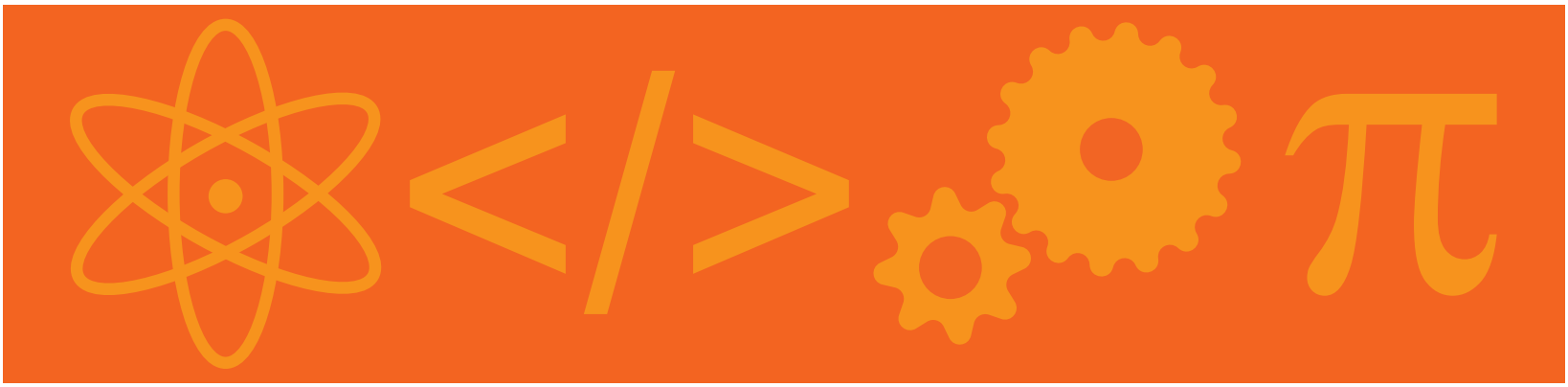


STEM

Classroom to Career:
Opportunities to Close the Gap

DESTINATION IMAGINATION

National Girls Collaborative Project

NAPE
National Alliance for Partnerships in Equity

ERCA
Educational Research Center of America

OVERVIEW

The United States faces a well-known challenge: it must develop a larger, qualified workforce in Science, Technology, Engineering and Math (STEM) to thrive in a technology-driven global economy. The US Bureau of Labor Statistics estimates that employment in STEM-related fields will increase by 1 million between 2012 and 2022[1].

One solution to this challenge is to attract more professionals from talent pools historically underrepresented in the STEM pipeline – i.e., women, African Americans, Hispanics, and Native Americans. This solution requires effective K-12 strategies. Students' voices can help shape those strategies to ensure they are smart and relevant.

The Research Consortium on STEM Career Pathways conducted a national survey of high school students in STEM classes during Spring 2015. This report draws on those data to identify opportunities, challenges, and promising practices for leveraging equity to meet STEM workforce needs.

Data from this sample of 7,325 student respondents suggest: 1) Equity efforts *can* increase the STEM workforce and 2) Realizing that potential requires *strategic efforts.*

Attracting and retaining females in the STEM pipeline requires:

- Boosting STEM career confidence
- Increasing STEM career aspirations

Attracting and retaining racial/ethnic groups historically underrepresented in STEM calls for:

- Ensuring stronger academic foundations in STEM
- Addressing unique barriers

> Failure is information-we label it failure, but it's more like, 'This didn't work, I'm a problem solver, and I'll try something else.'
>
> - Carol S. Dweck[2]

Despite the fact that students, regardless of race, ethnicity, or gender, begin from the same place – rating STEM as extremely or very relevant to their future careers – obstacles remain.

But there are solutions:

- Support creative learning in all STEM classrooms
- Address structural inequalities that contribute to an unequal STEM playing field

Taken together, these interventions can infuse the STEM pipeline with new talent to close the gap between supply and demand today – and to close the opportunity gap tomorrow.

