheachofthefollowing.Theotherund_A	Indicate your level of agreement with each of the following. - The other undergraduates had a better mentor than me	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
127	Indicateyourlevelofagreementwitheachofthefollowing.Theotherund_B	Indicate your level of agreement with each of the following. - The other undergraduates had a better experience overall than me	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
128	Indicateyourlevelofagreementwitheachofthefollowing.Otherundergra	Indicate your level of agreement with each of the following. - Other undergraduates had less professional development opportunities than I did	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
129	Indicateyourlevelofagreementwitheachofthefollowing.Otherunderg_A	Indicate your level of agreement with each of the following. - Other undergraduates gained less technical expertise than I did	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
130	DuringmyexperiencesintheSURFprogramI...Engagedinrealworldscience	During my experiences in the program, I ... - Engaged in real-world science research	1 = Checked 97 = Not checked

131	DuringmyexperiencesintheSURFprogramI...Feltlikeascientist	During my experiences in the program, I ... - Felt like a scientist	1 = Checked 97 = Not checked
132	DuringmyexperiencesintheSURFprogramI...Thoughtcreativelyaboutthe	During my experiences in the program, I ... - Thought creatively about the project	1 = Checked 97 = Not checked
133	DuringmyexperiencesintheSURFprogramI...Triedoutnewideasorprocedu	During my experiences in the program, I ... - Tried out new ideas or procedures on your own	1 = Checked 97 = Not checked
134	DuringmyexperiencesintheSURFprogramI...Feltresponsiblefortheproj	During my experiences in the program, I ... - Felt responsible for the project	1 = Checked 97 = Not checked
135	DuringmyexperiencesintheSURFprogramI...WorkedextrahoursbecauseIw	During my experiences in the program, I ... - Worked extra hours because I was excited about the research	1 = Checked 97 = Not checked
136	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfiedw	Indicate your level of agreement with each of the following. - I am satisfied with the extent of my experiences in research lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
137	Indicateyourlevelofagreementwitheachofthefollowing.Myresearchlab	Indicate your level of agreement with each of the following. - My research lab experience has had a positive influence on my intellectual growth and interest in the discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

138	Indicateyourlevelofagreementwitheachofthefollowing.Myinterestint	Indicate your level of agreement with each of the following. - My interest in the discipline has increased as a result of the research lab experience	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
139	Indicateyourlevelofagreementwitheachofthefollowing.Iammorelikely	Indicate your level of agreement with each of the following. - I am more likely to engage in work in a research lab now than I was before my experiences in this research lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
140	Indicateyourlevelofagreementwitheachofthefollowing.Ilearnedasmuc	Indicate your level of agreement with each of the following. - I learned as much as I anticipated I would in the research lab experience	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
141	Indicateyourlevelofagreementwitheachofthefollowing.Fewofmyactivi	Indicate your level of agreement with each of the following. - Few of my activities in the research lab have been intellectually stimulating	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

142	Indicateyourlevelofagreementwitheachofthefollowing.Thetimeandamo	Indicate your level of agreement with each of the following. - The time (and amount of time) I spent working in the research lab was meaningful	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
143	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_A	Indicate your level of agreement with each of the following. - I am satisfied with my level of responsibility on my undergraduate research experience (URE) project	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
144	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_B	Indicate your level of agreement with each of the following. - I am satisfied with the input I gave in designing the research project	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
145	Indicateyourlevelofagreementwitheachofthefollowing.Ididlittleorn	Indicate your level of agreement with each of the following. - I did little or nothing that seemed like real research	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

146	Indicateyourlevelofagreementwitheachofthefollowing.Iwasabletocom	Indicate your level of agreement with each of the following. - I was able to complete my research project	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
147	Indicateyourlevelofagreementwitheachofthefollowing.Iamhappywitht	Indicate your level of agreement with each of the following. - I am happy with the research experience overall	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
148	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_C	Indicate your level of agreement with each of the following. - I am satisfied with the amount of time I spent in the research lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
149	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_D	Indicate your level of agreement with each of the following. - I am satisfied with the amount of support/guidance I received in my research experiences in the lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

150	Indicateyourlevelofagreementwitheachofthefollowing.TheUREcontrib	Indicate your level of agreement with each of the following. - The URE contributed to increasing my awareness of the relevance of research to my coursework	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
151	Indicateyourlevelofagreementwitheachofthefollowing.Theresearchte	Indicate your level of agreement with each of the following. - The research team meetings I attended were beneficial to the development of my research project in the lab	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
152	AsaresultoftheSURFprogrammylabbasedskillshaveimprovedinIdentifyi	As a result of the program, my lab-based skills have improved in: - Identifying limitations of research designs	1 = Checked 97 = Not checked
153	AsaresultoftheSURFprogrammylabbasedskillshaveimprovedinUnderstan	As a result of the program, my lab-based skills have improved in: - Understanding the concepts guiding my research project	1 = Checked 97 = Not checked
154	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_E	Indicate your level of agreement with each of the following. - I am satisfied with the extent of my professional experiences in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

155	Indicateyourlevelofagreementwitheachofthefollowing.Iattendedmost	Indicate your level of agreement with each of the following. - I attended most of the professional development activities that were offered during my program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
156	Indicateyourlevelofagreementwitheachofthefollowing.Ireceivedadeq	Indicate your level of agreement with each of the following. - I received adequate professional support/guidance during my	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
157	Indicateyourlevelofagreementwitheachofthefollowing.Myexperiences	Indicate your level of agreement with each of the following. - My experiences outside the lab in the program have had a positive influence on my professional growth and interest in the discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
158	Indicateyourlevelofagreementwitheachofthefollowing.Myinteresti_A	Indicate your level of agreement with each of the following. - My interest in the discipline has increased as a result of my professional experiences in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

159	Indicateyourlevelofagreementwitheachofthefollowing.Iammorelike_A	Indicate your level of agreement with each of the following. - I am more likely to engage in professional activities now than I was before my experiences in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
160	Indicateyourlevelofagreementwitheachofthefollowing.Ilearnedasm_A	Indicate your level of agreement with each of the following. - I learned as much as I anticipated I would from the professional experiences in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
161	Indicateyourlevelofagreementwitheachofthefollowing.Fewofmyacti_A	Indicate your level of agreement with each of the following. - Few of my activities in the program have been professionally stimulating	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
162	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_F	Indicate your level of agreement with each of the following. - I am satisfied with the professional and social experiences in the program overall	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

163	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_G	Indicate your level of agreement with each of the following. - I am satisfied with my living/residence arrangement during the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
164	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_H	Indicate your level of agreement with each of the following. - I am satisfied with the opportunities to participate in social activities during the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
165	Indicateyourlevelofagreementwitheachofthefollowing.TheSURFprogra	Indicate your level of agreement with each of the following. - The program increased my awareness of the many career paths for scientists	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
166	Indicateyourlevelofagreementwitheachofthefollowing.Theresearch_A	Indicate your level of agreement with each of the following. - The research team meetings I attended were beneficial to my professional development in the discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

167	Indicateyourlevelofag reementwitheachofth efollowing.Thegroups ocia	Indicate your level of agreement with each of the following. - The group social activities that took place during the program helped me feel like a part of the team	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
168	AspartofmySURFpro gramIpresentedatalk orpostertootherstude ntsorfac	As part of my program - I presented a talk or poster to other students or faculty	1 = Checked 97 = Not checked
169	AspartofmySURFpro gramIpresentedatalk orposterataprofessio nalconfe	As part of my program - I presented a talk or poster at a professional conference	1 = Checked 97 = Not checked
170	AspartofmySURFpro gramIattendedaconfe rence	As part of my program - I attended a conference	1 = Checked 97 = Not checked
171	AspartofmySURFpro gramImentoredothers tudentsconductingres earchorl	As part of my program - I mentored other students conducting research or led a student research team	1 = Checked 97 = Not checked
172	AspartofmySURFpro gramIwroteorcowrote apaperthatwaspublis hedinanac	As part of my program - I wrote or co-wrote a paper that was published in an academic journal	1 = Checked 97 = Not checked
173	AspartofmySURFpro gramIwroteorcowrote apaperthatwaspublis hedinanun	As part of my program - I wrote or co-wrote a paper that was published in an undergraduate research journal	1 = Checked 97 = Not checked
174	AsaresultoftheSURF programmyresearchs killshaveimprovedinE xplainin	As a result of the program, my research skills have improved in: - Explaining my project to people outside my field	1 = Checked 97 = Not checked

175	AsaresultoftheSURF programmyresearchs killshaveimprovedinP reparing	As a result of the program, my research skills have improved in: - Preparing a scientific poster	1 = Checked 97 = Not checked
176	AsaresultoftheSURF programmyresearchs killshaveimprovedinD efending	As a result of the program, my research skills have improved in: - Defending an argument when asked questions	1 = Checked 97 = Not checked
177	AsaresultoftheSURF programmyresearchs killshaveimprovedin Writingsc	As a result of the program, my research skills have improved in: - Writing scientific reports or papers	1 = Checked 97 = Not checked
178	AsaresultoftheSURF programmyresearchs killshaveimprovedinC onductin	As a result of the program, my research skills have improved in: - Conducting research literature searches	1 = Checked 97 = Not checked
179	AsaresultoftheSURF programmyresearchs killshaveimprovedinU nderstan	As a result of the program, my research skills have improved in: - Understanding journal articles	1 = Checked 97 = Not checked
180	Indicateyourlevelofag reementwitheachofth efollowingaboutimpro veme	Indicate your level of agreement with each of the following about improvement in your research skills as a result of the program. - Taking greater care in conducting lab procedures	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
181	Indicateyourlevelofag reementwitheachofth efollowingaboutimpro ve_A	Indicate your level of agreement with each of the following about improvement in your research skills as a result of the program. - Making oral presentations	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

