Pathways to Impact

Cultivating Servingness in STEM Through Strategic Partnerships and Scaling Evidence-Based Practices

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We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O’odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.

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Panelists

Jen Fields
Executive Director,
Office of Societal Impact,
Research, Innovation, &
Impact

Dra. Jenni Batchelder
Director for Arizona's Science,
Engineering, & Math Scholars
(ASEMS)
STEM Learning Center

Dr. Noel Hennessey
Director of ENGAGED
(ENGineering Access, Greater
Equity, and Diversity)
College of Engineering

Kimberly Sierra-Cajas
Director of Undergraduate
Research & Inquiry,
Office of Societal Impact and
Co-Director, STEM Learning
Center

Dra. Lola Rodríguez Vargas
Director for the *CREAR* STEM
Learning Communities
STEM Learning Center

This event is sponsored by: FLINN FOUNDATION

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Agenda

Institutional STEM equity self-study

Two approaches to applying best practices for persistence in STEM
- *The ASEMS Program*
- *The Catapult Program*

HSI *servingness* as a framework

Scaling up best practices
- *Undergraduate research*
- *Culturally responsive & inclusive environments*
- *STEM learning communities*

Q & A

Closing

STEM Equity: A National Priority

On December 12, 2022, The White House Office of Science and Technology Policy (OSTP) released a national call to action **Equity and Excellence: A Vision to Transform and Enhance the U.S. STEMM Ecosystem**

On December 21, 2022 at the **White House Summit on Equity and Excellence in STEMM**, the **STEMM Opportunity Alliance** was announced. It is led by the American Association for the Advancement of Science (AAAS) in collaboration with the White House Office of Science and Technology Policy and the Doris Duke Foundation (DDF).

Purpose: To build a STEMM ecosystem rooted in equity, inclusion, and scientific excellence to power progress, innovation and prosperity for all by 2050

Goals: SOA will address key areas to attain fundamental, systemic change and ensure the diversity that is necessary for the increased performance and innovative ideas that are needed to keep the United States competitive.

- Foster a more just society by ensuring greater access to opportunities for economic prosperity;
- Coordinate a national effort across many sectors
- Ensure scientific excellence
- Maintain US growth and competitiveness
- Invest and scale

Why Now: The U.S. has a history of leading in global innovation, and federal legislation from the past few years coupled with policies under consideration will directly impact the nation's ability to innovate, drive scientific advancements and lead the world in manufacturing. If done right, these policies paired with adequate funding could drive millions of new STEMM jobs across the country and provide a foundation for economic growth and prosperity for generations to come. Promising past efforts to expand and diversify the workforce needed to manage these opportunities have failed to catch on at-scale, often hindered by fragmentation, limited visibility, or lack of accountability.

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Fall 2022 STEM Headcount, UAIR

IPEDS Race/Ethnicity Reporting Description	Headcount	Headcount %
American Indian or Alaska Native	148	1.1%
Asian	1,021	7.6%
Black or African American	481	3.6%
Hispanic or Latinx	3,434	25.6%
International	1,011	7.5%
Native Hawaiian or Other Pacific Islander	20	0.1%
Not reported	397	3.0%
Two or more races	694	5.2%
White	6,230	46.4%
Grand Total	**13,436**	**100.0%**

College	Headcount	Headcount %
College of Agric and Life Sci	2,358	17.5%
College of Applied Sci & Tech	332	2.5%
College of Education	33	0.2%
College of Engineering	2,874	21.4%
College of Medicine - Tucson	1,677	12.5%
College of Public Health	5	0.0%
College of Science	6,383	47.5%
College of Social & Behav Sci	537	4.0%
Eller College of Management	323	2.4%
James C Wyant Coll Optical Sci	90	0.7%
Grand Total	**13,436**	**100.0%**

Gender	Headcount	Headcount %
Female	6,738	50.1%
Male	6,697	49.8%
Unknown	1	0.0%
Grand Total	**13,436**	**100.0%**

Pell Recipient Flag	Headcount	Headcount %
Y	2,947	21.9%
N	10,489	78.1%
Grand Total	**13,436**	**100.0%**

First Generation Flag	Headcount	Headcount %
Y	3,887	28.9%
N	9,549	71.1%
Grand Total	**13,436**	**100.0%**

Institutional STEM Equity Self-Study

HHMI Driving Change: The Driving Change program aims to effect lasting culture change on research university campuses by creating a more inclusive learning environment for all. Its goal is to support undergraduate students, including people who have historically been excluded from science because of their background, so that they may excel in STEM and assume leadership roles in the field. UA was one of 38 institutions invited to participate, which included a mandatory self-study.

Self Study: To understand disparities in STEM participation and student outcomes, we examined institutional data on student outcomes (both new data pulls and data in already existing institutional research reports); surveys and interviews with students who left STEM to pursue non-STEM majors; and interviews with faculty and staff. Data collection and analysis focused on examining three dimensions of the student experience and pathway through the institution: 1) entry and math placement; 2) success in foundational STEM courses; and 3) persistence and graduation in STEM.

The Flinn Foundation supported program activities and commissioned two reports to study ASEMS best practices and identify opportunities to scale the program.

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Institutional STEM Equity Self-Study

