Challenges and Lessons Learned in Expanding Participation in Computational Science and Engineering

Advanced Scientific Computing Advisory Committee

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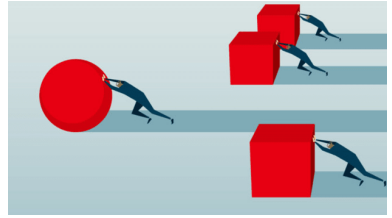
Sustainable Horizons Institute

DOE Labs face workforce development challenges

According to ASCR Workforce Committee Subcommittee Letter in **2014**:

DOE labs are facing workforce challenges and need to develop more effective techniques to attract and sustain a full spectrum of talent.

The letter also calls for new approaches to recruiting and retaining staff, especially those from underrepresented backgrounds such as women and minorities.

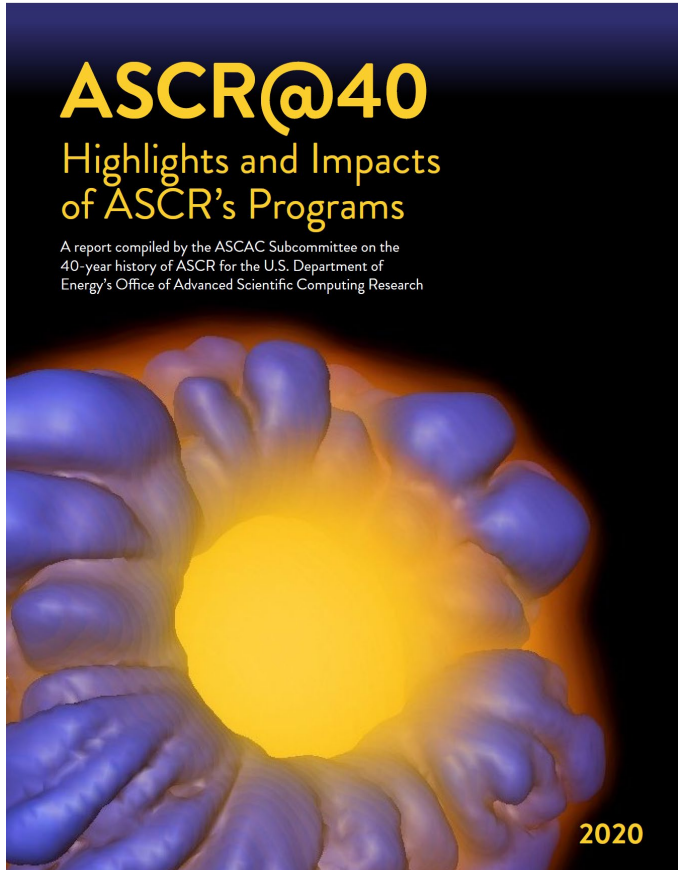


Six years later…

ASCR@40

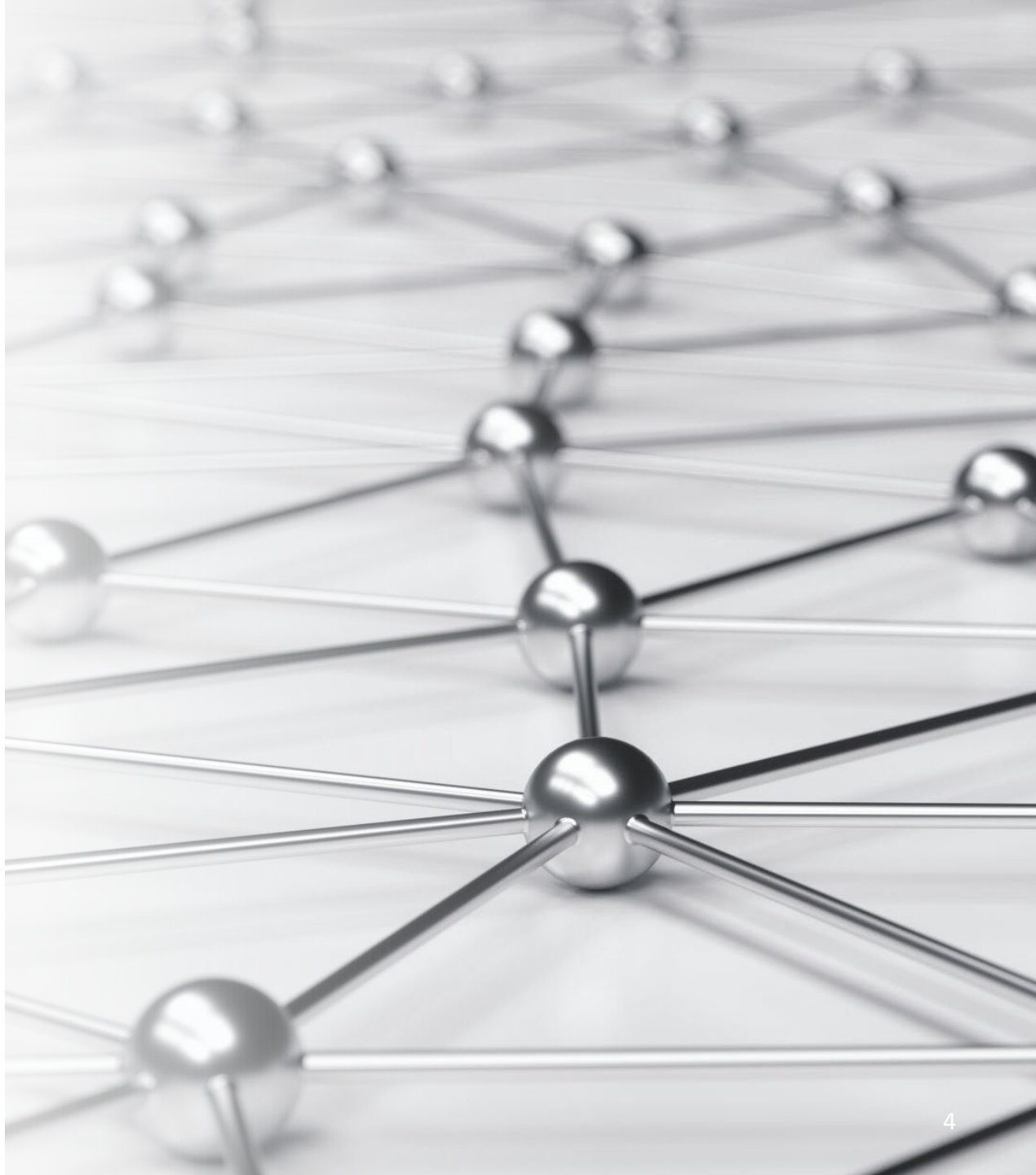
Highlights and Impacts of ASCR's Programs (2020)

> *Computationally trained scientists have vastly more opportunities in industry and academia than they did a generation ago, which increases competition for the "best and the brightest."*



Why expand participation?

