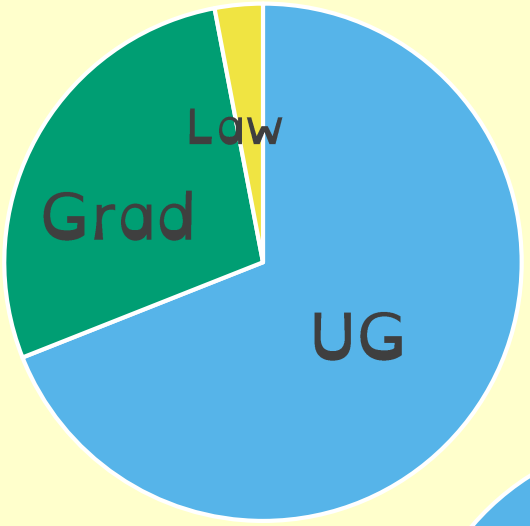
A Summer Bridge Program for STEM Student Success

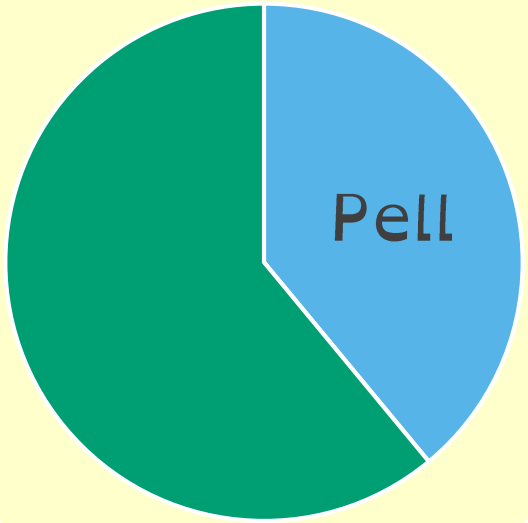
Axel Brandt (he/him)
John Carroll University