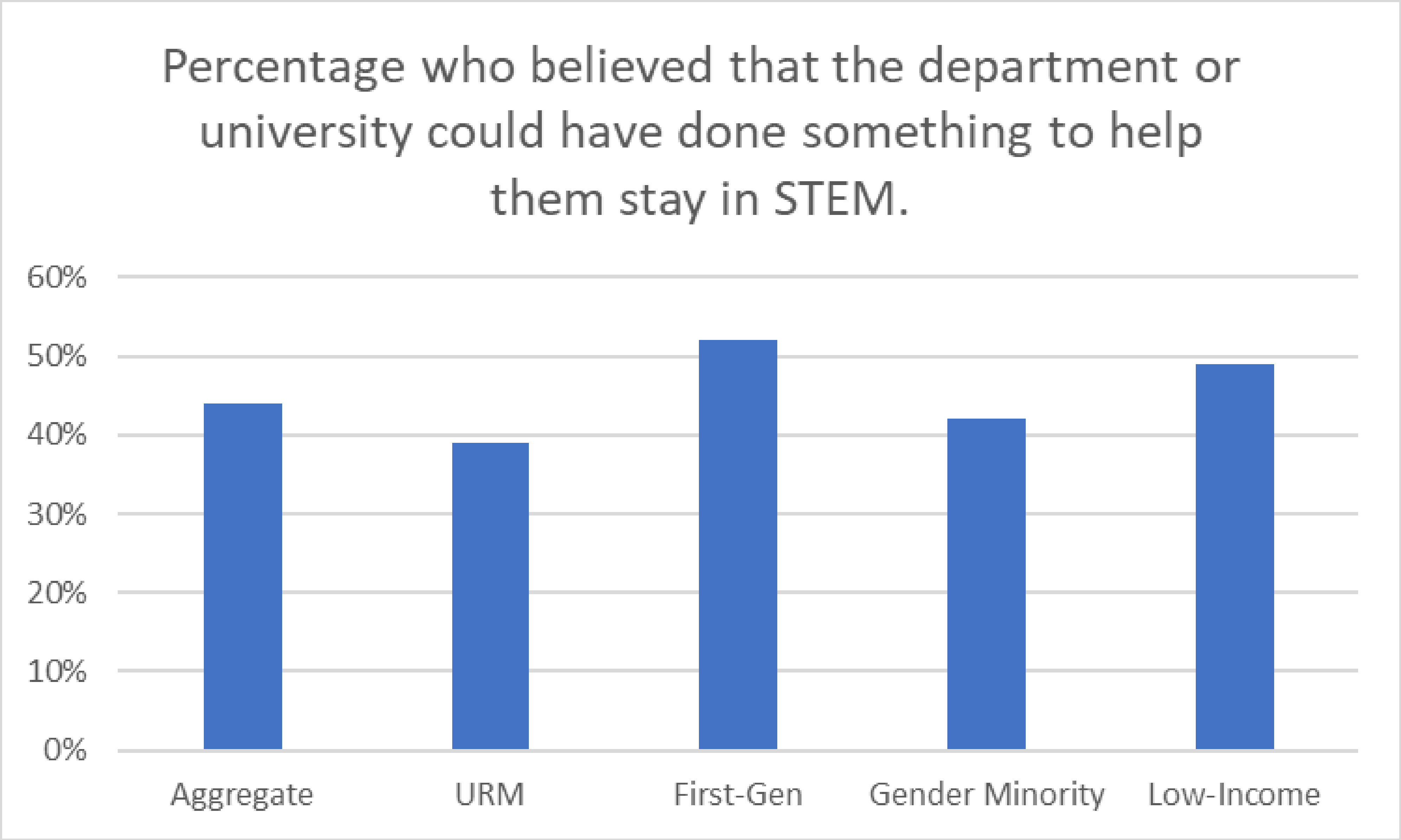
Strengths

- The University has a remarkable number of STEM student support programs with a focus on equity and serving students from marginalized and minoritized populations.
- There are many professional development opportunities available to faculty that provide opportunities to gain skills related to equitable and inclusive teaching and mentoring.
- There is a great deal of institutional knowledge and expertise (both academic and practice) related to fostering the success of minoritized and marginalized students in STEM courses. This expertise is distributed across the institution.
- There is a demonstrated ability to effectively garner external grants to support initiatives and programs focused on equity in STEM student outcomes.
- There is robust infrastructure at the institution related to institutional data access and growing efforts to expand data transparency.

Institutional STEM Equity Self-Study

Among students from groups underrepresented in STEM fields, 44% reported believing that the university or department could have done something to help them stay in STEM. Highly cited reasons for leaving STEM included: the difficulty, instructional practices, and faculty attitudes in foundational STEM courses; not feeling like they belonged; and mental health challenges associated with weed out culture.

Proportion of respondents (n=123) indicating that something could have been done to help them stay in STEM, by demographic group



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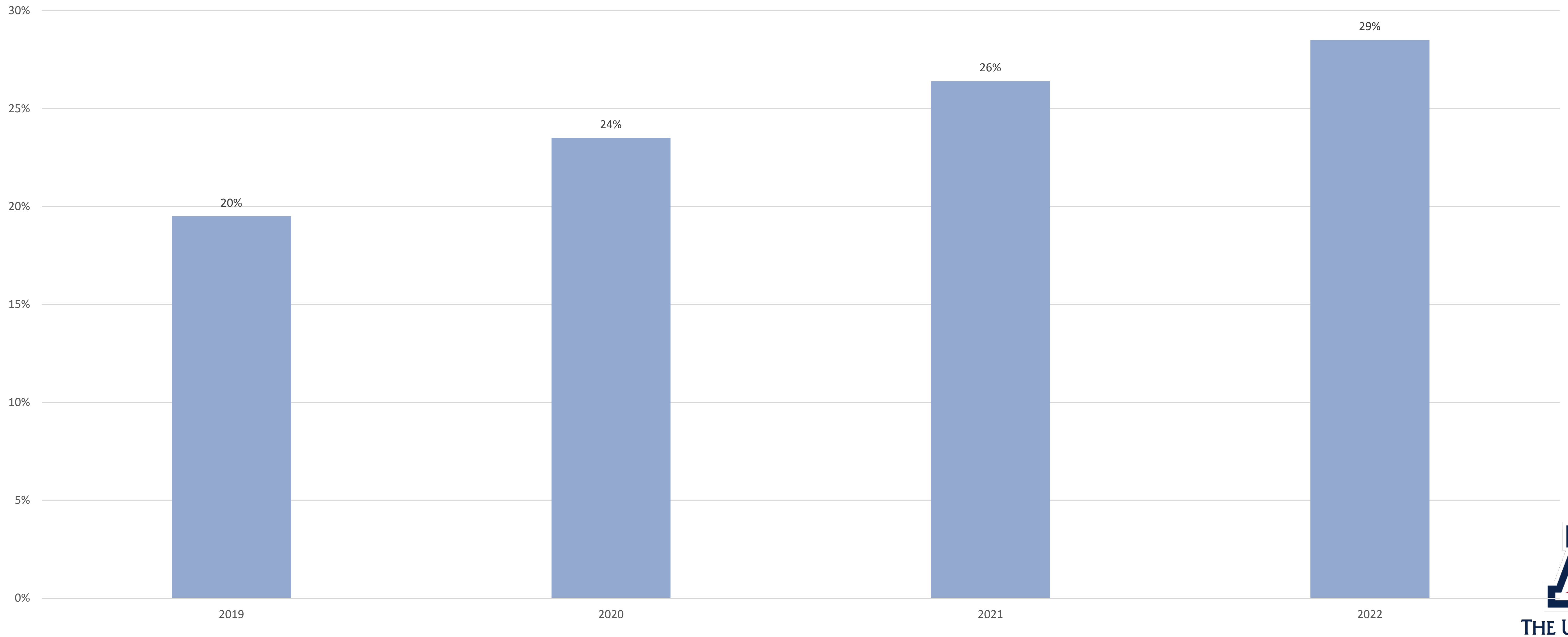
Institutional STEM Equity Self-Study

The proportion of incoming students who do not test into college-level math is growing, presenting a key challenge for the institution and students alike as these students must complete remedial courses to advance; minoritized students, Pell-eligible students, and first-generation students are over-represented amongst those who do not test into college-level math.

