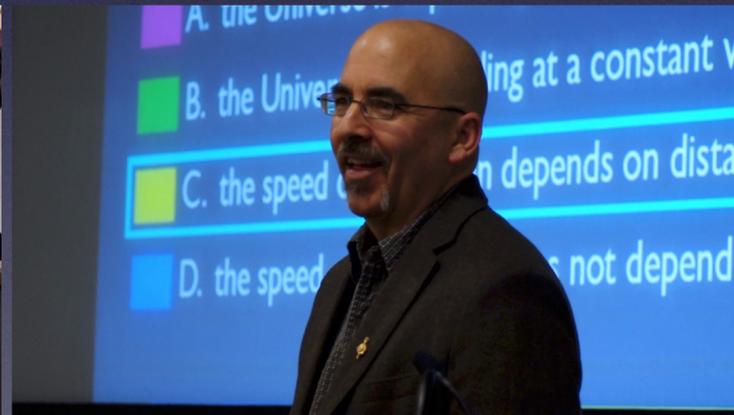


A Bridge to the Stars: An Equity-Minded Early-College Experience for Broadening Participation in STEM

Daniel H. McIntosh, PhD

**Chair & Professor of UMKC Physics & Astronomy
Director of STEM Education Innovation
Missouri Institute for Defense & Energy (MIDE)**

**2018-2019 Provost Fellow (STEM+M Ecosystem Framework)
2017-2019 Norman Royall Distinguished Professor
2016 U Missouri President's Award for Innovative Teaching**



UMKC Today

A Bridge to the Stars

Published on September 15, 2016



Photo by Brandon Parigo, Division of Strategic Marketing and Communications

An innovative pipeline to improve STEM diversity

Inner-city high school students in Kansas City now have a unique opportunity to learn in a college classroom with a professional astronomer through A Bridge to the Stars Scholarship and Mentoring Program at the University of Missouri-Kansas City.

The man behind the program is Daniel H. McIntosh, Ph.D., an award-winning professor of physics and astronomy, and a scientist researching the birth and growth of galaxies using the Hubble Space Telescope. As a teacher, McIntosh shares his knowledge, and his enthusiasm, to inspire others.

The Bridge to the Stars Program is a way to reach high school students when they are still excited about learning. McIntosh's program provides low-income and underrepresented minority students,

“Through this program, we’re providing students with high impact exposure to science through innovative experiential learning with a professional scientist. It’s a bridge between high school and college, and it fosters student success.”

— Prof. McIntosh

“A great program taught by a very inspired professor!”

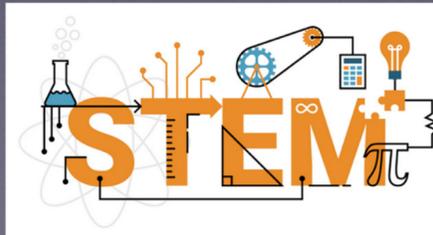
— Dr. Larry Weible
(East H.S. Science Chair)

“This program is not something that happens to you, it is something you are a part of.”

— Derrick Jennings II
(ABttS Mentoring Intern)



**MO DHEWD Bridges to Success
Webinar Series
March 17, 2022**



A Bridge to the Stars in a Nutshell

This equity-minded initiative is designed to give historically underserved and underrepresented 10th & 11th graders an early-college experience at UMKC through tuition support, enrollment, and near-peer mentoring in a student-centered introductory astronomy course.

Benefits participants with an immersive, confidence-building experience to increase the likelihood that they matriculate to college and persist through their crucial first year.



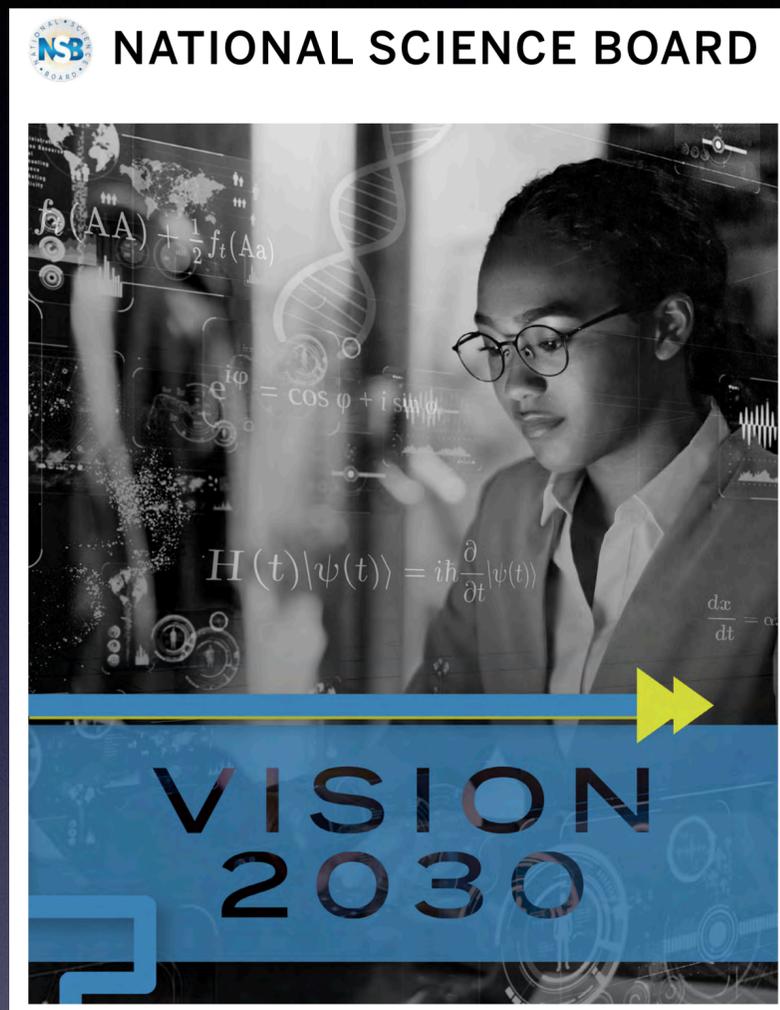
High-school Scholars & UMKC Mentors (Spring 2017).



A Bridge to the Stars is made possible by funding from the NASA Missouri Space Grant

- ✦ 81 tuition scholarships over 11 semesters
(*73 unique students from 14 KC high schools*)
- ✦ equity-minded selection for participation
(*70% URM's 70% non-male >90% low-\$*)
- ✦ 95% success rate
(*Scholar passed course, earned college credit*)
- ✦ confidence building & sense of belonging
(*no achievement gap between Scholars and UMKC students enrolled in same courses*)
- ✦ Long-term tracking of former Scholars:
(*40% of Scholars pursued/pursuing 4-year degree, 60% in STEM*)

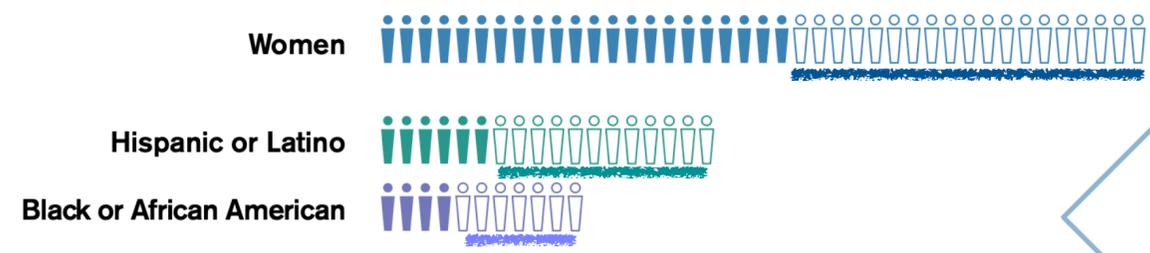
A More Representative Science & Engineering Workforce is a National Goal



NSB 2020 (<https://www.nsf.gov/nsb/publications/2020/nsb202015.pdf>)

FIGURE 2: MISSING MILLIONS: FASTER PROGRESS IN INCREASING DIVERSITY NEEDED TO REDUCE SIGNIFICANT TALENT GAP

While the number of people from under-represented groups in the S&E workforce has grown over the past decade, much faster increases will be needed for the S&E workforce to be representative of the U.S. population in 2030. To achieve that goal, the NSB estimates that the number of women must nearly double, Black or African Americans must more than double, and Hispanic or Latinos must triple the number that are in the 2020 U.S. S&E workforce. These estimates are based on projections from the U.S. Census and Bureau of Labor Statistics, together with data from the National Center for Science and Engineering Statistics, and assume that participation of these groups in the S&E workforce increases at current rates.



Legend

x 100,000 people in 2020 S&E workforce

x 100,000 additional people needed in 2030 for the S&E workforce to representative of the U.S. population



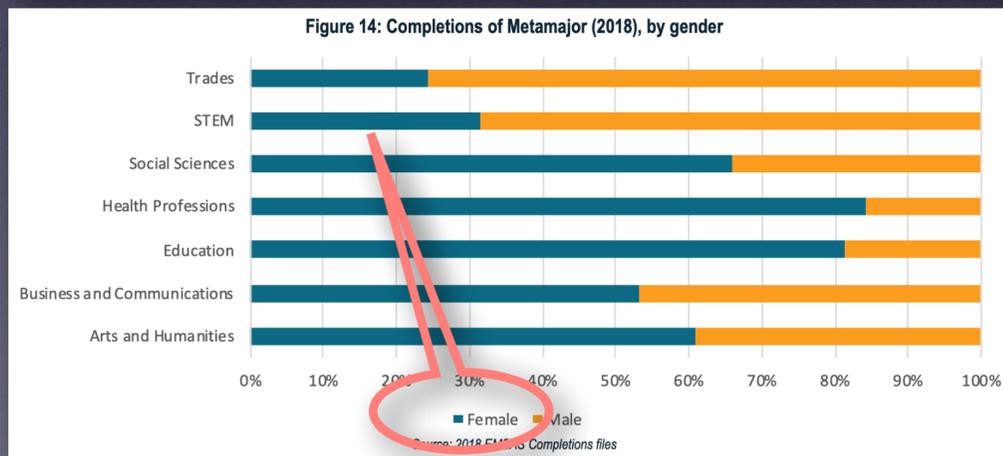
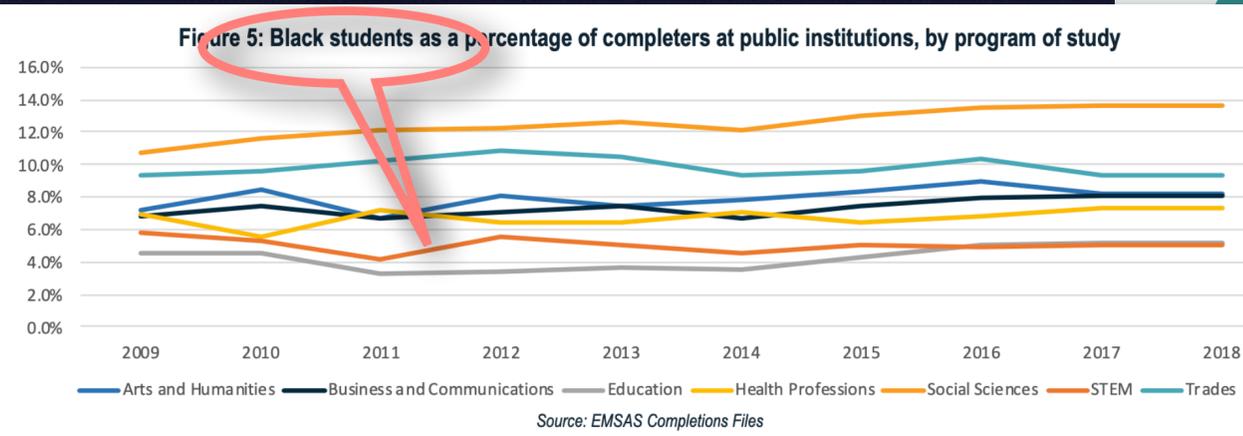
Regional Pressures to Increase & Broaden 4-Year STEM Degree Production to Meet Future Workforce Demands



