



Helping Students Reach Graduation and Beyond in a STEM Discipline

*Emergent Outcomes and Lessons Learned from A Collaborative NSF
S-STEM Project Designed to Increase Low-Income Student Success
Across Four **Yes We Must Coalition** Institutions*

Wednesday, May 17, 3:00-4:00 pm ET



Partial support for this work was provided by the National Science Foundation
Scholarships in Science, Technology, Engineering, and Mathematics (S STEM)
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YES WE MUST COALITION
COLLEGE SUCCESS FOR ALL

- www.yeswemustcoalition.org
- 45 independent, nonprofit colleges and universities where 50% + undergrad enrollment Pell-eligible
- Committed to collaborating to make changes to increase persistence rates for low-income students
- By working together through sponsored projects and YWM initiatives forming strategies for identifying privilege and reducing barriers

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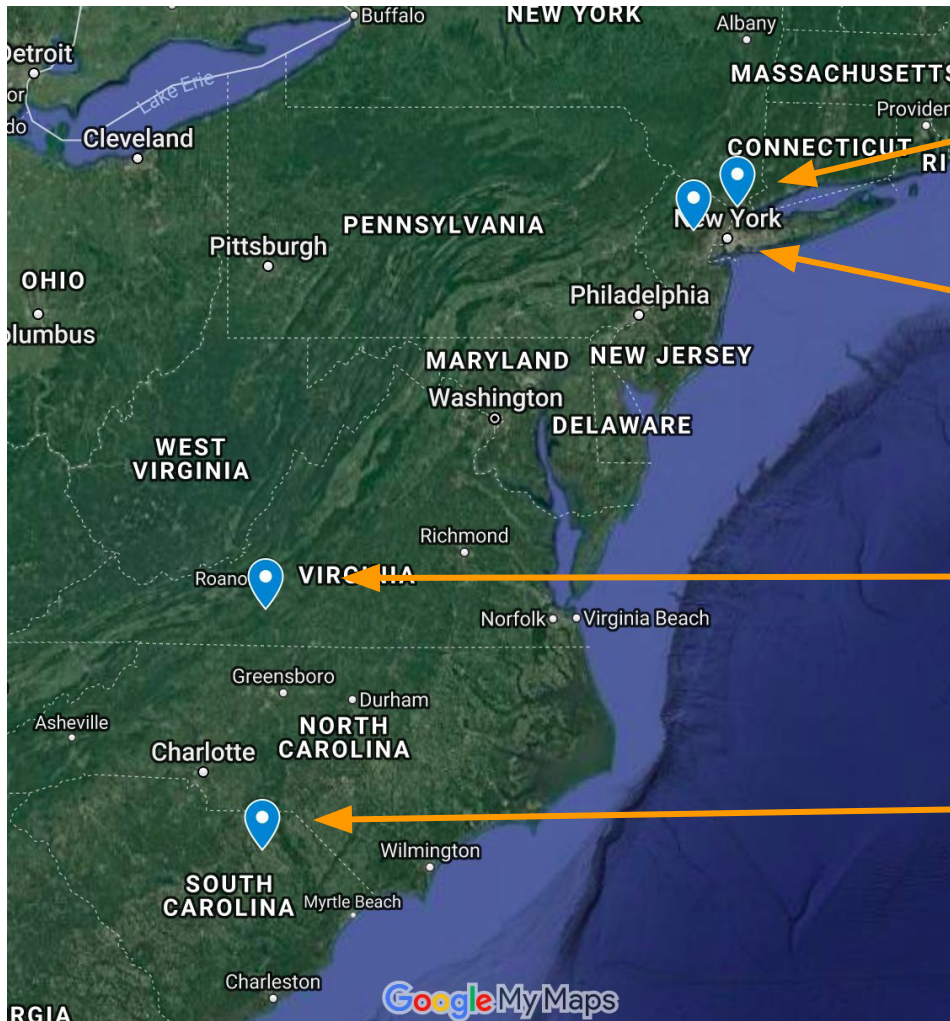
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Mercy College

(Dobbs Ferry, NY; Bronx, NY; Manhattan, NY)

St. Elizabeth Univ.