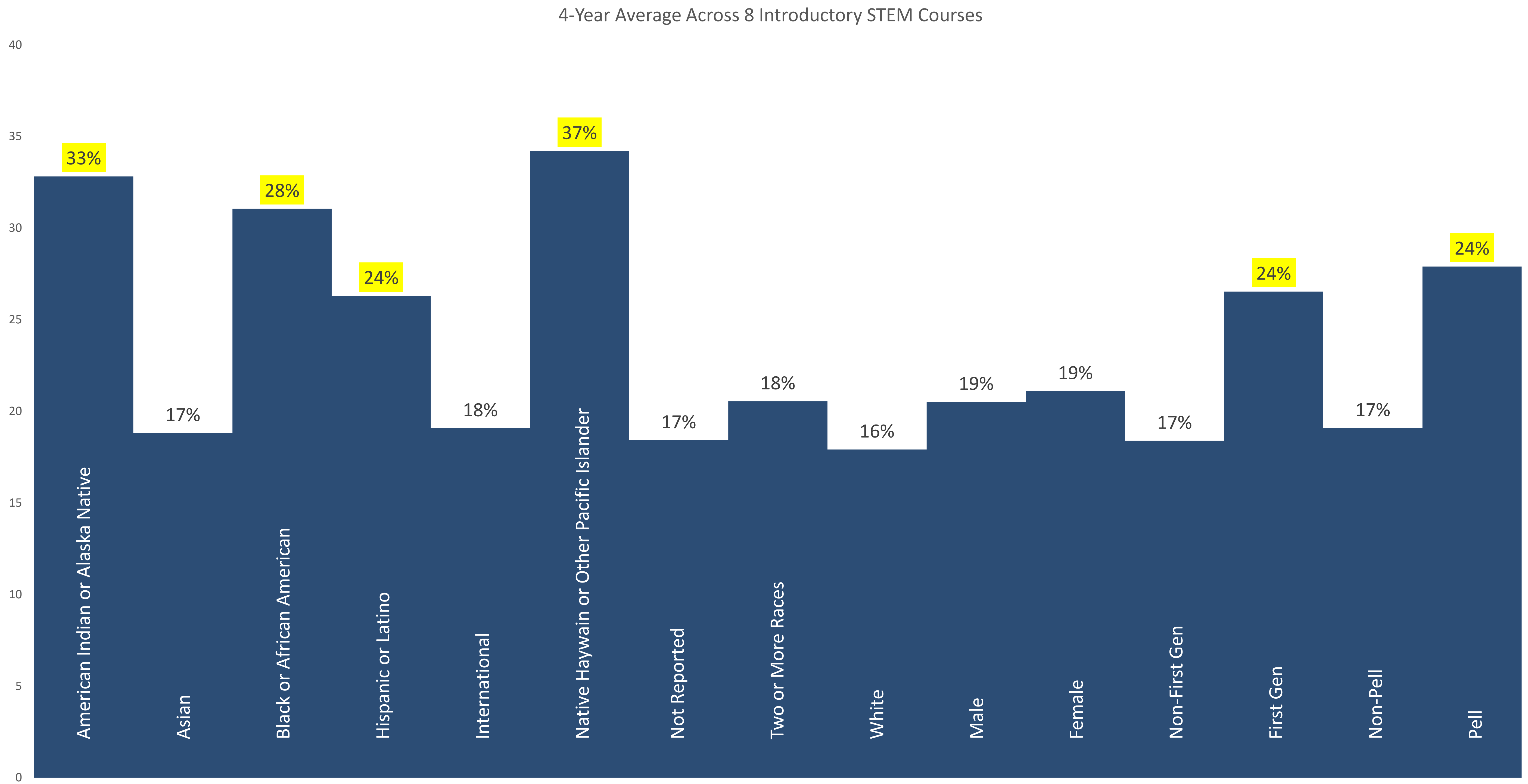
Proportion of First Year Class Placed into Pre-College Math



Institutional STEM Equity Self-Study

Reality: Significant disparities exist in STEM retention and graduation along lines of sex, race/ethnicity, Pell eligible status, and first-generation status; these disparities vary in degree across departments and colleges, but in general, students from marginalized and minoritized populations have lower chances of persisting and completing STEM degrees

Percentage Receiving DEW by Demographic Groups



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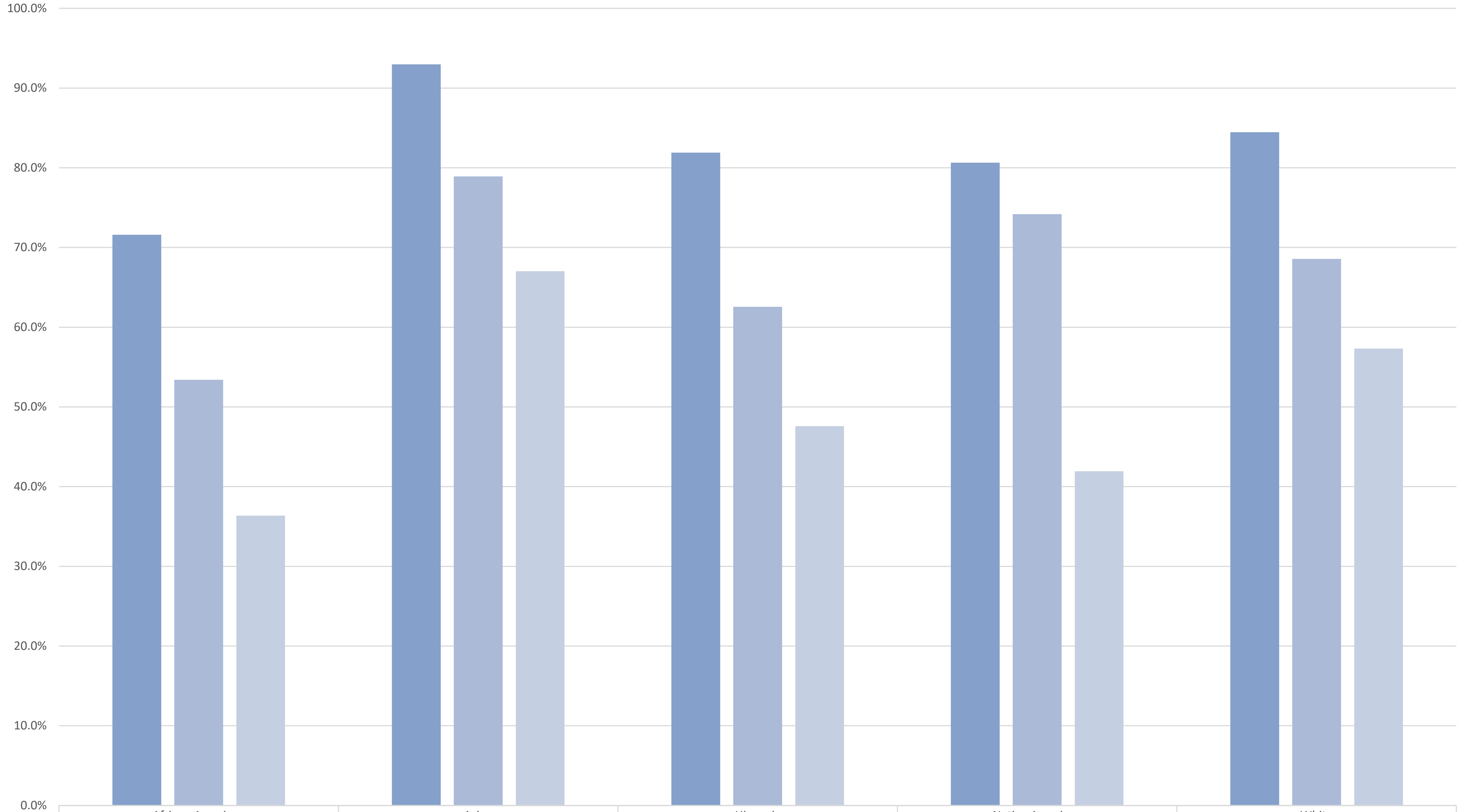
Institutional STEM Equity Self-Study

