

# Undergraduate Student Success in NSF REU Summer Programs

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# Introduction

- NSF REU: Foundation-wide program that supports active participation in science, engineering, and education research by undergraduate students
- Goal of attracting and retaining diverse STEM talent
- Program funds REU Sites (~10 students / yr up to 3 yrs) and Supplements
- Sites typically support 10 students / yr for 10 wks from institutions outside the host university



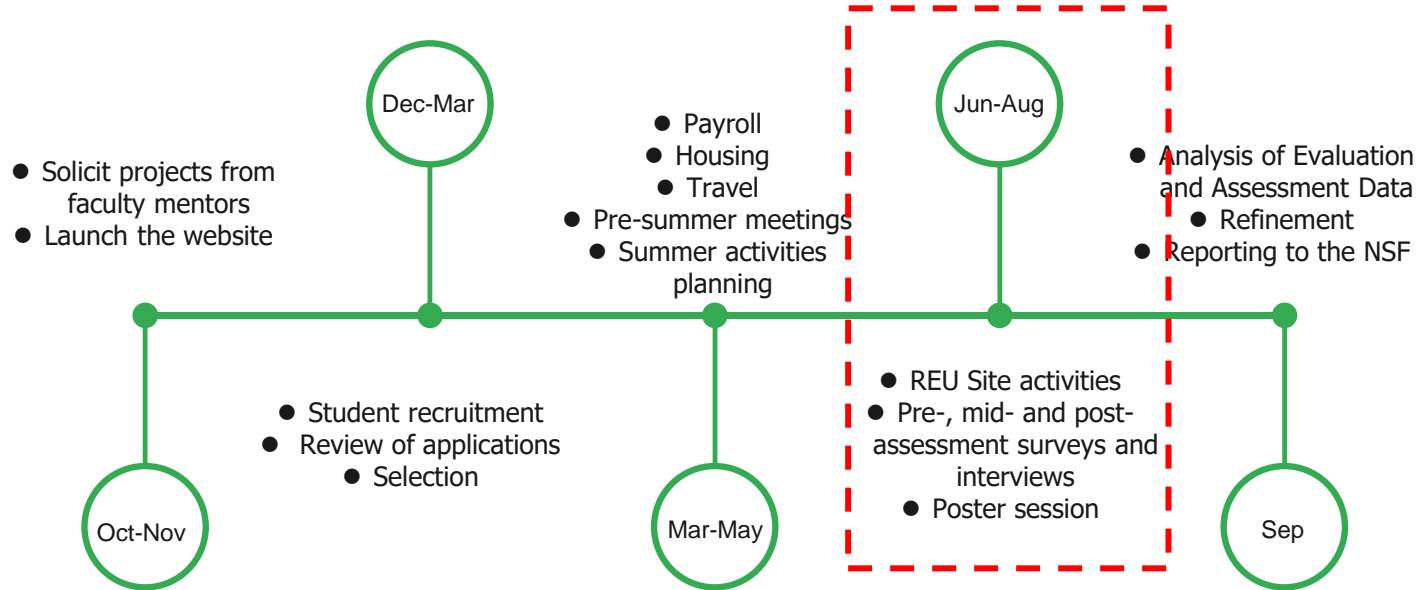
## Research Experiences For Undergraduates

# Sustainable Resilient Transportation Systems

- Focus on decarbonizing transportation
- Three research thrusts:
  - Electric and Autonomous Vehicles
  - Green Materials and Structures
  - Resilient Infrastructure
- Diverse cohorts



# REU Site Timeline



# Anticipated Outcomes

- increased understanding of the impacts of CO<sub>2</sub>e emissions on the environment;
- increased awareness about the impacts of transportation on climate change;
- increased understanding of methods to achieve sustainable and resilient transportation systems;
- increased confidence in working in a research laboratory setting;
- improved research skills; and
- improved communication skills.