FEBRUARY 2022

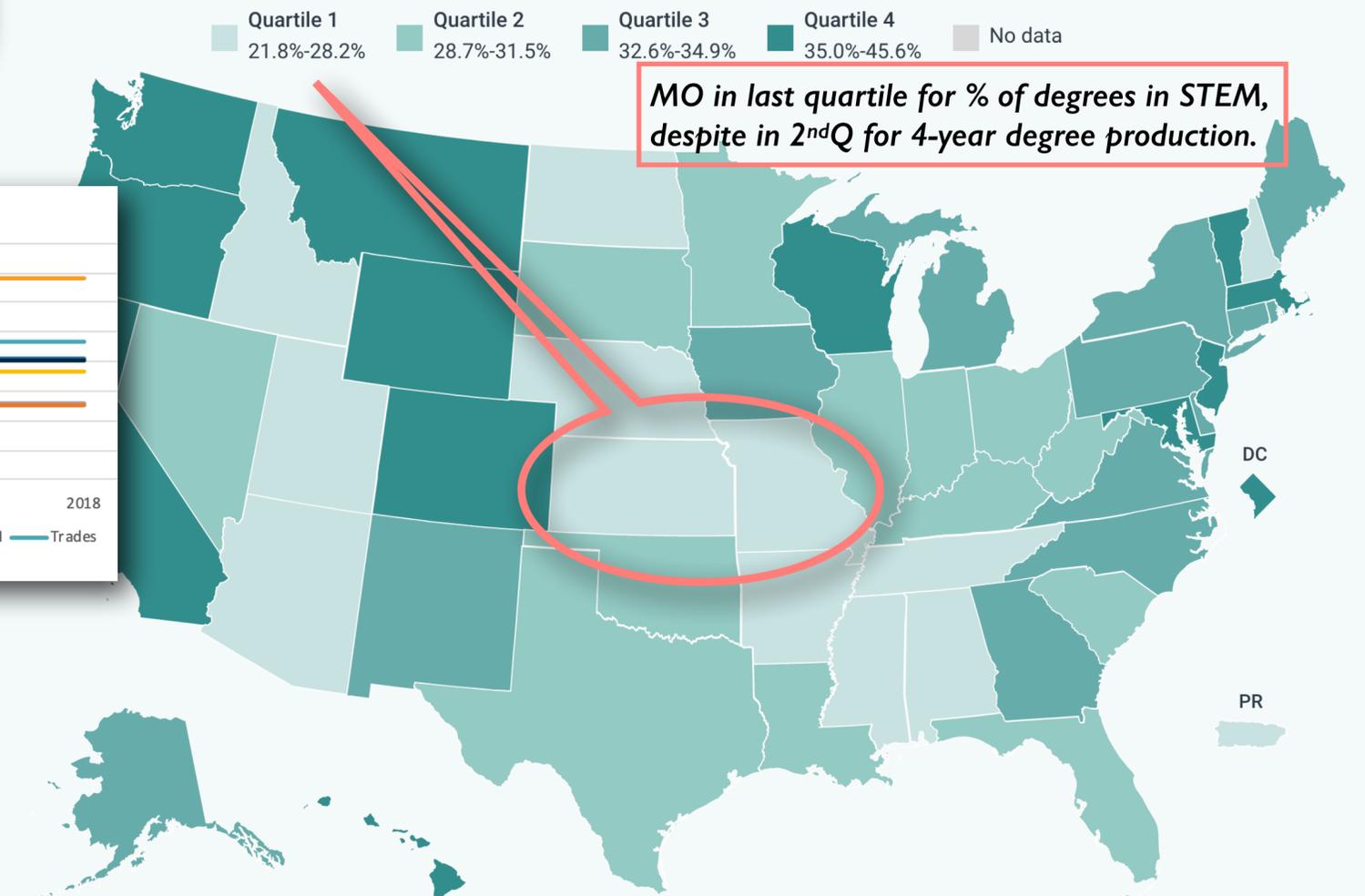
The [State of U.S. Science and Engineering 2022](#) report confirms that there continues to be large disparities in STEM education and student performance across demographic and socioeconomic categories and geographic regions.

e.g., STEM degree attainment disparities by race & gender persist ...



Science and Engineering Degrees as a Percentage of Higher Education Degrees Conferred (latest data: 2019)

This indicator represents the extent to which a state's higher education degree awards are concentrated in S&E fields. S&E fields include the physical, life, earth, ocean, atmospheric, computer, and social sciences; mathematics; engineering; and psychology. Counts of both S&E degrees and higher education degrees conferred include bachelor's, master's, and doctoral degrees; associate's degrees and professional degrees are not included.



QUICK TIP Because students may move across state lines after receiving their degrees, this indicator does not necessarily predict the qualifications of a state's future workforce.

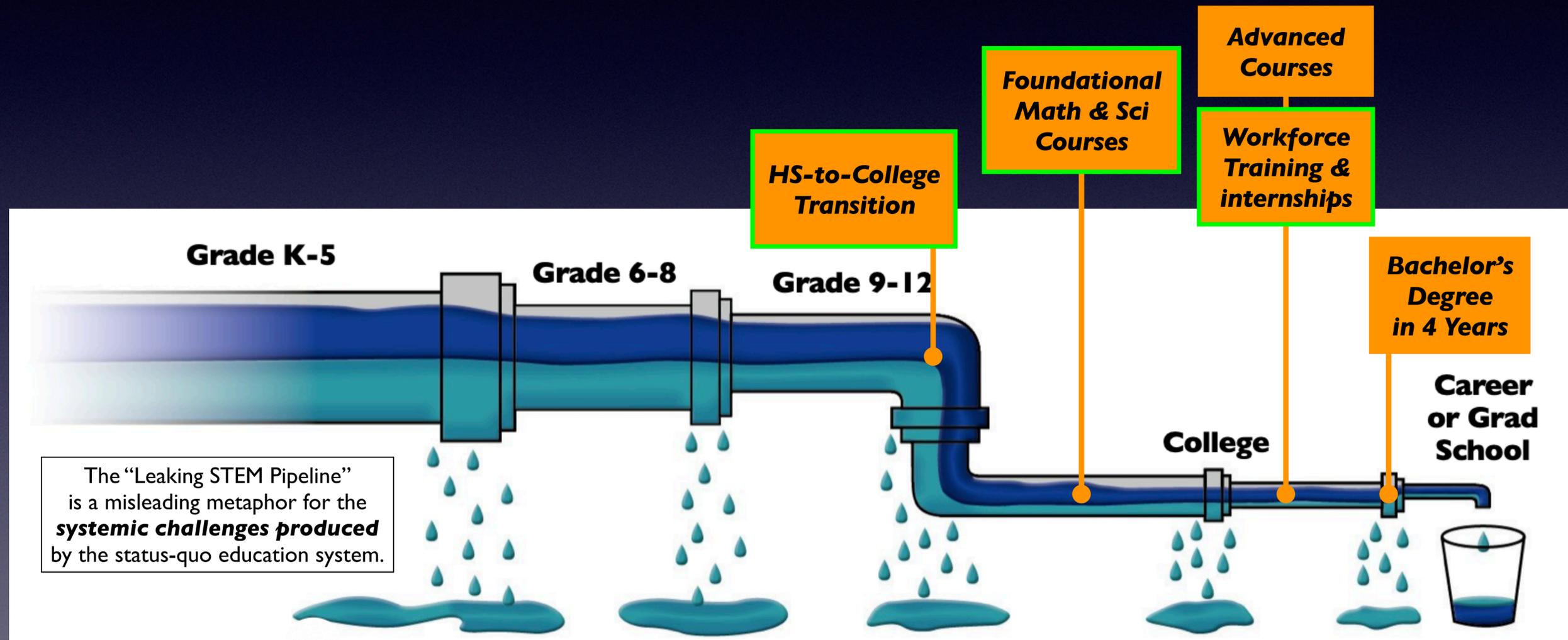
<https://nces.nsf.gov/indicators/states/indicator>

<https://dhewd.mo.gov>

Key Attrition Points to College Student Success in STEM

College Student Success: gain discipline-specific skills and content mastery, gain 21st century workforce skills, and graduate with desired Bachelor's degree.

Addressing persistent challenges to growing, broadening, and better preparing the future STEM workforce.



Losses of students at every step of the STEM education pathway is disproportionately greater for underrepresented groups based on race, income, and gender.