Fall 2018 Cohort STEM Retention by Race/Ethnicity



	African American	Asian	Hispanic	Native American	White
First Term STEM Retention (Agregate Average 84.6%)	71.6%	93.0%	81.9%	80.6%	84.5%
First Year STEM Retention (67.8%)	53.4%	78.9%	62.6%	74.2%	68.6%
Second Year STEM Retention or Graduation (53.7%)	36.4%	67.0%	47.6%	41.9%	57.3%

■ First Term STEM Retention (Agregate Average 84.6%) ■ First Year STEM Retention (67.8%) ■ Second Year STEM Retention or Graduation (53.7%)

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Institutional STEM Equity Self-Study

Disparities increase with intersectionality…

Predicted probability of STEM Graduation for ALL graduators, 2014-16 Cohorts (N=12,501)

Demographic Group				Non-STEM Entry	STEM Entry
Female	URM	First Gen	Pell	8%	57%
			Non-Pell	8%	59%
		Non-First Gen	Pell	9%	62%
			Non-Pell	10%	63%
	Non-URM	First Gen	Pell	10%	64%
			Non-Pell	11%	65%
		Non-First Gen	Pell	12%	68%
			Non-Pell	12%	69%
Male	URM	First Gen	Pell	14%	72%
			Non-Pell	15%	73%
		Non-First Gen	Pell	16%	75%
			Non-Pell	17%	76%
	Non-URM	First Gen	Pell	17%	77%
			Non-Pell	18%	78%
		Non-First Gen	Pell	20%	80%
			Non-Pell	21%	81%

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Student Voices

On weed-out culture:

"I had a difficult time with the intro classes for my major, like gen chem and such. I knew they would be intentionally difficult to weed out the many students (Chem152 for example, had about 500 students in the lecture hall), but going in with my academic full-ride scholarship from being valedictorian, I thought I'd be up to the challenge and wouldn't have too much difficulty. The courseloads were so extreme and the classes were so difficult that I struggled to even get C's. No matter how interested in the content material I was, my entire life became consumed by trying to stay afloat in these classes. My mental health took a serious toll and I started to lose the passion I'd once had for pursuing medical school because **I felt like my classes were designed to root against me and set me up for failure.**"

On Faculty Attitudes/Behavior:

"**I left the STEM major because the classes and some professors made me so depressed and anxious**, I wasn't able to leave my bed for days. I was constantly crying over classes and felt I could never succeed no matter how much effort and work I put into the classes. I was so depressed, I lost sight of what I was working for and what I was interested in, and so I chose something 'easier'."

On Time to Degree Completion:

"**Had my previous science credits transferred and not "expired"** (ie, did not transfer because they were ~4 years old), I would have stayed in the BS path. However, since I'm quite sure not much has changed in basic chemistry and physics, I realized that retaking those courses would be a giant waste of time, money, and added stress I absolutely did not need."

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Institutional STEM Equity Self-Study

Challenges

- Decentralized and siloed culture and structure of the institution limits collaboration and coordination across efforts, likely limiting impact and reducing efficiency (though this was outside of scope of this study and needs additional research to confirm).
- There is not a clear pathway for programs to move from being externally funded to being institutionally funded, regardless of demonstrated program success.
- Deeply held institutional culture that values research over teaching/learning and student outcomes creates challenges for engaging tenure-track faculty in equity-focused efforts and garnering stable support for equity-focused efforts.
- Despite the increased availability of institutional data, there is limited training available for how to interpret and analyze data in a way that is equity focused.
- There is a lack of centralized strategic planning surrounding equity in STEM efforts, resulting (in some cases) in the duplication of efforts and internal competition.

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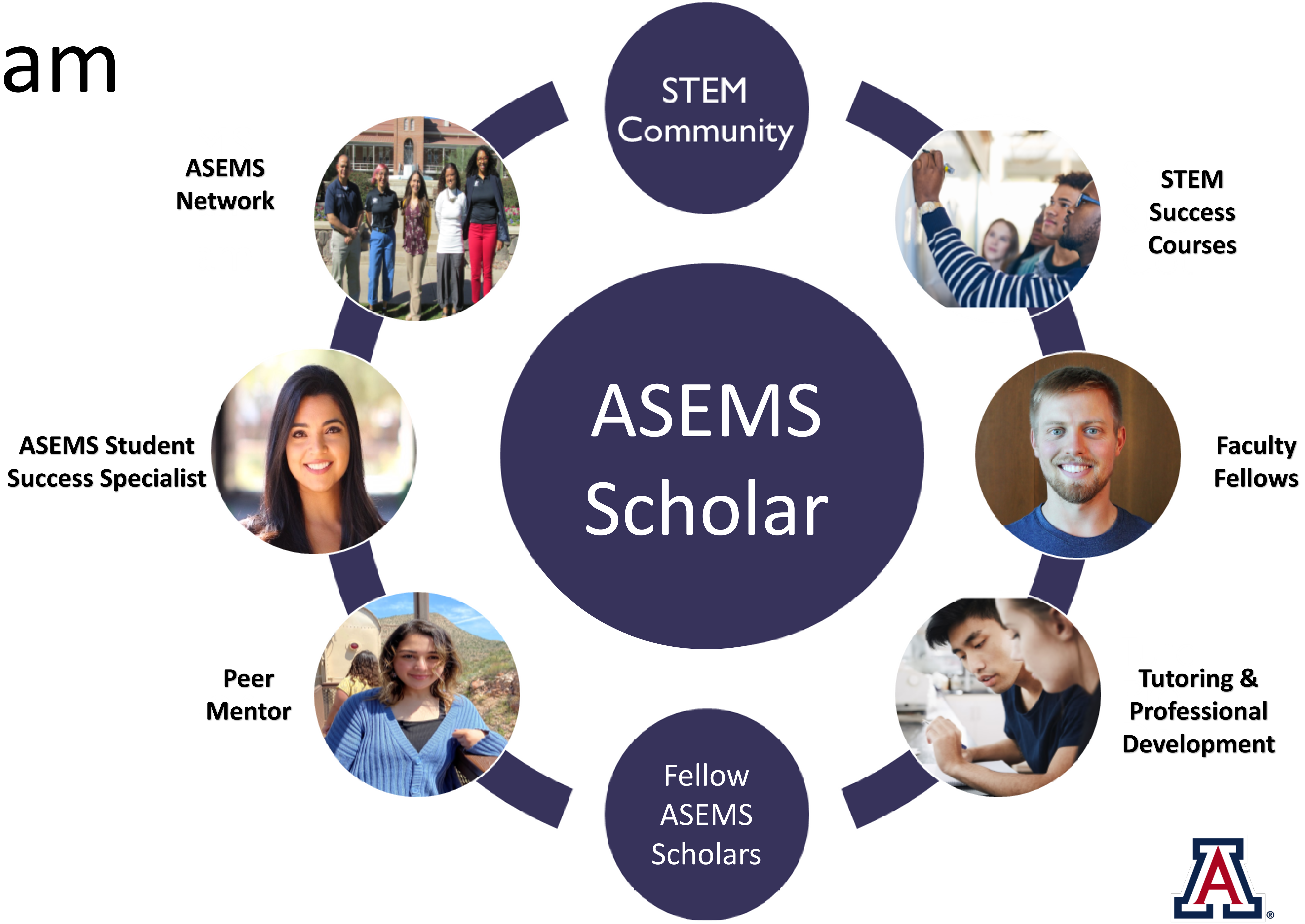
ASEMS Program Overview