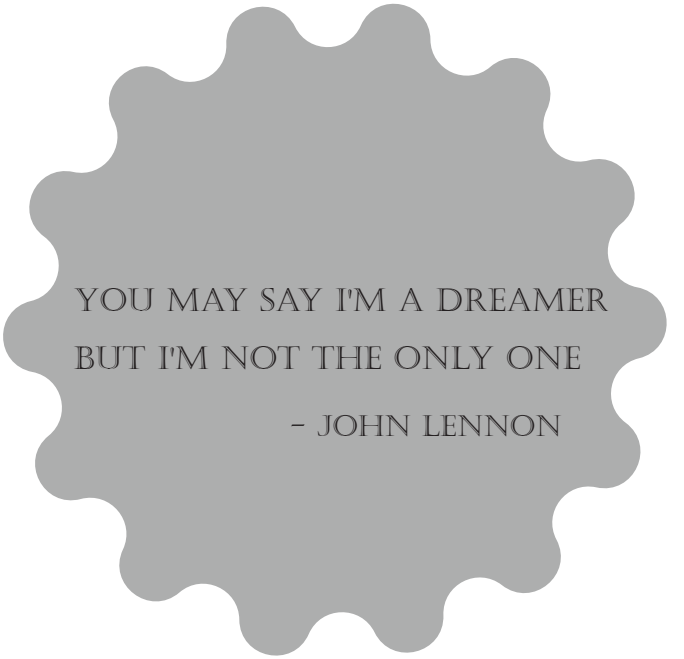
INTRODUCTION

Imagine every US student has an opportunity for a high-paying, in-demand career that inspires and engages.

Imagine the US has an adequate supply of highly trained and innovative workers to fill STEM jobs at all levels.

Imagine the US is the undisputed global leader of technology, innovation, and manufacturing – fueling an economy where parents see an even more promising future for their children.

These dreams can be reality if more high school students in STEM classes persist in the STEM pipeline and pursue STEM careers.



DEFINING STEM

Scholars, policy experts, and advocates agree the nation faces challenges fueling the STEM pipeline. They do not share a common definition of STEM careers[3]. We chose among alternatives based on our goal of closing the gap between workforce supply and demand[4]. Thus, social sciences, health careers, and accounting are excluded from the definition of STEM fields in this report.

Between classroom and career, the STEM pipeline loses many students who may enjoy and thrive in a STEM career. All demographic groups suffer losses. However, groups historically underrepresented in STEM fields suffer the greatest losses. The two largest of these groups are: 1) females and 2) African American, Hispanic, and Native American males.

- Whites and Asians comprise 72.4% of the US workforce, but 85.5% of the STEM workforce[5].
- Women are 47% of the US workforce, but only 25% of the Computer and Mathematical Sciences and 13% of the Engineering workforces[6].

Plugging leaks in the STEM pipeline is not only about equity, but an issue of economic urgency.

- By 2044, "minorities" will be the new "majority" of the US population[7].
- By 2020, the majority of US children will be members of racial/ethnic "minorities"[8].
- Today, nearly half of the engineering and advanced manufacturing workforce is approaching retirement[9]; new entrants to the STEM workforce are too few to replace them.

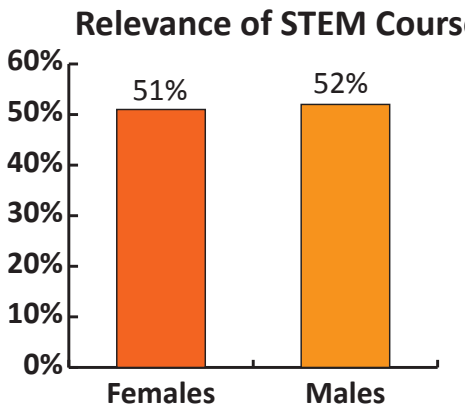
Destination Imagination, National Alliance for Partnerships in Equity, National Girls Collaborative, and the Educational Research Center of America formed the Research Consortium on STEM Career Pathways to address these needs.

FINDINGS

A Majority of High School Students see STEM Courses as Career Relevant, Regardless of Race/Ethnicity or Gender

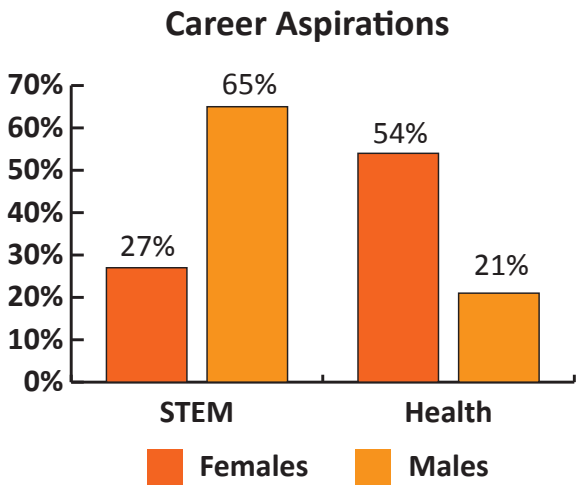
GENDER & THE STEM PIPELINE

Majorities of females and males rate STEM courses as "very" or "extremely" important to their future careers.