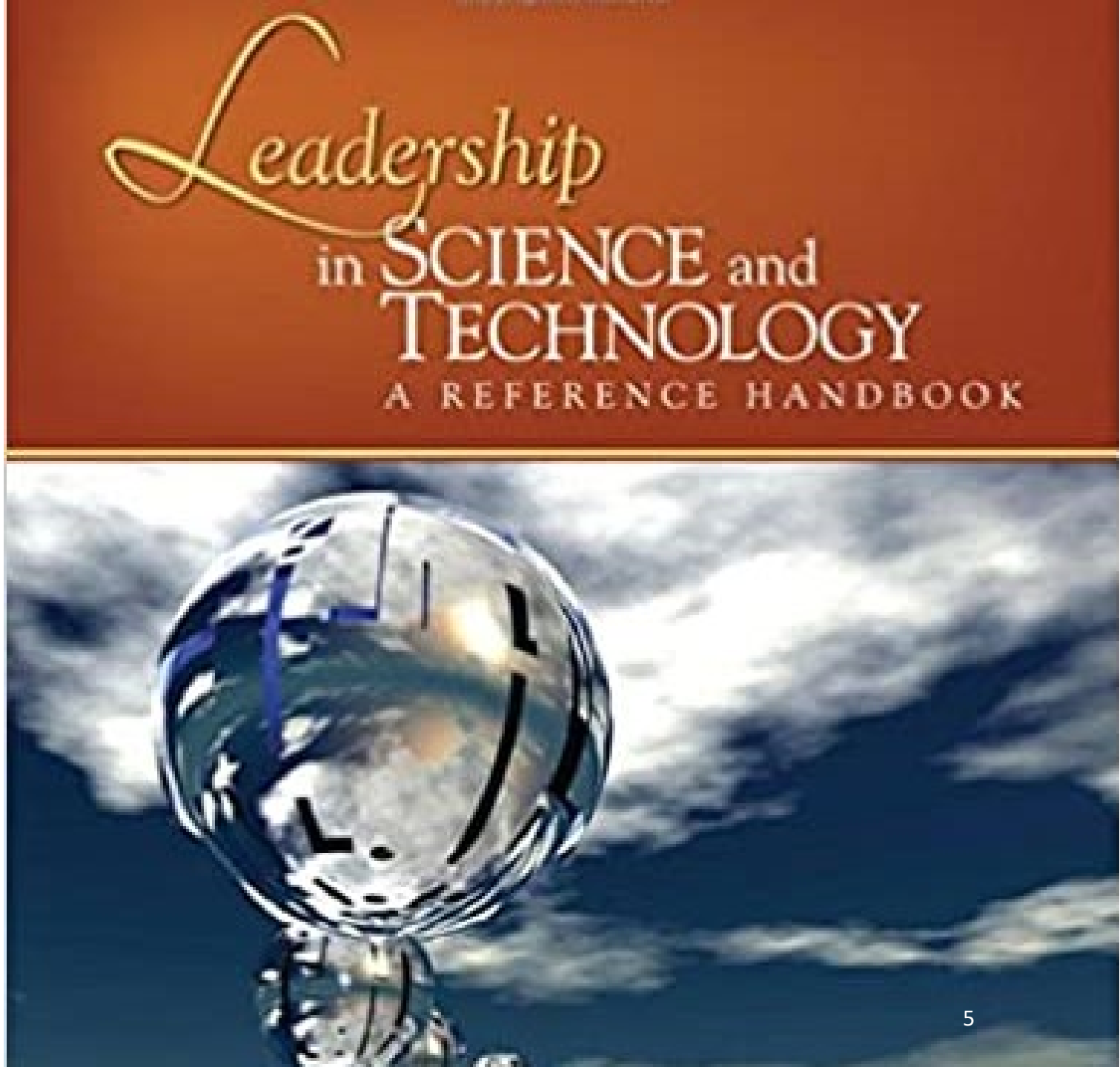
- Computational Science & Engineering inherently complex, requires creative solutions, collaboration
- Mission-driven science is a team sport
- Research → Diverse teams are more innovative



Cultivating Teams

"It is said that the truth shall set us free; yet we need freedom to discover the truth. Thus, leaders in science and technology must accept responsibility