PILOTED IN 2011

to retain more students in STEM who were first generation and/or from low-income households

STARTED WITH 12 STUDENTS

and now serves 130 incoming and 450 annually



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Practices of Successful STEM Persistence Programs

Asset-Based Mentoring
SS Specialists, faculty mentors, peer mentors

STEM Identity Development
Connect to personal interests, early research, & interventions to normalize experiences

Academic Support & Financial Support
SS Specialist, tutoring, grade reports, course load review, graduation planning

Learning Community
ASEMS courses with students from similar backgrounds

Effectiveness of ASEMS

Persistence in STEM (FG/LI F19-F22)

- First time-first year persistence in STEM
  - One-year
    - ASEMS Scholars 85%*
    - UArizona STEM Students 78%**
  - Three-year
    - ASEMS Scholars 77%*
    - UArizona STEM Students 65%**
- Transfer persistence in STEM
  - One-year
    - ASEMS Scholars 92%*
    - UArizona STEM Students 78%**
  - Three-year
    - ASEMS Scholars 66%*
    - UArizona STEM Students 57%**

Graduation in STEM (F11-F17)

- The average 6-year graduation rate for ASEMS FTFY students who started in a STEM major F11-F17 is 74% vs UArizona 66% average***

*ASEMS persistence data includes scholars who are both first generation and low-income in the F19-F22 cohorts .
*Comparison data includes non-ASEMS students at the university in a STEM Major that ASEMS serves who are both low-income & first-generation in the F19-F22 cohorts.
***Based on cohorts F11-F17, comparison from UAccess Retention dashboard (FTF, ABOR STEM flag, UA Main Campus); UA numbers do NOT exclude ASEMS students

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Effectiveness of ASEMS

Student Experiences

- Positive peer mentor experiences
- Early engagement in undergraduate research
- Graduate school preparation and matriculation

National Recognition

- ASEMS was the 2020 *Excelencia in* Education Example of Excellence for the baccalaureate category for high persistence in STEM of Latinx students

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Catapult + ENGAGED

- **First Year Community Linked Courses**
  - Cohort learning communities based on math placement
  - Built-in study community, enhanced psychological safety in the classroom
- **Peer Mentors/Advisory Board**
  - Created sense of belonging for students
  - Provided feedback on programming and policy to create authentic

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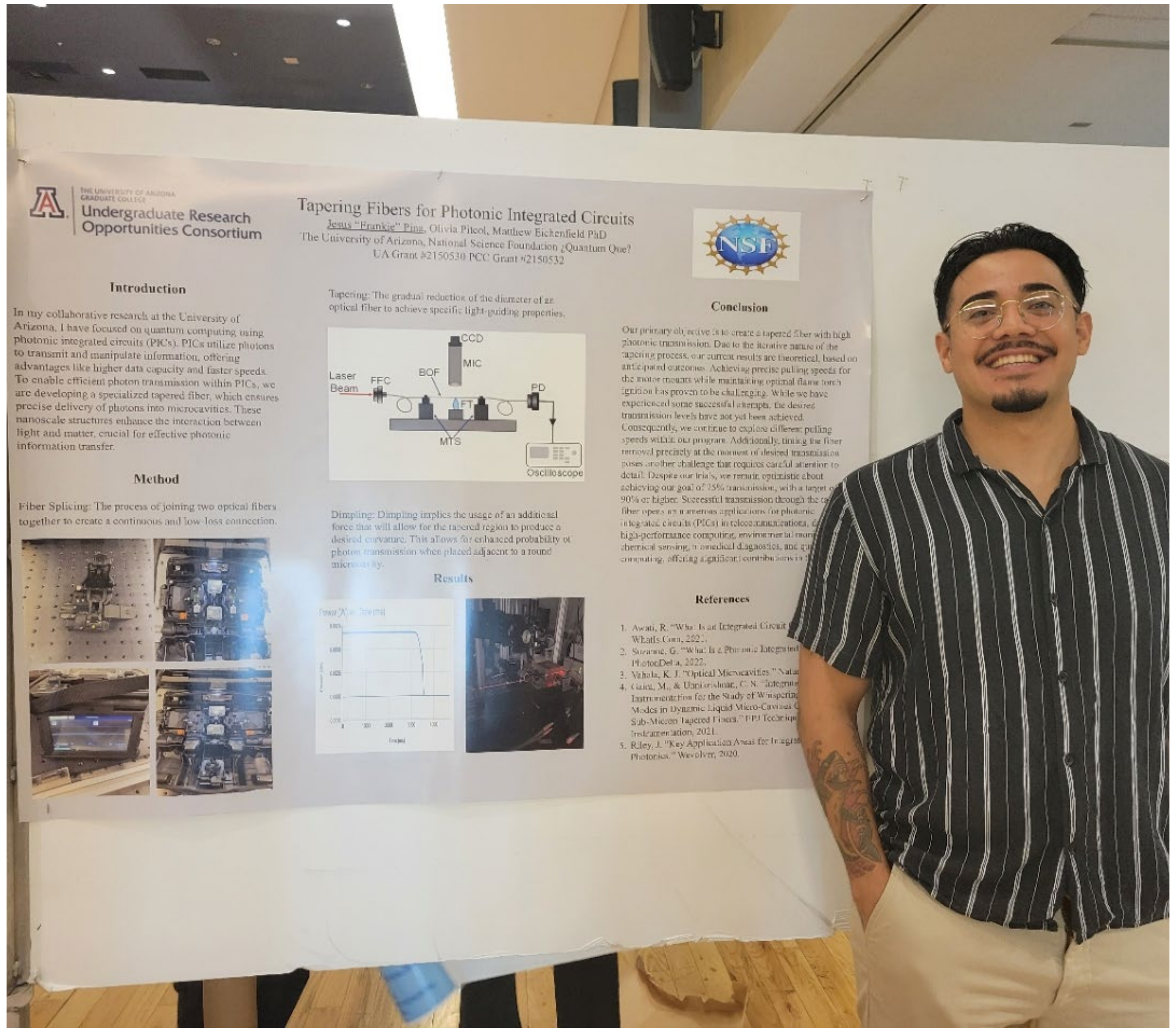
Catapult + ENGAGED



• Tailored and Responsive Ongoing Support

Summer TRACK

- Summer term cohorts for students following the first year
- Career development and professional mentorship course

REAL Work

- Paid undergraduate research positions
- Professional staff support for students *and* faculty
- Students engage in community outreach to center servingness in their STEM identities

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SERVINGNESS

Organizational Outcomes for Latinxs		Low	High
	High	Latinx-Producing	Latinx-Serving
	Low	Latinx-Enrolling	Latinx-Enhancing

Organizational Culture Reflects Latinxs

Garcia, G.A. (2017). Defined by outcomes or culture? Constructing an organizational identity for Hispanic-service institutions. American Educational Research Journal, 54(1_suppl), 111S-134S

