

## Increased STEM Inclusion and Career Interest among Racial/Ethnic Minorities and Low-Income Students in the Prefreshman Engineering Program (PREP)

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STEM learning and careers are ever stressed as important to the nation (National Science and Technology Council, 2018). But what helps to foster students' desire to pursue STEM throughout K-20 and ultimately go into a STEM career? Using data from the 2019 Prefreshman Engineering Program (PREP) Pre- and Post-Surveys (n=1,484), this report looks at PREP participants perceived STEM inclusion and its correlation to STEM career interest.

### Key Findings

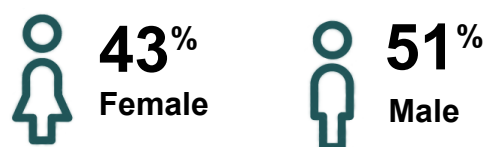
1. Participants felt more included in PREP activities and accepted by PREP peers than in school STEM classes.
2. Black and Hispanic participants reported higher inclusion and support at PREP compared to White peers.
3. Low-SES participants reported higher inclusion and fairer treatment at PREP compared to high-SES peers.
4. Participants who reported higher inclusion at PREP also reported higher interest in pursuing STEM careers.

**TCC PREP**, located at Tarrant County College South Campus in Fort Worth, Texas. Year 2 participants work collaboratively in team building activities. "Because our students come from different schools and backgrounds, the aim of this day is to quickly breakdown these barriers, get the students comfortable with each other and begin to develop collaboration" (Erika Zimmermann, TCC PREP Site Director).



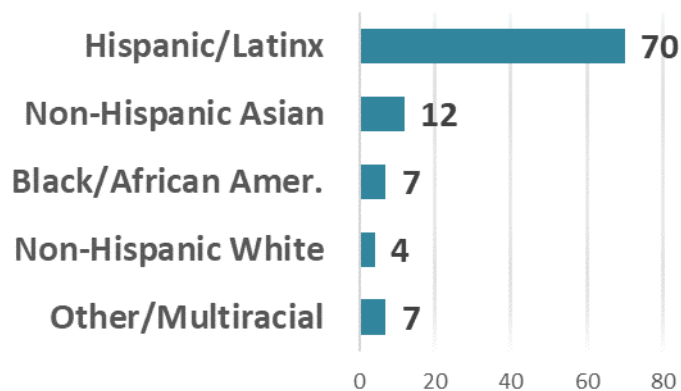
### Participant Demographics

#### Gender

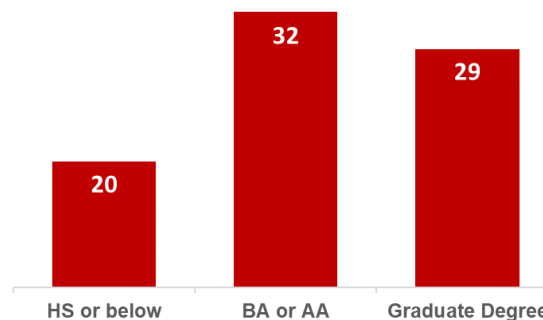


\*6% other gender or not reported

#### Race/Ethnicity by %



#### Parent Highest Degree %



\*19% not reported

## STEM Inclusion

To help increase diversity and retention in STEM, inclusion is an integral part of the educational process and refers to intentional practices of students working together across differences and fostering an increased sense of belonging and fairness in the classroom and with their peers (Dewsbury & Brame, 2019). To examine the effectiveness of PREP programming, the 2019 pre- and post-survey looked at participants' sense of inclusion in their regular school STEM classes and at PREP.