for the results of their work and for the means they use to accomplish it. Fundamental to that responsibility is ***respect*** *for facts, for creativity, and for colleagues."*

Bainbridge, W. S. (2012). Leadership in Science and Technology: A Reference Handbook. Thousand Oaks: Sage Publishing.



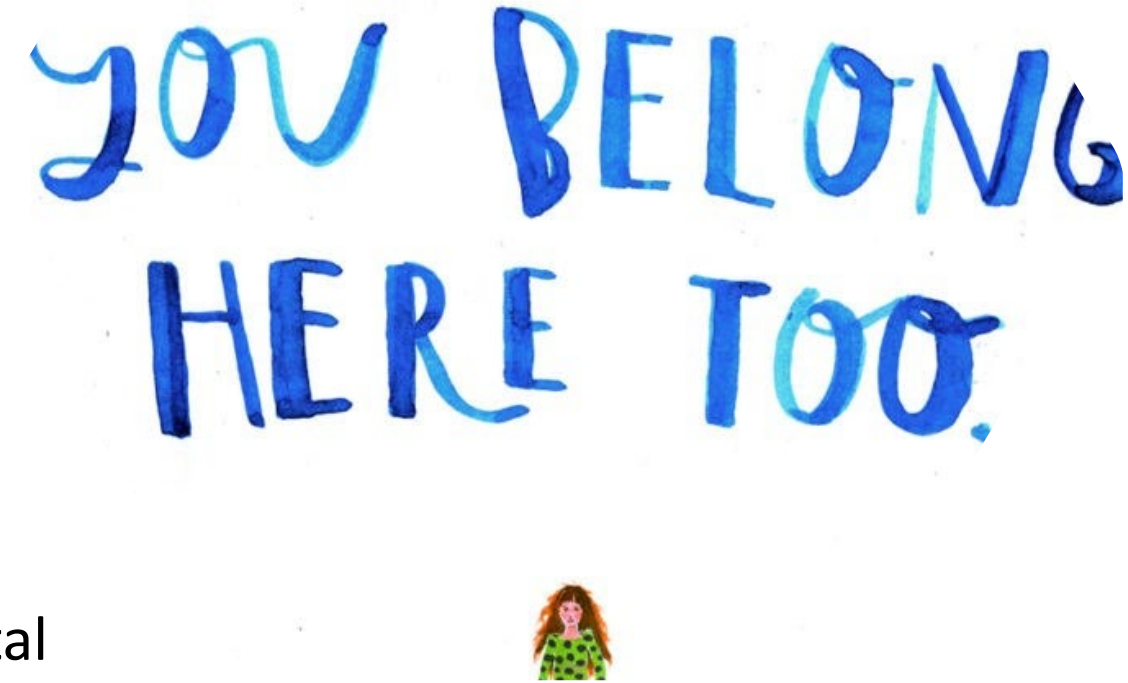
Expanding Participation in Computational Science and Engineering