Producing

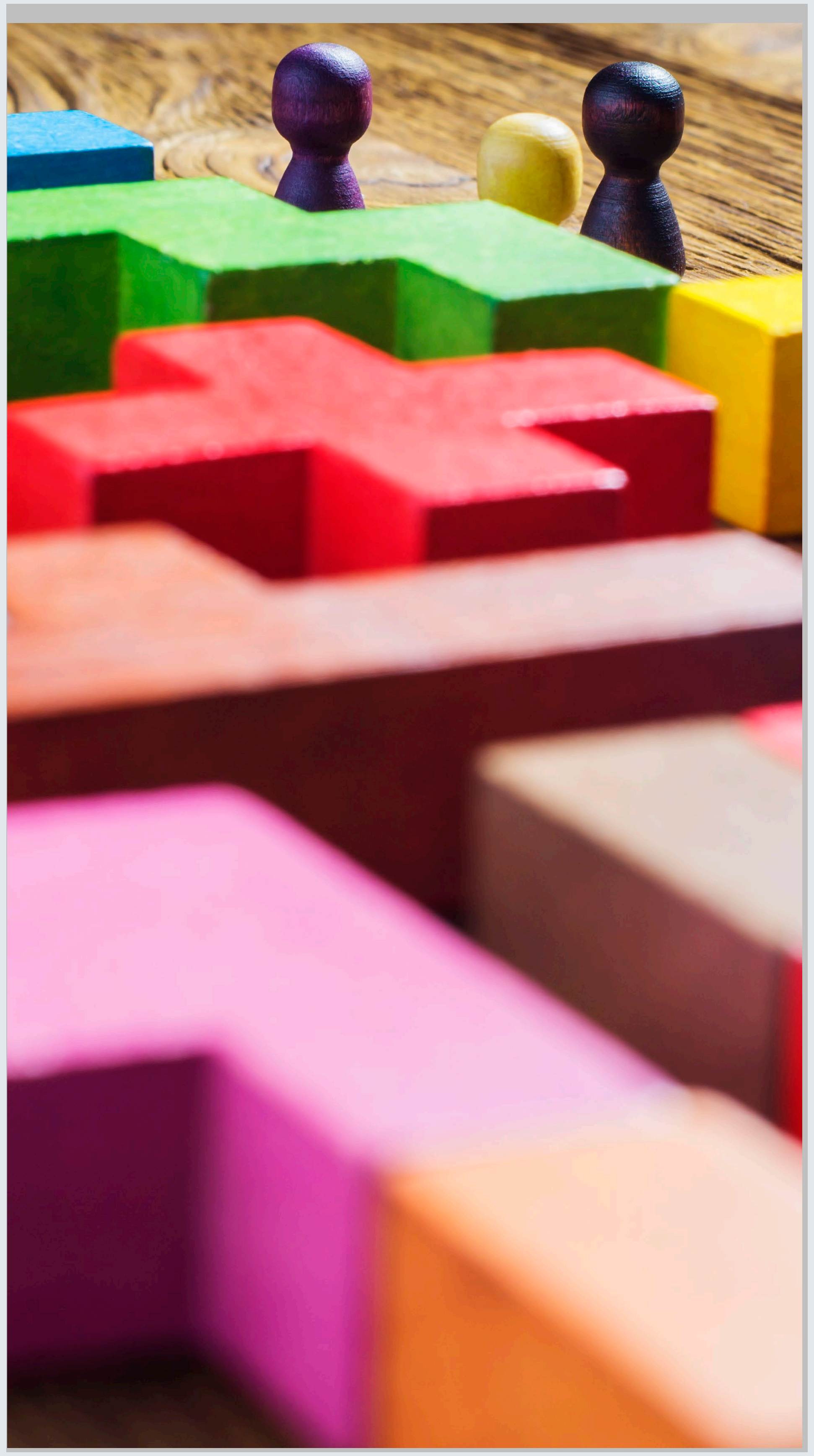
- Graduation
- Graduate School Enrollment
- Employment

Enhancing

- Community Engagement
- Positive Campus Climate
- Support Programs

Enrolling

- 25% Latinx identifying undergraduate students
- 50% low-income undergraduate stude



Challenges Operating Programs

- Programs overlapping in efforts
- Time consuming
- Staff burnout
- Growing student population: increased need

Opportunity to Scale Up Best Practices of ASEMS & Catapult

Flinn Foundation funding: Study and identify ASEMS best practices to scale up

Title III HSI STEM & Articulation Grant: Project CREAR

- *U.S. Department of Education funding to remove barriers in STEM*
- *Scale up early engagement with undergraduate research*
- *Cultivate culturally responsive & inclusive STEM environments*
- *CREAR STEM learning communities*

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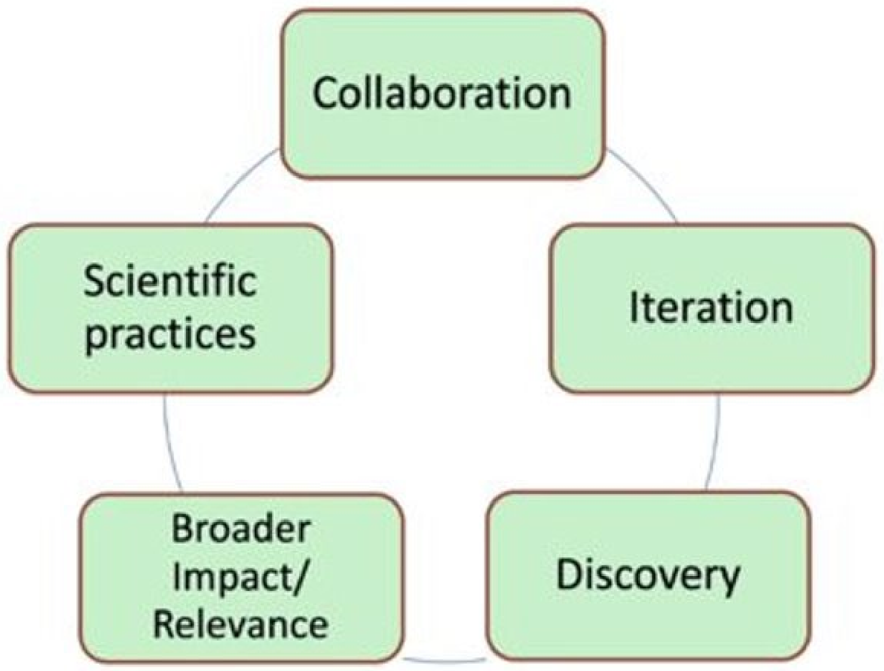
Expanding Early Access to Research... CUREs

CUREs – Course-Based Undergraduate Research Experiences

- Authentic research experiences incorporated into courses.
- Removes barriers of apprenticeship positions



Corwin Auchincloss et al., 2014

CUREnet: CUREs involve whole classes of students in addressing a research question or problem of interest to stakeholders outside the classroom. During a CURE, students will engage in scientific practices, such as collecting and analyzing data and developing and critiquing arguments. Auchincloss et al., 2014

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Annual CURE Training Institute