Vision for Rethinking STEM Higher Education

Aspirational Goal: A Thriving Higher-Education Ecosystem

Will Help Students From All Backgrounds
Persist to Success

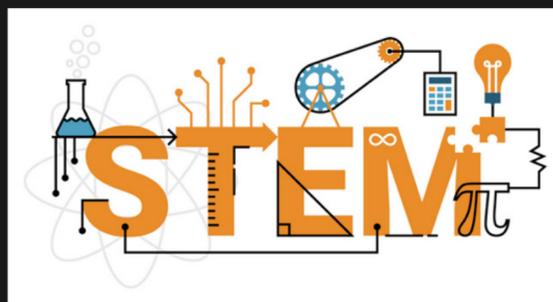
Inclusive
Excellence

Inclusion

Broadened
Participation

Opportunity

Access

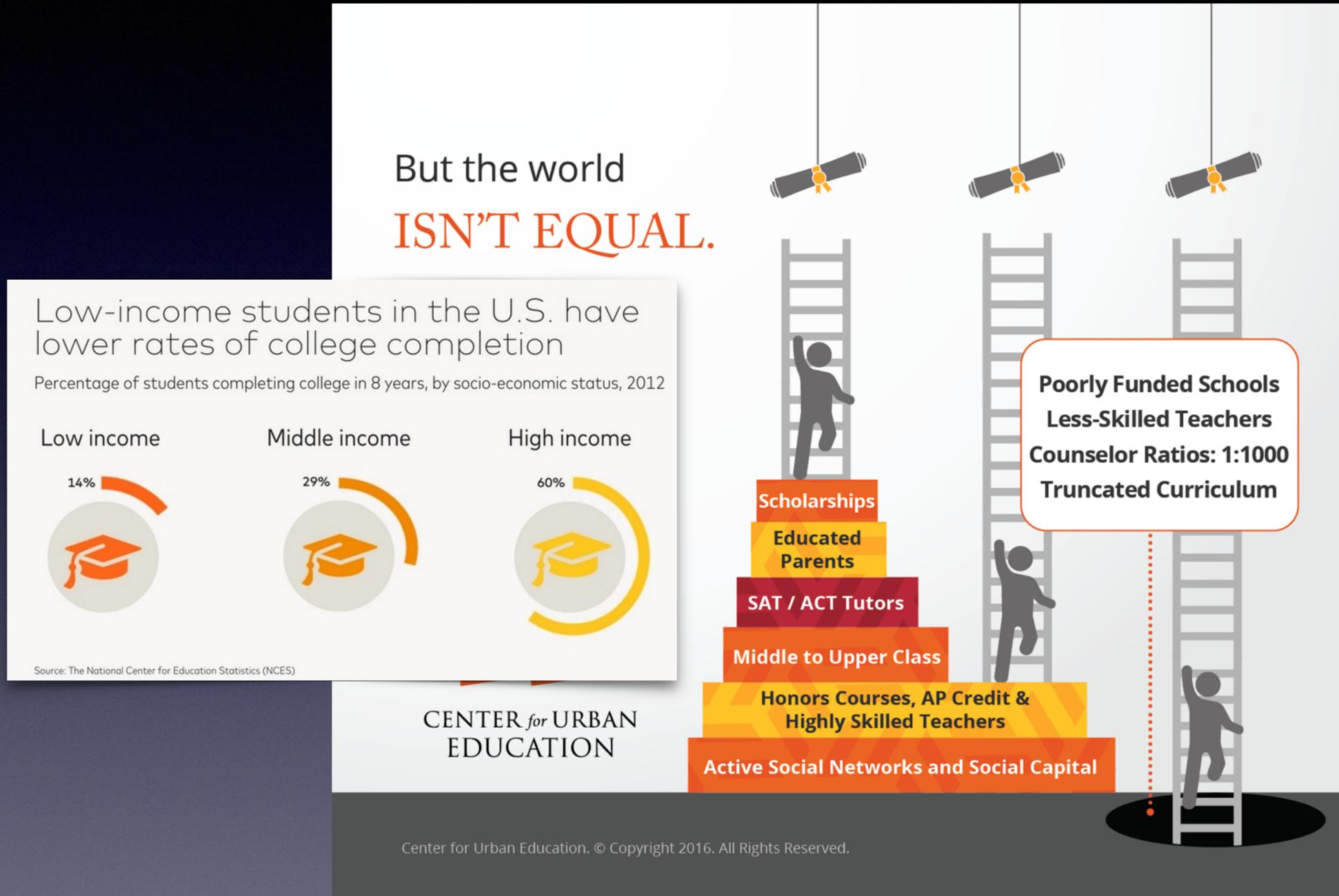


To truly **broaden success**, we must do more than provide access to opportunity. We must encourage inclusive engagement in learning and STEM workforce skill development. The outcome will not only be vast improvements in equity, but a thriving educational system that helps all students achieve their full potential.

1. Student-centered teaching (*intentional* with regard to student engagement and learning outcomes)
2. Equity-mindedness (*intentional* with regard to fostering a sense of belonging and removing barriers to inclusion)
3. Supporting faculty adoption and success with best practices (*intentional* with regard to faculty roles and incentives)

An Equity-Minded Approach

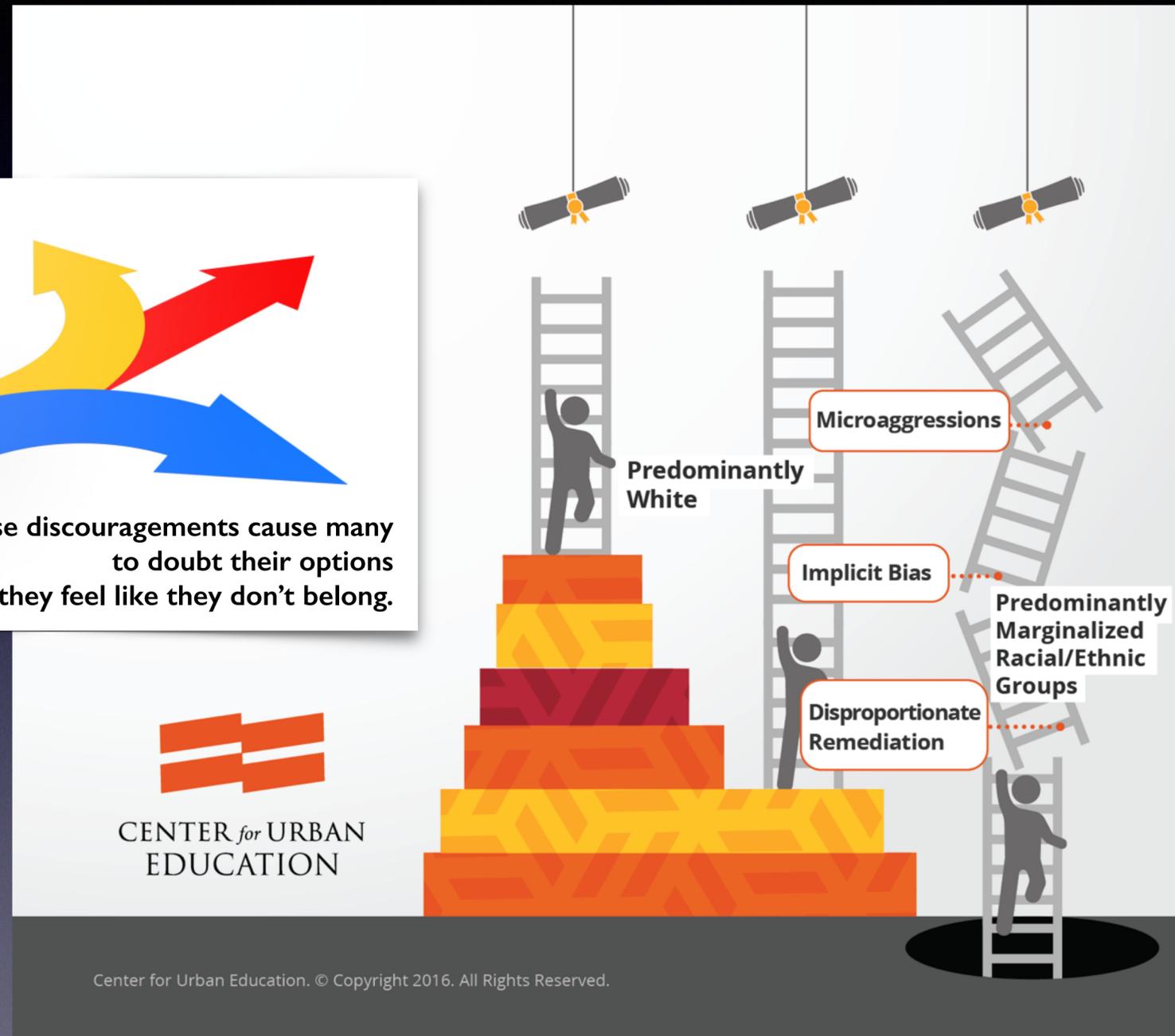
ABttS is intentional with regard to fostering a sense of belonging and removing barriers to inclusion:



- Scholarship selection is needs-based (>90% of participants have free/reduced lunch).

An Equity-Minded Approach

ABttS is intentional with regard to fostering a sense of belonging and removing barriers to inclusion:



- Scholarship selection is needs-based (>90% of participants have free/reduced lunch).
- Scholarship selection is based on aspirations rather than HS academic performance.
- Program focus is on student success utilizing evidence-based teaching & mentoring practices.

Vision for Rethinking STEM Higher Education

Aspirational Goal: A Thriving Higher-Education Ecosystem

Will Help Students From All Backgrounds
Persist to Success

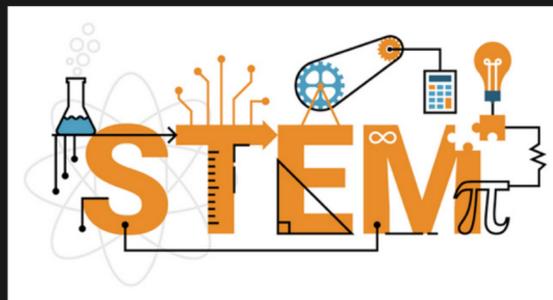
Inclusive
Excellence

Inclusion

Broadened
Participation

Opportunity

Access



To truly **broaden success**, we must do more than provide access to opportunity. We must encourage inclusive engagement in learning and STEM workforce skill development. The outcome will not only be vast improvements in equity, but a thriving educational system that helps all students achieve their full potential.

1. Student-centered teaching (*intentional* with regard to student learning engagement & outcomes)
2. Equity-mindedness (*intentional* with regard to overcoming barriers to inclusion & to fostering a sense of belonging)
3. Supporting faculty adoption and success with best practices (*intentional* with regard to faculty roles & incentives)

2022 Marks the 10th Anniversary of A Bridge to the Stars

10 years ago I was an Asst Prof focusing on building a new astronomy program at UMKC



UMKC GALAXY EVOLUTION GROUP

- Home
- People
- Research
- Publications
- Resources
- Press
- Contacts

What we do

The UMKC Galaxy Evolution Group in the Department of Physics and Astronomy conducts observational extragalactic astronomy research that focuses on the formation and evolution of structure on the largest scales. Galaxies are huge collections of normal matter (stars, gas and dust) and dark matter held together by gravity. There are over 100 billion galaxies in the Universe, ranging in size from small dwarf galaxies like the Magellanic clouds that are visible in the Southern hemisphere, to larger, more typical spiral galaxies like our own Milky Way, and on up to the most massive elliptical galaxies that tend to form in clusters of galaxies, which are the largest structures in the Universe.

We study galaxy formation and evolution on all of these scales in the context of the standard model of cosmology, in which galaxies and clusters form at the centers of high-density peaks in the underlying dark matter distribution making up the large-scale structure of the Universe. This model predicts that large, present-day galaxies were built primarily from major and minor mergers that occurred over the last 10 billion years. We empirically test these predictions using the largest astronomical data sets in existence and refine the model as our understanding grows.

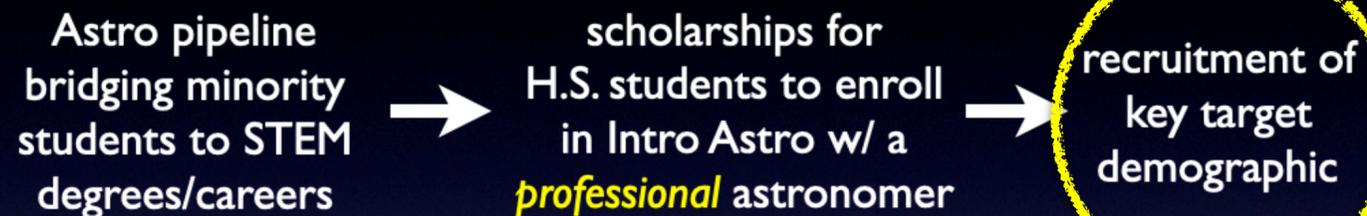
The standard model of cosmology also predicts the rate of the growth of structure on the largest scales. We carry out multi-wavelength surveys for galaxy clusters in order to (1) study how massive galaxies grow in the richest environments, and (2) constrain the cosmological parameters that describe the dynamics of the Universe itself. This includes studying the dark energy that is causing the expansion of the Universe to accelerate.

Our students analyze multi-wavelength data from large surveys as well as using targeted observations obtained from a host of ground-based and space-based instruments to gain new insights into the complex physics governing the growth of cosmic structures on all scales.

2022 Marks the 10th Anniversary of A Bridge to the Stars

April 2012, the initial proposal to MO Space Grant Executive Board for increasing representation in STEM

The Pipeline: A Targeted Solution



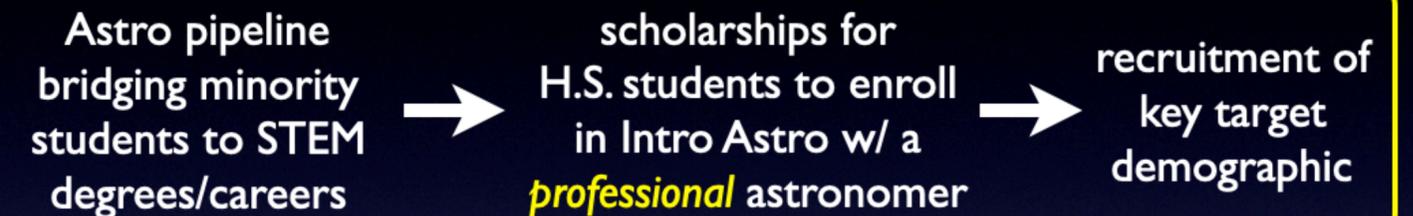
- Engaging/recruiting under-represented & disadvantaged minorities remains a critical problem in STEM.