182	Indicateyourlevelofagreementwitheachofthefollowingaboutimprove_B	Indicate your level of agreement with each of the following about improvement in your research skills as a result of the program. - Supporting assertions with evidence	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
183	Indicateyourlevelofagreementwitheachofthefollowingaboutimprove_C	Indicate your level of agreement with each of the following about improvement in your research skills as a result of the program. - Keeping a detailed lab notebook	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
184	Indicateyourlevelofagreementwitheachofthefollowingaboutimprove_D	Indicate your level of agreement with each of the following about improvement in your research skills as a result of the program. - Calibrating instruments needed for measurement	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
185	DuringtheSURFprogramdidyouattendcheckallthatapplySkillbasedhuman	During the program, did you attend (check all that apply) - Skill-based human subjects training - Yes, it was required	1 = Checked 97 = Not checked
186	DuringtheSURFprogramdidyouattendcheckallthatapplySkillbasedhum_A	During the program, did you attend (check all that apply) - Skill-based human subjects training - Yes, it was intellectually stimulating	1 = Checked 97 = Not checked
187	DuringtheSURFprogramdidyouattendcheckallthatapplySkillbasedhum_B	During the program, did you attend (check all that apply) - Skill-based human subjects training - Yes, it had direct	1 = Checked 97 = Not checked

		bearing on my research	
188	ParticipatedinHuman SubjectsTraining	Participated in Human Subjects Training	1 = Checked 97 = Not checked
189	DuringtheSURFprogramdidyouattendcheckallthatapplyEthicseducation	During the program, did you attend (check all that apply) - Ethics education/training - Yes, it was required	1 = Checked 97 = Not checked
190	DuringtheSURFprogramdidyouattendcheckallthatapplyEthicseducati_A	During the program, did you attend (check all that apply) - Ethics education/training - Yes, it was intellectually stimulating	1 = Checked 97 = Not checked
191	DuringtheSURFprogramdidyouattendcheckallthatapplyEthicseducati_B	During the program, did you attend (check all that apply) - Ethics education/training - Yes, it had direct bearing on my research	1 = Checked 97 = Not checked
192	ParticipatedinEthicstrainingEducation	Participated in Ethics training/Education	1 = Checked 97 = Not checked
193	DuringtheSURFprogramdidyouattendcheckallthatapplyAnimalsubjectst	During the program, did you attend (check all that apply) - Animal-subjects training - Yes, it was required	1 = Checked 97 = Not checked
194	DuringtheSURFprogramdidyouattendcheckallthatapplyAnimalsubject_A	During the program, did you attend (check all that apply) - Animal-subjects training - Yes, it was intellectually stimulating	1 = Checked 97 = Not checked
195	DuringtheSURFprogramdidyouattendcheckallthatapplyAnimalsubject_B	During the program, did you attend (check all that apply) - Animal-subjects training - Yes, it had direct bearing on my research	1 = Checked 97 = Not checked

196	ParticipatedinAnimalSubjectsTraining	Participated in Animal Subjects Training	1 = Checked 97 = Not checked
197	DuringtheSURFprogramdidyouattendcheckallthatapplySafetytrainingY	During the program, did you attend (check all that apply) - Safety training - Yes, it was required	1 = Checked 97 = Not checked
198	DuringtheSURFprogramdidyouattendcheckallthatapplySafetytrainin_A	During the program, did you attend (check all that apply) - Safety training - Yes, it was intellectually stimulating	1 = Checked 97 = Not checked
199	DuringtheSURFprogramdidyouattendcheckallthatapplySafetytrainin_B	During the program, did you attend (check all that apply) - Safety training - Yes, it had direct bearing on my research	1 = Checked 97 = Not checked
200	ParticipatedinSafetyTraining	Participated in Safety Training	1 = Checked 97 = Not checked
201	Indicateyourlevelofagreementwitheachofthefollowing.Iamsatisfie_I	Indicate your level of agreement with each of the following. - I am satisfied with the extent of my skill-based experiences in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
202	Indicateyourlevelofagreementwitheachofthefollowing.Myskillbasedt	Indicate your level of agreement with each of the following. - My skill-based training in the program has had a positive influence on my professional growth	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

203	Indicateyourlevelofagreementwitheachofthefollowing.Myinteresti_B	Indicate your level of agreement with each of the following. - My interest in the discipline has increased as a result of my skill-based training in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
204	Indicateyourlevelofagreementwitheachofthefollowing.Iammorelike_B	Indicate your level of agreement with each of the following. - I am more likely to engage in other skill-based training activities now than I was before my experiences in the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
205	Indicateyourlevelofagreementwitheachofthefollowing.Ilearnedasm_B	Indicate your level of agreement with each of the following. - I learned as much as I anticipated I would from the skill-based training of the program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
206	Indicateyourlevelofagreementwitheachofthefollowing.Fewofmyskillb	Indicate your level of agreement with each of the following. - Few of my skill-based training activities in the program have been stimulating	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

207	Indicateyourlevelofagreementwitheachofthefollowing.TheSURFprog_A	Indicate your level of agreement with each of the following. - The program contributed to increasing my awareness of connections among scientific disciplines	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
208	Indicateyourlevelofagreementwitheachofthefollowing.Theinformatio	Indicate your level of agreement with each of the following. - The information provided to me on how to use the lab equipment was sufficient	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
209	IndicateyourlevelofagreementwitheachofthefollowingrelatedtotheSU	Indicate your level of agreement with each of the following related to the program. - It was important for me to complete this program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
210	Indicateyourlevelofagreementwitheachofthefollowingrelatedtothe_A	Indicate your level of agreement with each of the following related to the program. - I am confident that I made the right decision in choosing to participate in this program	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

211	Indicateyourlevelofagreementwitheachofthefollowingrelatedtothe_B	Indicate your level of agreement with each of the following related to the program. - I understand how my work in this program contributes to the “bigger picture” of research	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
212	Indicateyourlevelofagreementwitheachofthefollowingrelatedtothe_C	Indicate your level of agreement with each of the following related to the program. - This program made me feel like a part of the scientific community	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
213	Indicateyourlevelofagreementwitheachofthefollowingrelatedtothe_D	Indicate your level of agreement with each of the following related to the program. - I am satisfied with the extent of my intellectual development during the undergraduate research experience (URE)	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
214	Indicateyourlevelofagreementwitheachofthefollowingrelatedtothe_E	Indicate your level of agreement with each of the following related to the program. - My interest in the discipline has increased as a result of the URE	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

215	Indicateyourlevelofag reementwitheachofth efollowingrelatedtoth e_F	Indicate your level of agreement with each of the following related to the program. - My participation in this program helped me perform better academically	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
216	Indicateyourlevelofag reementwitheachofth efollowingrelatedtoth e_G	Indicate your level of agreement with each of the following related to the program. - The field trips that I took while in the program benefitted my progress overall	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
217	ReflectingonmySURF experienceoverallitCh eckallthatapplyHelpe dmeto	Reflecting on my experience, overall it: (Check all that apply) - Helped me to be self-motivated	1 = Checked 97 = Not checked
218	ReflectingonmySURF experienceoverallitCh eckallthatapplyTaugh tmeth	Reflecting on my experience, overall it: (Check all that apply) - Taught me that I have the ability to be a competent researcher	1 = Checked 97 = Not checked
219	ReflectingonmySURF experienceoverallitCh eckallthatapplyTaugh tmeho	Reflecting on my experience, overall it: (Check all that apply) - Taught me how to work effectively with others	1 = Checked 97 = Not checked
220	ReflectingonmySURF experienceoverallitCh eckallthatapplyWaso neofth	Reflecting on my experience, overall it: (Check all that apply) - Was one of the best experiences of my life	1 = Checked 97 = Not checked
221	ReflectingonmySURF experienceoverallitCh eckallthatapplyTaugh tme_A	Reflecting on my experience, overall it: (Check all that apply) - Taught me how to apply concepts that I had learned in the classroom to a real	1 = Checked 97 = Not checked

		situation	
222	ReflectingonmySURFexperienceoverallitCheckallthatapplyTaughtmewh	Reflecting on my experience, overall it: (Check all that apply) - Taught me what it takes to be a successful graduate student	1 = Checked 97 = Not checked
223	ReflectingonmySURFexperienceoverallitCheckallthatapplyIncreasedm	Reflecting on my experience, overall it: (Check all that apply) - Increased my knowledge and understanding of my discipline	1 = Checked 97 = Not checked
224	ReflectingonmySURFexperienceoverallitCheckallthatapplyShowedmeth	Reflecting on my experience, overall it: (Check all that apply) - Showed me that research is not for me	1 = Checked 97 = Not checked
225	ReflectingonmySURFexperienceoverallitCheckallthatapplyGavemeanun	Reflecting on my experience, overall it: (Check all that apply) - Gave me an understanding of what the “world” of research is like	1 = Checked 97 = Not checked
226	ReflectingonmySURFexperienceoverallitCheckallthatapplyHelpedequi	Reflecting on my experience, overall it: (Check all that apply) - Helped equip me to better tackle complex problems	1 = Checked 97 = Not checked
227	ReflectingonmySURFexperienceoverallitCheckallthatapplyShowedme_A	Reflecting on my experience, overall it: (Check all that apply) - Showed me that I would like to continue research as a career in a field similar in my discipline	1 = Checked 97 = Not checked
228	ReflectingonmySURFexperienceoverallitCheckallthatapplyTaughtme_B	Reflecting on my experience, overall it: (Check all that apply) - Taught me that you have to have patience in research	1 = Checked 97 = Not checked

229	ReflectingonmySURFexperienceoverallitCheckallthatapplyTaughtme_C	Reflecting on my experience, overall it: (Check all that apply) - Taught me that there are different skills required for classroom success and research success	1 = Checked 97 = Not checked
230	ReflectingonmySURFexperienceoverallitCheckallthatapplyHelpedmese	Reflecting on my experience, overall it: (Check all that apply) - Helped me see that doing research can help me get better grades	1 = Checked 97 = Not checked
231	ReflectingonmySURFexperienceoverallitCheckallthatapplyShowedme_B	Reflecting on my experience, overall it: (Check all that apply) - Showed me that "real" research is much different from experience gained in lab classes	1 = Checked 97 = Not checked
232	ReflectingonmySURFexperienceoverallitCheckallthatapplyHelpedme_A	Reflecting on my experience, overall it: (Check all that apply) - Helped me to be more dependable	1 = Checked 97 = Not checked
233	ReflectingonmySURFexperienceoverallitCheckallthatapplyRealizedth	Reflecting on my experience, overall it: (Check all that apply) - Realized that I can do things I didn't think I could do	1 = Checked 97 = Not checked
234	ReflectingonmySURFexperienceoverallitCheckallthatapplyShowedme_C	Reflecting on my experience, overall it: (Check all that apply) - Showed me that I like research better than I expected I would	1 = Checked 97 = Not checked
235	ReflectingonmySURFexperienceoverallitCheckallthatapplyHelpedmede	Reflecting on my experience, overall it: (Check all that apply) - Helped me decide that I am more interested in medical school than graduate school	1 = Checked 97 = Not checked