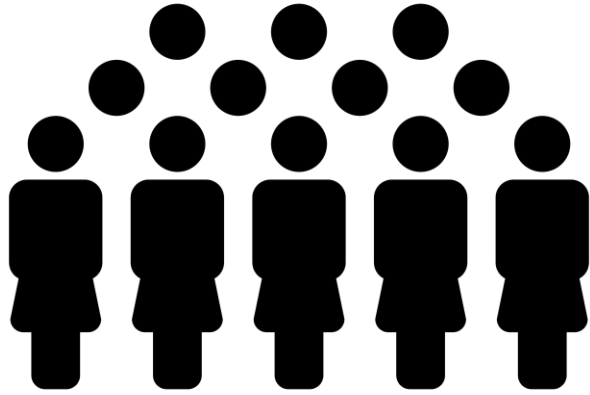
# Critical Aspects for Student Success

- Activities
- Mentoring
- Evaluation and Assessment



# Activities

## Cohort



- Develop broader understanding of subject matter
- Develop communication skills
  - Collaboration
  - Community

## Individual

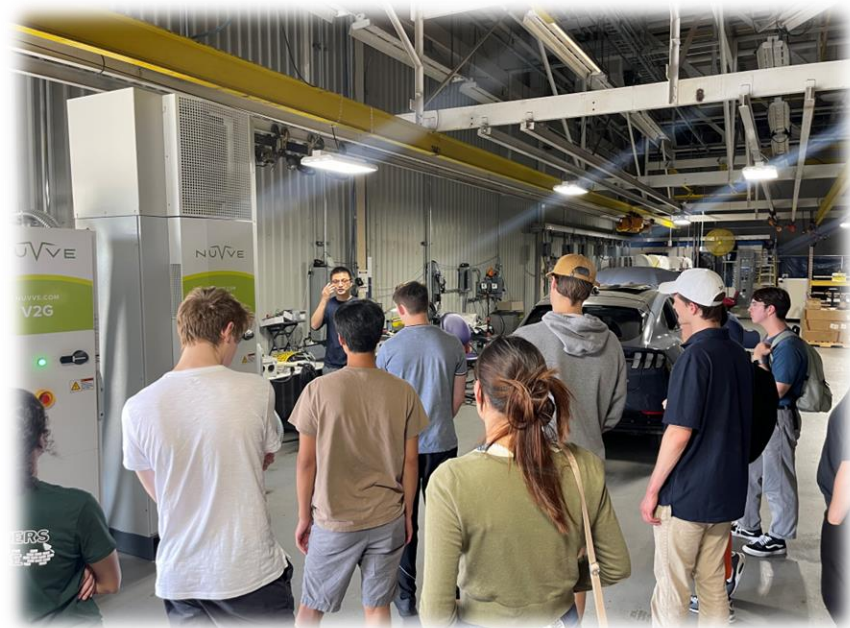


- Become an independent researcher
  - Prepare & present a poster
  - Write conference-style manuscript

# Cohort Activities

## Technical Workshops/Activities

- Transportation and Climate Change
- EVs, V2G, and tour of EV campus labs
- Sustainability Applications in Transportation
- Field trips





# Cohort Activities

## Professional Development Workshops

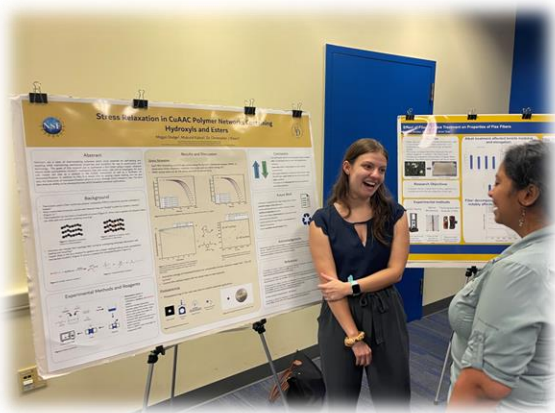
- Research ethics
- Public speaking and presentations/posters
- Literature review & technical writing
- Grad school application process
- Tech transfer and commercialization