(Morristown, NJ)

Ferrum College

(Ferrum, VA)

Coker Univ.

(Hartsville, SC)

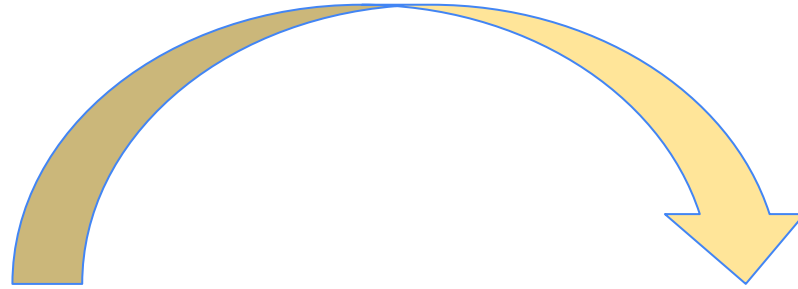
Institution	UG Enrollment	Demographics
Coker University	~900	50% Pell; 40% URM
Ferrum College	~1,100	61% Pell; 43% URM
Mercy College	~5,700	67% Pell; 67% URM
St. Elizabeth Univ.	~900	69% Pell; 67% URM

*all partner IHEs are private, non-profit comprehensive colleges with a liberal arts focus.

Historical Data From Our Schools

Average Persistence of Biology Majors		
	1st to 2nd year	1st to 3rd year
2011	50%	28%
2012	57%	33%
2013	53%	30%
2014	49%	
Average Graduation Rate		
	college-wide	students who would have qualified for SSB program
2011	28%	18.5%

Historical Data (prior to S-STEM project)
average of all four institutions



For every 100 students
majoring in BIO & Pell
eligible

19 graduate in 4 years

Target Student Population

- Pell eligible/demonstrated financial need
 - Scholarships provided, ~\$6,000/year, nearly doubling financial support
- Academically talented (SAT/ACT score, HS GPA, personal statement - holistic review)
- Biology majors (non-clinical, variety of concentrations)

Scholar Demographics

Female = 80%

African American = 26%

Hispanic = 33%

Avg. Est. Financial Contribution (EFC) = \$1,404



Project Goals

- Support qualifying SSB students with S-STEM scholarship
- Increase number of low-income biology students enrolled in our programs
- Elevate the rates of persistence (in STEM majors), retention, and graduation for low-income students in biology
- Close the observed equity gaps in:
 - Undergraduate success
 - GPA, self-efficacy, college skills
 - Job/graduate school placement



A Multi-Institutional Collaboration

YES WE MUST COALITION
COLLEGE SUCCESS FOR ALL



C O K E R
UNIVERSITY



A working group of YWM Coalition IHEs formed a submission to NSF S-STEM Track III with the goal to produce a scalable model of institutional collaboration, particularly for under-resourced colleges.

Senior personnel from each institution and the YWMC have defined roles and responsibilities that align with the proposed activities (including assessment).

Program Activities

Build Sense
of Belonging

Career
Readiness

Guidance &
Support

Scientific
Literacy &
Science Identity

- CATALYST, “Jumpstart” inspired program: team building at start of SSB program
- Integrated first-year experience including a STEM- based first-year seminar; cohort model for gateway biology courses
- Intrusive advising and faculty/peer mentors program
- Hands-on research/project based learning under faculty mentorship
- Graduate school/career preparation
- Faculty Development
- Annual SSB Institute to bring the cohort of students and faculty teams together
- Laptop program