236	ReflectingonmySURFexperienceoverallitCheckallthatapplyTaughtme_D	Reflecting on my experience, overall it: (Check all that apply) - Taught me how to figure out for myself things that I needed to know	1 = Checked 97 = Not checked
237	ReflectingonmySURFexperienceoverallitCheckallthatapplyTaughtme_E	Reflecting on my experience, overall it: (Check all that apply) - Taught me that I can do what I set out to do even if there are setbacks along the way	1 = Checked 97 = Not checked
238	ReflectingonmySURFexperienceoverallitCheckallthatapplyHelpedme_B	Reflecting on my experience, overall it: (Check all that apply) - Helped me see my personal strengths and/or weaknesses	1 = Checked 97 = Not checked
239	ReflectingonmySURFexperienceoverallitCheckallthatapplyTaughtmebe	Reflecting on my experience, overall it: (Check all that apply) - Taught me better time management skills	1 = Checked 97 = Not checked
240	ReflectingonmySURFexperienceoverallitCheckallthatapplyIntroduced	Reflecting on my experience, overall it: (Check all that apply) - Introduced me to a career that I had never known existed	1 = Checked 97 = Not checked
241	ReflectingonmySURFexperienceoverallitCheckallthatapplyShowedme_D	Reflecting on my experience, overall it: (Check all that apply) - Showed me that I am a good problem solver	1 = Checked 97 = Not checked
242	ReflectingonmySURFexperienceoverallitCheckallthatapplyTaughtme_F	Reflecting on my experience, overall it: (Check all that apply) - Taught me that I do not have the patience for research	1 = Checked 97 = Not checked
243	ReflectingonmySURFexperienceoverallitCheckallthatapplyMademewant	Reflecting on my experience, overall it: (Check all that apply) - Made me want to go for a PhD	1 = Checked 97 = Not checked

244	Indicateyourlevelofagreementwitheachofthefollowingregardingyourl	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Mentor other students conducting research or leading a student research team	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
245	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_A	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Participate in research-related field trips to other labs	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
246	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_B	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Attend student conferences on research (that include students from other colleges)	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
247	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_C	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Attend discipline-specific conferences (conferences not specifically for students)	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

248	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_D	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Prepare and present a poster describing my research	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
249	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_E	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Prepare written research papers describing my research and results	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
250	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_F	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Deliver an oral presentation describing my research and results	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
251	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_G	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Author or co-author a paper that is published in a professional journal in this discipline	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

252	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_H	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Become a faculty member at a research university	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
253	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_I	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Seek employment in a national lab or institute	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
254	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_J	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Enroll in medical or dental school	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
255	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_K	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Obtain both an MD and a PhD	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing

256	Indicateyourlevelofagreementwitheachofthefollowingregardingyou_L	Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program. - Pursue certification as a teacher	1= Strongly Disagree 2= Disagree 3 =Neutral 4 = Agree 5 = Strongly Agree 98 = Not Applicable (one of the response options) 99 = Missing
257	DidyouchangeyourmajoratanytimefollowingtheSURFexperience	Did you change your major at any time following the experience?	0 = No 1 = Yes 99 = Missing
258	WhichofthefollowingbestdescribesyourmajorafterSURF	Which of the following best describes your major after ?	1 = Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc. 2 = Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc. 3 = Business, including accounting, finance, management, marketing, etc. 4 = Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc. 5 = Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc. 6 = Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc. 7 = Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc. 8 = Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc. 9 = Pre-law 10 = Mathematical sciences, including applied mathematics, mathematics, statistics, etc. 11 = Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc. 12 = Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc. 13 = Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology,

			urban affairs, etc. 14 = Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories 15 = Other (please specify) 99 = Missing
259	Iintendtocompleteorhavealreadycompletedamaster'sdegree	I intend to complete/or have already completed a master's degree	0 = No 1 = Yes 99 = Missing

260	Whichofthefollowingbestdescribesthefieldorfieldsofyourmaster's de	Which of the following best describes the field or fields of your master's degree	1 = Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc. 2 = Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc. 3 = Business, including accounting, finance, management, marketing, etc. 4 = Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc. 5 = Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc. 6 = Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc. 7 = Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc. 8 = Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc. 9 = Law 10 = Mathematical sciences, including applied mathematics, mathematics, statistics, etc. 11 = Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc. 12 = Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc. 13 = Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc. 14 = Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories 15 = Other (please specify) 99 = Missing
261	Iintendtocompleteadoctoraldegree	I intend to complete a doctoral degree	0 = No 1 = Yes 99 = Missing

262	Whichofthefollowingbestdescribesthefieldorfieldsofyourdoctoraldegree	Which of the following best describes the field or fields of your doctoral degree	1 = Atmospheric, earth, environmental, or ocean sciences, including climatology, ecology, forestry, geology, hydrology, limnology, marine science, natural resources, paleontology, remote sensing, seismology, soil science, etc. 2 = Biology or other life sciences other than health/medical sciences, including agricultural sciences, animal science, biochemistry, biology, biomedical sciences, biophysics, biopsychology, biotechnology, botany, genetics, microbiology, neuroscience, pathology, zoology, etc. 3 = Business, including accounting, finance, management, marketing, etc. 4 = Chemistry, including environmental chemistry, forensic chemistry, industrial chemistry, inorganic chemistry, organic chemistry, polymer chemistry/science, etc. 5 = Computer sciences, including bioinformatics, computer graphics, information management, management information systems, simulation, etc. 6 = Education, including educational assessment, math ed, science ed, special ed, teacher ed, etc. 7 = Engineering, including bioengineering, chemical engineering, civil engineering, electrical engineering, engineering technology, environmental engineering, industrial engineering, MEMS, mechanical engineering, nanotechnology, robotics, systems engineering, etc. 8 = Health/Medical sciences, including anatomy, epidemiology, forensic science, nursing, optometry, pathology, pharmacology, physical therapy, physiology, pre-dentistry, pre-medicine, public health, veterinary science, etc. 9 = Law 10 = Mathematical sciences, including applied mathematics, mathematics, statistics, etc. 11 = Physics, including applied physics, astrophysics, biophysics, engineering physics, geophysics, nuclear physics, paleophysics, particle physics, plasma physics, theoretical physics, etc. 12 = Physical sciences other than physics, including aeronautical science, astronomy, kinesiology, materials science, optics, planetary science, surface science, etc. 13 = Social or behavioral sciences, including archeology, anthropology, criminology, economics, geography, linguistics, political science, psychology, social work, sociology, urban affairs, etc. 14 = Interdisciplinary sciences/math/engineering, involving two or more of any of the above categories 15 = Other (please specify) 99 = Missing
263	Yoursex	Your sex	1 = Female 0 = Male 99 = Missing
264	AreyouHispanicorLatino	Are you Hispanic or Latino?	0 = No 1 = Yes 99 = Missing

265	Whatisyourracialback ground	What is your racial background?	1 = African American or Black 2 = Asian or Asian American 3 = Cacasian or White 4 = Native American or Alaska Native 5 = Native Hawaiian or Pacific Islander 6 = More than one race 99 = Missing
266	Whatwasyourfamilyh ouseholdincomewhe nyouwereinvolvedinth eSURFprog	What was your family/household income when you were involved in the program?	1 = Less than $20,000 2 = $20,001 - $30,000 3 = $30,001-$40,000 4 = $40,001-$50,000 5 = $50,001-$60,000 6 = $60,001-$70,000 7 = $70,001-$80,000 8 = $80,001-$90,000 9 = $90,001-$100,000 10 = More than $100,000 99 = No Response
267	Undergraduatelevelat thetimeofparticipation inSURF	Undergraduate level at the time of participation in	1 = Freshman 2 = Sophomore 3 = Junior 4 = Senior 5 = Already achieved baccalaureate degree 99 = Missing
268	Levelinschoolnow	Level in school (now)	1 = Freshman 2 = Sophomore 3 = Junior 4 = Senior 5 = Graduated 6 = Other (please specify) 99 = Missing
269	LevelinschoolnowOth erpleasespecify	Level in school (now) - Other (please specify)	Open-ended response

270	Areyoucurrently	Are you currently ...	1 = Working toward my undergraduate degree 2 = In grad school for master's degree 3 = Graduated from grad school (no longer attending) 4 = Pursuing a PhD or other doctoral degree 5 = Other (please specify) 99 = Missing
271	Areyoucurrently...Otherpleasespecify	Are you currently ... - Other (please specify)	Open-ended response
272	Father'shighestlevelofeducationalattainment	Father's highest level of educational attainment	1 = Some high school 2 = High school diploma 3 = Some college 4 = Associate degree 5 = Bachelor's degree 6 = Some graduate or professional education 7 = Graduate or professional degree (M.A., M.S., M.D., J.D., Psy.D., etc.) 8 = Doctoral degree (Ed.D., Ph.D.) 98 = Other 99 = Missing
273	Mother'shighestlevelofeducationalattainment	Mother's highest level of educational attainment	1 = Some high school 2 = High school diploma 3 = Some college 4 = Associate degree 5 = Bachelor's degree 6 = Some graduate or professional education 7 = Graduate or professional degree (M.A., M.S., M.D., J.D., Psy.D., etc.) 8 = Doctoral degree (Ed.D., Ph.D.) 98 = Other 99 = Missing
274	Whatwasyourpositioninyourhighschoolgraduatingclass	What was your position in your high school graduating class?	1 = Top 5% 2 = Top 6-10% 3 = Top 11-15% 4 = Top 16-20% 5 = Greater than top 20% 97 = I do not know or my high school did not calculate rank 99 = Missing

275	Duringyourundergraduatecareerhaveyoureceivedanyofthefollowingche	During your undergraduate career, have you received any of the following? (check primary source)	1 = Student loan 2 = Scholarship 3 = Internship 4 = Pell Grant 5 = Direct Loan 6 = Merit Aid 7 = Federal Tax Credit 8 = Lottery Scholarship 9 = Multiples listed in comments 98 = Indicated in comments that they did not receive financial aid (did not include those that simply said “none” as they could have been referring to no other sources) 99 = Missing
276	WhatwasyoucumulativeundergraduateGPAinthesemesterpriortoyourpart	What was you cumulative undergraduate GPA in the semester prior to your participation in ? (based on a rounded four-point scale)	1 = Less than 3.5 2 = 3.5 to 3.75 3 = 3.76 to 3.8 4 = 3.9 or higher 97 = Have no idea 98 = One participant went to a school that did not use GPA 99 = Missing
277	Parental_Max_Education	Maximum Parental Education	Calculated from Maximum of Item 272 and 273