# Cohort Activities

## Experiential Activities

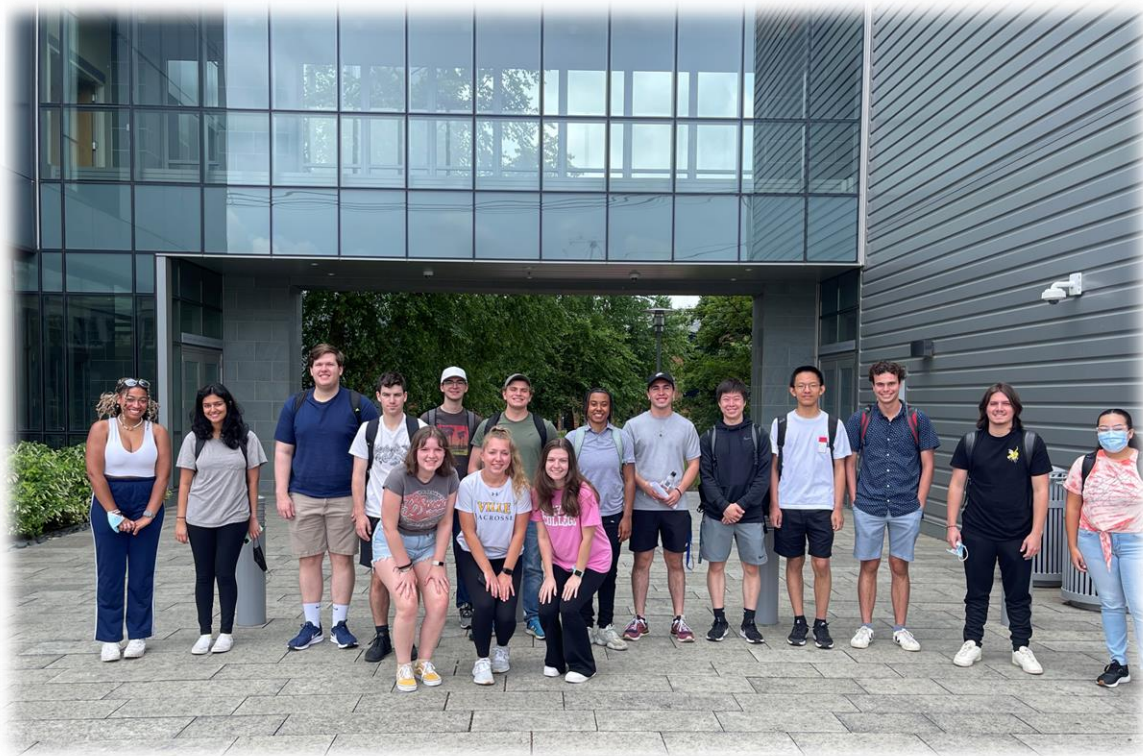
- Research plan presentations
- Progress update presentations
- Journal Club meetings
- Poster symposium



# Cohort Activities

## Social Events

- Welcome BBQ
- UD Creamery social
- Post-seminar lunches
- Field trips



# Individual Activities and Mentoring

- Success of individual activities heavily relies on faculty mentoring
- Challenges
  - Many R1 university faculty inexperienced in mentoring undergraduate researchers
  - Lack of communication about expectations
  - Lack of understanding where the undergrad fits in the larger scope of the project
  - Underestimation of time it takes to mentor an REU student





# Our Approach to Mentoring

- Tiered mentoring approach
- Pre-summer meeting:
  - Individualized development plan
  - Set expectations
  - Introduction to graduate student and/or postdoc mentors
  - Share papers
  - Project scope and schedule
  - Schedule weekly meetings (minimum)



# Evaluation and Assessment

- Best when conducted externally to eliminate bias
- Focus on student gains as well as student satisfaction
- Pre-, mid-, and post-summer surveys
- Student interviews
- Post-program tracking