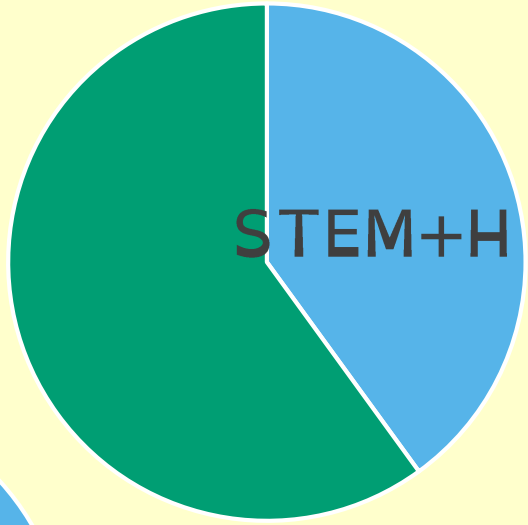
Ohio MAA Section Meeting, Fall 2022

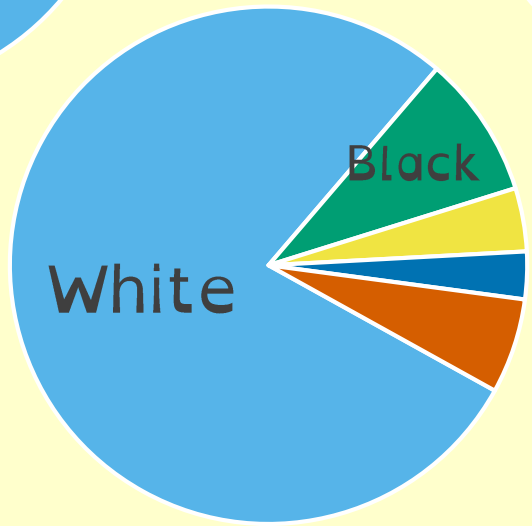
Northern Kentucky University

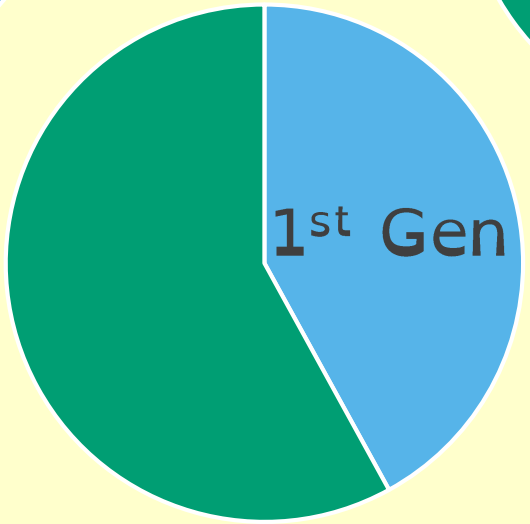
Student Profile





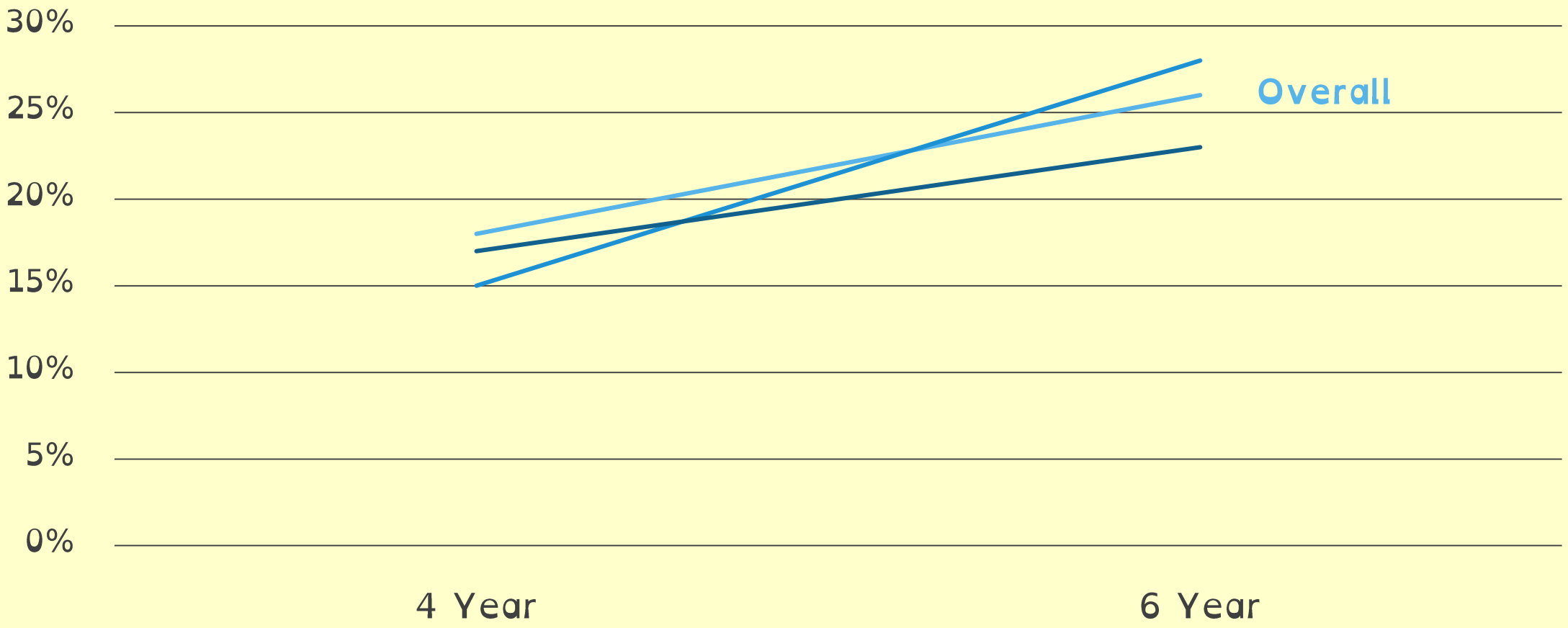






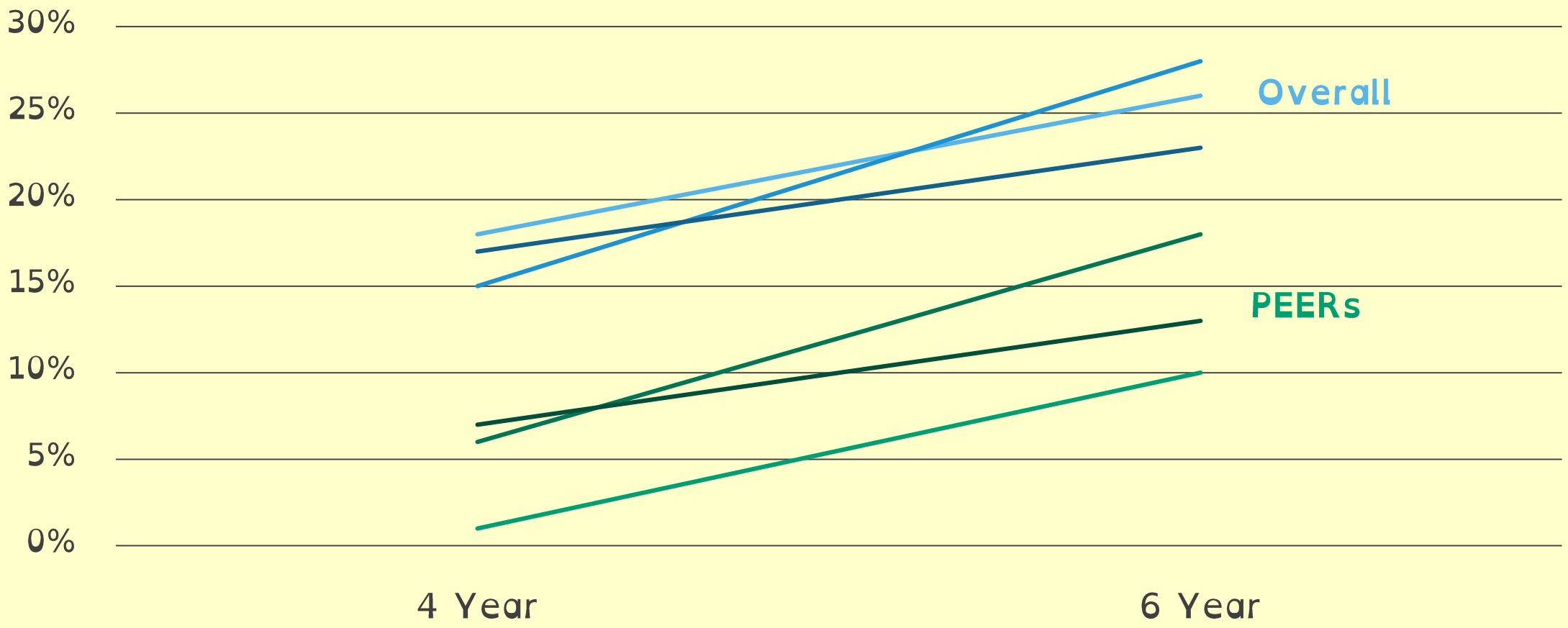
Northern Kentucky University

STEM Graduation Rates for students starting 2009-11



Northern Kentucky University

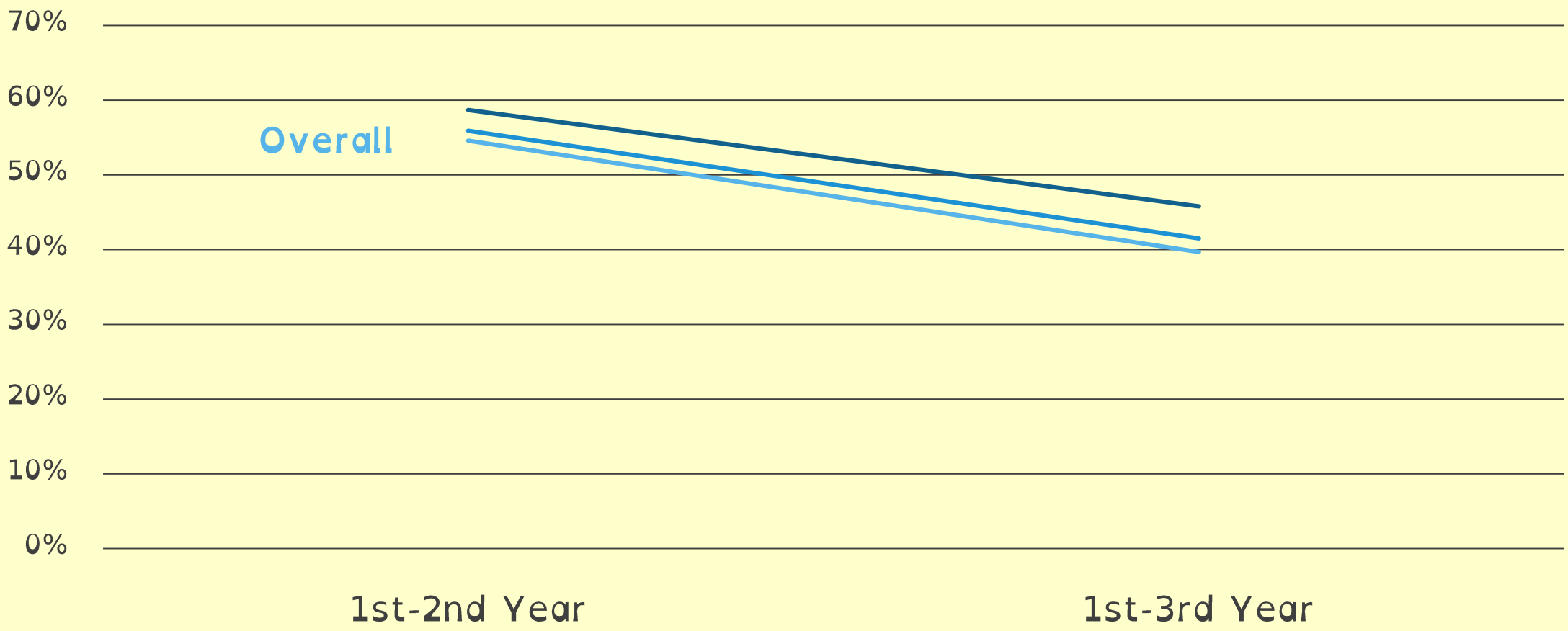
STEM Graduation Rates for students starting 2009-11