Appendix I
Detailed Scalar and Item-Level Data

Table 1

Organizational Context Scale

Item	SULI N	SULI M	SULI SD	SURF N	SURF M	SURF SD	t	df	Sig. (2-tailed)
What is your level of agreement with each of the following statements about the program?									
The application process for the undergraduate research experience (URE) program was straightforward	61	4.36	0.63	121	4.13	1.01	1.87	171	.064
There was sufficient program information available to help me choose a URE research project	56	4.05	0.86	111	3.93	0.97	0.85	123	.396
It was easy to identify a research mentor/supervisor	49	3.76	1.15	97	3.57	1.11	0.95	94	.346
I am happy with the support I received from the program/administrative staff	62	4.44	0.72	120	4.48	0.62	(0.45)	109	.656
The financial support I received from the program was sufficient to meet my living expenses while I was in the program	61	4.33	0.54	114	4.45	0.71	(1.25)	152	.213
~ There was a lack of program orientation	61	4.18	0.67	120	4.39	0.71	(1.96)	128	.052
~ The guidance I received in navigating the administrative process of getting started in my URE was lacking	61	4.25	0.70	120	4.12	0.86	1.08	145	.280
~ I am dissatisfied with the guidance I received from the program/administrative staff	62	4.19	0.92	121	4.30	0.89	(0.73)	120	.466
Select your level of agreement with the following statements about your lab-based interactions with the research team									
My lab-based interactions with members of the research team have had a positive influence on my research skills	46	4.39	0.61	86	4.27	0.85	0.96	118	.337
My lab-based interactions with members of the research team have had a positive influence on my interest in the discipline	46	4.22	0.70	86	4.22	0.76	(0.03)	99	.979
My lab-based interactions with members of the research team have had a positive influence on my career aspirations	46	4.15	0.84	85	4.15	0.82	(0.01)	91	.996
I had a great deal of lab-based interaction with members of the research team	47	3.98	1.01	90	3.61	1.35	1.79	119	.076
I am happy with the overall experience of working in the lab with the research team	46	4.33	0.63	89	4.17	0.86	1.21	117	.229
~ I had little lab-based contact with other members of the research team	47	3.74	1.07	91	3.09	1.32	3.14	111	.002

Note: Items marked with an ~ were reversed coded prior to analysis *p<=.05. **p<=.01

Table 2

Peer Environment Scale

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	SD			
Indicate the degree to which you agree with each of the following statements about your relationships with other undergraduates you met/worked with in the program.									
While participating in the program I developed close personal relationships with fellow undergraduates lab	51	3.88	1.16	101	4.38	1.03	(2.57)	90	.012
The friendships I developed with fellow undergraduates while participating in the program have been personally satisfying	52	4.10	0.96	101	4.37	0.88	(1.70)	96	.092
My interpersonal relationships with fellow undergraduates had a positive influence on my personal growth, attitudes, and values	51	4.12	0.82	101	4.30	0.96	(1.20)	116	.232
My interpersonal relationships with fellow undergraduates have had a positive influence on my intellectual growth and interest in the discipline	51	3.98	0.86	101	4.20	0.96	(1.42)	111	.160
Indicate your level of agreement with each of the following									
Other undergraduates had less professional development opportunities than I did	50	2.70	0.81	96	2.60	0.91	0.65	110	.519
Other undergraduates gained less technical expertise than I did	51	2.75	0.77	97	2.47	0.87	1.95	113	.054
~ It was difficult for me to meet and make friends with fellow undergraduates while in the program	53	4.06	1.03	101	4.16	1.13	(0.56)	115	.573
~ Few of the other undergraduates while in the program would be willing to listen to me and help me if I had a personal problem.	52	3.98	1.00	101	4.03	1.16	(0.27)	118	.787
~ Most of my fellow undergraduates who worked have values and attitudes different fom my own	52	3.63	0.93	99	3.44	0.99	1.17	110	.246
~ I had very little support guidance from fellow undergraduates	51	3.92	1.02	100	3.95	1.10	(0.16)	108	.875
~ The other undergraduates were smarter than me	52	3.52	0.83	100	3.24	0.81	1.99	101	.049
~ The other undergraduates had a better mentor than me	52	3.54	1.02	100	3.65	1.02	(0.64)	103	.523
~ The other undergradutes had a better experience overall than me	51	3.73	0.90	100	3.55	0.93	1.13	104	.263

Note: Items marked with an ~ were reversed coded prior to analysis *p<=.05. **p<=.01

Table 3

Curricular Experiences Scale

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	SD			
Indicate your level of agreement with each of the following.									
I am satisfied with the extent of my experiences in research lab	52	4.27	0.79	96	4.20	0.85	0.51	111	.613
My research lab experience has had a positive influence on my intellectual growth and interest in the discipline	52	4.38	0.66	97	4.36	0.77	0.20	118	.844
My interest in the discipline has increased as a result of the research lab experience	52	4.21	0.89	97	4.13	0.97	0.49	113	.626
I am more likely to engage in work in a research lab now than I was before my experiences in this research lab	52	4.13	0.86	97	4.02	1.10	0.70	127	.488
I learned as much as I anticipated I would in the research lab experience	52	4.04	0.99	97	3.94	0.99	0.59	104	.556
The time (and amount of time) I spent working in the research lab was meaningful	52	4.23	0.70	97	4.08	0.94	1.09	132	.280
I am satisfied with my level of responsibility on my undergraduate research experience (URE) project	53	4.17	0.94	97	4.14	0.94	0.16	107	.874
I am satisfied with the input I gave in designing the research project	52	3.92	1.06	95	3.86	1.04	0.33	103	.743
I was able to complete my research project	52	3.81	1.16	95	3.65	1.10	0.79	101	.431
I am happy with the research experience overall	53	4.38	0.69	97	4.30	0.83	0.62	125	.537
I am satisfied with the amount of time I spent in the research lab	53	4.26	0.88	96	4.17	0.84	0.66	103	.513
I am satisfied with the amount of support/guidance I received in my research experiences in the lab	53	4.19	0.90	97	4.16	0.98	0.15	115	.881
The URE contributed to increasing my awareness of the relevance of research to my coursework	52	4.06	0.96	97	4.12	0.83	(0.42)	93	.676
The research team meetings I attended were beneficial to the development of my research project in the lab	43	4.21	0.77	82	3.84	1.12	2.16	114	.033
~ Few of my activities in the research lab have been intellectually stimulating.	46	3.59	1.05	87	3.61	1.06	(0.12)	93	.908
~ I did little or nothing that seemed like real research	52	4.15	0.94	97	4.04	1.08	0.66	118	.509

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Table 4

Co-Curricular Experiences Scale

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	SD			
Indicate your level of agreement with each of the following about improvement in your research skills as a result of the program.									
Taking greater care in conducting lab procedures	45	4.09	0.90	82	4.00	0.99	0.51	99	.609
Supporting assertions with evidence	50	4.02	0.80	89	3.94	0.86	0.53	108	.599
Keeping a detailed lab notebook	44	3.98	1.17	87	3.82	1.09	0.76	81	.449
Calibrating instruments needed for measurement	39	3.95	1.23	71	3.89	0.99	0.27	65	.790
Indicate your level of agreement with each of the following.									
I am satisfied with the extent of my skill-based experiences in the program	49	4.27	0.73	88	4.07	0.91	1.39	118	.168
My skill-based training in the program has had a positive influence on my professional growth	48	4.25	0.73	87	4.09	0.90	1.11	115	.270
My interest in the discipline has increased as a result of my skill-based training in the program	47	3.98	0.94	86	3.85	0.91	0.77	92	.445
I am more likely to engage in other skill-based training activities now than I was before my experiences in the program	47	3.83	0.99	88	3.75	1.06	0.44	101	.664
I learned as much as I anticipated I would from the skill-based training of the program	47	3.87	0.90	87	3.79	0.85	0.50	90	.621
The program contributed to increasing my awareness of connections among scientific disciplines	50	3.96	0.92	91	4.01	0.96	(0.31)	104	.758
The information provided to me on how to use the lab equipment was sufficient	40	4.23	0.80	85	3.99	0.85	1.51	81	.135
~ Few of my skill-based training activities in the program have been stimulating	46	3.59	1.05	87	3.61	1.06	(0.12)	93	.908

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Table 5

Extra-Curricular Experiences Scale

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	SD			
Indicate your level of agreement with each of the following.									
I am satisfied with the extent of my professional experiences in the program	53	4.11	0.93	94	4.18	0.84	(0.44)	99	.663
I attended most of the professional development activities that were offered during my program	52	4.02	1.00	93	4.17	0.82	(0.94)	89	.349
I received adequate professional support/guidance during my program	53	3.98	1.03	94	4.13	0.74	(0.91)	83	.364
My experiences outside the lab in the program have had a positive influence on my professional growth and interest in the discipline	52	3.98	0.90	94	4.19	0.64	(1.50)	81	.139
My interest in the discipline has increased as a result of my professional experiences in the program	53	3.98	0.99	94	4.12	0.81	(0.85)	92	.398
I am more likely to engage in professional activities now than I was before my experiences in the program	53	4.00	0.92	92	3.87	0.99	0.80	115	.425
I learned as much as I anticipated I would from the professional experiences in the program	52	3.88	0.92	93	3.91	0.88	(0.19)	102	.852
I am satisfied with the professional and social experiences in the program overall	52	4.15	0.85	93	4.33	0.73	(1.28)	93	.202
I am satisfied with my living/residence arrangement during the program	45	4.29	0.76	79	4.53	0.83	(1.66)	99	.101
I am satisfied with the opportunities to participate in social activities during the program	52	4.13	0.84	93	4.43	0.73	(2.13)	94	.036
The program increased my awareness of the many career paths for scientists	53	4.08	0.90	94	4.29	0.81	(1.42)	99	.158
The research team meetings I attended were beneficial to my professional development in the discipline	44	4.00	0.89	81	4.05	0.85	(0.30)	85	.764
The group social activities that took place during the program helped me feel like a part of the team	48	3.94	1.00	92	4.17	0.88	(1.38)	86	.171
~ Few of my activities in the program have been professionally stimulating.	53	3.74	1.06	94	3.66	1.01	0.43	104	.671
Indicate your level of agreement with each of the following about improvement in your research skills as a result of the program. - Making oral presentations	48	4.04	0.82	92	4.27	0.83	(1.57)	96	.121