- *"Fundamental to that responsibility is **respect** for facts, for creativity, and for colleagues."*

- Cultivate Respect for:
  - Facts
  - Creativity
  - Colleagues

Cultivating Respect

Cultivating respect for colleagues from underrepresented groups, has proven elusive given the common sources of attrition



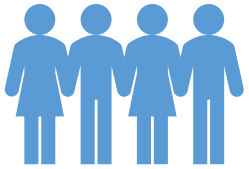
- Bias & discrimination
- Feelings of isolation
- Lack of role models, confidence, social capital
- Imposter syndrome
- Harassment

A look at challenges and lessons learned

- Society of Industrial and Applied Mathematics (SIAM)
  2021 Computational Science and Engineering Conference (CSE21)
  Diversity and Inclusion Panel
- Sustainable Research Pathways – Recruiting “unusual suspects”
- Broader Engagement – Cultivating talent and building community

SIAM CSE21 Diversity & Inclusion Panel

Part 1: Stories; panelists share their experiences of being a minority in CSE



Part 2: Strategies; panelists discuss effective practices in promoting diversity and inclusion

Part 3: Responses & Interactive Discussion

Opening Remarks

Dr. Ron Buckmire
SIAM VP for Equity, Diversity, and Inclusion
Occidental College

Diversity is a fact.
Inclusion is optional.
Equity is the goal.

Part 1: Stories

Part II: Strategies

Samuel Scott Collis

Director

Center for Computing Research

Sandia National Laboratories

Lesia L. Crumpton-Young

Provost and

Senior Vice President, Academic Affairs

Morgan State University

Bruce Hendrickson

Associate Lab Director Computing

Lawrence Livermore National Laboratory

Maria Klawe

President

Harvey Mudd College

What we learned

- Being the “only one” presents challenges

  *“I just wondered **why any of these famous computer scientists don’t look like me**. “*

  *“I saw on the news the other day that there was a famous scientist at NASA that was a black woman that was one of the first people to help run some of the simulations to make space travel possible and **I didn’t learn about that in school**. “*

  *“It wasn’t until I got to Old Dominion that somebody looked at me. A professor looked at me and said oh wow she’s good, we got to put her in the PhD program. So, they actually put me in the PhD program without asking me. So, **I’m thinking why it took that long**.“*

What we learned

- Sometimes challenges are “invisible”

> *I actually did not tell anyone in the program that I had a kid and that I was a single parent.* ***I had nightmares that people would find out*** *and that I would lose my fellowship.*

What we learned
Data About Harvey Mudd College Students

15 Years Ago	**Now**
• 75-80% Caucasian	• Now 30% Caucasian; minorities spread across majors
• 30% female student population	• 50 % female
• 30 % female across computer science, engineering, and physics	• 50% female

Challenges

- Role Models
  - Why don’t they look like me?
  - Actually, there are some out there; need to get the stories out
- Hidden needs
  - Being different may cause one to feel fear or shame
  - Basic needs many take for granted
- Explicit & implicit bias

Note: Research indicate people from under-represented backgrounds are more likely to have non-traditional paths