Survey questions:

### Pre-survey

- I felt supported by my teachers
- I felt accepted by my classmates
- I felt included in the STEM activities
- I felt treated fairly by my teachers

### Post-survey

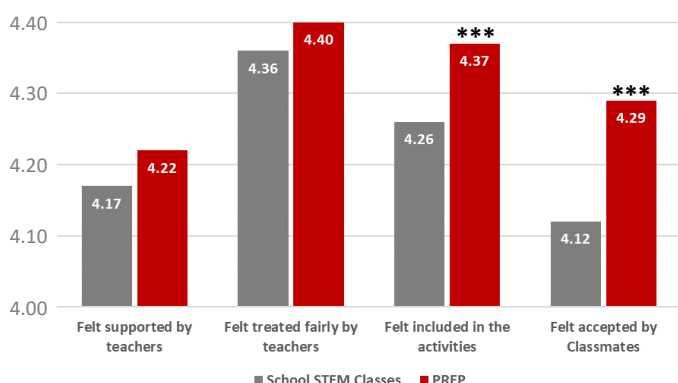
- I felt supported by my instructors and PAs
- I felt accepted by my classmates
- I felt included in the PREP activities
- I felt treated fairly by my instructors and PAs

### Program Assistant Mentors

(PAs) are dedicated college students, and often PREP graduates, who accompany PREP participants throughout the summer and provide guidance and feedback to help with the curriculum, college experience, and other learning components and experiences.

## 1. Perceived STEM Inclusion in School STEM Classes vs. at PREP

- PREP participants generally reported higher levels of “feeling included in the activities” and “feeling accepted by classmates” at PREP than in school STEM classes.
- There were no significant differences in “feeling supported by teachers” and “feeling treated fairly by teachers” between school STEM class and PREP.



Note:

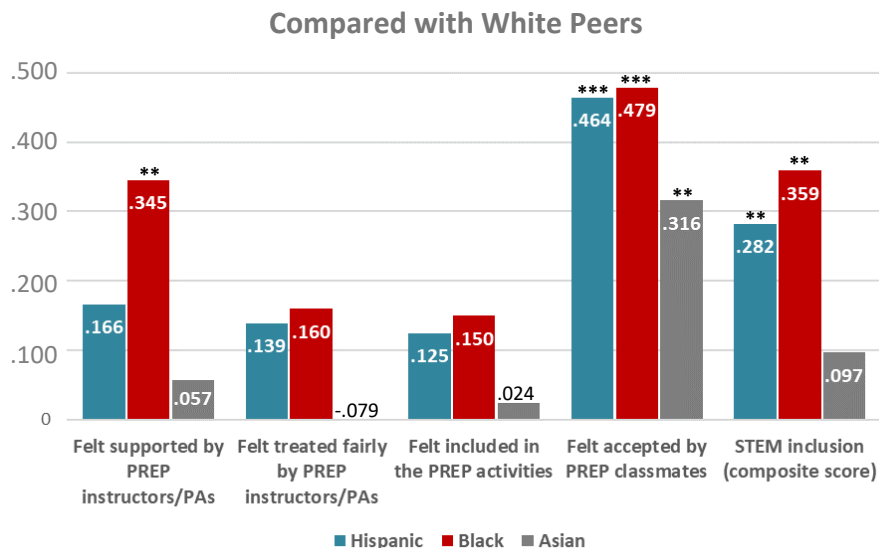
- (a) 5-point Likert scale: from “1 = Never” to “5 = Always.” Results are similar after controlling for demographics (gender, race/ethnicity, SES), site, grade, and math and science performance in school.
- (b) Significantly different from school STEM classes (\*\*\*)  $p < 0.01$ .



**UT PREP**, located at The University of Texas at Austin in Austin, Texas. Year 2 participants work collaboratively and with their PA (a Physics major at UT Austin) to learn about physics and mathematical logic through circuit design. Additionally, the PA will tutor students as needed to help them master the content taught in classes, as well as mentor them about going to college.

## 2. Perceived STEM Inclusion at PREP by Race/Ethnicity

- Compared with their White peers, Hispanic and Black participants generally reported higher levels of STEM inclusion at PREP.
- Black participants reported higher levels of “feeling supported by PREP instructors and program assistants.”



Note:

- (a) The composite score of STEM inclusion was computed by using factor analysis. The Cronbach alpha is 0.82.  
 (b) All models controlled for demographics (gender, race/ethnicity, SES), site, grade, and math and science performance in school.  
 (c) Significantly different from White peers (\*\*  $p < .05$ , \*\*\*  $p < .01$ ).

## PREP Site Spotlight

### Texas Tech University

Located in Lubbock Texas, PREP at Texas Tech University (TTU) started in 1986. Housed in the Department of Mathematics and Statistics, TTU PREP has been providing crucial STEM enrichment to students from across Lubbock and rural West Texas for over 30 years.