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Table 6

Scientist/Mentor Scale

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	SD			
Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor									
My lab-based interactions with my research mentor/supervisor have had a positive influence on my research skills	57	4.39	0.77	109	4.36	0.86	0.21	124	.830
My lab-based interactions with my research mentor/supervisor have had a positive influence on my interest in the discipline	57	4.28	0.84	109	4.17	0.93	0.75	124	.457
My lab-based interactions with my research mentor/supervisor have had a positive influence on my career aspirations	57	4.33	0.79	109	4.28	0.84	0.44	120	.659
I had a great deal of lab-based interaction with my research mentor/supervisor	58	3.86	1.13	109	3.97	1.17	(0.59)	120	.554
While participating in the program, I was able to work in the lab with leading scientists/researchers	58	4.16	0.89	109	4.17	0.95	(0.07)	122	.947
I am happy with the support/guidance I received in the lab from my research mentor/supervisor	58	4.21	1.04	107	4.29	0.92	(0.51)	106	.612
My research mentor/sponsor was generally interested in developing my research lab skills	58	4.16	0.97	108	4.09	0.95	0.40	115	.691
My research mentor/sponsor was generally an outstanding teacher	59	4.07	1.08	108	4.04	0.99	0.18	111	.857
My research mentor/sponsor was involved in developing my research skills	59	4.19	0.96	109	4.13	0.94	0.38	118	.707
My non-lab interactions with my research mentor/supervisor have had a positive influence on my personal growth, values, and attitudes	49	4.00	1.08	104	4.04	1.01	(0.21)	89	.835
My non-lab interactions with my research mentor/supervisor have had a positive influence on my intellectual growth and interest in discipline	49	4.10	0.92	103	4.07	0.93	0.21	96	.832
My non-lab interactions with my research mentor/supervisor have had a positive influence on my career goals and aspirations	49	4.08	0.91	103	4.17	0.97	(0.58)	101	.566
While participating in the program I developed a close, personal relationship with my research mentor/supervisor	56	3.29	1.25	111	3.50	1.18	(1.09)	105	.278
I am satisfied with the opportunities I had to interact informally with my research mentor/supervisor	57	3.68	1.07	110	4.00	0.84	(1.94)	92	.055
I am happy with the overall experience with my research mentor/supervisor	59	4.22	1.00	111	4.28	0.94	(0.37)	112	.709

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	N			
Select your level of agreement with the following statements about your lab-based interactions with your research mentor/supervisor									
My research mentor/sponsor was generally interested in developing my career	59	4.10	0.99	111	4.10	0.97	0.02	116	.987
My research mentor/sponsor was generally an outstanding professional mentor	59	3.95	1.12	111	4.12	0.96	(0.98)	104	.331
My research mentor/sponsor was willing to spend time outside of class to discuss professional development issues that were important to me	52	3.81	1.16	99	3.99	0.92	(0.98)	86	.327
My research mentor/sponsor was willing to provide me with graduate school advice	52	3.98	1.13	100	4.34	0.89	(1.99)	85	.049
My research mentor/sponsor was willing to provide me with career advice	55	4.09	1.02	105	4.30	0.81	(1.34)	90	.182
~ I had little contact with my research mentor/supervisor in the lab	58	3.76	1.25	108	3.88	1.24	(0.60)	116	0.55
I had little contact with my research mentor/supervisor outside the lab	59	2.95	1.37	111	3.14	1.33	(0.89)	115	0.37

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Table 7

Research Team Scale

Item	SULI N	SULI M	SULI SD	SURF N	SURF M	SURF SD	t	df	Sig. (2-tailed)
Select your level of agreement with the following statements about interactions outside the lab with the research team									
While participating in the undergraduate research experience (URE) I developed close personal relationships with members of the research team	47	3.43	1.10	86	3.33	1.18	0.49	101	.627
The friendships I developed with members of the research team while participating in the URE have been personally satisfying	44	3.70	0.95	79	3.70	0.99	0.05	92	.964
My interpersonal relationships with members of the research team had a positive influence on my personal growth, attitudes, and values	46	3.74	0.93	82	3.83	0.90	(0.53)	91	.596
My interpersonal relationships with members of the research team have had a positive influence on my intellectual growth and interest in the discipline	46	3.80	0.91	82	3.91	0.86	(0.67)	89	.504
The experience with members of the research team overall was excellent	47	4.15	0.86	83	4.11	0.75	0.27	85	.788
I am happy with the overall experience of spending time with members of the research team outside of the lab	42	4.02	0.75	81	3.91	0.90	0.72	97	.472
~ Few of the members of the research team I met while in the summer URE would be willing to listen to me and/or help me if I had a personal problem	47	4.06	0.92	85	3.67	1.13	2.17	112	.032
~ Most of the members of the research team in this URE have values and/or attitudes different from my own.	48	3.60	1.01	82	3.51	0.95	0.51	94	.608
~ I had little contact outside the lab with other members of the research team	48	3.17	1.34	87	2.93	1.28	0.99	93	.324
~ It was difficult for me to meet and make friends with members of the research team while in the summer URE	48	4.02	0.93	87	3.74	1.20	1.53	118	.128

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Table 8

URE Experiences Scale

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	SD			
Indicate your level of agreement with each of the following related to the program.									
It was important for me to complete this program	51	4.49	0.76	90	4.51	0.77	(0.16)	105	.876
I am confident that I made the right decision in choosing to participate in this program	51	4.59	0.61	90	4.74	0.55	(1.52)	96	.132
I understand how my work in this program contributes to the “bigger picture” of research	51	4.33	0.84	90	4.47	0.78	(0.93)	98	.356
This program made me feel like a part of the scientific community	51	4.31	0.91	90	4.48	0.80	(1.08)	93	.283
I am satisfied with the extent of my intellectual development during the undergraduate research experience (URE)	51	4.27	0.90	90	4.38	0.88	(0.66)	103	.510
My interest in the discipline has increased as a result of the URE	50	4.24	0.92	90	4.34	0.89	(0.65)	99	.515
My participation in this program helped me perform better academically	51	3.96	1.06	89	3.94	1.00	0.09	100	.926
The field trips that I took while in the program benefitted my progress overall	38	4.18	0.98	63	4.02	0.92	0.85	74	.397

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Table 9

Research Experiences Scale

Item	SULI			SURF			t	df	Sig. (2-tailed)
	N	M	SD	N	M	SD			
Indicate your level of agreement with each of the following regarding your likelihood to do the following based on your experiences in the program.									
Mentor other students conducting research or leading a student research team	48	4.15	0.85	89	3.88	1.06	1.62	116	.109
Participate in research-related field trips to other labs	49	3.96	0.98	86	3.86	1.10	0.54	110	.591
Attend student conferences on research (that include students from other colleges)	49	4.04	1.00	86	3.91	1.06	0.73	105	.466
Attend discipline-specific conferences (conferences not specifically for students)	46	4.13	0.96	88	4.17	0.95	(0.23)	91	.818
Prepare and present a poster describing my research	49	4.18	0.86	88	4.11	0.99	0.43	111	.666
Prepare written research papers describing my research and results	48	4.02	1.04	89	4.15	0.92	(0.70)	87	.487
Deliver an oral presentation describing my research and results	49	4.16	0.96	89	4.36	0.90	(1.17)	93	.244
Author or co-author a paper that is published in a professional journal in this discipline	48	4.00	1.15	89	3.98	1.11	0.11	93	.912

Note: Items marked with an ~ were reversed coded prior to analysis

*p<=.05. **p<=.01

Appendix J

Comparison of SURF and SULI Respondents on Long-Term Outcomes

Table 1

Comparisons of SURF and SULI Respondents on Intent to Earn Doctoral Degree

Program	Value	Intent for Doctoral Degree					
		No	Yes	N	Chi-Sq.	Df	Phi
SURF		17	33	50	4.70*	1	0.18
SULI		16	74	90			
Gender							
Both	Male	17	55	72	0.00	1	0.00
	Female	16	52	68			
SULI	Male	9	18	27	0.01	1	(0.02)
	Female	8	15	23			
SURF	Male	8	37	45	0.00	1	-
	Female	8	37	45			
	Cochran-Mantel-Haenszel				0.01	1	
	Mantel-Haenszel				0.02	1	
	Breslow-Day				0.01	1	
Ethnicity							
Both	Non-Hispanic	30	97	127	0.00	1	0.00
	Hispanic	3	10	13			
SULI	Non- Hispanic	15	31	46	0.50	1	(0.10)
	Hispanic	2	2	4			
SURF	Non- Hispanic	15	66	81	0.30	1	0.06
	Hispanic	1	8	9			
	Cochran-Mantel-Haenszel				0.00	1	
	Mantel-Haenszel				0.10	1	
	Breslow-Day				0.79	1	

*p<=.05. **p<=.01

Program	Value	Intent for Doctoral Degree					
		No	Yes	N	Chi-Sq.	Df	Phi
Race		17	33	50	4.70*	1	0.18
Both	African American	2	6	8	4.44	3	0.18
	Asian/Asian American	5	6	11			
	Caucasian	23	90	113			
	Native American/Alaska Native	3	5	8			
SULI	African American	2	4	6	1.69	2	0.18
	Asian/ Asian American	0	0	0			
	Caucasian	12	27	39			
	Native American/Alaska Native	3	2	5			
SURF	African American	0	2	2	7.28	3	0.28
	Asian/ Asian American	5	6	11			
	Caucasian	11	63	74			
	Native American/Alaska Native	0	3	3			
URE Before Program							
Both	No	22	44	66	6.60*	1	0.22
	Yes	11	63	74			
SULI	No	11	15	26	1.67	1	0.18
	Yes	6	18	24			.
SURF	No	11	29	40	4.66*	1	0.23
	Yes	5	45	50			
	Cochran-Mantel-Haenszel				6.05*	1	
	Mantel-Haenszel				5.01*	1	
	Breslow-Day				0.27	1	