What we learned - Challenges

Institutional/ organizational change is SLOW & challenging

Could take decades, but dramatic shifts are realized

Long standing practices, policies, attitudes present challenges

It's a zero sum gain → Trade off between diversity & excellence

What we learned – Effective Approaches

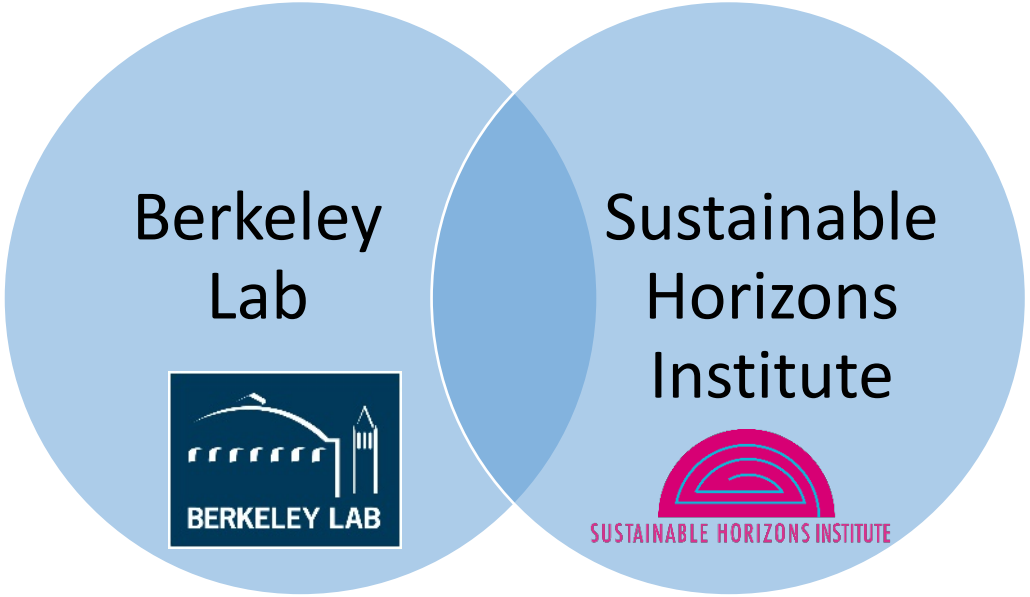
- Changing the paradigm – adopting classroom/teaching models to appeal to broader demographic
- Diversity + Inclusion = Equity
- Tactical vs. Strategic Hiring
- Implicit Bias Training
- Partnerships with Diversity Organizations
- Re-tooling to cultivate the authentic self; respect for all
- Working *together* to support & create inclusive environments

What made a difference?

- Recognition for talent instead of being told not to try
- Having an advocate; they don’t have to look like me
- Access to:
  - Resources
  - Programs
  - Opportunities

Sustainable Research Pathways Program

Expanding the network and diversifying through research collaborations



Sustainable Research Pathways: Basic Idea

- Build relationships centered on research collaborations
- Recruit
  - Faculty working with underrepresented students
  - Students from underrepresented backgrounds
- Provide opportunities for staff scientists
  - Research collaborations
  - Learn/contribute to diversity and inclusion efforts
- Supplement existing D&I Laboratory programs

Summary of Participation

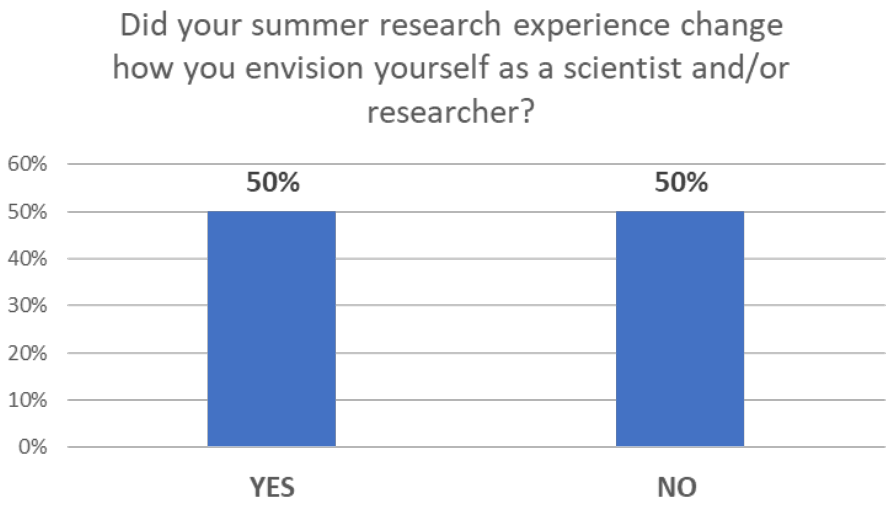
- Faculty & Students 2015-2020
  - 450 applied representing >1100 students
  - 150 attended workshop
  - 90% matched with staff
  - 80 faculty & 200 students conducted summer research