Typical engagement solutions involve limited contact time with a broad audience (i.e., all students in a class or at a one-time event).

Typical recruitment targets college students, but cream of the crop are focused on more lucrative career tracks.

A nascent guiding hypothesis: to increase representation by meaningful amounts requires engaging a larger pool of capable and curious students in meaningful ways.

The Pipeline: A Targeted Solution



- My unique solution:

maximizes *my* impact - a dynamic, student-centered, concept-driven course
maximizes contact time (25 x 1.25h lectures)
maximizes science engagement of strong minority students before college
maximizes success by including UG mentor/ambassador scaffolding

2022 Marks the 10th Anniversary of A Bridge to the Stars

2013 & 2014, established a network of partners

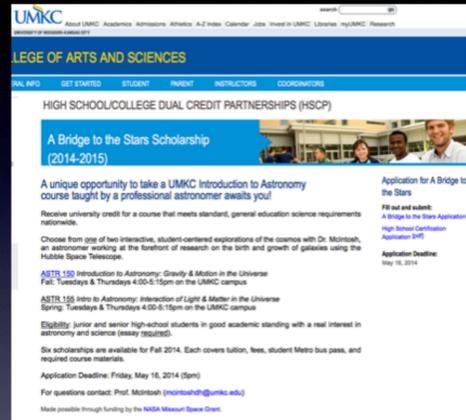
A Bridge to the Stars

- Developing Bridge Network

Partnerships established with:

- KC Public Schools
- KC STEM Alliance
- PREP-KC
- Science Pioneers
- UMKC High School College Partnerships
- UMKC Institute for Human Development

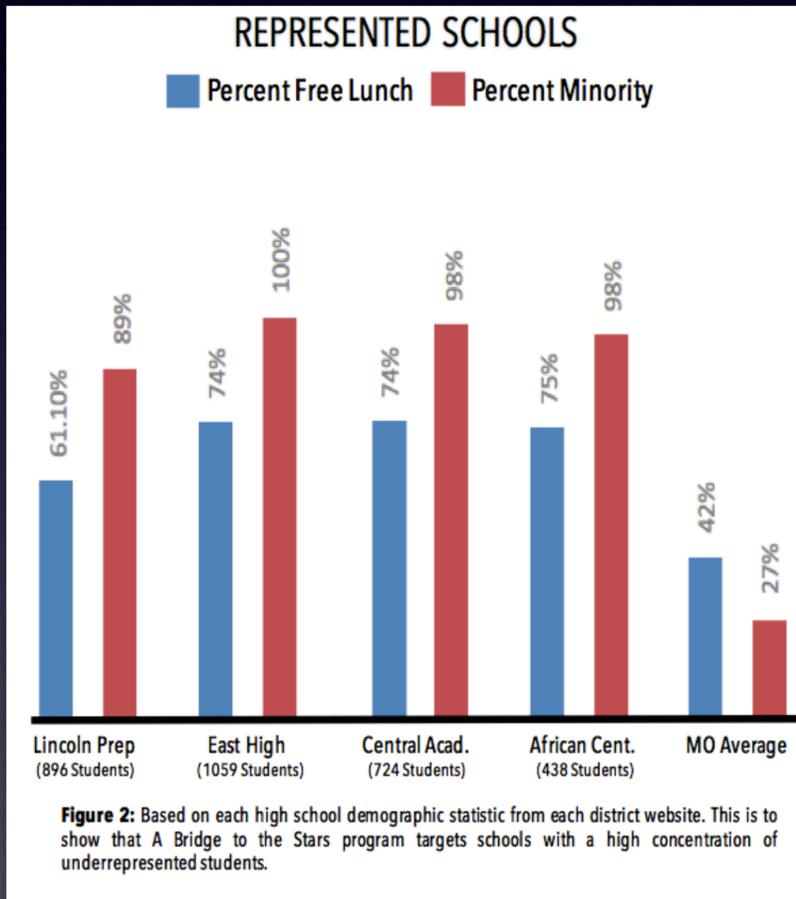
plus counsellors/administrators at
 Hogan Prep.Academy
 KCMUSD South West Early College Campus
 Lincoln Prep.Academy



23rd Annual Spring Meeting of the NASA-Missouri Space Grant Consortium (U.Missouri-Rolla) Apr. 25, 2014

Prof. Daniel H. McIntosh

2015, expansion to more local high schools with largely high-needs and URM student populations



June 2016, first national conference presentation

Bridge Program Experiential Impact

Scholar F. Mohamed w/ Mentor B. Liles (Spr 2014)

Scholars C. Smith & D. Wooten w/ Mentor C. Gilliam (Spring 2013)

Scholars M. Crisp, E. Verge, A. Woolley, N. Ulloa, T. Lindsey, & F. Mohamed w/ Mentors C. West & B. Liles (Spring 2014)

Scholars C. Holmes, V. Capadanno & A. Seawood (Spring 2016)

Mentoring Intern Linda Pham (Spring 2016) at MO Space Grant Annual Meeting

AAS #228 June 13, 2016 A Bridge to the Stars Prof. Daniel H. McIntosh

2022 Marks the 10th Anniversary of A Bridge to the Stars

Apr 2018, intern poster at MO Space Grant Annual Meeting

2016, added an intern to develop web-based application and initiate longitudinal tracking

#1 Innovative Bridge Adopts Best Engagement Strategies to Foster Student Success & Confidence in STEM

A Bridge to the Stars
Published on September 16, 2016



Photo by Brandon... Division of Student Marketing and Communications

An innovative pipeline to improve STEM learning
Inner-city high school students in Kansas City now have a unique opportunity to learn in a college classroom with a professional astronomer through A Bridge to the Stars Scholarship and Mentorship program at the University of Missouri-Kansas City.

UMKC near-peer Mentors

HS Scholars
interactive learning in Astro 100 @ UMKC

- 31 Scholarships: 4/5 underrepresented minorities, 2/3 female, 100% low-income
- 95% success rate in 6 semesters (earned university credit for freshman introductory science course with grade of 6.7% or better)
- average course grade for participants *on par* with over 500 UMKC 'peer' UGs enrolled in same course

SCHOLAR'S RACE

Hispanic American	10%
Asian*	9%
Caucasian*	13%
African American	68%

SCHOLAR'S GENDER

Transgender	3%
Male	32%
Female	65%

On-line Advertisement & Application
Improves recruitment/enrollment coordination with HS

Long-term Voluntary Tracking
62% of former Scholars joined Facebook group; all view program favorably (70% pursuing STEM degrees)

A Bridge to the Stars Longitudinal Tracking Survey

A Bridge to the Stars

AAS #229 January 6, 2017 A Bridge to the Stars Prof. Daniel H. McIntosh



UMKC Mentors, from left to right, Lauren Higgins, Jaime Crouse, Rubyet Evan (former 2x Bridge Scholar!), Osiris Hines.

Jan 2017, advocating at national conference for scaling up like-minded programs

Summary: Transforming diversity in STEM over next 20 years requires a real shift in 'our' approach.

Transforming the diversity in STEM over the next 20 years will require a sea change in the recruitment, engagement and preparation of underserved youth, especially in the physical sciences.

The STEM community needs to immediately identify and support the expansion and implementation of role-model programs that significantly increase numbers.

A Bridge to the Stars is a good HS-to-College bridge model.

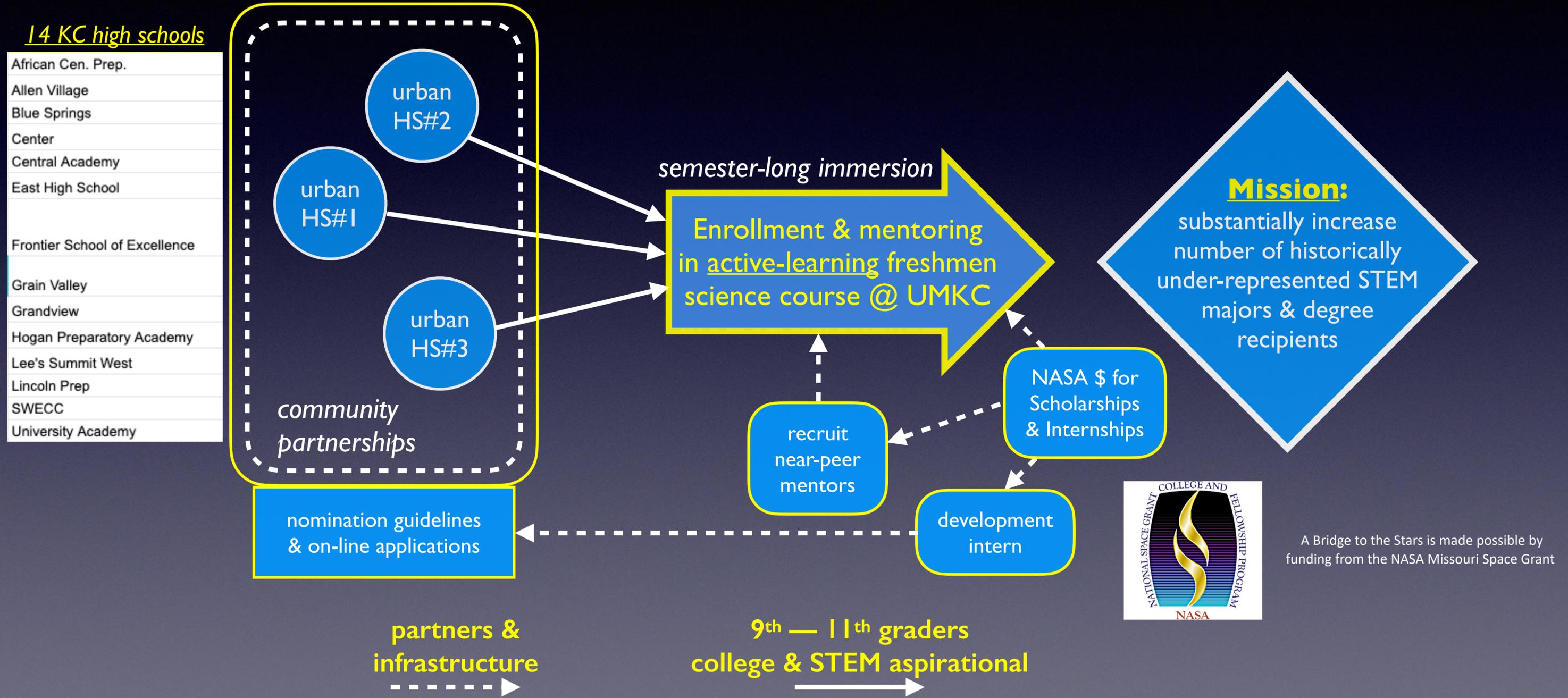
Let's chat: I am happy to share my broader impact innovations, to help others get started, and to brainstorm with interested educators/administrators regarding how to tackle the biggest challenges.

A Bridge to the Stars is made possible by funding from the NASA Missouri Space Grant

AAS #229 January 6, 2017 A Bridge to the Stars Prof. Daniel H. McIntosh

A Bridge to the Stars: Logistics

Fall Semester Promotion, Recruitment, and Enrollment



High-School Scholar Recruitment

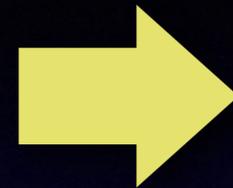
A BRIDGE TO THE STARS
Congratulations!
 You have been nominated to apply for a special UMKC scholarship

To learn more, go to the web page:
<http://cas.umkc.edu/hscp/students-and-parents/dual-credit-options/bridge-to-the-stars/>
 Watch the three minute video and click "Apply Now" by: Thursday October 31st, 2019. You will need to know the email address of a teacher or advisor that will recommend you.