*p<=.05. **p<=.01

Table 2

Comparisons of SURF and SULI Respondents on Long-Term Outcomes

Program	Value	Intent for Doctoral Degree					
		No	Yes	N	Chi-Sq.	Df	Phi
Academic Discipline Before Program							
Both	Earth Science	2	0	2	25.51**	9	0.43
	Biology	1	9	10			
	Chemistry	1	16	17			
	Computer Sci.	5	9	14			
	Engineering	18	32	50			
	Health/Medical	1	3	4			
	Mathematics	1	5	6			
	Physics	1	29	30			
	Social/Behavioral	0	1	1			
	Interdisciplinary	3	3	6			
SULI	Earth Science	2	0	2	23.23**	9	0.68
	Biology	1	3	4			
	Chemistry	1	6	7			
	Computer Sci.	4	0	4			
	Engineering	7	8	15			
	Health/Medical	1	2	3			
	Mathematics	0	2	2			
	Physics	0	11	11			
	Social/Behavioral	0	1	1			
	Interdisciplinary	1	0	1			
SURF	Earth Science	0	0	0	12.42**	7	0.37
	Biology	0	6	6			
	Chemistry	0	10	10			
	Computer Sci.	1	9	10			
	Engineering	11	24	35			
	Health/Medical	0	1	1			
	Mathematics	1	3	4			
	Physics	1	18	19			
	Social/Behavioral	0	0	0			
	Interdisciplinary	2	3	5			

*p<=.05. **p<=.01

Program	Value	Intent for Doctoral Degree					
		No	Yes	N	Chi-Sq.	Df	Phi
Undergraduate Rank During Program							
ALL	Freshman	5	6	11	7.47	4	0.23
	Sophomore	7	31	38			
	Junior	12	40	52			
	Senior	9	20	29			
	Graduated	0	10	10			
SULI	Freshman	3	3	6	3.47	4	0.48
	Sophomore	4	12	16			
	Junior	5	9	14			
	Senior	5	6	11			
	Graduated	0	3	3			
SURF	Freshman	2	3	5	3.71	4	0.49
	Sophomore	3	19	22			
	Junior	7	31	38			
	Senior	4	14	18			
	Graduated	0	7	7			

*p<=.05. **p<=.01

Table 3

Comparisons of SURF and SULI Respondents on Long-Term Outcomes

Program	Value	Intent for Doctoral Degree					
		No	Yes	N	Chi-Sq.	Df	Phi
Undergraduate Grade Point Average During Program							
Both	Less than 3.5	11	17	28	7.92*	3	0.25
	3.5 to 3.75	7	24	31			
	3.76 to 3.8	6	20	26			
	3.9 or higher	5	40	45			
SULI	Less than 3.5	7	7	14	3.58	3	0.28
	3.5 to 3.75	4	9	13			
	3.76 to 3.8	2	6	8			
	3.9 or higher	2	10	12			
SURF	Less than 3.5	4	10	14	3.16	3	0.20
	3.5 to 3.75	3	15	18			
	3.76 to 3.8	4	14	18			
	3.9 or higher	3	30	33			
Both	Less than 3.5	11	17	28	7.92*	3	0.25
	3.5 to 3.75	7	24	31			
	3.76 to 3.8	6	20	26			
	3.9 or higher	5	40	45			

*p<=.05. **p<=.01

Table 4

Comparisons of SURF and SULI Respondents on Long-Term Outcomes

Program	Value	Intent to Work in a National Lab: Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	% Agreement	Chi-Sq.	df	Phi
SULI		0	4	10	20	15	49	71%	2.54	4	0.14
SURF		4	5	18	35	26	88	69%			
Gender											
Both	Male	3	6	17	27	18	71	63%	3.45	4	0.16
	Female	1	3	11	28	22	65	77%			
SULI	Male	0	2	8	9	8	27	63%	3.39	3	0.27
	Female	0	2	2	11	6	21	81%			
SURF	Male	3	4	9	18	10	44	64%	4.21	4	0.22
	Female	1	1	9	17	16	44	75%			
Ethnicity											
Both	Non-Hispanic	3	9	26	48	38	124	69%	4.04	4	0.17
	Hispanic	1	0	2	7	2	12	75%			
SULI	Non- Hispanic	0	4	10	17	14	45	69%	4.48	3	0.31
	Hispanic	0	0	0	3	0	3	100%			
SURF	Non- Hispanic	3	5	16	31	24	79	70%	1.77	4	0.14
	Hispanic	1	0	2	4	2	9	67%			
Race											
Both	African American	0	1	0	3	4	8	88%	13.89	12	0.32
	Asian/Asian American	1	1	3	1	4	10	50%			
	Caucasian	2	6	24	49	30	111	71%			
	Native American/Alaska Native	1	1	1	2	2	7	57%			
SULI	African American	0	0	0	3	3	6	100%	4.66	6	0.31
	Asian/ Asian American	0	0	0	0	0	0	0%			
	Caucasian	0	3	9	16	10	38	68%			
	Native American/Alaska Native	0	1	1	1	1	4	50%			
SURF	African American	0	1	0	0	1	2	50%	20.32	12	0.48
	Asian/ Asian American	1	1	3	1	4	10	50%			
	Caucasian	2	3	15	33	20	73	73%			
	Native American/Alaska Native	1	0	0	1	1	3	67%			

*p<=.05. **p<=.01

Table 5

Comparisons of SURF and SULI Respondents on Long-Term Outcomes

Program	Value	Intent to Work in a National Lab									
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	% Agreement	Chi-Sq.	df	Phi
URE Before Program											
Both	No	2	6	18	22	17	65	60%	6.34	4	0.22
	Yes	2	3	10	33	24	72	79%			
SULI	No	0	3	7	12	3	25	60%	8.78*	3	0.42
	Yes	0	1	3	8	12	24	83%			
SURF	No	2	3	11	10	14	40	60%	7.00	4	0.28
	Yes	2	2	7	25	12	48	77%			

*p<=.05. **p<=.01

Table 6

Comparisons of SURF and SULI Respondents on Long-Term Outcomes

Program	Value	Intent to Work in a National Lab									
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	% Agreement	Chi-Sq.	df	Phi
Academic Discipline Before Program											
Both	Earth Science	0	0	0	0	1	1	100%	42.30	36	0.56
	Biology	0	1	2	6	1	10	70%			
	Chemistry	0	0	1	8	8	17	94%			
	Computer Sci.	0	0	6	6	2	14	57%			
	Engineering	1	4	13	20	10	48	63%			
	Health/Medical	1	1	0	2	0	4	50%			
	Mathematics	0	1	1	0	4	6	67%			
	Physics	2	2	4	11	12	31	74%			
	Social/Behavioral	0	0	0	0	1	1	100%			
	Interdisciplinary	0	0	1	2	2	5	80%			
SULI	Earth Science	0	0	0	0	1	1	100%	28.04	27	0.76
	Biology	0	1	1	1	1	4	50%			
	Chemistry	0	0	0	4	3	7	100%			
	Computer Sci.	0	0	3	1	0	4	25%			
	Engineering	0	1	3	7	3	14	71%			
	Health/Medical	0	1	0	2	0	3	67%			
	Mathematics	0	0	0	0	2	2	100%			
	Physics	0	1	3	4	4	12	67%			
	Social/Behavioral	0	0	0	0	1	1	100%			
	Interdisciplinary	0	0	0	1	0	1	100%			
SURF	Earth Science	0	0	0	0	0	0	0%	45.31*	28	0.72
	Biology	0	0	1	5	0	6	83%			
	Chemistry	0	0	1	4	5	10	90%			
	Computer Sci.	0	0	3	5	2	10	70%			
	Engineering	1	3	10	13	7	34	59%			
	Health/Medical	1	0	0	0	0	1	0%			
	Mathematics	0	1	1	0	2	4	50%			
	Physics	2	1	1	7	8	19	79%			
	Social/Behavioral	0	0	0	0	0	0	0%			
	Interdisciplinary	0	0	1	1	2	4	75%			

*p<=.05. **p<=.01

Table 7

Comparisons of SURF and SULI Respondents on Long-Term Outcomes

Program	Value	Intent to Work in a National Lab: Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	% Agreement	Chi-Sq.	df	Phi
Undergraduate Rank During Program											
ALL	Freshman	1	1	5	3	1	11	36%	14.48	16	0.33
	Sophomore	2	2	7	14	11	36	69%			
	Junior	1	3	12	23	13	52	69%			
	Senior	0	2	4	11	10	27	78%			
	Graduated	0	1	0	4	5	10	90%			
SULI	Freshman	0	0	3	2	1	6	50%	9.97	12	0.46
	Sophomore	0	2	2	8	3	15	73%			
	Junior	0	2	2	5	5	14	71%			
	Senior	0	0	3	4	3	10	70%			
	Graduated	0	0	0	1	2	3	100%			
SURF	Freshman	1	1	2	1	0	5	20%	21.55	16	0.50
	Sophomore	2	0	5	6	8	21	67%			
	Junior	1	1	10	18	8	38	68%			
	Senior	0	2	1	7	7	17	82%			
	Graduated	0	1	0	3	3	7	86%			

*p<=.05. **p<=.01

Table 8

Comparisons of SURF and SULI Respondents on Long-Term Outcomes

Program	Value	Intent to Work in a National Lab									
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	% Agreement	Chi-Sq.	df	Phi
Undergraduate Grade Point Average During Program											
Both	Less than 3.5	0	1	7	8	10	26	69%	12.11	12	0.31
	3.5 to 3.75	0	3	6	10	12	31	71%			
	3.76 to 3.8	1	1	3	15	6	26	81%			
	3.9 or higher	3	3	10	18	10	44	64%			
SULI	Less than 3.5	0	0	5	5	3	13	62%	10.27	9	0.47
	3.5 to 3.75	0	2	2	3	6	13	69%			
	3.76 to 3.8	0	0	2	5	1	8	75%			
	3.9 or higher	0	1	1	6	4	12	83%			
SURF	Less than 3.5	0	1	2	3	7	13	77%	12.10	12	0.39
	3.5 to 3.75	0	1	4	7	6	18	72%			
	3.76 to 3.8	1	1	1	10	5	18	83%			
	3.9 or higher	3	2	9	12	6	32	56%			

*p<=.05. **p<=.01

Appendix K

Table 1

Comparison of Early and Late Responders by Key Characteristics

Item	Responders	Early Responders	Late Responders	N	Chi-Sq	df	Phi
Program	SULI	30	37	67	31.71	1	(0.40)
	SURF	107	21	128			
Gender	Female	52	16	68	3.03	1	0.15
	Male	45	27	72			
Ethnicity	Hispanic	6	7	13	3.60	1	0.16
	Non-Hispanic	91	36	127			
Race	African American or Black	3	5	8	10.32*	3	0.27
	Asian or Asian American	10	1	11			
	Caucasian or White	81	32	113			
	Native American or Alaskan Native	3	5	8			