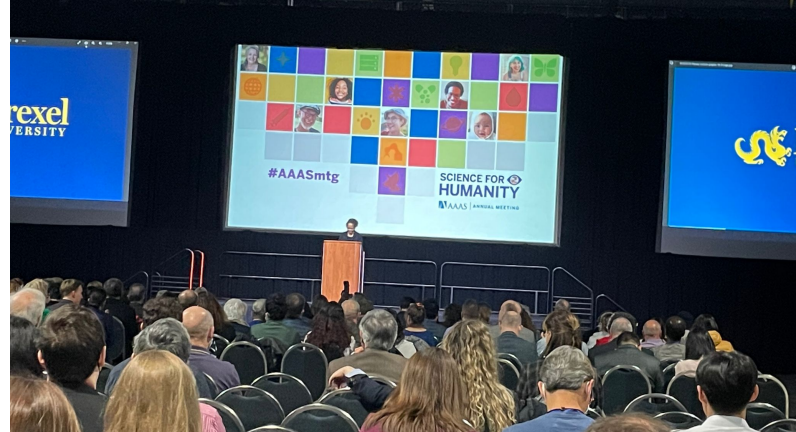
SSB Institutes

2019: Research Triangle Park, NC

2020-21: Virtual

2022: New Jersey (SEU campus) and Manhattan (Mercy campus)

2023: Washington, DC (AAAS conference)



WE FUND SCIENTIFIC RESEARCH

CZI funds groundbreaking research across different disciplines to accelerate the pace of scientific progress.

OUR SCIENCE PROGRAMS

- Imaging
- Neurodegeneration Challenge Network
- Open Science
- Science in Society
- Single-Cell Biology

Learn more 

WE DO AWESOME SCIENCE

We partner with scientists, researchers and engineers to do the science that can't be done in conventional environments.

CHAN ZUCKERBERG INSTITUTE FOR ADVANCED BIOLOGICAL IMAGING

Located in California's Bay Area, the CZI Imaging Institute will bring together diverse disciplines to develop revolutionary new imaging hardware and software tools that provide comprehensive views of biological systems in their native context.

Learn more 

KEMPER INSTITUTE FOR THE STUDY OF NATURAL AND ARTIFICIAL INTELLIGENCE

The Kemper Institute at Harvard seeks to better understand the basic intelligence in natural and artificial. It will study AI systems, including neural networks, to develop both principles and a practical understanding of how they operate and learn.

Learn more 

Knowledge Generation

- We hypothesize that the combination of enhanced financial support along with carefully planned activities centered on evidence-based practices will increase student success
- Scalability of the activities studied in this project will apply to the remaining 35+ member institutions of the YWMC

Research questions

- Can creating a network of students, faculty and scientists coupled with a more secure financial situation while at school,
 - **increase persistence in STEM** majors, retention rates, and graduation rates for low-income students?
 - **increase job placement/graduate school** placement rates for low-income students in STEM fields?
- What factors **contribute to the overall success** of a low-income student in biology?
- What is the relative **impact of carefully planned (and assessed) activities** on a low-income student's success in persisting in a STEM major and completing a STEM degree?
- Will the implementation of the SSB program at each collaborating institution **increase the overall numbers** of academically talented, low-income entering freshman who enroll in STEM biology (or STEM overall)?

Impact on Student Success

Persistence

Year 1 to Year 3 (cohort 1)

	SSB	Control (Pell)	Control (Affluent)
Persistence rate (range)	70% (57-78%)	32% (0-55%)	28% (8-50%)

Persistence rate = number of students remaining in a STEM major at the beginning of 2021 divided by the number enrolled in the biology major at the start of Fall 2018 (cohort 1 shown)

Impact on Student Success

Cumulative GPA

<i>Cohort 1 (through year 2)</i>	SSB	Control (Pell)	Control (Affluent)
cGPA	3.21	3.01	3.31

<i>Cohort 2 (through year 1)</i>	SSB	Control (Pell)	Control (Affluent)
cGPA	3.59	2.88	2.98

Assessment of STEM Scholars Program

- End-of-year surveys (administered in spring of all years)
- COVID impact survey (administered in late spring 2020)
- Morehouse Instrument (science literacy and confidence)
- ePortfolios (specific prompts administered annually)
- Post-programming surveys administered (e.g., institutes, workshops)