Accepted scholars will enjoy an interactive learning experience in ASTR 150: Motions of the Cosmos with Distinguished Professor McIntosh on Tuesdays, Wednesdays, and Thursdays from 4:00-5:15 PM on the UMKC campus for the Spring 2020 Semester (January 21-May 15, 2020). Eligible applicants should be high school students with an interest in science; we consider sophomore or junior applicants first.

Other benefits include free tuition and enrollment fees, a Metro bus pass for the entire semester, transferable college credit, and a resume-building opportunity.

Made possible through funding by the NASA Missouri Space Grant.



UMKC UNIVERSITY OF MISSOURI-KANSAS CITY

High School College Partnerships
 College of Arts and Sciences

Students and Parents | Get Started | Instructors | About Us

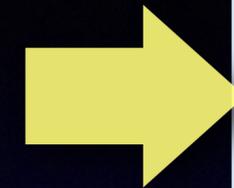
A Bridge to the Stars
 NASA Space Grant/A Bridge to the Stars Pipeline Program at UMKC

The pre-application period for high-school students is now closed. We will send scholarship award notifications by Oct. 27, 2018.

Watch this short video to learn more about this unique opportunity now!

Why fill out the pre-application now?
 To be eligible for one of a number of full scholarships for interested 10th or 11th grade students to take a freshman astronomy course at UMKC in Spring 2019 with Prof. McIntosh, a distinguished educator (2017-2019 Norman Royall Endowed Professorship, 2016 UM System President's Award) and professional astrophysicist (like Neil

<https://cas.umkc.edu/areas-of-study/hscp/bridge-to-the-stars.html>



Thank you for your interest in NASA MO Space grant/ A Bridge to the Stars Scholarship program. Please answer the following questions as honestly as possible to help us determine your eligibility for this exciting opportunity. ANSWERS ARE KEPT CONFIDENTIAL AND WILL NOT BE SHARED WITH ANYONE. If you have any questions please email abtts@umkc.edu

First Name

Last Name

Email Address

Which High School do you attend?

Which year are you in?

Enter the email address of the teacher giving you a recommendation

*(Recommendations are an important part of our selection process. As such, lack of a teacher recommendation will be seen as a poor recommendation.)

In one paragraph describe what you like about astronomy.

In 100 words or less describe the skills you use to succeed in school.



Teacher/Advisor Recommendation

Thank you for your time in helping the NASA MO Space Grant/A Bridge to the Stars Scholarship program identify deserving candidates.

This will only take 1 minute to complete.

- Please provide your name:
- Please provide your institution:
- Please provide the full name of the student that you recommend:
- How well does this student work with other students? Poor n/a Well
- How committed to her/his academic career is this student? Not Committed n/a Committed
- When this student struggles academically, how willing is she/he to seek help? Not Willing n/a Willing

students & recommenders (due mid Oct)

awards to students (Nov 1) registration & enrollment (w help from Registrars, HSCP)

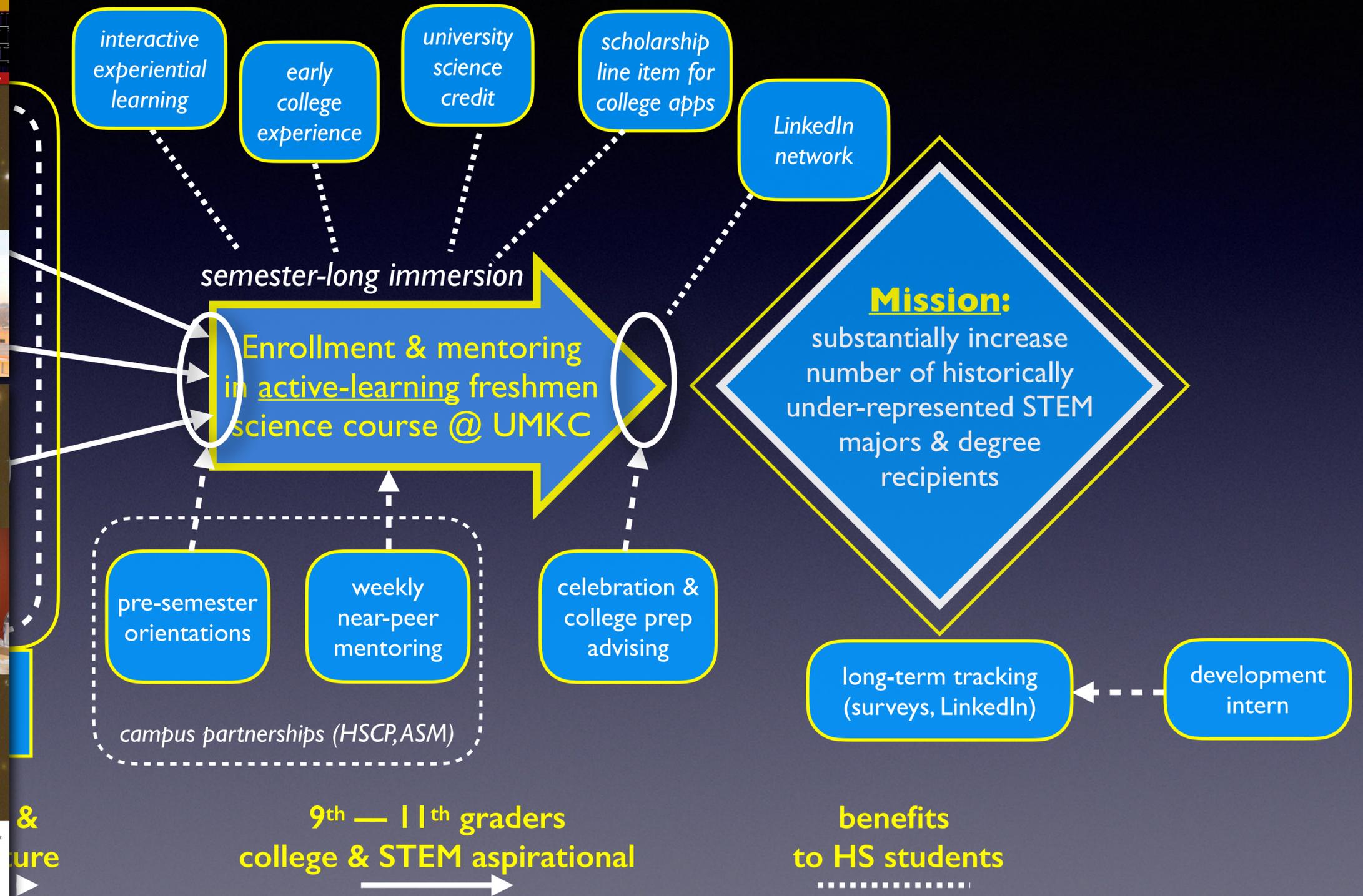
+ email instructions to select HS contacts & KC STEM Alliance partners (due mid Sep)

Orientation

High School College Program Office Ice Breaker	
University of Missouri-Kansas City Campus Tour	
Scholars receive their UMKC Student ID's	
Visit Linda Hall Library	
Pizza Dinner	
A Bridge to the Stars Scholar Contract Please carefully read the following contract with your parent/guardian, and sign to confirm that you understand and agree to its terms. As a Bridge to the Stars scholar enrolling in classes at UMKC, you assume an obligation to conduct yourself as a student compatible with the functions of the college as an educational institution. A Bridge to the Stars mentors will provide guidance as you transition to college classes at the UMKC campus. As a Bridge to the Stars scholar, you are not only a high school student, you are also a college student.	Contract For Success
Keys to Success	<p>Keys to Success in the Classroom:</p> <ol style="list-style-type: none"> Engage with your peers with TPS's and LT's. While the professor is lecturing and while doing LT's be determined to understand the subject material. Ask questions. Be Wrong. Make suggestions. It's scary but do it anyway. <p>Keys to Success at the Mentoring Sessions:</p> <ol style="list-style-type: none"> Engage with the other scholars and mentors, in coming up with solutions. While you are discussing if something doesn't make sense, Ask a mentor. Don't give up on understanding. Explore your ideas and play with curiosity. Share with others. <p>Keys to Success Outside of Class:</p> <ol style="list-style-type: none"> Meet up with other scholars or other students. Do your homework together. Go over LT's together. Figure out things you are struggling with together. If you are struggling with homework and a little flustered. Don't give up. Keep trying. Write down what you are struggling with and move on. Bring what you have written down to mentoring sessions. It takes bravery to address your frustration. It takes bravery to know that your homework is confusing but trying anyway.

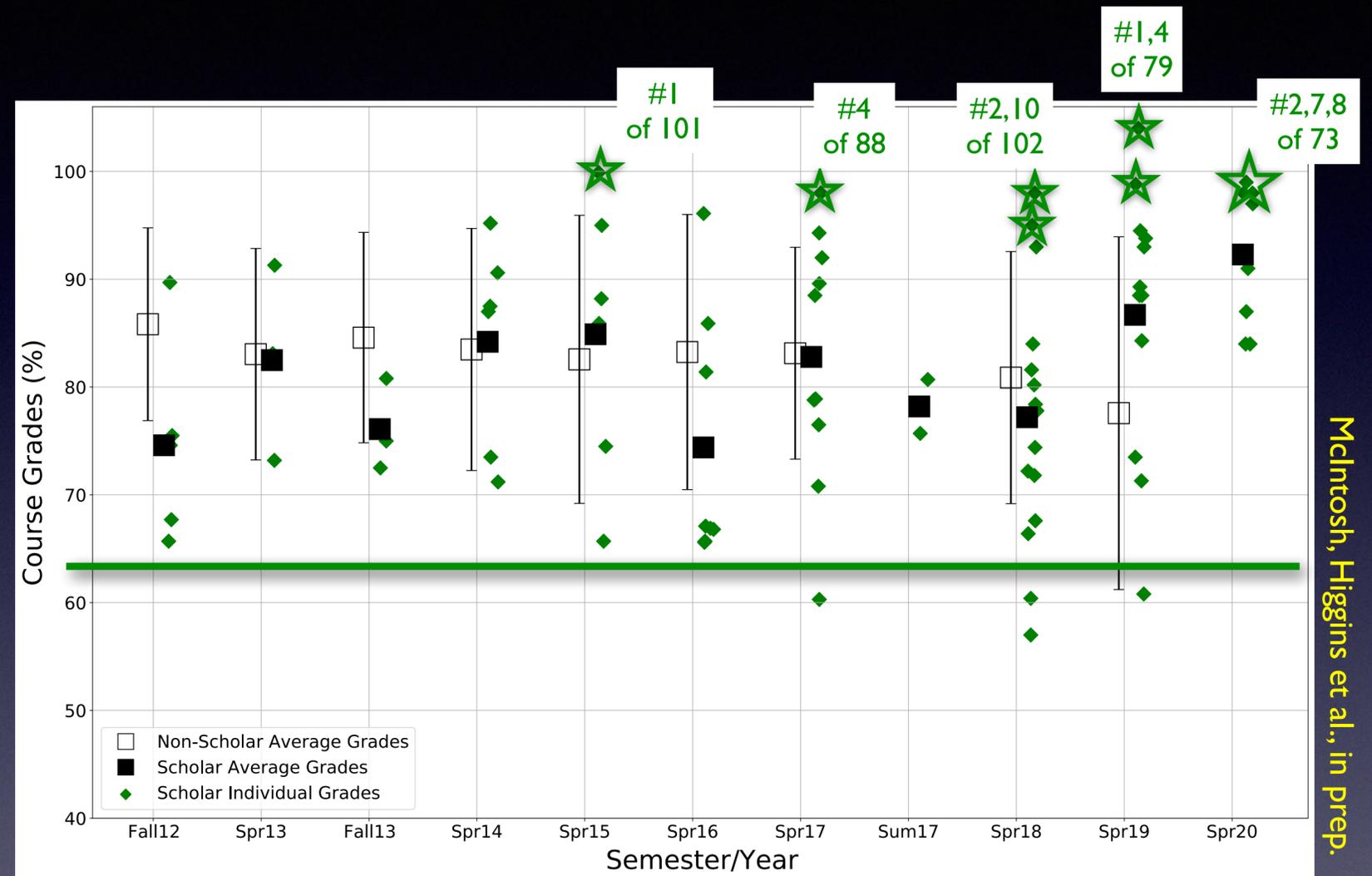
A Bridge to the Stars: Logistics

Spring Semester Onboarding, Learning, and Offboarding



A Bridge to the Stars: Metrics of Success

- ◆ 81 tuition scholarships over 11 semesters
(73 *unique* students from 14 KC high schools)
- ◆ equity-minded selection for participation
(70% URM, 70% non-male, >90% low- $\$$)
- ◆ 95% success rate
(Scholar passed course, earned college credit)
- ◆ confidence building & sense of belonging
(no achievement gap between Scholars and UMKC students enrolled in same courses)
- ◆ Long-term tracking of former Scholars:
(40% of Scholars pursued/pursuing 4-year degree, 60% in STEM)