However, when presented with a list of 100 career options and allowed to choose up to two to consider, males were much more likely to aspire to STEM careers – and only STEM careers[10].

- Females are 38 points *less* likely than males to aspire to a STEM career.
- Males and females channel STEM's career-relevance into different career pathways with females preferring health careers over STEM.
- A gender gap in STEM aspirations may make it harder to retain females in the STEM pipeline.

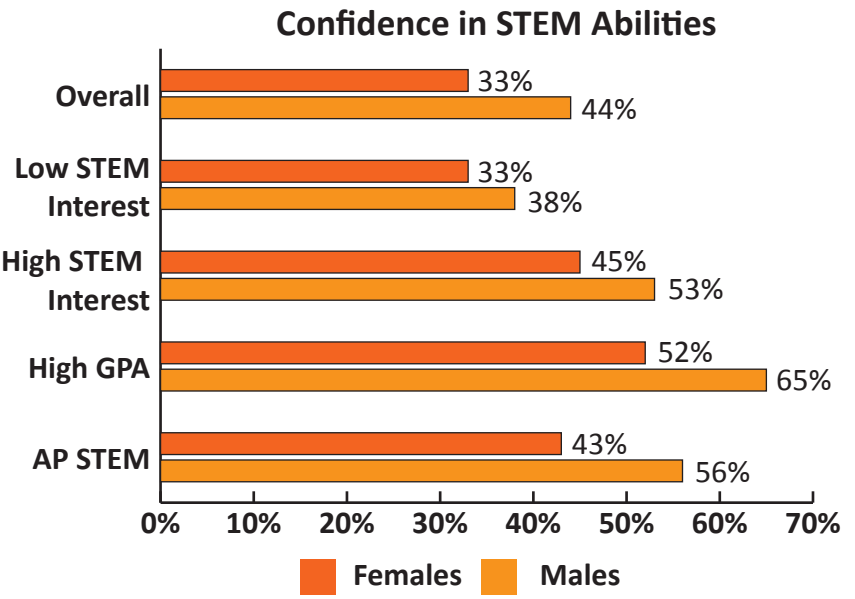


STEM CONFIDENCE

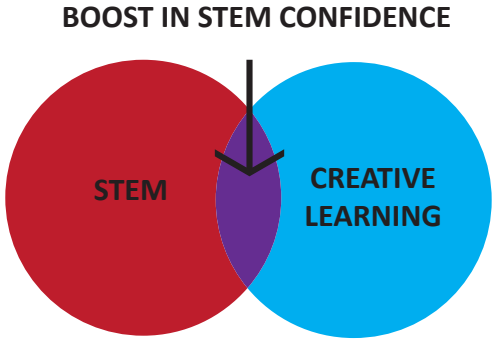
Males are consistently more confident of their STEM abilities than females. This holds:

- Whether they aspire to a STEM career or not.
- Among students with high GPAs who aspire to STEM careers.
- For students in AP STEM classes.

"Reverse engineering" may shed light on what can close the gender gap in confidence and help raise STEM confidence for all STEM students with promise. So what (besides gender) distinguishes students with the highest and lowest STEM confidence? One distinction is creative learning opportunities in their STEM classrooms.

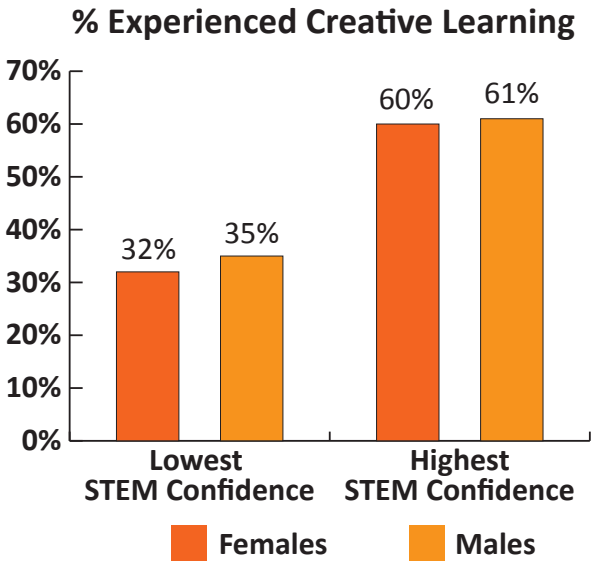


CREATIVE LEARNING & STEM



Creative learning matters. It characterizes the educational environment of confident students, regardless of gender. That suggests that greater access to STEM learning environments which *students themselves see as creative* might boost the STEM confidence of a generation. It might also help close the gender gap.