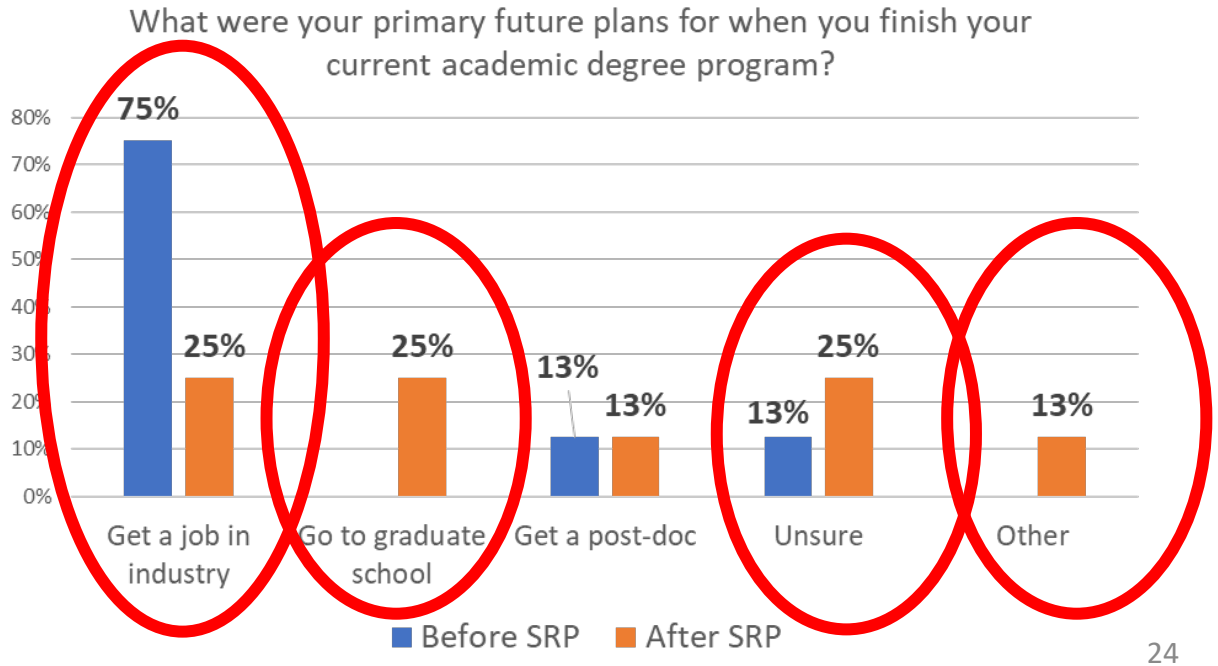
Summer Student Demographics 2015-2020

Demographic N=202	%
Academic Status: Undergraduate	62
Female	35
Black/African American	17
Hispanic or Latino	25
Disability	3
First Generation Scholar	40

Selected Survey Results 2015-2017: Student Impacts

- 50% indicated experience changed vision of themselves as scientists
- 75% planned to seek industry employment prior to the summer experience, while only 25% remained with those plans after resulting in 25% wanting to go to graduate school





SRP Impacts

- Programmatic:
  - Brought people together that would never have met otherwise
  - Started new productive collaborations
  - Showcased lab work externally
- Students:
  - Changed the professional trajectory of many participants
  - Described as “life changing” experience by students
- Faculty:
  - Provided vibrant research experiences for faculty
  - Increase awareness of DOE Labs
  - Impacted faculty teaching, research, and technical skills
- Staff:
  - Infused a new dimension of diversity awareness among Laboratory staff
  - Provided research collaboration opportunities
  - Allowed staff to expand their research portfolios