- Scholar average course grades are same (~80%) as >800 'peer' UMKC students (*enrolled in same classes!*)
- Scholar course grade spread is similar to that of UMKC 'peers'

A Bridge to the Stars: Metrics of Success

- ◆ 81 tuition scholarships over 11 semesters
(73 unique students from 14 KC high schools)
- ◆ equity-minded selection for participation
(70% URM, 70% non-male, >90% low- $\$$)
- ◆ 95% success rate
(Scholar passed course, earned college credit)
- ◆ confidence building & sense of belonging
(no achievement gap between Scholars and UMKC students enrolled in same courses)
- ◆ Long-term tracking of former Scholars:
(40% of Scholars pursued/pursuing 4-year degree, 60% in STEM)

(preliminary findings; data collection is ongoing)

Informal surveying within one year of program:

- 49% of Scholars (36 of 73) responded
 - 72% (26 of 36) of respondents planned to pursue a 4-year STEM degree

National Student Clearinghouse, surveying, and other data:

- at least 40% (29 of 73) of Bridge Scholars did pursue, or are pursuing, a 4-year degree
 - 59% of these in STEM, thus, 1/4 of all Scholars at a minimum
- 75% of Scholars known to be pursuing a 4-year degree have completed, or are on track to complete

A Bridge to the Stars: Metrics of Success

Select written feedback from surveying former Bridge Scholars:

“The program, the mentorship I've received, and the astronomy class itself has definitely given me the confidence that I needed to know that it is possible for me to succeed in a STEM field. I was always discouraged in the past because I was never really "good" at math, but the program has taught me that STEM goes beyond just math, and that there is always another side to the story (i.e. concept wise).”

“This program was my first look into what it felt like to be a college student. It realistically prepared me for college courses and the level of studying I would need to do. I am proud to have been granted the opportunity to take the course.”

“I believe that A Bridge to the Stars has helped me by giving me a deeper understanding of how college works. ... This program gave me connections to an abundance of great people, and I would definitely recommend this to everyone that has the opportunity to take. Overall I appreciate Professor McIntosh, I believe he was a wonder professor and everything he taught me stuck with me!”

Success Factor #1: Active Learning

ABttS is intentional with regard to student engagement and learning outcomes.

Following 4 guiding principles of quality implementation:

Bridge Scholar's typical learning experience:

Roughly half of lecture time in activities carefully-designed for student practice with peers on higher-order thinking and problem solving in the presence of their instructor.

collaborative active learning



authentic

frequent

inclusive

encouraging

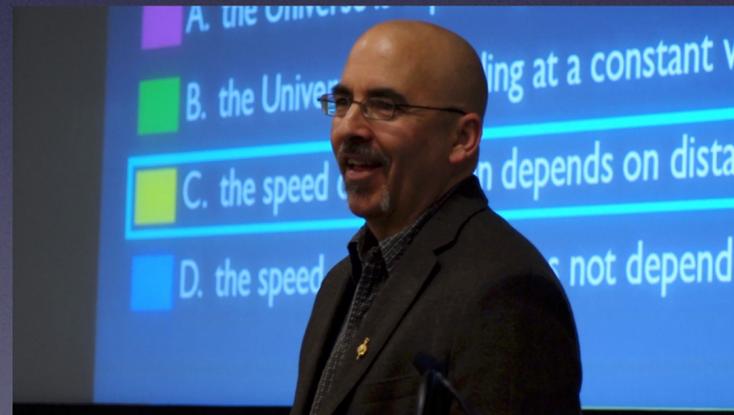
Active Learning is Learner-Centered Teaching

Specifically: utilize carefully designed activities that intellectually engage students in rich collaborative discussions and practice with peers on key higher-order thinking and problem-solving difficulties in the presence of their instructor.

Take Home Messages

- Research-validated interactive learning strategies can benefit ALL students in ALL classroom environment - BUT
- The quality of our implementation is likely the most deterministic factor toward student achievement

Edward Prather, Director
Center for Astronomy Education (U Arizona)



Happy to share during Q&A an example of active learning from a student perspective.

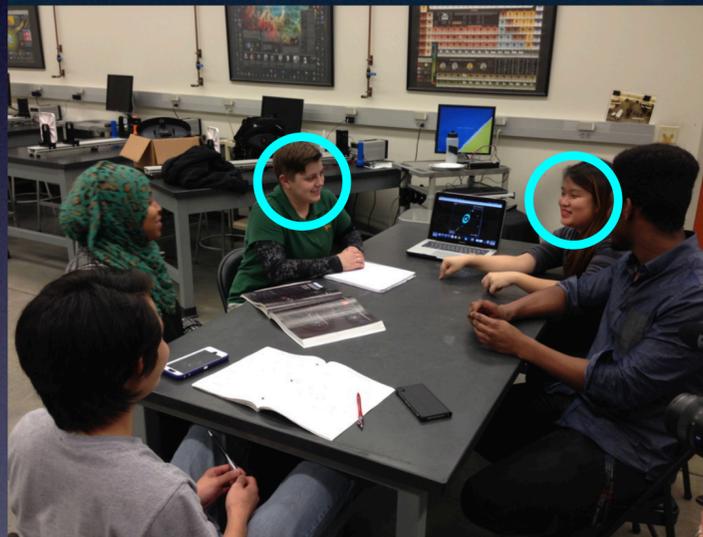


Success Factor #2: Near-Peer Mentoring

ABttS is intentional with regard to student engagement and learning outcomes.

Mentoring Sessions

- Applied Study Habits
 - Lecture Tutorials
 - Think-Pair-Share
 - Practice Exams
 - Post Exam Review



- Peer-Peer Mentoring
- Mandatory Weekly
- Dynamic Guidance
 - Active Feedback
 - Adapt Quickly
 - Weekly Check-Ins

Near-peer mentoring: 21 UMKC students from 9 degree programs

Bridge Mentors



Top left: Scholars and Mentors in front of image of Galaxy in Linda Hall. Top right: Mentors Jaime, Rubyet, and Osiris by the Galaxy Image at Linda Hall Library. Bottom left: Dr. McIntosh with scholars outside of his Office. Bottom right: Jaime with scholars at Lind Hall Library.



High-school Scholars & UMKC Mentors (Spring 2017).



High-school Scholars & UMKC Mentor (Spring 2014).

Program Challenges and Key Lessons Learned

Hypothesis behind A Bridge to the Stars:

To increase representation by meaningful amounts requires engaging a larger pool of capable and curious students in meaningful ways.

- Running a program like this is a significant (~10%) time commitment for a STEM faculty member.
- Continuous evaluation of a program like this requires additional workload and proactive planning.
- Status-quo HE promotion and merit practices do not adequately account for the faculty workload.

Program Challenges and Key Lessons Learned

Hypothesis behind A Bridge to the Stars:

To increase representation by meaningful amounts requires engaging a larger pool of capable and curious students in meaningful ways.

- Running a program like this is a significant (~10%) time commitment for a STEM faculty member.
- Continuous evaluation of a program like this requires additional workload and proactive planning.
- Status-quo HE promotion and merit practices do not adequately account for the faculty workload.
- Maintaining a network of HS contacts is a major barrier to consistent recruitment.
— target schools have especially high turnover rates

Program Challenges and Key Lessons Learned

Hypothesis behind A Bridge to the Stars:

To increase representation by meaningful amounts requires engaging a larger pool of capable and curious students in meaningful ways.

- Running a program like this is a significant (~10%) time commitment for a STEM faculty member.
- Continuous evaluation of a program like this requires additional workload and proactive planning.
- Status-quo HE promotion and merit practices do not adequately account for the faculty workload.
- Maintaining a network of HS contacts is a major barrier to consistent recruitment.
— target schools have especially high turnover rates
- Sustaining and scaling programs like this is beyond the capacity of typical faculty roles and responsibilities.

Long-term Goal: Help Others Adopt Similar Programs to Substantially Increase STEM Representation

NSB: "... much faster increases will be needed for the S&E workforce to be representative of the U.S. population in 2030."

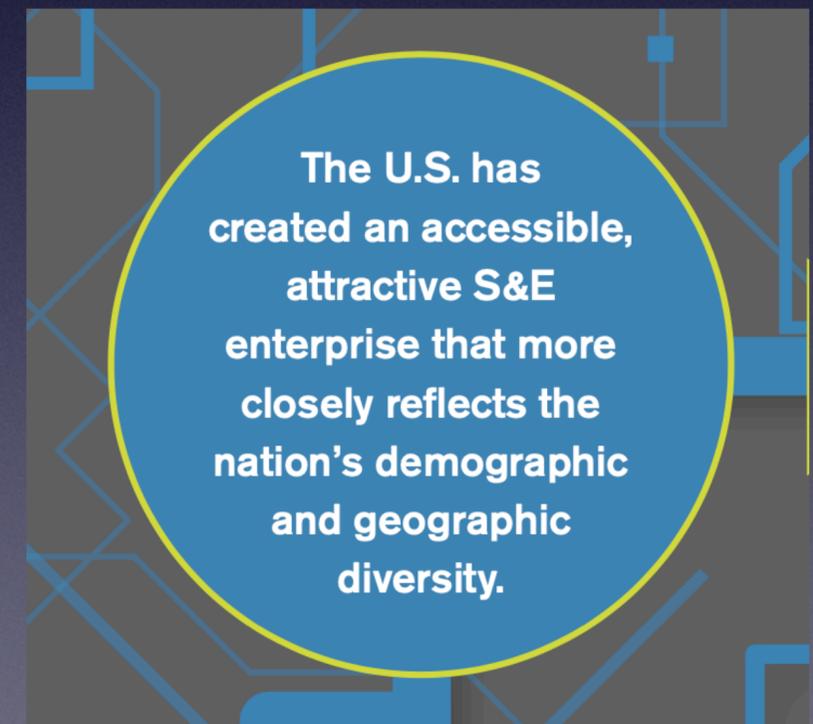
Tried approaches for scaling this pre-College broadening STEM participation model:

- [no success] Grassroots advocacy to STEM faculty at national conferences:

Establishing a HS pipeline into a learner-centered freshmen science course/lab is a win-win investment of your time:

*effectively combine your service and teaching efforts
address a national challenge with a B.I. favored by funding agencies
establish a visible program that your upper admin will find positive*

Let's chat! contact info: mcintoshdh@umkc.edu



Long-term Goal: Help Others Adopt Similar Programs to Substantially Increase STEM Representation

NSB: "... much faster increases will be needed for the S&E workforce to be representative of the U.S. population in 2030."