- **2 ½ day workshop** taught by national expert, Dr. Sara Brownell, ASU
- **17 CUREs taught; 1104 students**
  - *63% first generation, Pell Grant recipients, or from an underrepresented ethnic group*
  - *49.8% 1st or 2nd year students*
- **2 STEM labs being converted** (ECOL 182L + 1 TBD)
- **9 additional CUREs in development**
- **1760 students expected for 2023-2024 CUREs**
  - *1300 from the Biology II lab (ECOL 182L)*
- **39 faculty, staff, post docs, and grad students have attended**

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Culturally Responsive & Inclusive Environment in STEM

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Culturally Responsive Curriculum Development Institute (CRCDI): Years 1 & 2 Progress

31
STEM Faculty

STEM Gateway Courses:

- CHEM 197B: General Chemistry Chemical Thinking Supplemental Instruction (Fall 22 - 200)
- CHEM 197C: General Chemistry Lecture II: Chemical Thinking Supplemental (Spring 23 - 200)
- CHEM 151: General Chemistry I Lecture (Fall 22 – 200)
- CHEM 152: General Chemistry II Lecture (Spring 23 – 200)
- ECOL 182L: Biology II Lab (Fall 22 – 400; Spring 23– 800)
- ECOL 182R: Biology II Lecture (Fall & Spring 23, 24 – 800)
- MCB 181R: Intro to Biology I (4600)

Target Number of Students Reached: 1,000

Estimated Number of Students Reached: 8,000+

Additional STEM Focused Courses, not identified as gateway courses:

- SLHS 574: Speech Disorders 2 (Spring – 25)
- NURS 478: Nursing Leadership & Management in Health Systems (Fall & Spring – 100)
- CSC 110: Computer Programming I (Fall – 450)
- PSY150A: The Structure of Mind & Behavior (Fall – 450)

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Culturally Responsive & Inclusive Student and Staff Training

Grant Batchelder

Employee Development, Growth & Engagement
Learning

Student Leader Training

- Target audience: peer mentors, peer advisors that serve STEM students and STEM course preceptors and TAs
- Trainings launched fall 2023
- Asynchronous training to be offered through EDGE Learning

Staff Training

- Target audience: staff that serve STEM students such as support staff and advisors
- Asynchronous training will be piloted in spring 2024

CONTACT US TO SCHEDULE A TRAINING!

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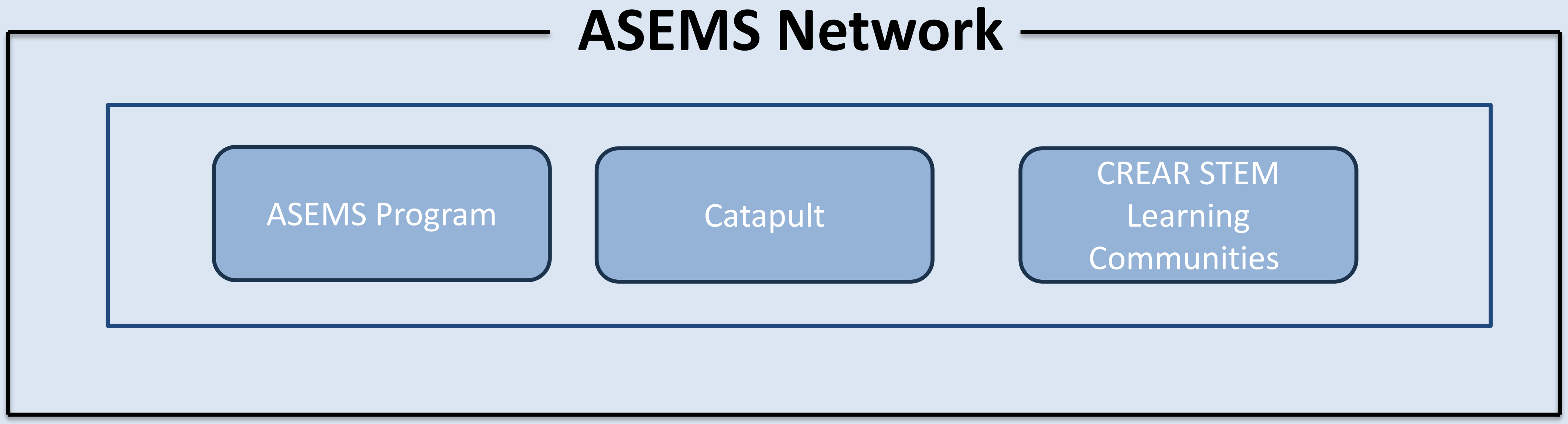
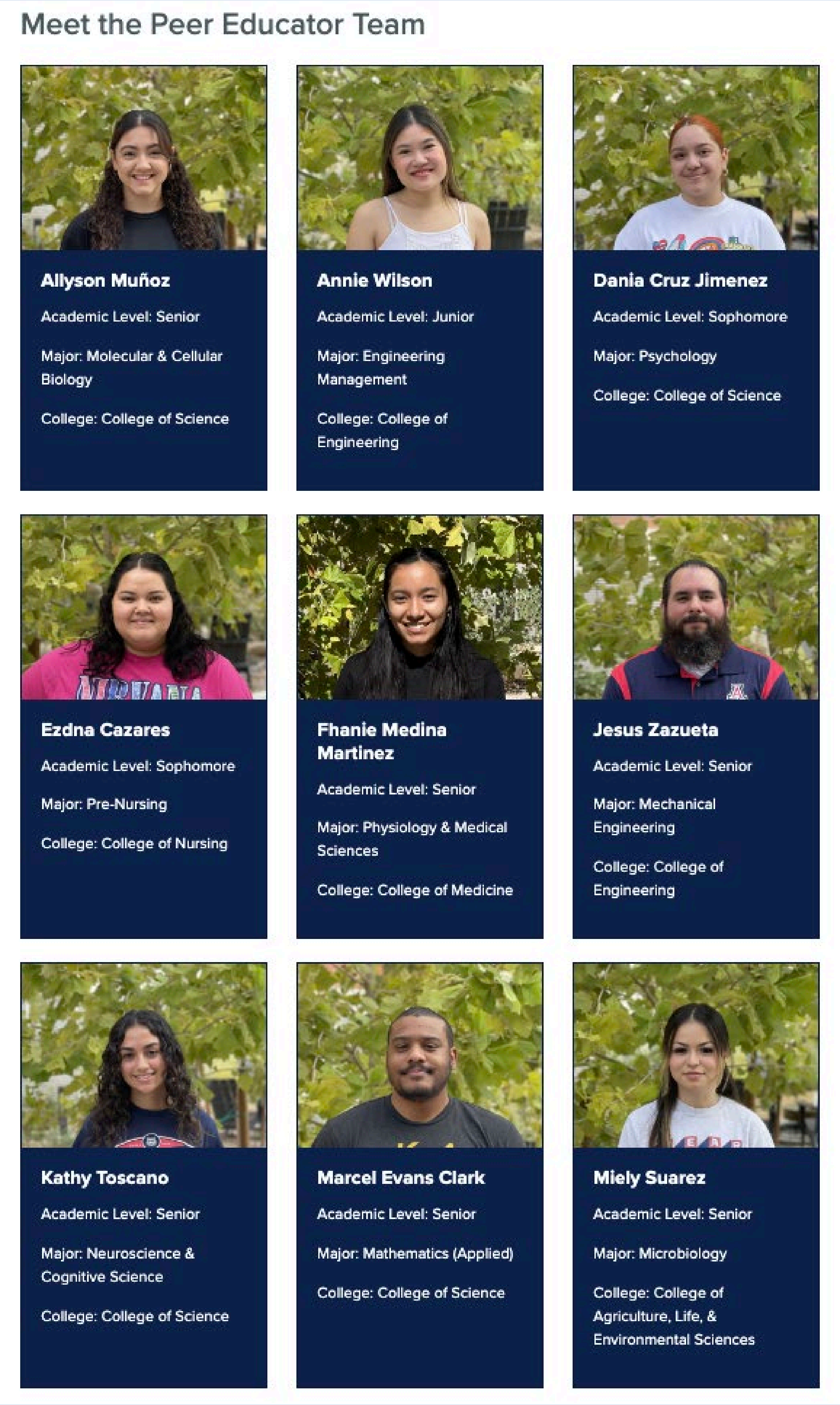
Developing the ASEMS Network