PEERs: Persons Excluded based on Ethnicity or Race

Northern Kentucky University

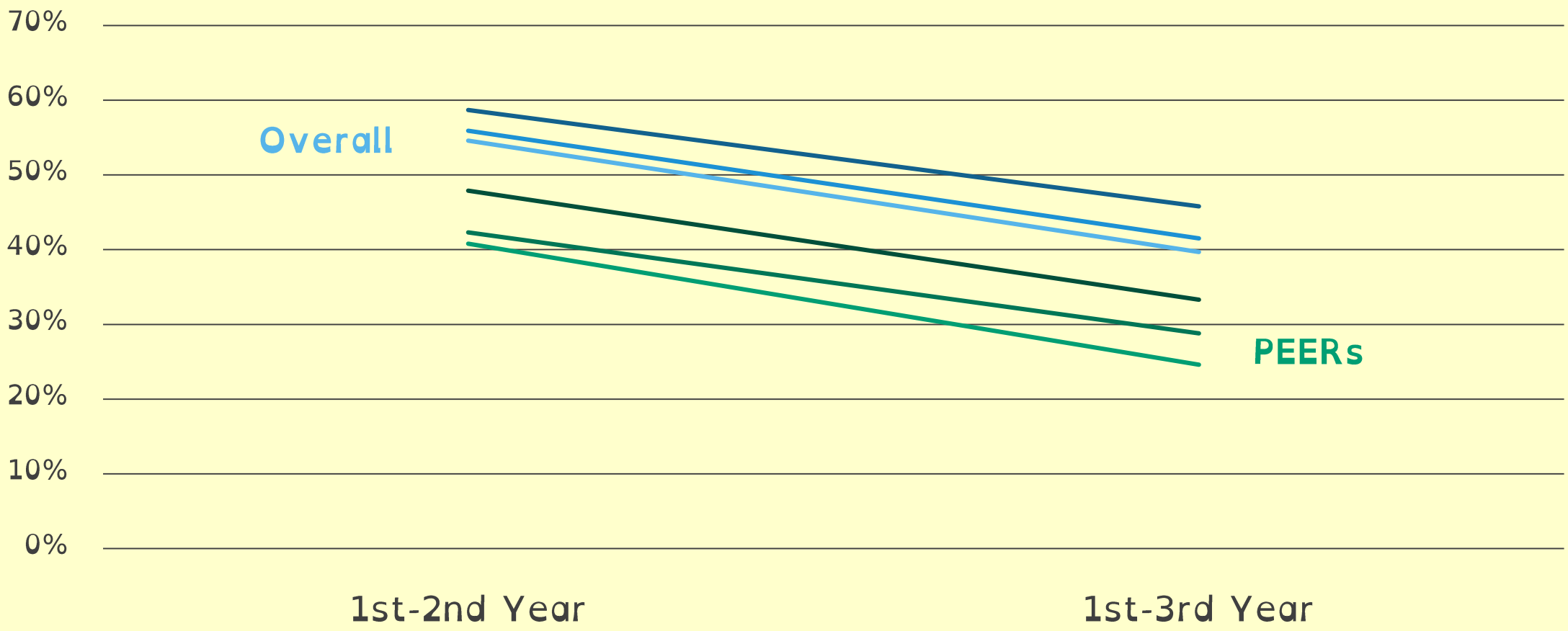
STEM Retention 2013-15



PEERs: Persons Excluded based on Ethnicity or Race

Northern Kentucky University

STEM Retention 2013-15



PEERs: Persons Excluded based on Ethnicity or Race

Q:
Why might students choose to stop pursuing their STEM major in their first year?

Q:
Why might students choose to stop pursuing their STEM major in their first year?

Our Focus: effects of not “deemed ready” to start in calculus

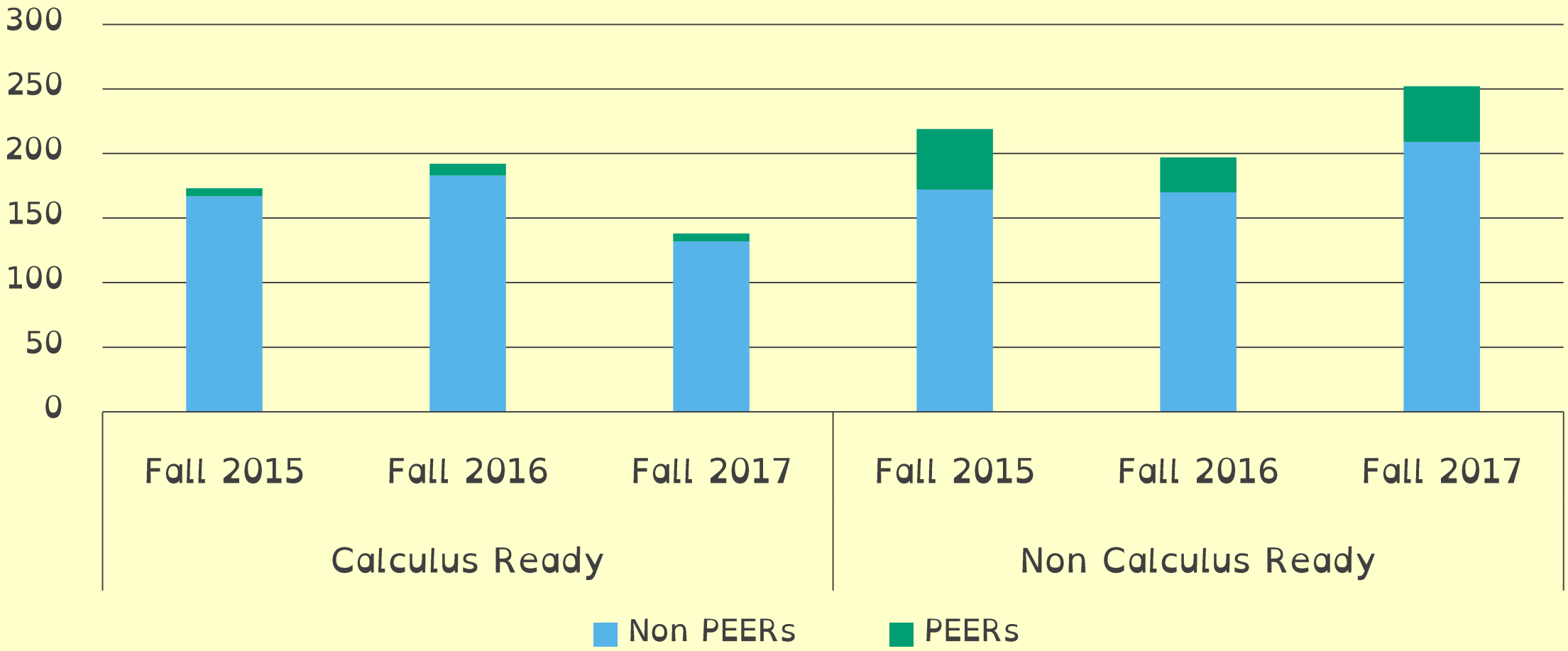
1. Decrease time to start STEM courses for major
2. Increase sense of belonging

Motivation

the ultimate goal of the K–12 mathematics curriculum should not be to get students into and through a course in calculus by twelfth grade but to have established the mathematical foundation that will enable students to pursue whatever course of study interests them when they get to college

MAA/NCTM Joint Position Statement on Teaching Calculus

Motivation



PEERs: Persons Excluded based on Ethnicity or Race

STEM Ready Team

DUE IUSE 1900036

Bethany Bowling (PI)
Assoc. Dean, College of Arts & Sciences

Seth Adjei (Co-PI)
Computer Science

Brooke Buckley (Co-PI)
Math/Stat Dept Chair

Patrick Hare
Chemistry

Axel Brandt (Co-PI)
Mathematics

Josh Cooper
Biology

STEM Ready

DUE IUSE
1900036

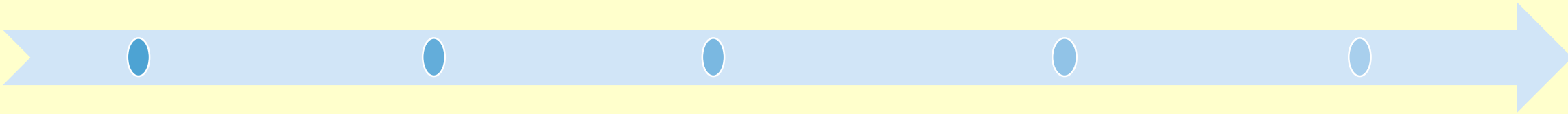
Primary Objective

- Test mechanisms to address mathematics preparation in a reduced amount of time to increase STEM retention and graduation rates

Primary Mechanism

- Develop two-week bridge programs to improve math readiness for students interested in STEM

Annual Timeline



Recruit Students

- Online and residential formats
- Coordinate with Admissions
- Applications

Select and Assign Students

- Prioritized selection of PEERs, First-Gen, Low-Income
- Random assignment to online vs residential