Tried approaches for scaling this pre-College broadening STEM participation model:

- [no success] Grassroots advocacy to STEM faculty at national conferences:

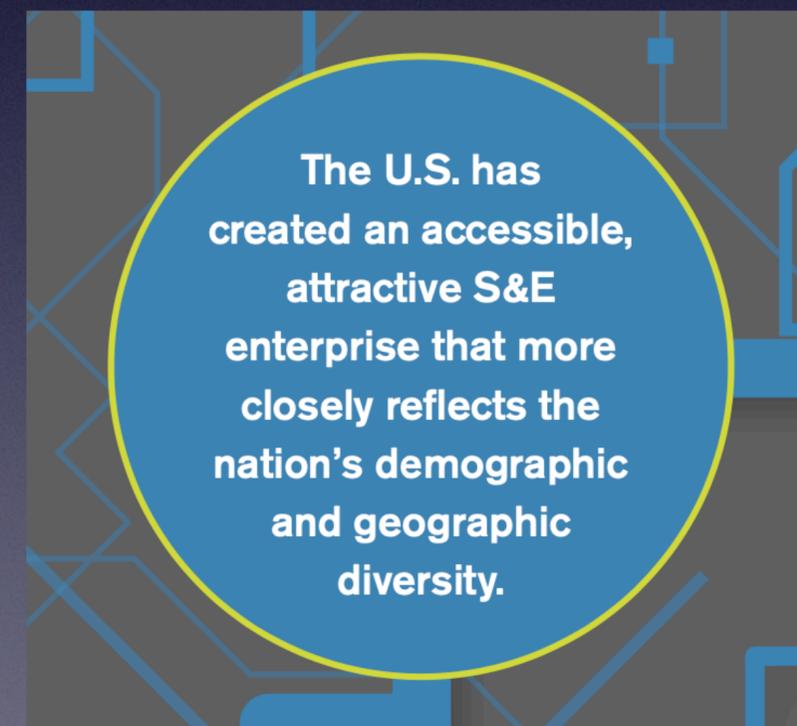
Establishing a HS pipeline into a learner-centered freshmen science course/lab is a win-win investment of your time:

*effectively combine your service and teaching efforts
address a national challenge with a B.I. favored by funding agencies
establish a visible program that your upper admin will find positive*

Let's chat! contact info: mcintoshdh@umkc.edu

- [no success as a lone faculty] Propose for funding from foundations and federal agencies:

The STEM community needs to immediately identify and support the expansion and implementation of role-model programs that significantly increase numbers.



Long-term Goal: Help Others Adopt Similar Programs to Substantially Increase STEM Representation

NSB: "... much faster increases will be needed for the S&E workforce to be representative of the U.S. population in 2030."

Tried approaches for scaling this pre-College broadening STEM participation model:

- [no success] Grassroots advocacy to STEM faculty at national conferences:

Establishing a HS pipeline into a learner-centered freshmen science course/lab is a win-win investment of your time:

*effectively combine your service and teaching efforts
address a national challenge with a B.I. favored by funding agencies
establish a visible program that your upper admin will find positive*

Let's chat! contact info: mcintoshdh@umkc.edu

- [no success as a lone faculty] Propose for funding from foundations and federal agencies:

The STEM community needs to immediately identify and support the expansion and implementation of role-model programs that significantly increase numbers.

- [no success as a lone faculty] Advocate for inclusion in institutional strategic planning.



Long-term Goal: Help Others Adopt Similar Programs to Substantially Increase STEM Representation

NSB: “... much faster increases will be needed for the S&E workforce to be representative of the U.S. population in 2030.”

Necessary ingredients for scaling this pre-College broadening STEM participation model:

- Institutional leadership is essential for scaling across multiple disciplines.
— increased enrollment is the leverage for program sustainability
- Gen-Ed science courses scheduled during AY semesters after normal HS hours.
— recommend phasing in new STEM disciplines



Long-term Goal: Help Others Adopt Similar Programs to Substantially Increase STEM Representation

NSB: “... much faster increases will be needed for the S&E workforce to be representative of the U.S. population in 2030.”

Necessary ingredients for scaling this pre-College broadening STEM participation model:

- Institutional leadership is essential for scaling across multiple disciplines.
— increased enrollment is the leverage for program sustainability
- Gen-Ed science courses scheduled during AY semesters after normal HS hours.
— recommend phasing in new STEM disciplines
- Dynamic faculty instructors with the commitment and passion for helping students learn using evidence-based practices.



Long-term Goal: Help Others Adopt Similar Programs to Substantially Increase STEM Representation

NSB: “... much faster increases will be needed for the S&E workforce to be representative of the U.S. population in 2030.”

Necessary ingredients for scaling this pre-College broadening STEM participation model:

- Institutional leadership is essential for scaling across multiple disciplines.
 - increased enrollment is the leverage for program sustainability
- Gen-Ed science courses scheduled during AY semesters after normal HS hours.
 - recommend phasing in new STEM disciplines
- Dynamic faculty instructors with the commitment and passion for helping students learn using evidence-based practices.
- Equitable accounting of the additional faculty workload (~10%/semester)*:
 - recruit, select, and supervise UG mentoring interns from an available candidate pool
 - oversee the recruitment and selection of HS participants
 - coordinate with campus offices in charge of scholarships, enrollment, etc
 - coordinate pre-semester orientations and end-of-semester celebrations
 - provide HS student college preparatory advising

* Much of this work could be assigned to admin support.



Summary

This equity-minded initiative is designed to give historically underserved and underrepresented 10th & 11th graders an early-college experience at UMKC through tuition support, enrollment, and near-peer mentoring in a student-centered introductory astronomy course.

Benefits participants with an immersive, confidence-building experience to increase the likelihood that they matriculate to college and persist through their crucial first year.



High-school Scholars & UMKC Mentors (Spring 2017).

A Bridge to the Stars: <https://cas.umkc.edu/areas-of-study/hscp/bridge-to-the-stars.html>

- Successful 10-year program provides a role model for broadening the successful transition from HS to College (in STEM or non-STEM).
- My long-term goal is to scale and sustain the adoption of similar programs across my campus, across Missouri, and across the U.S.
- I welcome feedback and collaboration ...

Let's chat! contact info: mcintoshdh@umkc.edu

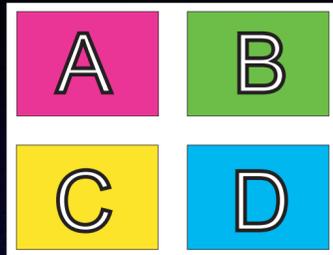


A Bridge to the Stars is made possible by funding from the NASA Missouri Space Grant

extra slides for 3/17/22

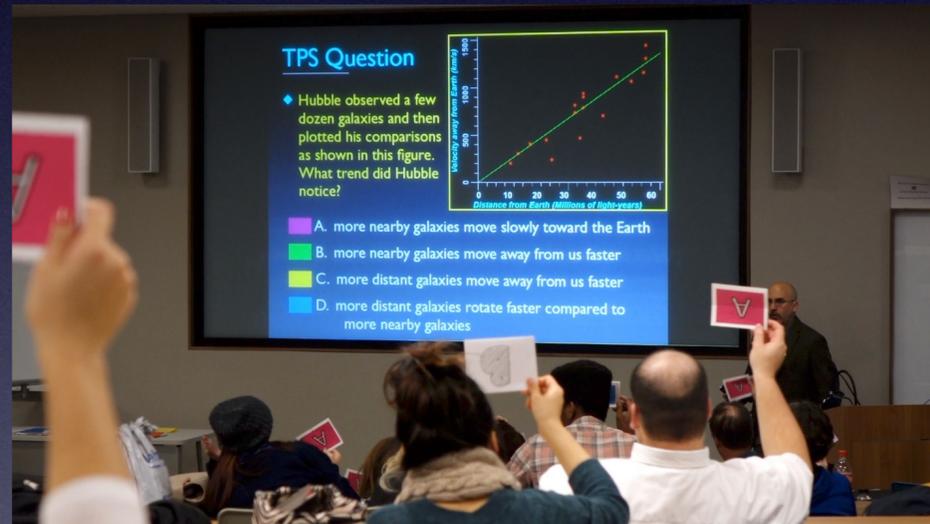
Guide to Adding Active Learning to Existing Lectures

Keep it simple!



E.g., a great starter strategy: Think-Pair-Share questions

- Easy to implement in large-enrollment, face-to-face or even asynchronous online courses.



A

B

C

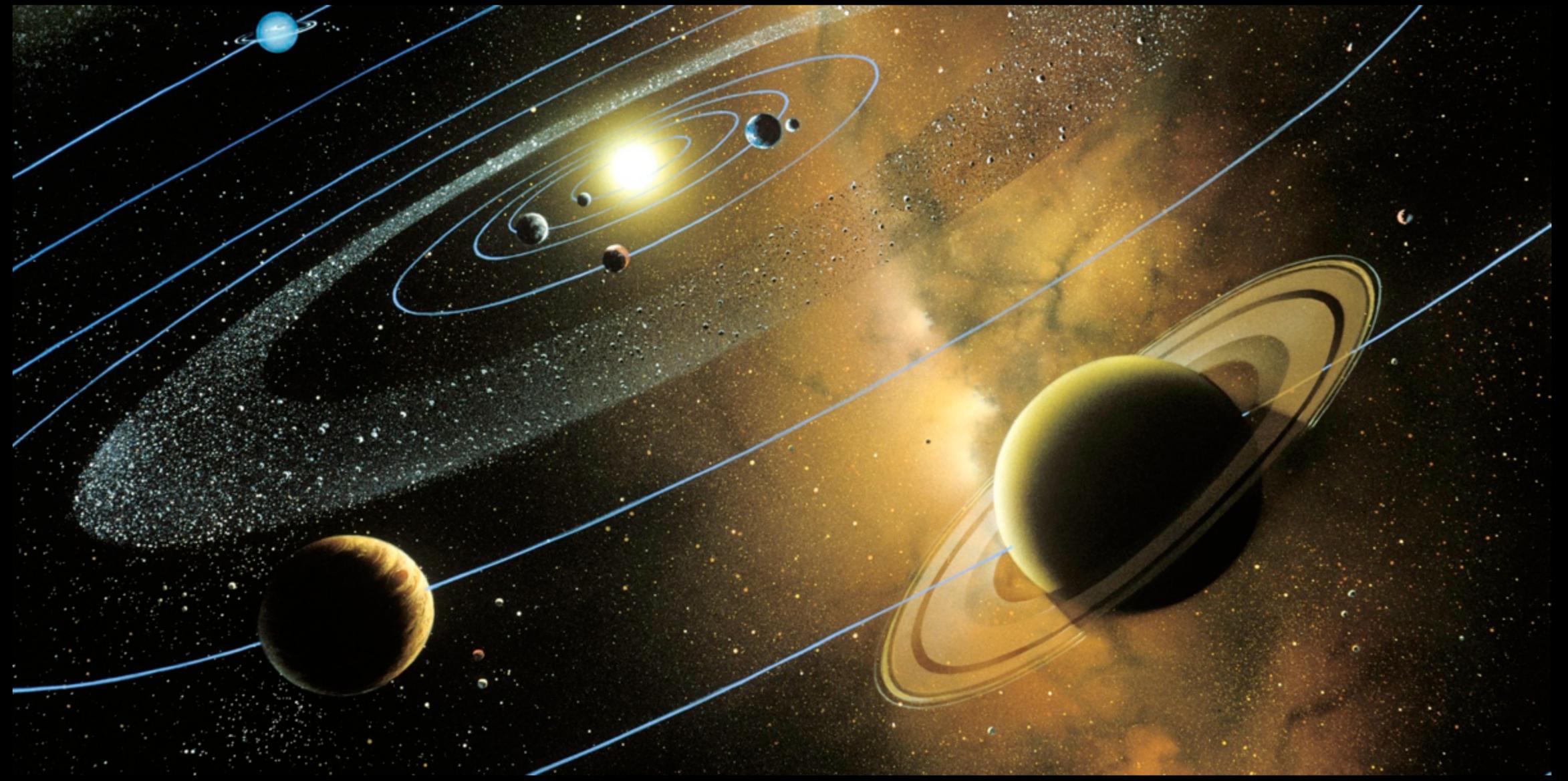
D

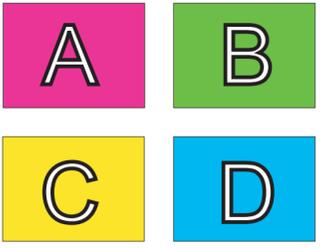
Unit: A Unique Tour of Our System

Clues to Earth's Formation

Utilize TPS in existing lecture or unit on a topic.