*p<=.05. **p<=.01

Table 2

Comparison of Early and Late Responders by Key Characteristics

Item	Responders	Early Responders	Late Responders	N	Chi-Sq	df	Phi
	Organizational Context	57.77	62	57.00	31	0.51	59
	Peer Environment	53.19	96	52.13	39	0.74	61
	Curricular	66.78	82	63.84	38	1.32	69
	Co-curricular	47.80	65	48.00	30	(0.12)	56
	Extracurricular	63.68	65	58.81	31	2.16*	44
	Scientist/Mentor	91.94	86	88.33	36	1.20	59
	Research Team	38.18	77	36.68	34	1.03	62
	URE Experience	34.81	67	33.88	33	0.73	58
	Research Activities	32.62	84	32.19	43	0.74	61
	Organizational Context	57.77	62	57.00	31	0.51	59

*p<=.05. **p<=.01

Table 3
Comparison of Early and Late Responders by Key Characteristics

Item	Responders	Early Responders	Late Responders	N	Chi-Sq	df	Phi
	Intent to Obtain a Doctoral Degree	No	23	10	67	0.00	1
		Yes	74	33	33		
	Intent to Work in National Lab	Strongly Disagree	3	1	84	1.54	4
		Disagree	7	2	43		
		Neutral	20	8	28		
		Agree	35	20	55		
		Strongly Agree	30	11	41		
	Intent to Obtain a Doctoral Degree	No	23	10	67	0.00	1
		Yes	74	33	33		
	Intent to Work in National Lab	Strongly Disagree	3	1	84	1.54	4

*p<=.05. **p<=.01

Appendix M

Verbatim Comments from Survey

RespondentID	Program	If you were accepted to another program, why did you select SURF over that program? - Open-Ended Response
1229015349	SULI	Housing allowance and location (New York).
1229100598	SULI	I already had experience at the other company that offered me a position
1232085086	SULI	Location
1232574092	SULI	Location
1235821502	SULI	I had previous experience in industrial and academic research and I wanted to experience research in a government laboratory. Also, I was very interested in the specific research project I would be doing at SULI
1238006818	SULI	It was the best fit.
1244186392	SULI	The fellowship opportunity.
1246509156	SULI	Actual hands on national lab/government experience for future job opportunities.
1247555160	SULI	because it was closer to home.
1260619720	SULI	Not accepted
1260660969	SULI	They were the first to respond to me and sounded very excited to have me. That was a big surprise to me as someone who has never participated in a notable research experience at a major laboratory. The project offered by SULI sounded very interesting and I could immediately relate to the project objectives.
1260774122	SULI	SULI offered a very unique experience that I knew would be difficult to find anywhere else.
1261003605	SULI	Was not accepted
1263883188	SULI	Location - a chance to do research in a different state, research interests
1263985698	SULI	Not accepted
1270186180	SULI	I was not accepted to another program.
1272585861	SULI	SULI was more applicable to my undergraduate degree
1273908525	SULI	The reputation of the SULI program site far exceeded any of my other applications.
1274733318	SULI	NA
1274734766	SULI	N/A
1274777069	SULI	At the time I believed that I wanted to do nuclear chemistry and preferred hands on research over a course.
1274937888	SULI	N/A

1275101787	SULI	was not accepted
1276392537	SULI	The project at my SULI internship was more interesting to me
1235015046	SURF	Only got into SURF
1235028131	SURF	Stipend, prestige, most applicable to interests
1235184978	SURF	Closer to home
1235254279	SURF	N/A
1235749919	SURF	I was not accepted.
1235757574	SURF	Early notification from SURF (before other programs responded)
1235764825	SURF	not accepted
1235775160	SURF	NIST seemed like it would be a better experience
1235842105	SURF	Wasn't accepted for other program.
1236007019	SURF	The others were not research. I wanted to try out doing research to see if I liked it.
1236329823	SURF	Because I like what the program offered me in terms of knowledge and experience, so I decided to select SURF a second time.
1236568635	SURF	Better project
1237164636	SURF	Deadline for SURF was before my acceptance to other program.
1237533440	SURF	The environment of a national lab seemed more interesting than my other option, which was a REU at a university.
1238091836	SURF	The SURF program had more integrated programs involving physics chemistry and engineering research labs.
1238106777	SURF	I wasn't accepted into the other program.
1238145908	SURF	more interesting projects and better housing
1238245463	SURF	I accepted SURF before hearing from other programs and withdrew my applications.
1238726277	SURF	Location
1238735186	SURF	SURF would be better for my resume and was higher-paying
1238743974	SURF	stipend, housing provided, close location, larger program, seemed well-organized and fun
1238750335	SURF	Better reputation
1238755038	SURF	I was not accepted to another program.
1238757502	SURF	I considered: NIST was the best option.
1238770422	SURF	more well know program
1238846589	SURF	Was not accepted
1239025574	SURF	This SURF program accepted me first and gave a week deadline to decide to attend. I was accepted into the other programs after I decided to attend SURF

1239092167	SURF	I was offered an undergraduate research position at NASA. I chose SURF (even though I had yet to be accepted) because the location of the NASA program was pretty bad and I wasn't very interested in the project.
1239099412	SURF	The reputation that NIST has and The people running the program.
1239120144	SURF	SURF was away from my home institution, my other position was at the home institution.
1239182619	SURF	I was invited to work on a very interesting project on which I would gain valuable experimental design experience as oppose to solely analytical experience.
1239185966	SURF	The project was the best match with my interests, and the housing arrangements were significantly better.
1239201217	SURF	The deadline for a reply to my acceptance in the SURF program was required before I had heard back from the other internship, the stipend was considerably higher, I had friends in the SURF program, and I wanted SURF over the other originally.
1239406590	SURF	Was not accepted into another program.
1239427586	SURF	They contacted me first, and it seemed like a good opportunity
1239437752	SURF	I was not accepted in other program
1239510614	SURF	The deadline for response to SURF was much earlier.
1239589970	SURF	n/a
1239591369	SURF	N/A
1239594117	SURF	N/A -- Wasn't accepted to other programs
1239980091	SURF	The SURF program was more prestigious and I wanted to know if I wanted to pursue a career in government affiliated research.
1240072873	SURF	Location, partnership between my school and the SURF program, research topic
1240446923	SURF	Not accepted to any other programs.
1240599783	SURF	Was not accepted to another program.
1243081130	SURF	I was accepted into a program which I had participated in the previous summer and I wanted to see a new laboratory and make new professional contacts.
1244753549	SURF	I was not accepted
1245330854	SURF	NIST's program was at a nationally recognized organization and the opportunity was something different from what I had the previous summer.
1245556992	SURF	Seemed like a more fun collaborative experience to be with other students participating in research, even if they weren't working on the same project.

1248257135	SURF	No.
1249129222	SURF	N/A
1250081811	SURF	The other program was my undergraduate research which I had been participating in for one year and would return to after the summer.. I chose NIST as a chance for performing different work and broadening my experiences.
1250706654	SURF	quality of research opportunities at NIST
1252616557	SURF	Closer to home
1258912631	SURF	SURF responded first and had research on the particular topic I was interested in (solar energy).
1263554567	SURF	Was not accepted to other programs
1263993949	SURF	Based on location and research project.
1265030602	SURF	The dynamic feedback from previous surfers and uniqueness of the institution
1268994712	SURF	I was not accepted to another program.
1269921086	SURF	I was not accepted to another program.
1270316999	SURF	The SURF program offered a more realistic view of the life of a researcher following graduate school.
1272731661	SURF	n/a
1273589707	SURF	Not accepted to other programs due to scheduling conflicts.

RespondentID	Program	If you were designing undergraduate research programs, how would you make them better than the programs in which you participated? - Open-Ended Response
1229011486	SULI	Sometimes I felt as if the researchers and mentors were happy to have me there and participating, but found the organization of the program more of a nuisance. It would be great to get everybody on the same page.
1229276893	SULI	The assigned mentor was quite hands-off, and I was placed in the hands of a lab technician who was not excited about science at all. I remember her complaining that people didn't wear cute/nice things--we were working in labs!! She seemed bothered when I wanted to talk to her about work. Then, a post-doc started in my division and she then guided me. She was great!! She was totally engaged in the research. She let the project continue to be mine, but was extremely supportive in helping make it more successful. My recommendation would be to make sure that there is a project that the undergraduate can work on and be personally invested in, and make sure there are people around with the time and interest to foster excitement about research.

1235821502	SULI	I was very satisfied with the research programs in which I participated (SULI, Merck intern program, and research at Williams College). Together these experiences provided complete training, so I would not add anything.
1237467863	SULI	I did not receive a housing stipend so I did not feel very close to the other SULI interns who were living together in the same apartment complex my research was computer analysis rather than a laboratory experience so I did not learn much about laboratory research
1244624742	SULI	Frankly I could not think of much that would make the program better. I truly was one of best experiences of my life. I learned a great deal that has prove very useful to me
1260680993	SULI	Give students the opportunity to rate their mentors, it's a two way street.
1260818498	SULI	have a mentor that more closely works with you, at least in the beginning of the summer
1261525162	SULI	The projects did not match the interests of the interns. Having this matched more accurately would enhance the experience.
1263985698	SULI	I would include more interdisciplinary training to participants. I would accept hard and social science majors as well as education majors and combine programs that provide real-world research experiences with programs on teaching/mentoring. I would also provide programs for training social science majors in biology/chemistry/engineering research and vice versa.
1270186180	SULI	The program I was in (at NREL) was very well run. I couldn't think of ways to improve it. A lot comes down to individual interactions with one's mentor and research team and there are limits to what program design can do along those lines.
1270275253	SULI	I would focus on getting students involved on short-term projects or small pieces of larger research projects so that they can be part of the entire process from beginning to end within their short appointment.
1272479391	SULI	One major problem I had was that while I was motivated and wanted to finish, there simply wasn't enough time to for me to complete my project. I would suggest lengthening the program duration to maybe 12 or 14 weeks if possible.
1272587639	SULI	A bit more social interaction, like more meetings for lunch on Friday or something. I thought the research aspect was superb, but I missed out on making friends and connections in my cohort.