Two-Week Summer Bridge Program

- ALEKS
- STEM research projects
- Study skills
- Campus Tours of STEM spaces

Reassess Math Placement

- ALEKS
- Fill reserved seats in calculus-sequence courses

Continued Support

- First-Year Seminar Sequence
- Mathematics Support via continued ALEKS access

Summer Program Math Skills

	Su	M	T	W	R	F	Sa	Su	M	T	W	R	F
7:00													
8:00		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Move-Out & Celebration Breakfast
9:00		Welcome, Intros & Logins	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS Skills Assesment 2	ALEKS	Research Exploration	ALEKS	ALEKS Skills Assessment 3
10:00		ALEKS Skills Assessment 1	Break / Travel	Break / Travel	Break / Travel	Break / Travel				Break / Travel	Break / Travel	Break / Travel	
11:00			Research Exploration	ALEKS	Research Exploration	ALEKS			Break?	Research Exploration	ALEKS	Research Exploration	
12:00		Break / Travel	Lunch	Lunch	Lunch	Lunch			Lunch	Lunch	Lunch	Lunch	Working Lunch & Practice Talks
1:00		Campus Connections	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS & 1-1 Progress Chats	ALEKS	Tips for STEM Talks & Group Formation	ALEKS	
2:00		Break				Break / Travel						Break / Travel	Research Presentation Preparation
3:00		Growth Mindset	Highlight: Campus Rec	Highlight: Science Center	Metacognition / Study Cycle	ALEKS			Highlight: Game Room	Highlight: Learning PLUS	Highlight: CINSAM/ISRCA	Research Presentation Preparation	Break
4:00	Move-In	ALEKS	Research Exploration	ALEKS	Research Exploration	Break			Research Exploration	Research Exploration	ALEKS	Break	Research Presentations
5:00		Break	Break	Break	Break				Break	Break	Break		
6:00	Welcome Picnic	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	
7:00		Social	Social	Social	Social	Social			Social	Social	Social	Social	
8:00													

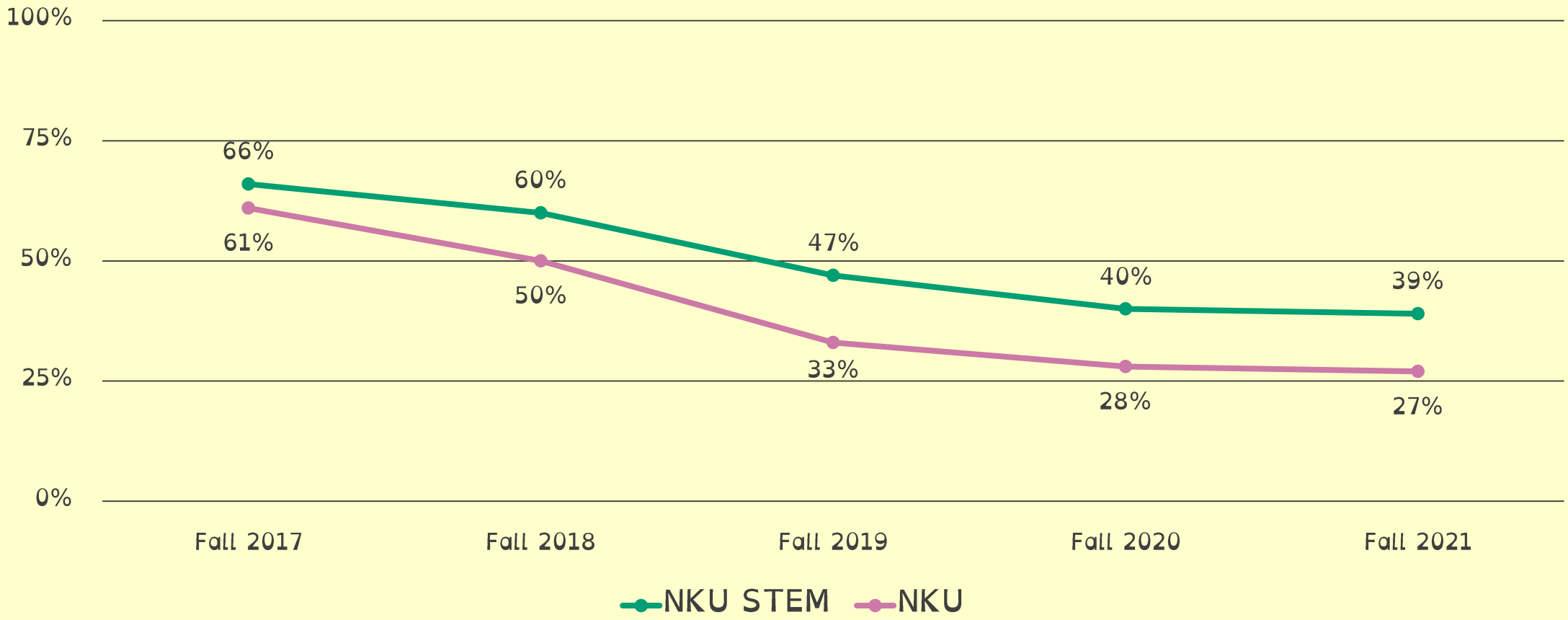
Summer Program Study Skills

	Su	M	T	W	R	F	Sa	Su	M	T	W	R	F
7:00													
8:00		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Move-Out & Celebration Breakfast
9:00		Welcome, Intros & Logins	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS Skills Assesment 2	ALEKS	Research Exploration	ALEKS	
10:00		ALEKS Skills Assessment 1	Break / Travel	Break / Travel	Break / Travel	Break / Travel				Break / Travel	Break / Travel	Break / Travel	ALEKS Skills Assessment 3
11:00			Research Exploration	ALEKS	Research Exploration	ALEKS			Break?	Research Exploration	ALEKS	Research Exploration	
12:00		Break / Travel	Lunch	Lunch	Lunch	Lunch			Lunch	Lunch	Lunch	Lunch	Working Lunch & Practice Talks
1:00		Campus Connections	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS & 1-1 Progress Chats	ALEKS	Tips for STEM Talks & Group Formation	ALEKS	
2:00		Break				Break / Travel						Break / Travel	Research Presentation Preparation
3:00		Growth Mindset	Highlight: Campus Rec	Highlight: Science Center	Metacognition / Study Cycle	ALEKS			Highlight: Game Room	Highlight: Learning PLUS	Highlight: CINSAM/ISRCA	Research Presentation Preparation	Break
4:00	Move-In	ALEKS	Research Exploration	ALEKS	Research Exploration	Break			Research Exploration	Research Exploration	ALEKS	Break	Research Presentations
5:00		Break	Break	Break	Break				Break	Break	Break		
6:00	Welcome Picnic	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	
7:00		Social	Social	Social	Social	Social			Social	Social	Social	Social	
8:00													