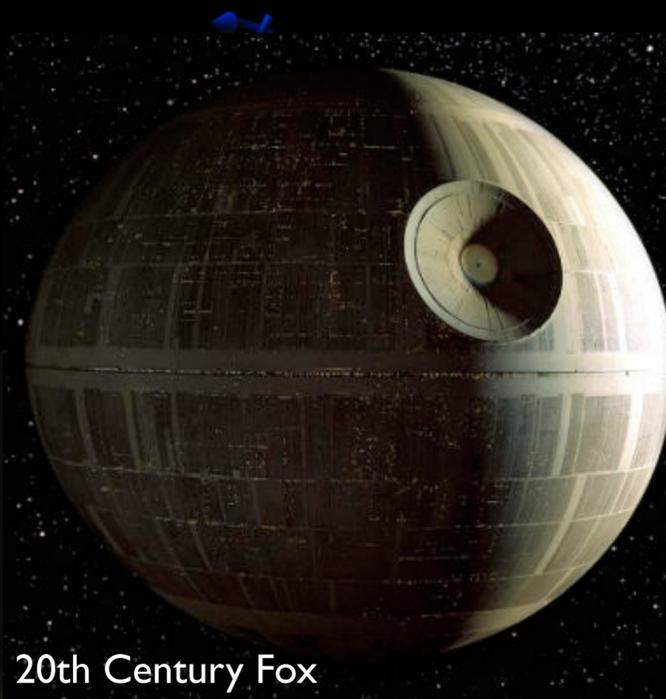
A grand tour of the Solar System's large "worlds" reveals many clues to how the Earth and the rest of Sun's family of planets, moons, asteroids & comets formed 4.6 billion years ago.





Saturn

- Atmosphere: thick (mostly H)
- Composition: H ice, rock, metal
- ▶ Moons: 82 (ice, rock)
- ▶ Rings: yes (water ice)

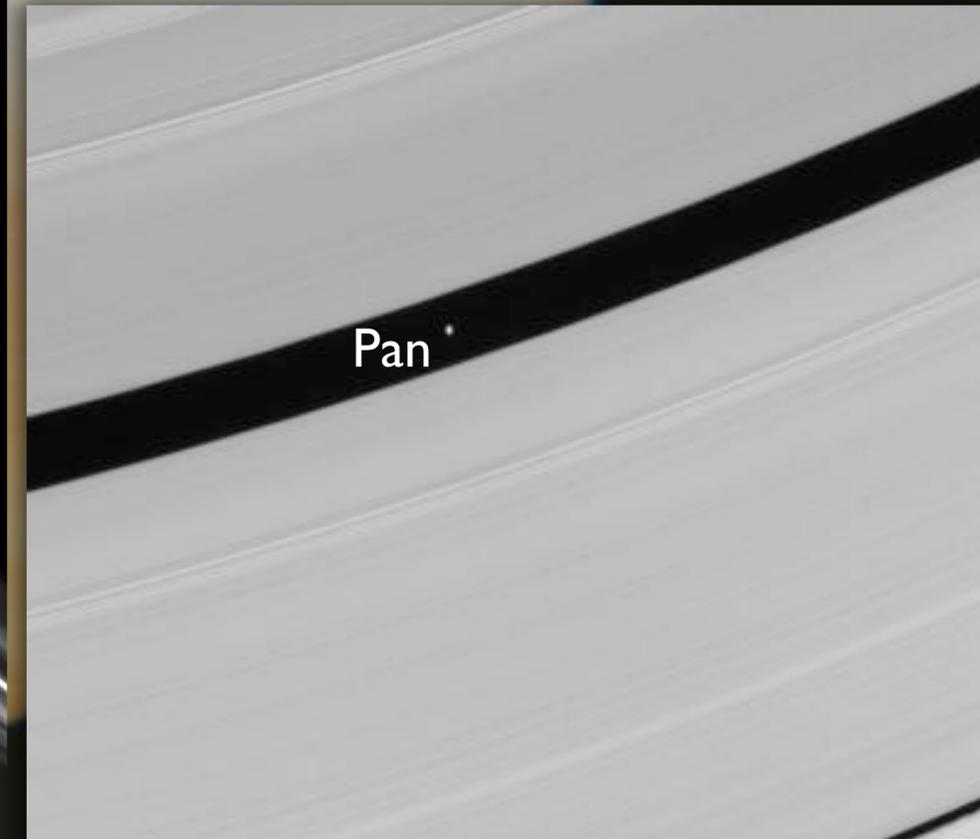
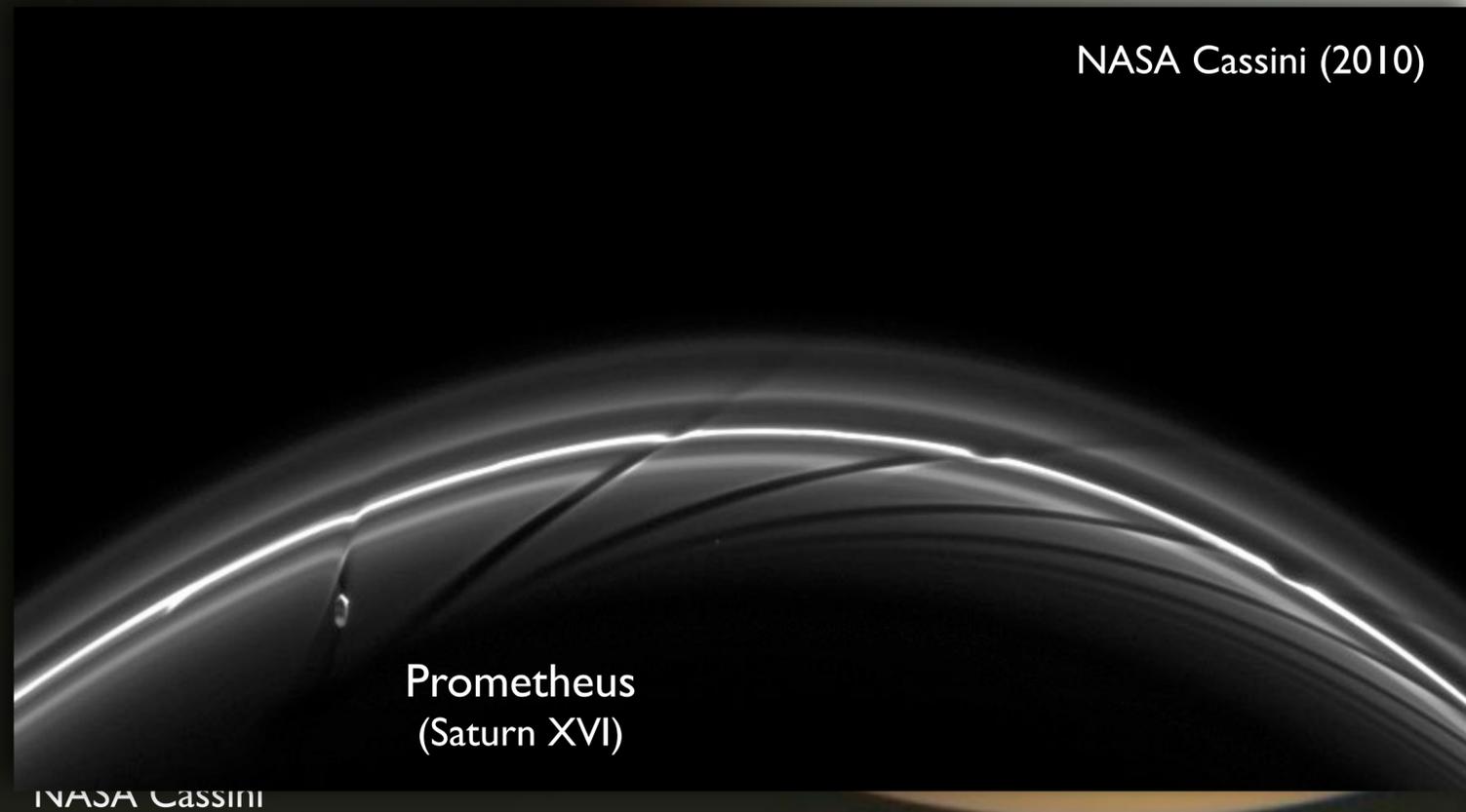


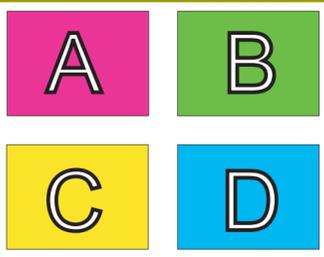
Mimas (#96)

#2
116,464 km
9.1 Earths

moons all orbit in same plane as the rings

Set up TPS with a mini lecture to introduce new topic.





TPS Question

“Techniques provide the framework, the structure, the context. What really matters is what we put in the structure — what students are thinking about and sharing when they’re pairing.”

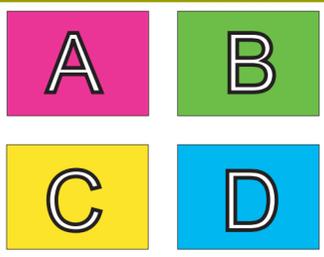
from Weimer, *Deeper Thinking about Active Learning*, in *Faculty Focus*, Feb. 2018

- ◆ The composition of most moons around large planets is _____ and the composition of moons around small (terrestrial) planets is _____.

Use a TPS question to assess student comprehension and to initiate rich peer discussions.

- A. more like comets, just like the host planet
- B. more like comets, more like asteroids
- C. just like the host planet, more like asteroids
- D. more like asteroids, more like comets

TPS Process: (1) pose question, give time for students to read question and answers
(2) prepare class to vote together on answer ... “prepare your vote, ready, 1-2-vote!”
(3) if >85% correct, show answer and move on, otherwise ask students to **pair & share**
(4) let peer discussion run until it starts to die down ... “pause, let’s revote, 1-2-vote!”
(5) repeat as needed until reach >85% consensus



TPS Question

- ◆ The composition of most moons around large planets is _____ and the composition of moons around small (terrestrial) planets is _____.

A. more like comets, just like the host planet

B. more like comets, more like asteroids

C. just like the host planet, more like asteroids

D. more like asteroids, more like comets

TPS conclusion:
Reveal answer, provide additional info for studying, address open questions.

Comets: composition mostly **ice** (frozen Hydrogen compounds like water, methane & ammonia)

Asteroids: composition mostly **rock** (elements like oxygen & silicon) **and metal** (elements like iron & nickel)