Impacts

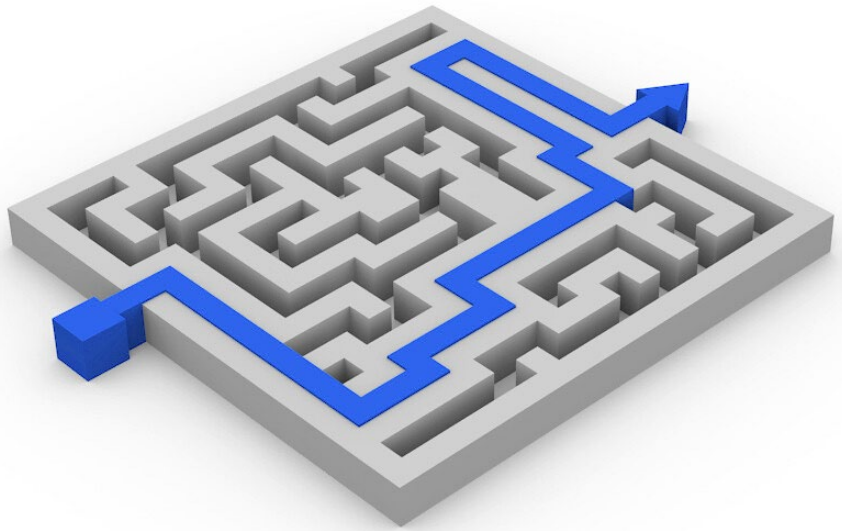
Programmatic	Faculty	Students	Staff
• Brought people together that would never have met otherwise • Started new productive collaborations • Showcased lab work externally	• Provided vibrant research experiences • Increase awareness of DOE Labs • Impacted teaching, research, and technical skills	• Changed the professional trajectory of many participants • Described as “life changing” experience by students	• Infused a new dimension of diversity awareness • Provided collaboration opportunities • Allowed staff to expand research portfolios

Broader Engagement Program at Society of Industrial and Applied Mathematics Computational Science & Engineering (BE@CSE)

- Provides a rich scientific experience, mentoring, and career and professional development to students, faculty, and professionals
- Focusing on underrepresented populations, the BE program enables students and early career participants to more easily become part of their scientific community

What participants get with BE@SIAM

- Support and full access to SIAM CSE conference
- Special activities in addition to conference
  - Guided Affinity Groups
  - Mentor Protégé Program
  - Diversity & Inclusion Panel
  - Community Building
    - Roommates
    - Networking event
  - Opportunity to present research
  - Tutorials
  - Professional Development



A Few Alumni: Derek Jones University of Kentucky

- Master's student SRP@Berkeley Lab summers of 2016 & 2017
  Mentor: Bert de Jong
- Summer 2018 internship LLNL with SRP faculty
- Oral presentation @BECSE19
- Now employed full time at LLNL in the global security group conducting research using deep learning techniques to study drug-protein interactions
- Now enrolled in PhD program at UC San Diego

Derek Jones currently employed at LLNL & pursuing PhD

A Few Alumni:
Rafael Zamora-Resendiz
Hood College

- Post-bachelor's student SRP@Berkeley Lab during summer 2017, Mentor: Silvia Crivelli
- Hired directly into a fulltime research position @Berkeley Lab & still employed developing machine learning algorithms for Million Veterans Program
- Presented posters at SC17 and 2017 Rocky Mountain Bioinformatics Conference
- Co-author of SC18 poster
- Oral presentation through BE@CSE19
- An outstanding researcher believed to be DOE Computational Science Graduate Fellowship (CSGF) worthy when ready to pursue PhD

Rafael Zamora-Resendiz

presenting SRP research at SIAM CSE19 Broader Engagement mini-symposium

A Few Alumni: Alexandra Ballow Youngstown State University

- First generation undergraduate student in extremely economically challenged community
- Took advantage of the BE Lightning Talks session to prepare for her poster blitz for over 1000 SIAM community members
- Conducted research thru SRP@Berkeley lab in 2018 in John Wu's group
- Presented research through BE@CSE19 & met Ann Almgren (Guided Affinity Group leader) and returned to SRP@Berkeley in 2020
- Presented research BE@CSE21
- Just award DOE CSGF!

Alexandra Ballow, Youngstown State University prepares in Lightning Talk session for her Poster Blitz

Dan Rosa (right) in front of his SRP research poster at SIAM CSE19 with Julian Cuevas SRP undergraduate from University of Puerto Rico

A Few Alumni:
Dan Rosa
Univ. of Puerto Rico, Mayaguez, Berkeley Lab, PNNL

- Master's student SRP@Berkeley Lab summer of 2018; Mentor: Silvia Crivelli
- Subsequently awarded a GEM scholarship to support doctoral work at University of Texas, El Paso and summer research at Pacific Northwest National Laboratory
- Currently employed as Data Scientist @PNNL