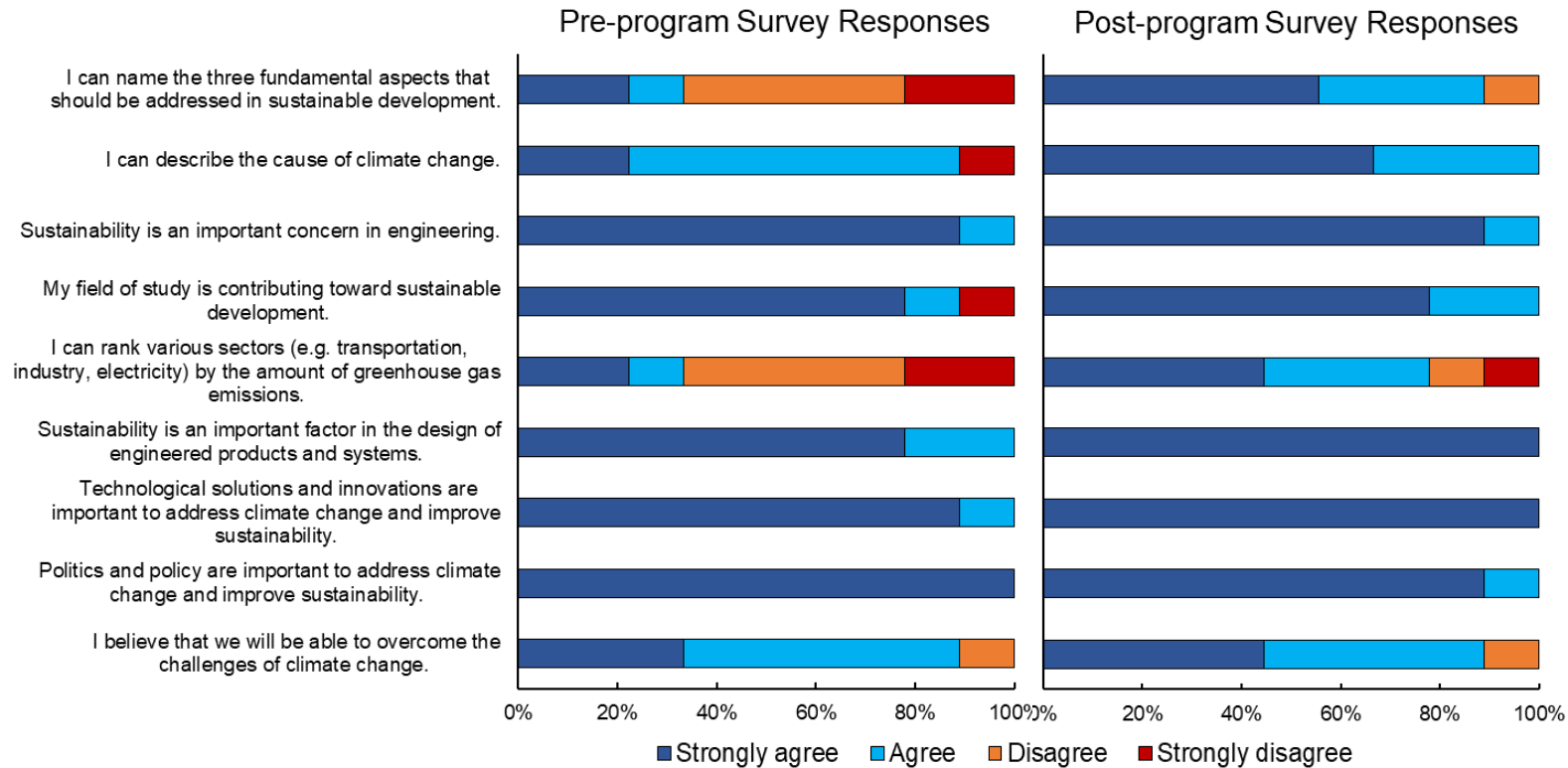


Center for Research in  
Education & Social Policy

# Sustainability-related Questionnaire for Pre-program and Post-program Surveys

Question	Answer Choice
In your words, briefly describe the term, “sustainability”.	Open-ended
In your words, how would you describe a resilient system?	
I can name the three fundamental aspects that should be addressed in sustainable development.	Four-level Likert scale: Strongly agree Agree Disagree Strongly disagree
I can describe the cause of climate change.	
Sustainability is an important concern in engineering.	
My field of study is contributing toward sustainable development.	
I can rank various sectors (e.g. transportation, industry, electricity) by the amount of greenhouse gas emissions.	
Sustainability is an important factor in the design of engineered products and systems.	
Technological solutions and innovations are important to address climate change and improve sustainability.	
Politics and policy are important to address climate change and improve sustainability.	
I believe that we will be able to overcome the challenges of climate change.	







# End-of-Summer Interviews

- How (if at all) your knowledge of issues of sustainability relevant to transportation was impacted by your experience in the REU program?
- “Definitely, I've gained way more knowledge. ***Since there were different majors, I learned how each of them could contribute to it. We could work together.*** And certainly, I was made more aware of issues that we have that I wasn't aware of, and the importance of acting towards changing those things.”



# End-of-Summer Interviews

- How (if at all) your knowledge of issues of sustainability relevant to transportation was impacted by your experience in the REU program?
- “I think a lot of the topics I had already learned in classes I've taken, but it definitely reinforced a lot of the things that I learned before. They also showed me how we, as engineers, can work to solve these problems. ***Because in the classes we've had before, they just tell you the problem, but they don't tell you what we can do to fix it. And in this program, we were actively making solutions to these problems. So, it definitely showed me how there are a lot of different ways to go about finding a solution to these problems.*** So I definitely enjoyed learning more about both the problems and the solutions.”