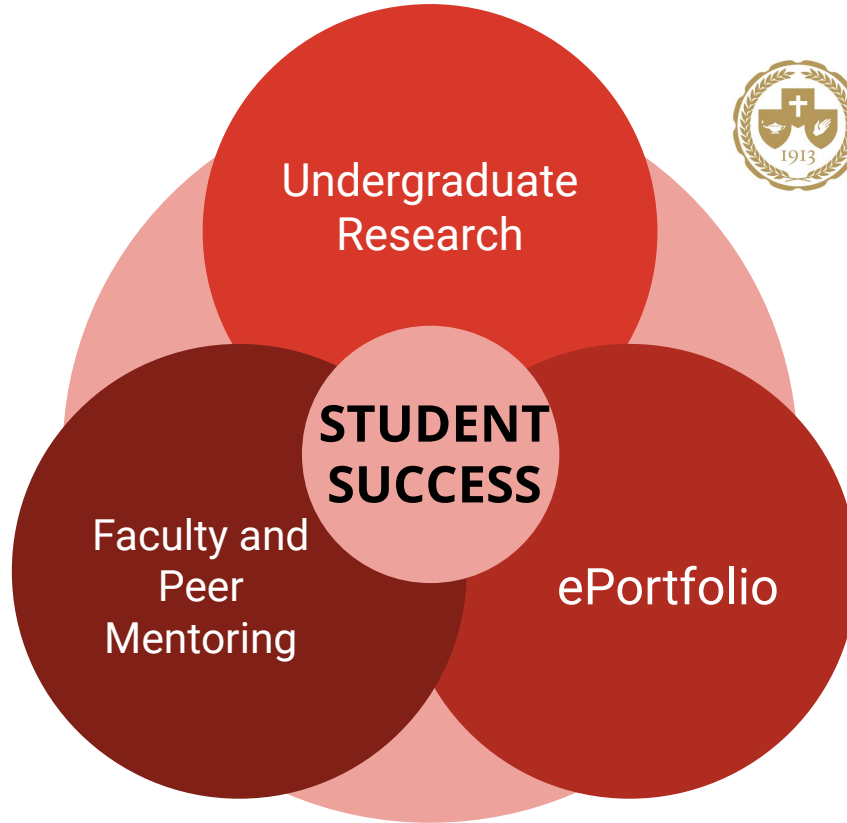
Additional Data Collected

- Admissions/Recruitment: Total # of students (total and low-income) who applied/accepted/enrolled who intend to major in approved major (Biology-related, non-clinical)
- Student Demographic Information
- Estimated Family Contribution (EFC)
- Grades (in entry level Math, gateway Biology, other gateway Science, FYE course), credits earned, semester GPA, cGPA
- Engagement in Undergraduate Research, Internships
- Job/Graduate Placement

What did each institution gain from this collaboration?

- A system of sharing (and shaping) best practices, collaborating across institutions, a scalable, structured model of student supports
- Developed an assessment model
- Led to an increased enrollments of STEM students at all institutions
- Faculty development opportunities

Synergistic partnerships allow for sharing of best practices and strategies to support the success of low income STEM students



Summary Impact – Research Results

Q: Can creating a network of students, faculty and scientists coupled with a more secure financial situation while at school, increase persistence in STEM majors, retention rates, and graduation rates for low-income students?

A: Controlling for the effect of student gender, race, home locale, and institution locale, using logistic regression, the researchers find that only student type is statistically significant in the model. *Controlling for other student characteristics, Scholars are nearly twice as likely to be retained compared to students in either control group.*

Impact: Retention for All Students (Non-Scholars & Scholars) is Influenced by Scholar Status, Race, & Gender

All Student Retention Cross Tabulation, Chi-Square Testing, & Columns Proportions Testing for Key Variables

Note: † p < .10; * p < .05; ** p < .01; *** p < .001; Significant results are in bold font.

		Row Percentages		Chi-Square Test Statistics			
		Retained	Not Retained	X ² -value	p-value	Sig.	Effect Size
Gender (n = 382)	Male (n=97)	28.9% _a	77.1% _a	7.71	.005	**	.142
	Female (n=285)	44.9% _b	55.1% _b				
Race (n = 309)	White (n=97)	41.2% _a	58.8% _a	5.66	.059	†	.135
	Student of Color (n=120)	41.7% _a	58.3% _a				
Scholar Status (n = 378)	Scholar (n=157)	66.2% _a	33.8% _a	74.04	<.001	***	.443
	Pell Control (n=143)	21.7% _b	78.3% _b				
	Affluent Control (n=78)	23.1% _b	76.9% _b				
Institution Locale (n = 383)	Rural (n=168)	43.5% _a	56.5% _a	0.75	.387	--	.044
	Urban (n=215)	39.1% _a	60.9% _a				
Locale (n = 345)	City (n=122)	34.4% _a	65.6% _a	4.97	.174	--	.120
	Suburb (n=134)	41.0% _{a, b}	59.0% _{a, b}				
	Town (n=18)	61.1% _b	38.9% _b				
	Rural (n=71)	39.4% _{a, b}	60.6% _{a, b}				