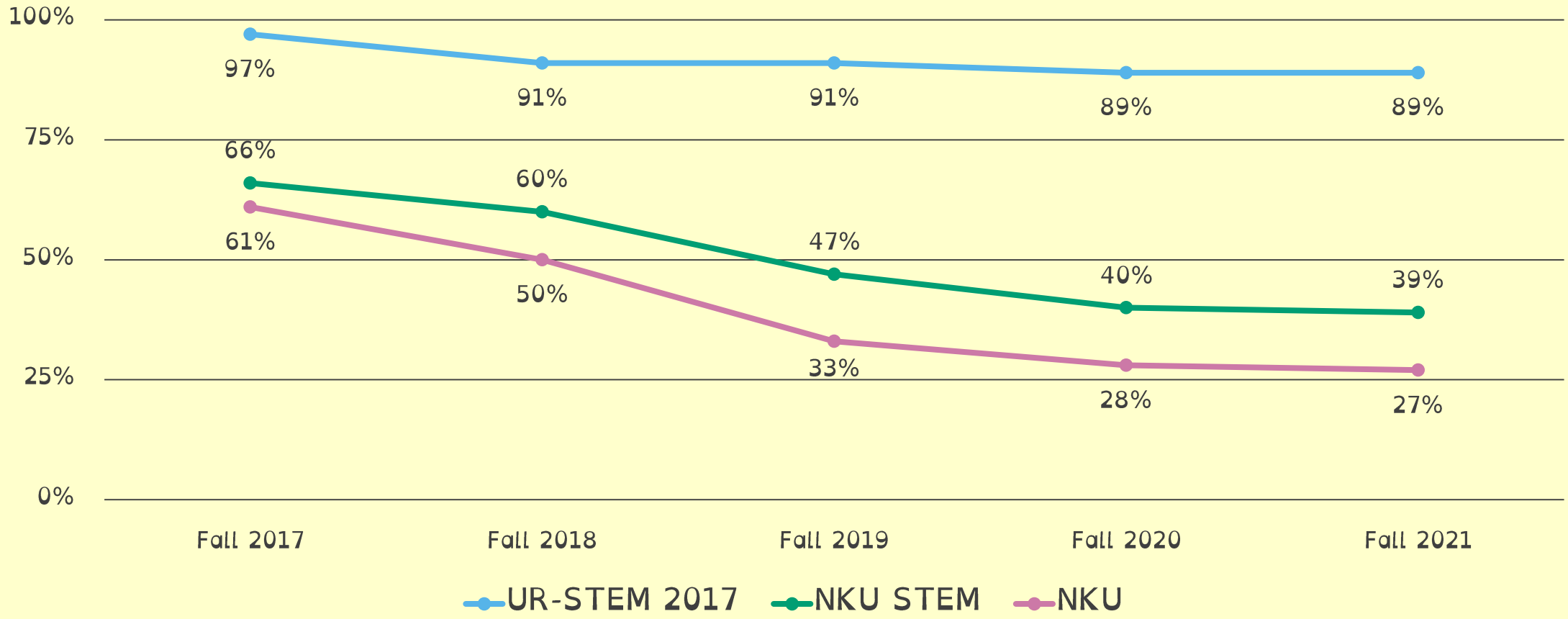
Summer Program Belonging

	Su	M	T	W	R	F	Sa	Su	M	T	W	R	F
7:00													
8:00		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Move-Out & Celebration Breakfast
9:00		Welcome, Intros & Logins	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS Skills Assesment 2	ALEKS	Research Exploration	ALEKS	
10:00		ALEKS Skills Assessment 1	Break / Travel	Break / Travel	Break / Travel	Break / Travel				Break / Travel	Break / Travel	Break / Travel	ALEKS Skills Assessment 3
11:00			Research Exploration	ALEKS	Research Exploration	ALEKS			Break?	Research Exploration	ALEKS	Research Exploration	
12:00		Break / Travel	Lunch	Lunch	Lunch	Lunch			Lunch	Lunch	Lunch	Lunch	Working Lunch & Practice Talks
1:00		Campus Connections	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS & 1-1 Progress Chats	ALEKS	Tips for STEM Talks & Group Formation	ALEKS	
2:00		Break											Research Presentation Preparation
3:00		Growth Mindset	Highlight: Campus Rec	Highlight: Science Center	Metacognition / Study Cycle	Break / Travel			Highlight: Game Room	Highlight: Learning PLUS	Highlight: CINSAM/ISRCA	Break / Travel	Break
4:00	Move-In	ALEKS	Research Exploration	ALEKS	Research Exploration	ALEKS			Research Exploration	Research Exploration	ALEKS	Research Presentation Preparation	Research Presentations
5:00		Break	Break	Break	Break	Break			Break	Break	Break	Break	
6:00	Welcome Picnic	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	
7:00		Social	Social	Social	Social	Social			Social	Social	Social	Social	
8:00													

Retention in Department



Retention in Department



UR-STEM

DUE STEP
0969280

NKU STEM
Center

- Paid summer research with open application
- Prioritized selection model to include students at-risk of leaving a STEM major
    - No STEM experience (e.g. research, STEM job)
    - Struggle in STEM course
    - First-Year
    - PEERs
    - First-Generation
    - Low-SES
    - Female (in comp sci, physics, engineering)

Team: Vaughn, Henderson, Bowling, Kulkarni, Hokkanen

Summer Program STEM Research

	Su	M	T	W	R	F	Sa	Su	M	T	W	R	F
7:00													
8:00		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Move-Out & Celebration Breakfast
9:00		Welcome, Intros & Logins	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS Skills Assesment 2	ALEKS	Research Exploration	ALEKS	
10:00		ALEKS Skills Assessment 1	Break / Travel	Break / Travel	Break / Travel	Break / Travel				Break / Travel	Break / Travel	Break / Travel	ALEKS Skills Assessment 3
11:00			Research Exploration	ALEKS	Research Exploration	ALEKS			Break?	Research Exploration	ALEKS	Research Exploration	
12:00		Break / Travel	Lunch	Lunch	Lunch	Lunch			Lunch	Lunch	Lunch	Lunch	Working Lunch & Practice Talks
1:00		Campus Connections	ALEKS	Research Exploration	ALEKS	Research Exploration			ALEKS & 1-1 Progress Chats	ALEKS	Tips for STEM Talks & Group Formation	ALEKS	
2:00		Break											Research Presentation Preparation
3:00		Growth Mindset	Highlight: Campus Rec	Highlight: Science Center	Metacognition / Study Cycle	Break / Travel			Highlight: Game Room	Highlight: Learning PLUS	Highlight: CINSAM/ISRCA	Break / Travel	Break
4:00	Move-In	ALEKS	Research Exploration	ALEKS	Research Exploration	ALEKS			Research Exploration	Research Exploration	ALEKS	Research Presentation Preparation	Research Presentations
5:00		Break	Break	Break	Break	Break			Break	Break	Break	Break	
6:00	Welcome Picnic	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	
7:00		Social	Social	Social	Social	Social			Social	Social	Social	Social	
8:00													