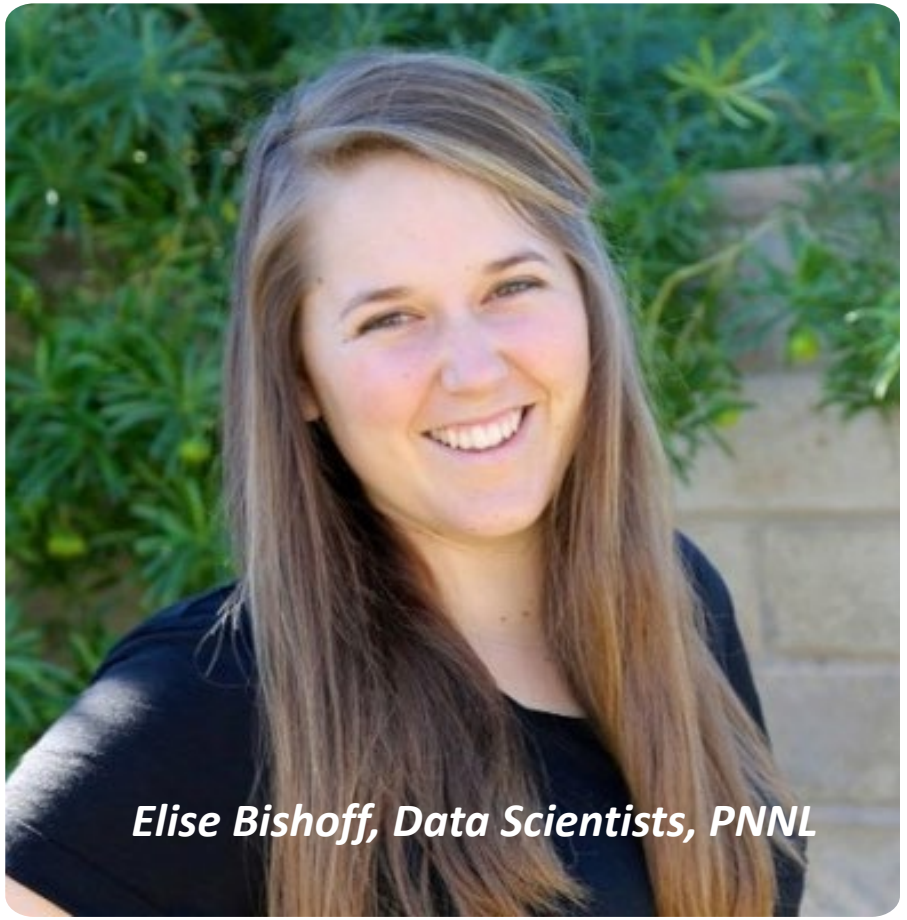
Few Alumni:
Bryce Kroencke - American River College
Berkeley Lab, Oak Ridge National Lab, UC Davis

- Community college student (first generation)
- Summer of 2018 SRP@Berkeley Lab;
  Mentor: Silvia Crivelli
- Presented his summer research at SC18 where he was invited by ORNL and accepted into their Artificial Intelligence Summer Internship
- Gave an oral presentation through BE@CSE19
- Transferred to UC, Davis to complete bachelor's degree in computer science in 2020
- Currently Solutions Architect at Dianomic

Bryce Kroencke, SRP community college student

A Few Alumni: Elise Bishoff
Seattle Pacific University
Berkeley Lab and
Pacific Northwest National Lab

- 3rd Year Undergrad SRP@Berkeley Lab summer 2017; Mentor: Ann Almgren
- Completed Applied Math Masters University of Washington
- Now data scientist at PNNL
- Note: ~70% females at SPU



Courtney Shafer

- UC Santa Barbara Post-Baccalaureate Fellow Berkeley Lab; Mentor: Dan Martin
- BE@CSE21 participant & poster presenter "Comparison of the Performance of Different Asymptotic Approximations for Marine Ice Sheet Modeling"
- Co-author: Edwards, T.L., Nowicki, S., Marzeion, B. et al. Projected land ice contributions to twenty-first-century sea level rise. **Nature** 593, 74–82 (2021).
- Just award CSGF to attend University of Buffalo!

Victor Zendejas Lopez

- UC Berkeley, Mechanical Engineering & Berkeley Lab Intern, Mentor: Ann Almgren
- BE@CSE21 Participant & Poster Presenter "Investigation of H_2 Addition and Lewis Number Effects in Triple Flame Structures via Direct Numerical Simulation"
- Currently co-mentoring two current SRP@Berkeley Lab summer interns
- Heading to CalTech this fall
- Just awarded CSGF!

Summary

- Being first and/or the “only one” comes with challenges
- Challenges may be hidden, or might be things others take for granted
- Unrecognized talent is “out there”
- Organizational change may be slow, but dramatic change is possible
- Diversity + Inclusion = Equity
- Advocates make a difference & “don’t have to look like me”
- Resources, programs, opportunities make a difference