Impact: Retention of Scholars is Not Influenced by Demographic Differences

Scholar Retention Crosstabulation, Chi-Square Testing, & Columns Proportions Testing for Key Variables

Note: † p < .10; * p < .05; ** p < .01; *** p < .001; Significant results are in bold font.

		Row Percentages		Chi-Square Test Statistics			
		Retained	Not Retained	X ² -value	p-value	Sig.	Effect Size
Gender (n = 156)	Male (n=30)	56.7% _a	43.4% _a	1.45	.228	--	.096
	Female (n=126)	68.3% _a	31.7% _a				
Race (n = 123)	White (n=46)	63.0% _a	37.0% _a	1.55	.460	--	.112
	Student of Color (n=60)	60.0% _a	23.5% _a				
Institution Locale (n = 157)	Hispanic (n=17)	76.5% _a	40.0% _a	2.53	.112	--	.127
	Rural (n=72)	59.7% _a	40.3% _a				
Locale (n = 133)	Urban (n=85)	71.8% _a	28.2% _a	2.51	.473	--	.137
	City (n=48)	58.3% _a	41.7% _a				
	Suburb (n=47)	70.2% _a	29.8% _a				
	Town (n=8)	75.0% _a	25.0% _a				
	Rural (n=30)	56.7% _a	43.3% _a				

Student Testimonials



Impact: Cohorts Build a Sense of Belonging Together

- “Whenever we felt imposter syndrome, a vulnerable moment when you think you can’t succeed. They [other STEM Scholars] were always there to communicate and bring you back to reality.” (Graduate Scholar)
- “We were the first class as NSF scholars. We didn’t have mentors. We were a small class too, so it was 15, maybe less. We had to rely on each other actually. Everybody got to learn that we were all different thinkers and learners. We all learned from each other, and we all helped each other, knowing that we’re the first class.” (Graduate Scholar)
- “The main thing I loved the most about it was the diversity between different professors, students, even our advisor on campus.” (New Rural Scholar)
- “Last year’s trip when we went to Manhattan, there were a few students there that I maintained contact with and one of them is trying to help me with resume building right now.” (Returning Urban Scholar)

Impact: Networking, Research & Site Visits Build Career Readiness

- "I came to school thinking I was going to go the pre-med route and then I had a research experience and I realized that's kind of what I wanted to do more. Not just work in a hospital and work with patients. That wouldn't have been possible had I not been able to actually work with professors in labs and doing research at Coker." (New Rural Scholar)
- "I plan on going to grad school. Having that research experience and being able to say that I worked in a lab, that I've done field experience, I think that's is very valuable compared to someone who's going in and they only have the academics and the grades so far. (New Rural Scholar)
- "I would say broadening your scope is a very important thing. The scholarship really does bring you to see what's out there, people who are in those fields, and gives you more of a broad scope of something you weren't thinking of before or something you might be interested in." (New Urban Scholar)
- "Being able to mix with different students and professors, just learn new things. That's what really helped me because I've been able to do a lot of different things since being a STEM Scholar from talking to different professors and learning from different students. (New Rural Scholar)

Impact: Guidance & Support Come From Funding, Mentors & Networking

- “For the past two years, with us having gone to New York last year and then Washington right now, I feel like we are getting different connections and having different perspectives with all of the speakers and people whom we've come across. That also connects with giving [us] a confidence booster. (Returning Rural Scholar)
- “I think the experiences that we have, the average student doesn't get that. You don't get to come to these conferences and listen to amazing speakers talk about their journey and their research and all of that. It opens our eyes to what's possible. If you can see it then you can dream about it and you can make strides towards becoming that if that's what you want for yourself. It has broadened our horizon.” (Graduate Scholar)
- “I had the chance to have mentors in my program - people who were a year ahead of me that had their trials and errors with their projects. Even though we weren't working on the same project, I was able to have some sort of community to rely on. (Returning Rural Scholar)
- “The financial [scholarship] very much does make a difference. In my case, it makes the difference of being able to afford to go to college at all. It's the difference between me going into potentially a PhD program versus me collecting garbage for the next 40 years. The program wasn't just helping out and making it so the debt was a little bit lighter. It made college possible.” (Returning Urban Scholar)