## Did You Know?

Lubbock is located on the Llano Estacado, one of the largest mesas in the world. Dry and featureless, the area is prone to high winds and dust storms. Soil erosion is a concern for the farmers who produce about 1/4 of the cotton crop in the United States.

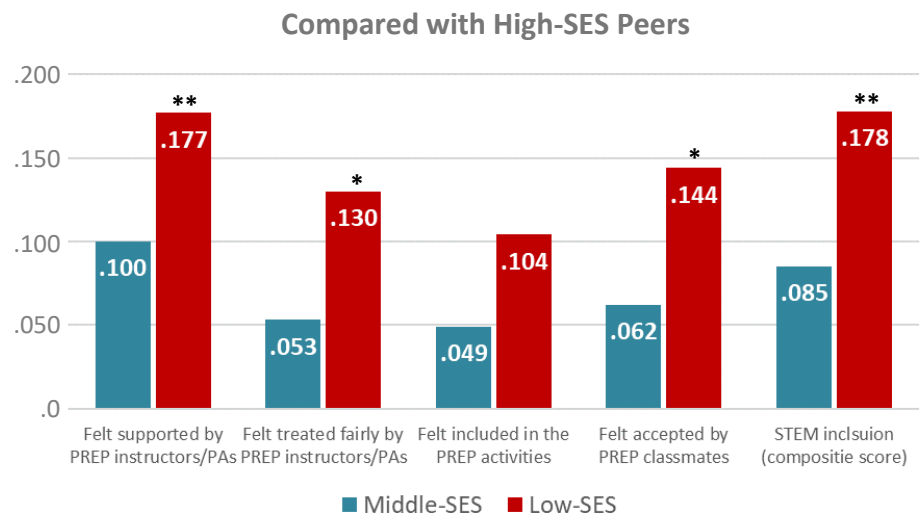


Pictured left, **TTU PREP** Year 4 participants learn about soil erosion and conservation using a soil erosion tray in their Earth Sciences class.



### 3. Perceived STEM Inclusion at PREP by Socio-Economic Status (SES)

- Compared with their high-SES peers whose parents had a graduate degree, low-SES participants whose parents had a high school diploma or below generally reported higher levels of STEM inclusion at PREP.
- Particularly, low-SES participants reported higher levels of “feeling treated fairly by PREP instructors and program assistants” and “feeling accepted by PREP classmates.”
- There were no significant differences in perceived STEM inclusion between high-SES participants and middle-SES participants whose parents had an associate’s or bachelor’s degree.



Note:

- The composite score of STEM inclusion was computed using factor analysis. The Cronbach’s alpha = 0.82.
- All models controlled for demographics (gender, race/ethnicity, SES), site, grade, and math and science performance in school.
- Participant SES was determined by their parents highest level of education. High school diploma or below = low-SES, BA or AA = middle-SES, and graduate degree = high-SES.
- Significantly different from high-SES peers (\*  $p < 0.1$ , \*\*  $p < 0.05$ ).