- **Identified elements of Catapult and ASEMS to scale up**
  - First year seminar course, linked courses, support staff, peer mentors, supplemental instruction



ASEMS Network

- **Infrastructure to support scaling up**
  - Recruitment, marketing, linked courses, cohorts
  - Curriculum and Training Manager
    - Peer Educators leading Success in STEM
    - Peer Educators and staff - culturally responsive and inclusive training
    - Revamped first year seminar
      - Success in STEM; adopted by Catapult
      - Sense of belonging and STEM Identity



CREAR STEM
Learning Communities

- High Impact Practices
- ASEMS & Catapult
- Learning Communities
  - Andrea M. Palacio
- First Year Seminar
  - Christopher Oka

Kuh, G. D. (2008). Excerpt from high-impact educational practices: What they are, who has access to them, and why they matter. *Association of American Colleges and Universities*, *14*(3), 28-29.

Strategic Partnerships

- ASEMS
- Catapult
- Think Tank
- A-Center
- College of Science: Chemistry & Math
- College of Agriculture, Environmental, and Life Sciences
- College of Engineering
- General Education Faculty & Instructors
- Office of the Registrar
- Enrollment Management
- University Information Technology Services (UITS)
- Wildcat LEAP

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1st semester
- Linked courses
- Inclusive mentoring
- Community building

2nd semester
- Inclusive mentoring
- Community building
- STEM experiences

3rd semester +
- Support as needed
- Connected to STEM opportunities

- **Increased capacity from 175 to 450 incoming students**
    - Staff can focus more time meeting with students and connecting them to STEM experiences
- **Evaluation support**

Structures & Future Partnerships

- Identifying and collaborating with programs that work with student success that are interested in strengthening:
  - Sense of Belonging: Perceived social support, connectedness, mattering.
  - STEM Identity: Development of a social identity as a scientist, self-perception.

WE LOOK FORWARD TO PARTNERING WITH YOU

Concluding Remarks

RSVP here for our upcoming STEM Equity Mixer on December 6th:

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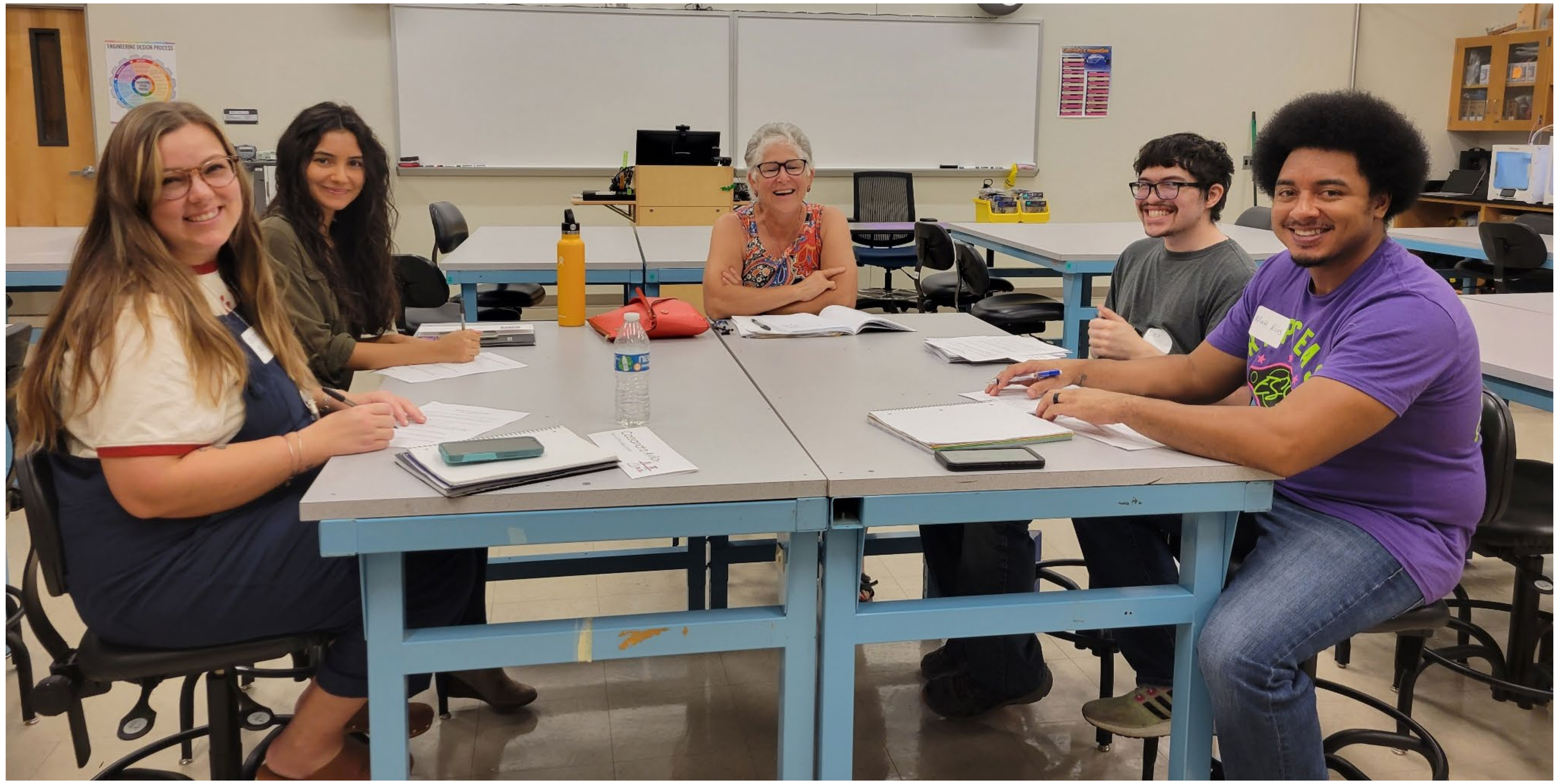
Discussion



Thank you

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RESEARCH, INNOVATION & IMPACT
Societal Impact

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