Impact: Scientific Reasoning & Critical Thinking Skills – Morehouse Post-test Attitudinal Attributes

- Of the five Morehouse Survey scales measuring attitudinal attributes and non-cognitive skills, one was found to increase significantly, and two approached statistical significance.
- Scholars' self-conception as a scientist increased significantly from pre- to post-test measurement.
- Scholars' comfort engaging in conversations about science and research showed a marginal increase from pre- to post-test measurement.
- Scholars' ability to work in a team showed a marginal *decrease* from pre- to post-test measurement.
 - These marginal differences do not meet the .05 threshold for statistical significance.

Impact: Scientific Reasoning & Critical Thinking Skills – Morehouse Post-test Attitudinal Attributes Continued

Change in Attitudinal Attributes and Non-Cognitive Skills (n = 34)

	Pre-Test Mean	Post-Test Mean	Effect Size Hedge's g	Paired sample t-test		
				t-value	p-value	Sig.
Aspiration for a career in science (Range: 6-30)	26.97	27.26	0.15	0.47	.321	--
Self-conception as a scientist (Range: 5-25)	14.94	18.88	1.29	5.67	<.001	***
Ability to work in a team (Range: 4-20)	15.12	14.21	0.28	1.32	.099	†
Comfort engaging in conversations about science and research (Range:3-15)	10.47	11.21	0.39	1.51	.070	†
Confidence in their own abilities as a scientist (Range: 6-30)	22.29	22.44	0.08	0.19	.425	--

Impact: Scientific Reasoning & Critical Thinking Skills – Morehouse Post-test Scholar Attitudinal Attributes and Local Comparisons

Statistically Significant Scholar Results for Locale:

- Results approaching statistical significance for Locale:
 - Scholars from rural institutions' self-conception as a scientist is marginally greater compared to those from urban institutions ($p < .10$).
 - Scholars from rural institutions' have marginally greater confidence in their abilities as scientists compared to those from urban institutions ($p < .10$).

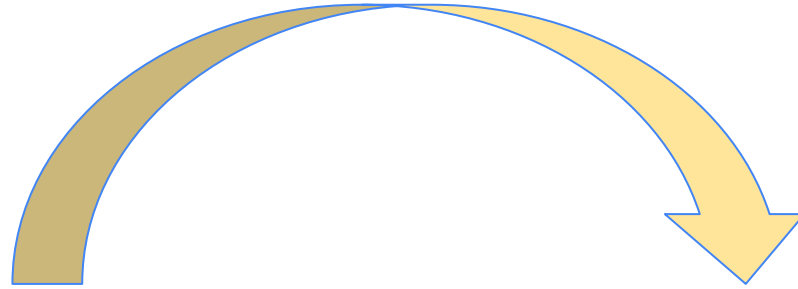
- ✓ Note that this test (Analysis of Co-Variance) failed to meet test assumptions. While mean differences are apparent, it is difficult to say if this is the result of true differences between students attending urban and rural institutions or if it is approaching significance as a consequence of data irregularities. Nevertheless, it is included here so that we may be on the lookout for differences occurring more long-term at participating institutions.