Program Iterations

Summer 2020

Only Online – 19 Participants

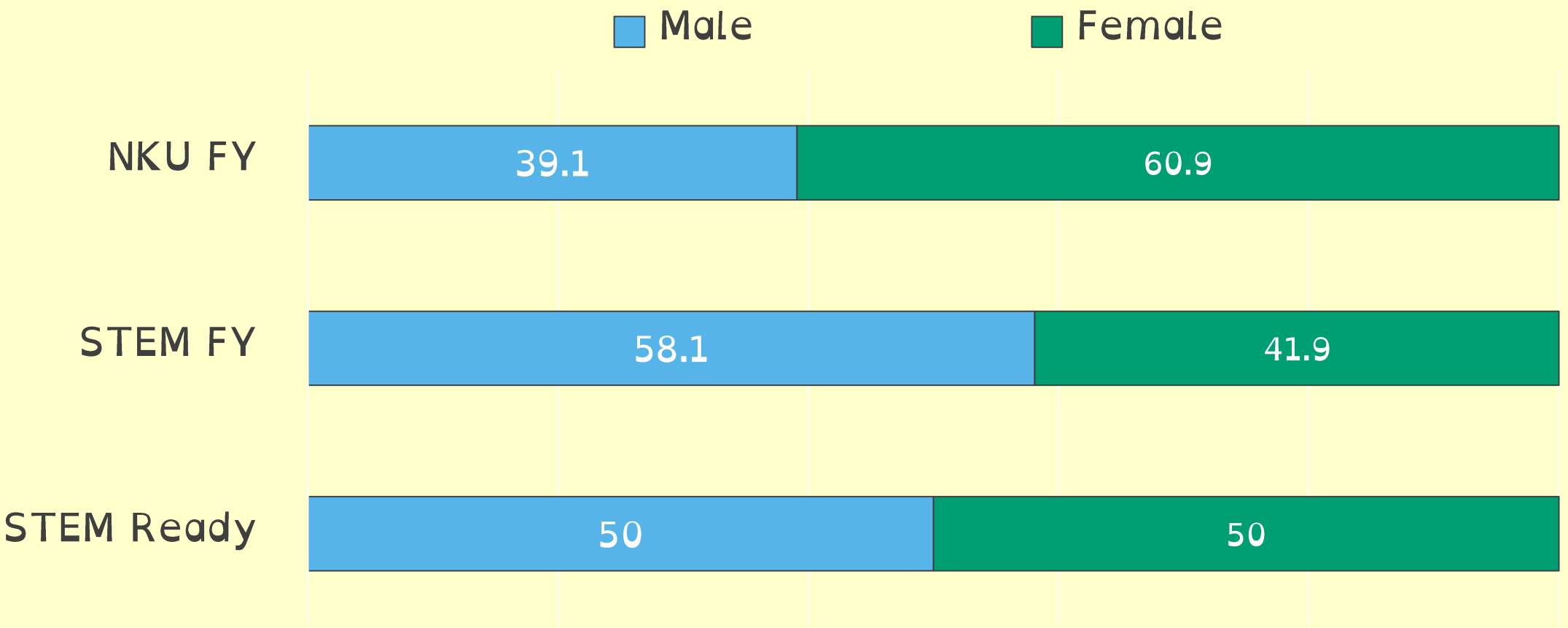
Summer 2021

Only Residential – 14 Participants

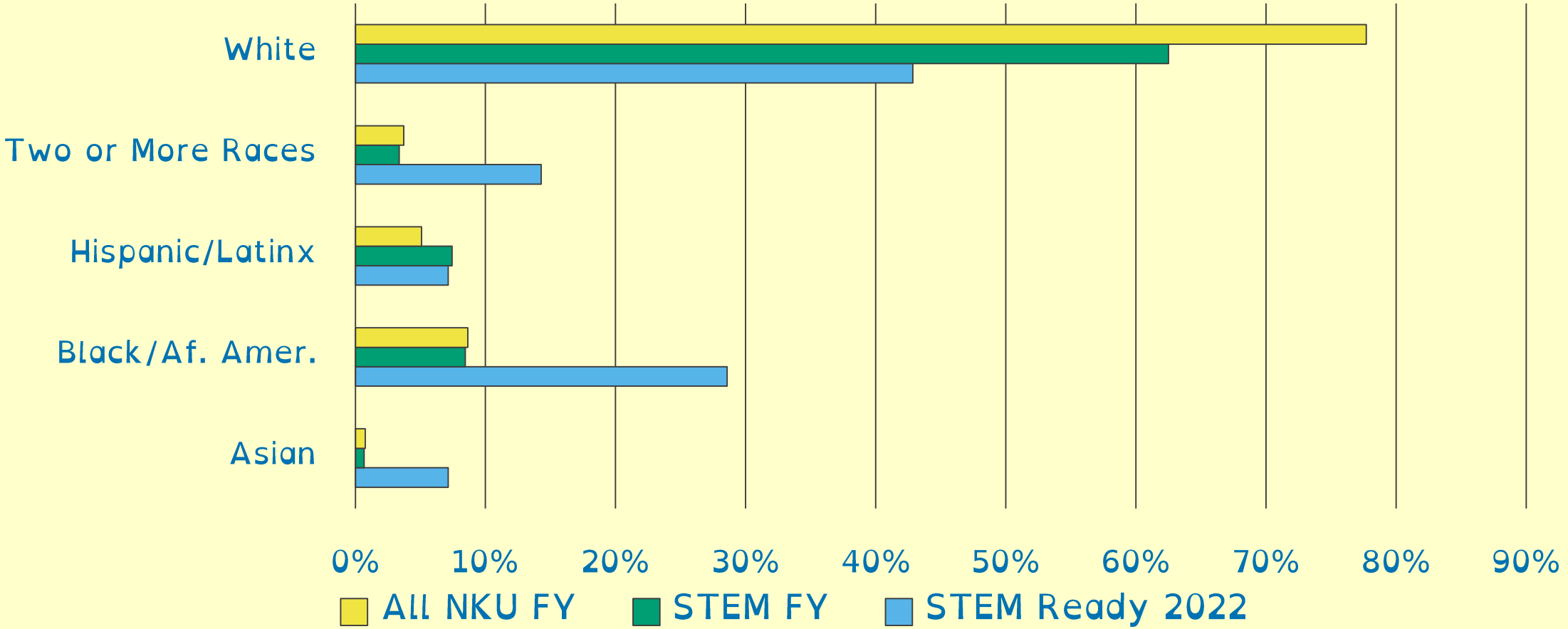
Summer 2022

Only Residential – 22 Participants

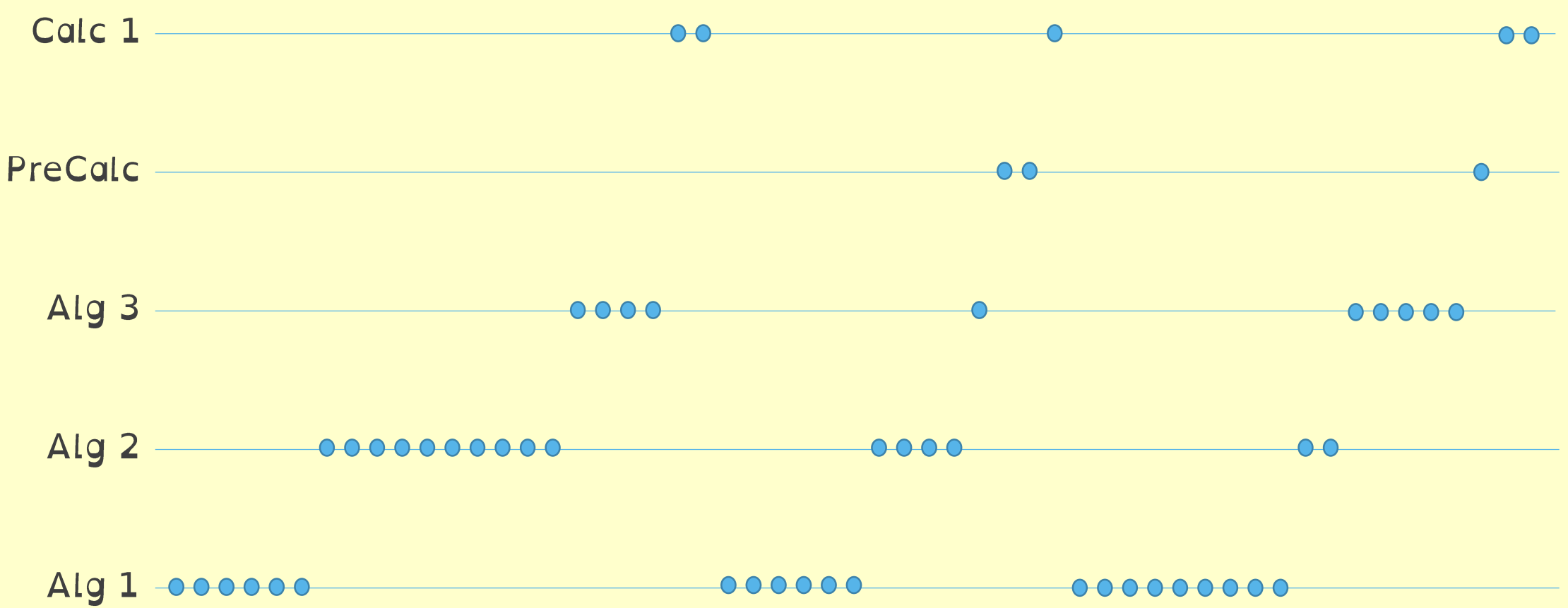
2022 Cohort Demographics Gender



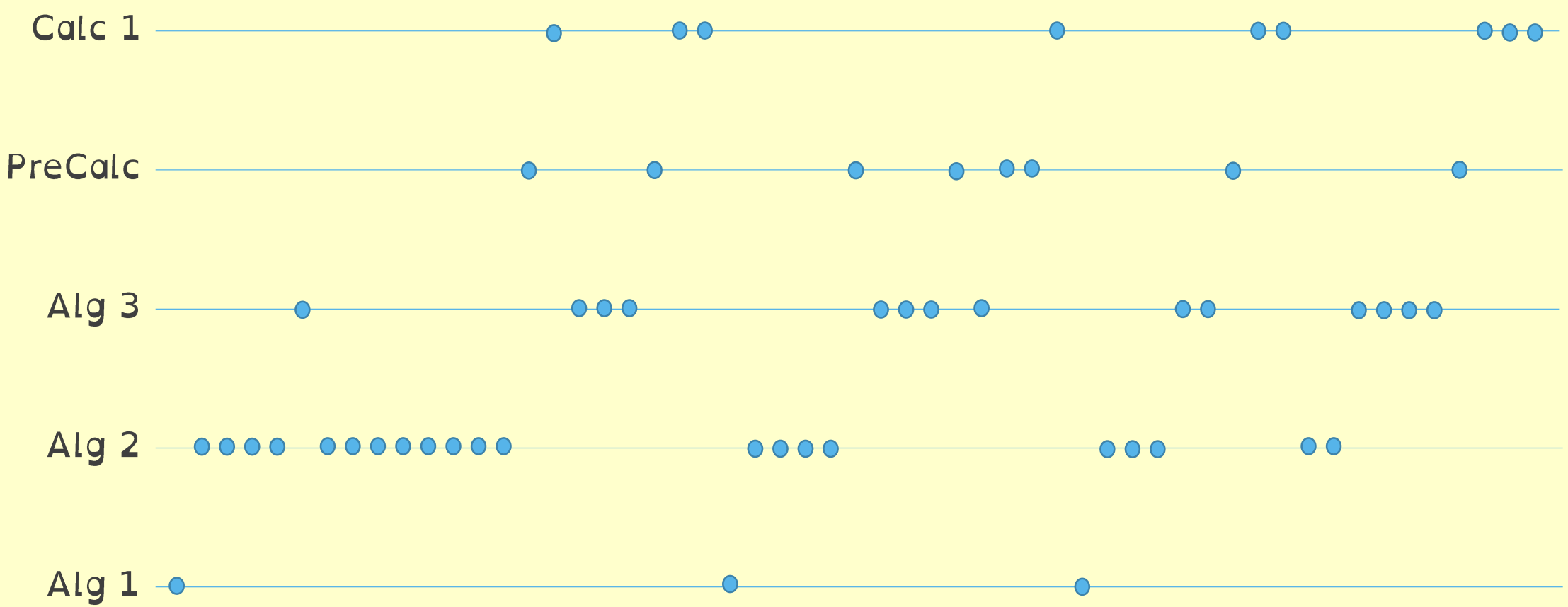
2022 Cohort Demographics Race



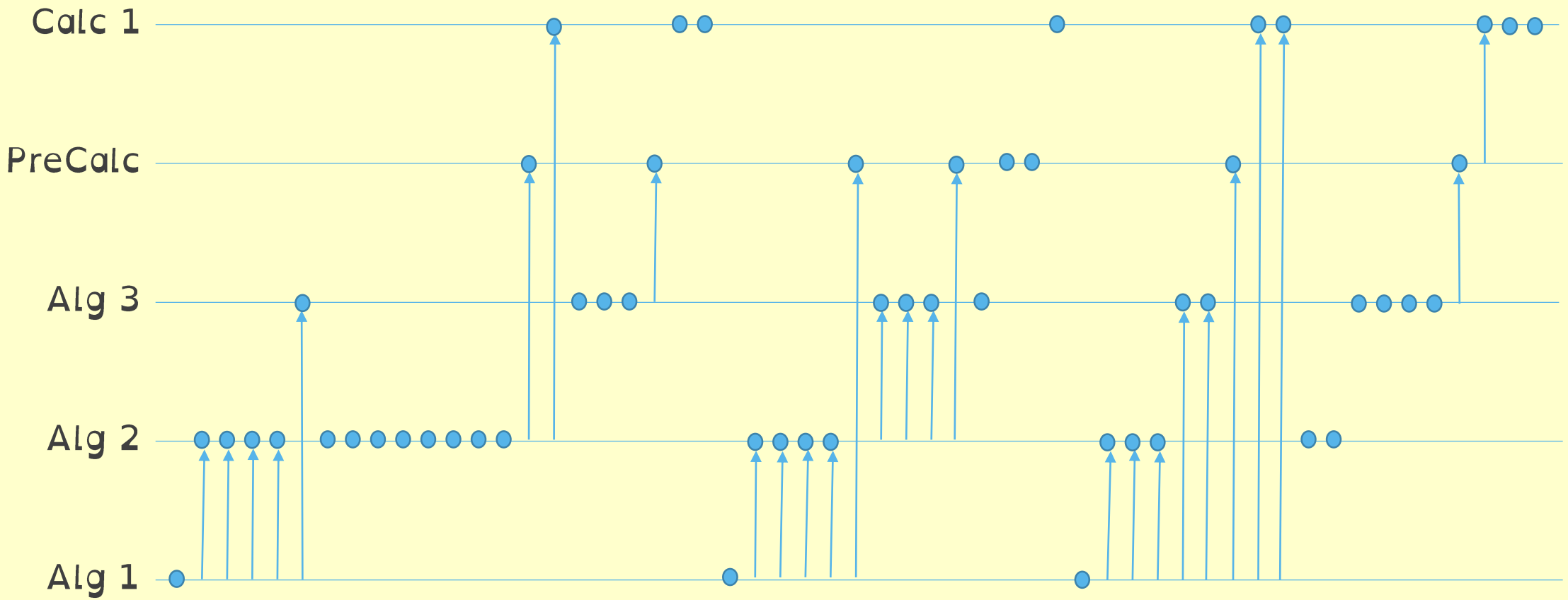