1272786458	SULI	Have a strong inter-disciplinary component to all research projects. In addition, facilitate anonymous peer-reviewed strengths and weaknesses. It would be good to begin the research with a clear goal possibly as part of longitudinal studies already in progress, but allow some flexibility for the students to contribute some aspect of the methods. This will enhance practical application of the scientific method towards problem solving. And finally, more research paper and abstract writing classes to help strengthen writing aptitude necessary for submitting papers to academic journals.
1274733318	SULI	Since becoming a graduate student, I feel that I didn't have a clue what research was like at the time of this internship. I don't know if any specific modifications could be made that would have enticed me into graduate school better than this did, but if I knew then what I know now, I may have just used the research experience as a resume builder. I think the program was set up right in trying to have each participant have some finished paper or publication, but only a few actually seemed to do that because the tasks given by mentors were not of that calliber. It wasn't expected by mentors that we would make significant progress-and really 10 weeks is not long enough for significant results in many cases. I would say a longer appointment would be better overall.
1274777069	SULI	I don't think the design was poor, but rather I was in the wrong field and didn't do laboratory experiments because the lab was still being established.
1274937888	SULI	N/A
1275101787	SULI	I worked on projects, but not actual research projects. While enjoyable and stimulating, some research would have been good, too.

1275727808	SULI	First, we were not allowed to choose our own mentors, we were chosen by the mentors. I wouldn't do it this way, because they the students, like myself, may end up being chosen for a project they are not interested in. I think the mentors should be chosen wisely. I know that in order for the program to work, willing mentors are needed, but this does NOT mean that the mentors who volunteer will actually effectively mentor. Mine did not once step foot into the lab, which seems backwards when trying to advise someone on research in a lab. Moreover, he was not motivating and seemed to lack the capability to have an intellectual discussion when encountered a problem. The graduate students in the group were much better at giving helpful advice and very useful discussions. Perhaps the students should be allowed to participate (or give) some sort of feedback upon ending the program that gives a review of the mentor. Obviously, this should be confidential so that the students name is not given, but bad mentors should be determined and removed, or monitored in some way. Otherwise it just seems like they are doing it to make themselves look better since they have helped "mentor" undergraduates in the SULI program.
1235040096	SURF	Don't make certain seminars required. They weren't of interest to me and I could have spent more time on the research I was interested in instead.
1235254279	SURF	Ensure that the research advisor/mentor is a good teacher and have a lab SURF director checking up to see if you're getting enough attention.
1235277330	SURF	SURF is a very well balanced program. I would appreciate it if there had been tours of other projects before the end of the summer to get an idea of what the other students were working on. I was able to do this by visiting friend's labs, but I think it would have been beneficial for the entire group of students.
1235310681	SURF	I would model other undergraduate research programs like the SURF program at NIST.
1235380614	SURF	I would like to have seen more material about the project that I was working on prior to getting to the SURF program. Since my degree is Mechanical Engineering and my project was Organic Chemistry based, it would have been nice to get a list of papers and an idea before getting there the first week, so I did not already feel behind with a lack of knowledge about the project.
1235452620	SURF	I'd like to have a more involved choice in my research area. It was sort of a surprise for everyone.

1235749919	SURF	My experience was great (not the norm) because I was able to attend conferences both summers outside of the US and present my work. Traveling to another country to present was an eye opener into the rewards of working hard to complete research, and inspired me to work hard throughout the summer.
1235764825	SURF	more choice of projects? more informational seminars or training? i dont know
1235834789	SURF	I do not think that a full summer is sufficient for an undergraduate research program, especially if the program's intent is to introduce the student to the life of a graduate student. Perhaps if the program I attended were at a university/college, I would have gained a better idea of what it takes to be a graduate student. Working at a government laboratory, I think I got lost in just completing the project. I am not discounting the usefulness of working at a government laboratory; some people would probably prefer to work at a government laboratory over working at a university/college. However, if you are going to be a researcher, then you are most likely going to have to do some graduate school work. Thus, it is extremely beneficial to be in that environment for some period of time to know to some extent what it is going to be like.
1235983612	SURF	More output and recognition of outcome of projects (journal paper, citation in NIST documents).
1236007019	SURF	Researchers should give students legitimate projects or just not participate in the program. If researchers don't want students then the students should not be forced on them. It's not beneficial for either party.
1236158985	SURF	I would have a mid-program research symposium. This way students could share what they're working on in a formal setting, and maybe find other students working on similar projects. Most students don't talk much (if at all) about their work in social settings, so I found it difficult to learn about others' work before the final day of talks in August. Of course by then it's too late for students to learn much from each other that will help each others' research.
1237533440	SURF	Having contact with the mentor a few weeks before the program could have been very helpful in knowing what to prepare for and feel ready to start.

1238091836	SURF	In the NIST SURF program I had the opportunity to work with a new project leader (Dr. David Gundlach) who devoted substantial time and effort to developing my skills since I was the only student working for him at the time. This one-on-one interaction was very encouraging for me and facilitated my progress towards my goal to obtain publishable results (data obtained during my SURF tenure is published in Nature Materials, 2008). I would suggest that newer faculty/staff members are more effective at training young students since their focus is on quickly developing novel techniques and experimental designs. Furthermore, it was beneficial for me to work with several divisions (CMOS/Novel electronics, Polymers, CNST) since I obtained multiple experiences from different fields of work (electrical tests, surface analysis, material design). This was a tremendously informative experience and I would emphasize integrative study for the students.
1238145908	SURF	Have more explicit mentoring with the adviser.
1238735186	SURF	I would encourage more collaboration between students--in the SURF program, most students worked on projects individually or with one other student. I think more peer support would help students come up with new ideas and learn about collaboration and would make the projects more interesting.
1238736667	SURF	I would make the mentoring part a bit more structured so that it doesn't feel so overwhelming in the beginning.
1238750335	SURF	I honestly don't know. I'm sorry. I'm not saying it was perfect, but I don't know how to realistically change it for the better.
1238846589	SURF	No comment
1239025574	SURF	Many research programs require you to already have research experience to get into them (or it is simply just much harder to get in without prior research). This creates a barrier of experience/no experience that can be hard to cross. Since these programs are designed to give undergraduates the experience of research I would make more programs that look at academic credentials for admittance criteria rather that prior experience.
1239099412	SURF	I would like to see the opportunity to continue with the research project throughout the school year available for all SURF students. I was fortunate enough to be able to continue my project as a Student employee that continued until graduation. (2 more years.)

1239185966	SURF	More activities between my adviser and the other professional research staff and I outside of lab - all of our interactions occurred in lab and thus limited our conversations largely to the research at hand.
1239201217	SURF	I would want to make sure that they are very similar to the SURF program. One of the experiences I had involved a mentor relationship that was very detrimental and involved differing expectations and communication problems. My mentors in SURF were extremely helpful and open; the project was intriguing and challenging without being discouraging; everyone I met, both students and faculty, were always delightful to be around; the living arrangements were fantastic and located close to work, which was nice; and the people that I met, particularly the girls that I housed with, are some of the best friends I ever made.
1239437752	SURF	Add more workshops dedicated to topics like how to write abstracts, proposals and how to get funded.
1239510614	SURF	Make sure that the scientists chosen as mentors actually have specific research-based projects that they want the undergraduates working on. Mentors should not disappear on two-week vacations at the beginning of the summer. Mentors should have some expertise in the problem which they give the undergraduate.
1239589970	SURF	I wish that my advisor was able to help me understand where my project fit in to the big picture. I really enjoyed the topic and thought it was interesting, but wasn't really sure why I was doing it. Also, while my advisor was able to help me get started, she wasn't able to help me once I got further into it. This may have not been a bad thing, as a result I really had to push through the project and was able to understand things that I had no idea I could tackle, but in the moment, it was pretty frustrating. Also, I wish the seminars had been more applicable to mathematics.

1239742079	SURF	My personal experience didn't reflect the experiences of everyone else I met at the SURF program. I think the program, overall, was designed well. Since it was my individual experience that was lacking, I would expect better training for the mentors/supervisors that agree to take part in this program, so they understand not the responsibility but to motivate them to educate and inspire the undergraduates they work with. To have them recognize what experience their undergraduate has had prior to SURF and fill in the research gaps. Have the undergraduate participate in team meetings, understand the goals of project and keep them involved in the design, direction, and timeline of the project. This will most likely improve their contribution and productivity because they have some structure and guidance, yet allow them to still think outside the box. The undergraduate has to understand his/her role in the project outcome.
1239834545	SURF	I would run a research program similar to that of the SURF program.
1243205204	SURF	Make sure the project can be reasonably completed in the time allotted, considering time required for training.
1243208134	SURF	Selection of the research projects should be more than just anyone at NIST who wants to have an undergraduate for the summer. The quality of projects varied greatly and some were not sufficient to make for an interesting experience.
1244753549	SURF	Put more than one student from the program in each lab group so that the team can bond and discuss their ideas outside of work
1249395408	SURF	I honestly think SURF did a very good job of balancing the academic, research, and recreation aspects of a summer research program. The extra activities offered by simply being on the NIST Gaithersburg campus were great additions. I think its important for students to be exposed to other disciplines of research as a part of their REU. SURF did a great job of that.
1250081811	SURF	Overall I think that the NIST SURF program is a robust and well-designed program -- the seminars, other undergraduate researchers, and social events led to an overall successful and fulfilling experience. The only weak point for me was my particular advisor and project. For a better program I would aim to ensure that each mentor has the sincere time and interest in providing a complex and interest project for an undergraduate researcher.

1253961167	SURF	-offer more guidance as the norm, rather than offering a choice of more supervision versus more independent work (it can always be toned back). offer a project that really has a chance at being published, that the mentor will continue with.
1263733917	SURF	- help us write papers - I would have loved to have published my work, but as far as I know no students were able to get that far into their projects.
1263993949	SURF	More emphasis on laboratory safety. Provide more background knowledge on the project.
1270316999	SURF	Weekly seminars for SURFers could be improved. Speakers were consistently either way below or way above the technical understanding of the students. Two shorter talks (20-30 minutes rather than one hour) would have been more appropriate. In half an hour, a speaker can introduce a topic/field/set of experiments to novices without losing them to boredom or lack of understanding. Also, more talks in the course of the summer would introduce interns to more of the exciting research happening at the institution.
1270513012	SURF	In my case in particular, if the adviser had been more present, then the experience would have been completely different. It would have been helpful for someone to explain when I was reading papers, and give more guidance concerning how to use lab equipment.
1275786746	SURF	Choose the mentors better. The influence that mentors can give to the students will make or break the experience. I personally had a nice influence from scientists that weren't even in my building?!