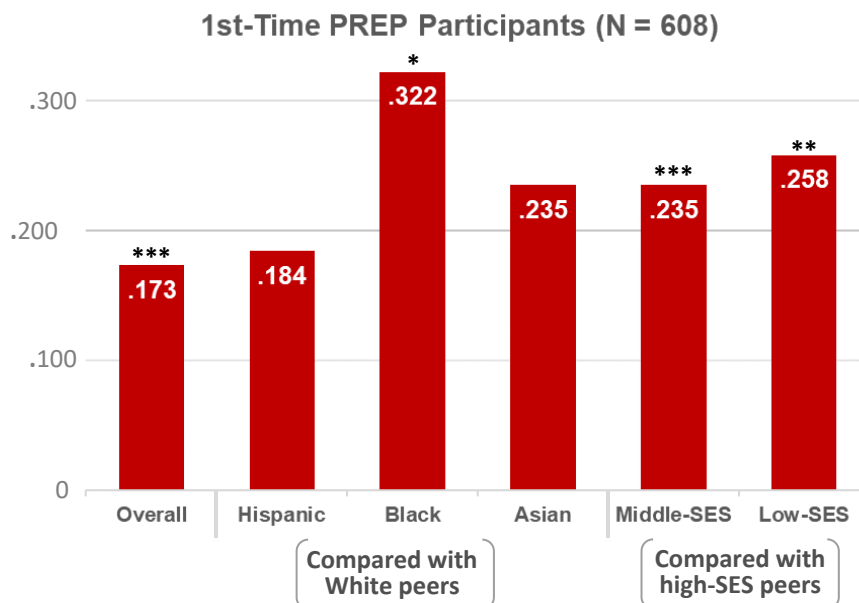


**STC PREP**, located at South Texas College in McAllen, Texas. Participants and administrators gather for a group picture. Located in South Texas, near the U.S.-Mexico border, STC has two additional PREP sites, one in Rio Grande City and another in Weslaco. Together, STC PREP provides crucial STEM based enrichment to students in the South Texas area.

#### 4. Relationship between Perceived STEM Inclusion at PREP and STEM Career Interest

- Participants who reported higher levels of STEM inclusion at PREP tend to report higher levels of STEM career interest by the end of the program, controlling for background characteristics and STEM career interest assessed in pre-survey.
- The positive relationship between perceived STEM inclusion at PREP and STEM career interest is larger for Black and lower SES participants, especially among 1<sup>st</sup>-time PREP participants.

##### Predicting STEM career interest with perceived STEM inclusion at PREP



Note:

- STEM career interest was assessed by four survey items (4-point Likert scale from “not at all interested” to “extremely interested”), including “taking more advanced STEM coursework in school,” “studying in a STEM degree program in college,” “working as a STEM professional in the future,” and “building a career in STEM fields in the future”.
- The composite score of STEM career interest was computed using factor analysis. The Cronbach alpha is 0.92.
- All models controlled for demographics (gender, race/ethnicity, SES), site, grade, math and science performance in school, and STEM career interest assessed in pre-survey.
- Significantly different from comparison groups (\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ).



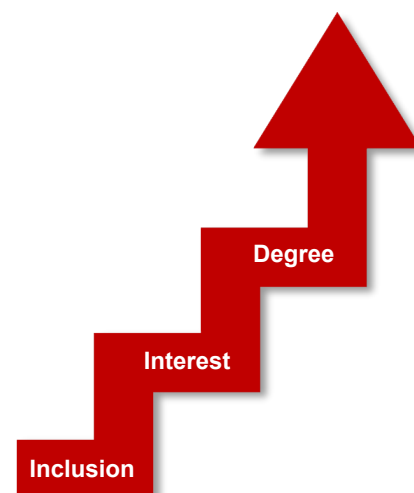
**CVC PREP**, located at Cedar Valley College in Lancaster, Texas. Year 2 participants work in collaborative teams building submersible robots. In addition to learning about content such as electrical engineering, structural engineering, and fluid dynamics, students also learn about team building and effective communication to design and control their robots.

## Summary

Despite numerous diversity initiatives across the country, the STEM workforce remains unrepresentative of the greater US population (National Center for Science and Engineering Statistics, 2019). To help broaden participation in STEM, programs like PREP can be critical for encouraging under-represented youth to pursue STEM careers (Saw, 2020; Saw et al., 2019; Chan et al., 2020).

Overall, PREP participants reported greater inclusion than in their school STEM classes, especially among Hispanic, Black, and low-SES students. Importantly, STEM inclusion is associated with greater interest in STEM careers, and the effect is larger for racial minority and lower SES students. Our data, however, found no evidence of larger positive effects for female students, underscoring the need for enhancing gender-inclusive program components of PREP.

## STEM CAREER



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## Thank you PREP sites for your participation!

Cedar Valley College	South Texas College	University of Houston-Downtown
Del Mar College	St. Mary's University	The University of Texas at Arlington
Huston-Tillotson University	Tarrant County College-South Campus	The University of Texas at Austin
Northeast Lakeview College	Texas A&M International University	The University of Texas Rio Grande Valley
Northwest Vista College	Texas Tech University	The University of Texas at San Antonio
San Antonio College	Texas Wesleyan University	



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