Summary of Scholar Impacts

- The collaborative S-STEM and its components are facilitating STEM success for students, especially those historically marginalized in STEM fields and from low-income backgrounds.
- There are interesting interactions taking place between locale, Scholar status, and gender that are deserving of follow-up as the program continues beyond the grant.
- *Controlling for the effect of student gender, race, home locale, and institution locale, student type is statistically significant in the model - Scholars are significantly more likely to be retained than both control groups.*



Historical Data (prior to S-STEM project)
average of all four institutions

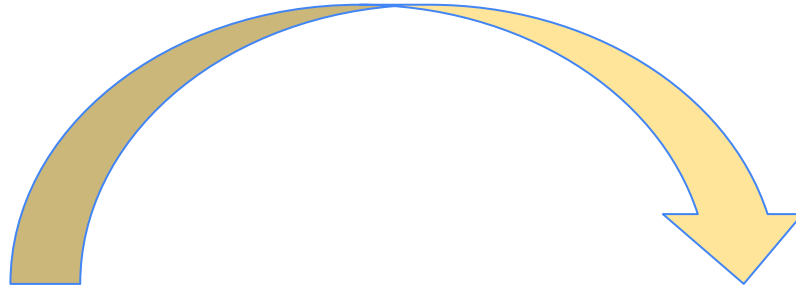


For every 100 students
majoring in BIO & Pell
eligible

19 graduate in 4 years

S-STEM Scholars in Biology (starting in 2018 or 2019)

average of all four institutions

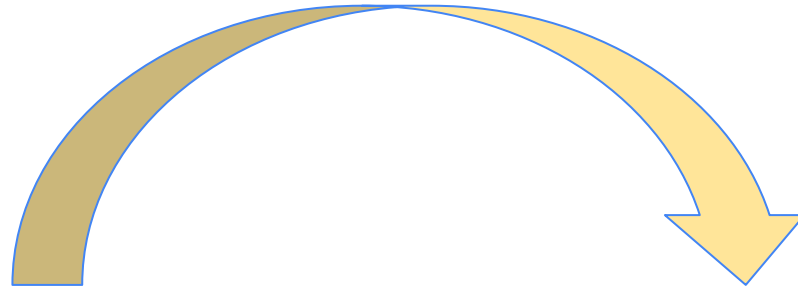


For every 100 students in the **STEM Scholars Program**

66 graduate in 4 years (in STEM major) - 3 fold increase over five-year average prior to project cohort years.



Helping Students Reach Graduation and Beyond in a STEM Discipline



For every 100 students in the **STEM Scholars Program**

66 graduate in 4 years (in STEM major) - 3 fold increase over five-year average prior to project cohort years.

New questions emerging:

- Was there a difference in success metrics between rural and urban students?
 - Our data suggests there is not, but additional analysis is underway...
- How did the program impact hispanic students at the HSIs?
 - *Mercy and Saint Elizabeth are both Hispanic Serving Institutions*

Cohort 1: Fall 2018 – Fall 2021

	Retained	Total	Percent
All	71	108	66%
Race/Ethnicity – All Schools (Mercy, Coker, SEU, Ferrum)			
Hispanic	27	35	77%
Black	23	34	68%
White	22	39	56%
Race/Ethnicity – Mercy			
Hispanic	14	17	82%
Black	4	11	36%
White	1	4	25%

Cohort 2: Fall 2019 – Fall 2021

	Retained	Total	Percent
All	27	46	59%
Race/Ethnicity – All Schools (Mercy and Coker)			
Hispanic	6	11	55%
Black	9	19	47%
White	13	17	76%
Race/Ethnicity – Mercy College			
Hispanic	5	8	63%
Black	5	9	56%
White	2	2	100%

Cohort 1: Fall 2018 – Fall 2021

Race/Ethnicity – Mercy			
Hispanic	14	17	82%
Black	4	11	36%
White	1	4	25%

Morehouse Scientific Literacy Survey: measures content knowledge domain, scientific reasoning and self-efficacy/attitudinal domains of scientific literacy

- <https://scientificliteracycenter.org/scientific-literacy-test/>

From the 2018 SSB Cohort, Hispanic students scored significantly higher ($p < 0.05$) than non-Hispanic students on the following items:

- **Commitment to science**
- **Participation in scientific discourse**
- **Team Learning**

Broader Impacts

- The collaborative S-STEM, especially given its partnership with YWMC, will result in a validated set of comprehensive best practices that will facilitate STEM success for students, especially those underrepresented in STEM and from low-income backgrounds.
- The success of this S-STEM program, increasing enrollment in Biology, lays a strong groundwork for future collaborations between IHEs and the YWMC.



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& Program Evaluation***

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Microbiome Discovery Team
April 5th 2019

Thank you!!!!