Outcomes Course Placement (Pre)



Outcomes Course Placement (Post)



Outcomes Improved Course Placement



Outcomes By the Numbers

	Cohort 1 (Summer 2020)	Cohort 2 (Summer 2021)	Cohort 3 (Summer 2022)
# of Participants	19	14	22
Delivery Method	Online	On Campus	On Campus
Hours in ALEKS	15 hours	23 hours	---
Improved Placement	8 (42%)	9 (64%)	9 (47%)

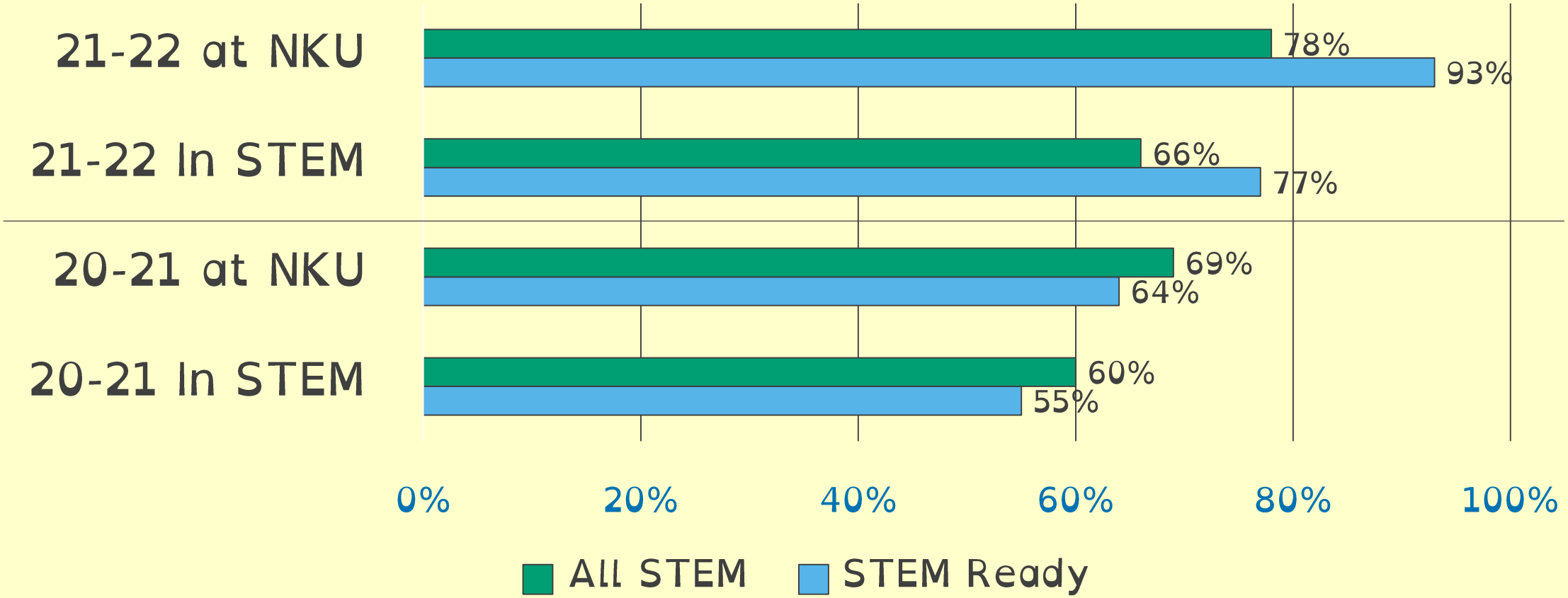
Outcomes Academic Success (Math GPA)