# OUR MENTORS



**REU Site Director & Faculty Mentor**  
**Dr. Jovan Tatar**

The main goal of Prof. Tatar's research is to develop and integrate advanced materials in bridges, residential, and commercial buildings, to make them more durable and resilient when faced with today's natural hazards.



**REU Site Co-Director & Faculty Mentor**  
**Dr. Mark Nejad**

Autonomous and connected vehicles, electric vehicles, sustainable transportation, interdependent infrastructure systems, operations research, network optimization, cloud computing, game theory



**Faculty Mentor**  
**Dr. Lena Mashayekhy**

Prof. Mashayekhy specializes in Edge Computing, Cloud Computing, Energy-Efficient Computing, Cyber-Physical Systems, Autonomous Vehicles, Electric Vehicles, and Game Theory.



**Faculty Mentor**  
**Dr. Jennifer McConnell**

Bridge engineering, non-linear behavior and stability of steel structures, aging infrastructure, sustainable infrastructure



**Faculty Mentor**  
**Dr. Weisong Shi**

Edge Computing, Vehicle Computing, Autonomous Driving, Connected Health



**Faculty Mentor**  
**Dr. Michael Chajes**

Dr. Chajes teaches classes and conducts research in the areas of structural engineering, structural health monitoring of bridges, and applications of sustainability.



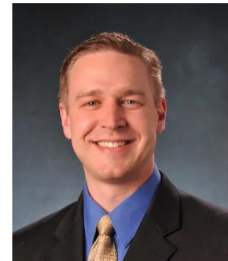
**Faculty Mentor**  
**Koffi Pierre Yao**

Professor Yao's research focuses on the design, fabrication, and characterization of energy materials for energy storage including Lithium-Ion, Sodium-Ion and Lithium-Sulfur, and conversion-based batteries.



**Faculty Mentor**  
**Dr. Shangjia Dong**

Prof. Dong's interdisciplinary research on smart and resilient urban systems uses a network paradigm that bridges the boundaries between network science, civil engineering, and social science.



**Faculty Mentor**  
**Dr. Christopher Kloxin**

Prof. Kloxin's research focuses on design and synthesis of polymers from the monomer up to precisely tune the macromolecular architecture.



# Acknowledgements

- National Science Foundation Award #2050879 – REU Site: Sustainable Resilient Transportation Systems
- Delaware Center for Transportation
- UD Center for Composite Materials