	Summer 2020		Summer 2021	
	STEM Ready	All STEM	STEM Ready	All STEM
1st Fall GPA	2.378	2.467	3.061	2.773
1st Spring GPA	2.804	2.568	3.111	2.408
ACT Math	22.2	24.98	21.4	22.96

Outcomes Academic Success (Semester GPA)

	Summer 2020		Summer 2021	
	STEM Ready	All STEM	STEM Ready	All STEM
1st Fall GPA	2.556	2.526	2.994	2.897
1st Spring GPA	2.475	2.713	3.041	2.743
ACT Math	22.2	24.98	21.4	22.96

Outcomes Fall-Fall Retention



Summary Comparison

- On Campus > Online *

Residential Cohort vs All First-Year STEM

- Lower ACT but favorable academically
- Same/better academically
- Better retention

Research Project Priorities

1. Draw connections b/w math & other STEM fields
2. Accessible to students with diverse mathematics preparation and scientific interests/backgrounds
3. Open-ended
4. Fit in 6-hour timeframe
5. Well-suited for in-person and online facilitation
6. Scalable to larger cohorts
7. Investigate real-world problems

Value of UG Research

- Recruit, and then retain, the best students … primarily a teaching effort on the part of faculty

2013 AMS Culture Statement on UG Research

- Educational benefits for student participants – including and especially those from demographic groups historically underserved by higher education

AAC&U (Kuh, 2008)

Thank You

Dyslexia-Friendly Font Info
(and other accessibility tips)

Slides

Axel Brandt (he/him)
abrandt@jcu.edu

STEM Ready Biology Research Project

Goal of the Project

- Assemble genomes of potentially antibiotic resistant bacteria and identify if they are pathogenic

Tool Used

- Department of Energy Systems Biology Knowledgebase (KBase) – Webserver with bioinformatic tools

Mathy Bit

- Calculating coverage statistics for sequencing DNA

STEM Ready Chemistry Research Project

Goal of the Project

- Find a potential new fire suppressor molecule through computational chemistry and thermodynamics calculations

Tools Used

- Gaussian (professional computational chemistry software)
- WebMO, a web-based computational chemistry interface

Mathy Bits

- Systems of equations for enthalpies of combustion
- Discussion of geometric optimization algorithms

STEM Ready Data Science Research Project

Goal of the Project

- Select a dataset and create visualizations to answer client specific questions

Tool used

- City of Cincinnati Open Data Portal

Mathy Bit

- Application of basic data analysis and visualization

UR-STEM Eligibility and Prioritization System

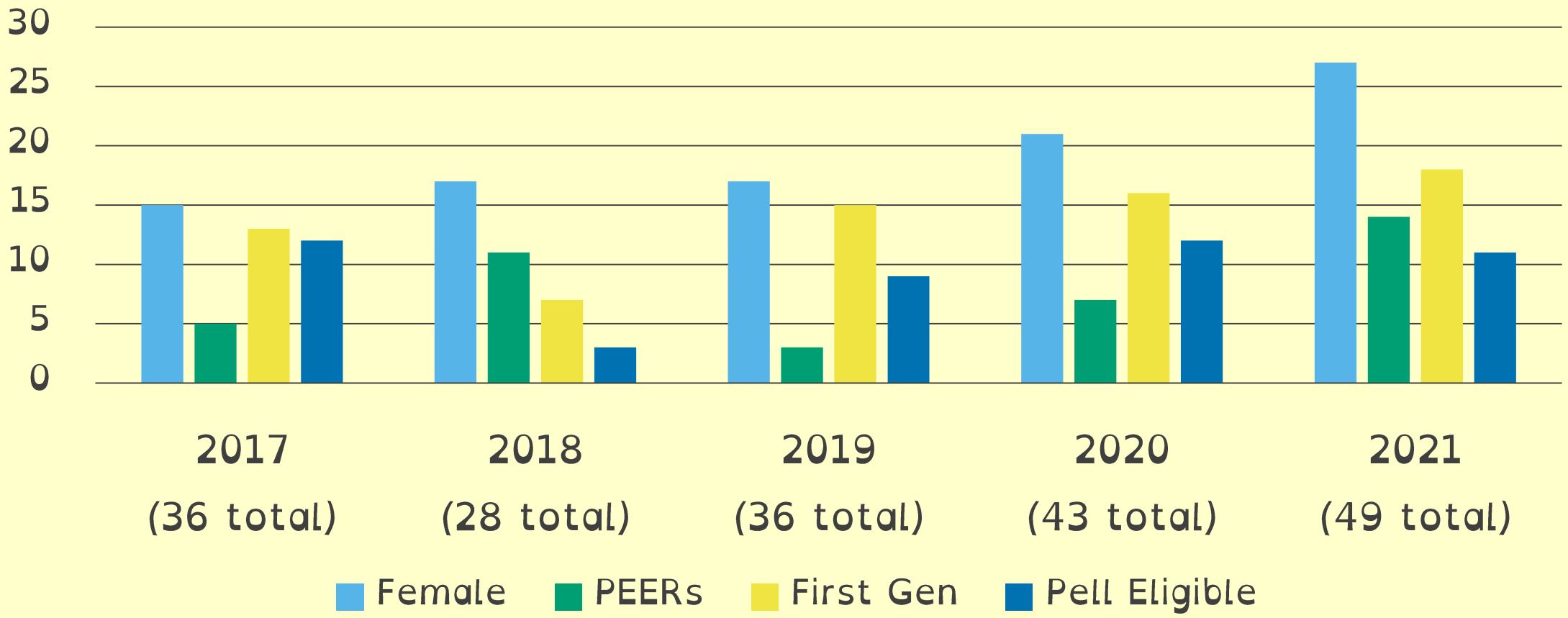
Eligibility

- No prior research experience
- UG registered for fall semester
- Faculty reference listed in application

Prioritization (max 11 pts)

- Enrollment Year
  1st → 4 pts, 2nd → 2 pts
- Struggle in Required Course
  C/D → 2 pts, B → 1 pt
- No STEM Employment → 1 pt
- Non-STEM Student* → 1 pt
- PEER or Female** → 1 pt
- First Gen → 1 pt
- Pell Recipient → 1 pt

UR-STEM Participant Demographics



UR-STEM Math/Stat Projects

- Sports Statistics golf handicaps, Rule of 71
- PIC Mathy actuarial projects, Nature Center data
- Machine Learning algae blooms, trees
- Connection to Arts music composition, fxn viz
- Graph Theory traveling salesman, pursuit-evasion
- Special Interest alternative voting methods

UR-STEM Coasters Done Quick

- Traveling Salesman at local amusement park
- 4 Student Team
  - 2 Math/Stat double
  - Comp Sci (math minor)
  - Chemistry
- SageMath

UR-STEM Searching Networks

- Pursuit-Evasion on Graphs

- 3 Student Team
  - Math/Stat
  - Math/Physics
  - Math/Stat/Comp Sci

- Virtual

UR-STEM (CURM inspired) Project Timeline

Mathy Bits

- Jump in Deep End
- Drink from Fire Hose
- Bare Bones of LaTeX
- Follow Interests

Surrounding Bits

- Collaboration Personas
- Emotional Rollercoaster
- Poster 2.0
- Communication Practice