Majorities of students highly confident of STEM abilities[11] report frequently experiencing creative learning[12] in their STEM classes. Not so among students with the lowest STEM confidence. This pattern holds equally for males and females.



Education about career options is a logical solution. Yet a 38-point gender gap may require overcoming micromessages as well[13].

Micromessages are subtle, often negative, messages that reinforce stereotypes. Over time, micromessages accumulate. Unless countered, micromessages can lower STEM confidence.

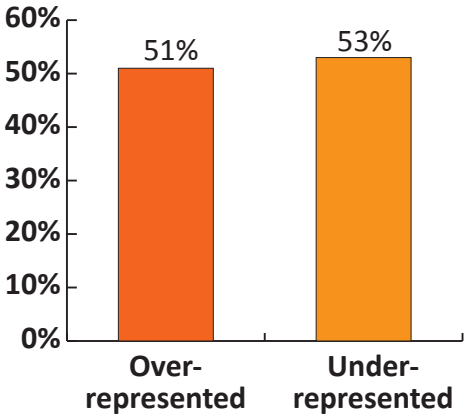
RACE/ETHNICITY & THE STEM PIPELINE

Racial/ethnic groups historically overrepresented and underrepresented in STEM careers agree STEM classes are highly relevant to their future careers.

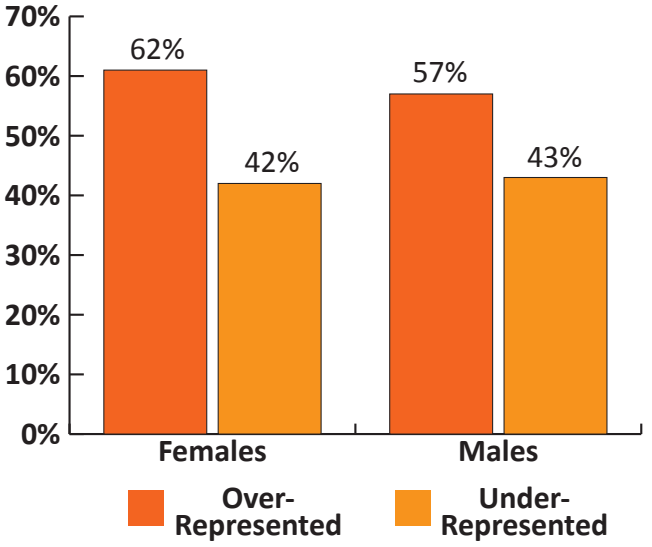
Whites and Asians leave high school with a stronger academic foundation in STEM than African Americans, Hispanics, and Native Americans. Among high school seniors surveyed:

- Whites and Asians more often than African Americans, Hispanics, and Native Americans complete 7+ STEM classes by senior year. This is true regardless of gender.
- More Whites and Asians than students from groups historically underrepresented in STEM fields take AP STEM courses.

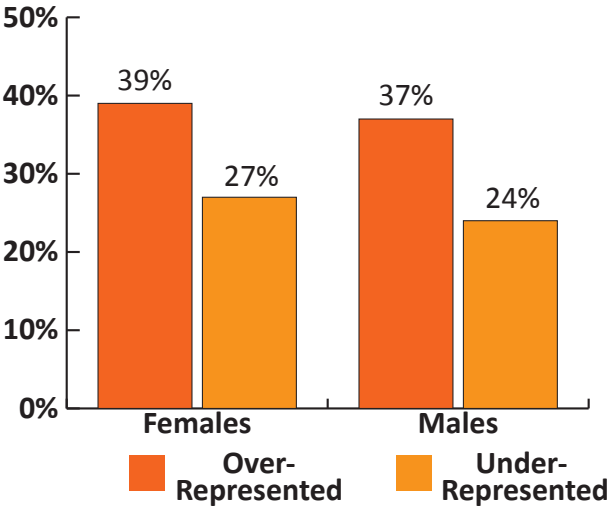
Relevance of STEM Courses



Completed 7+ STEM classes by senior year



Seniors taking an AP STEM class

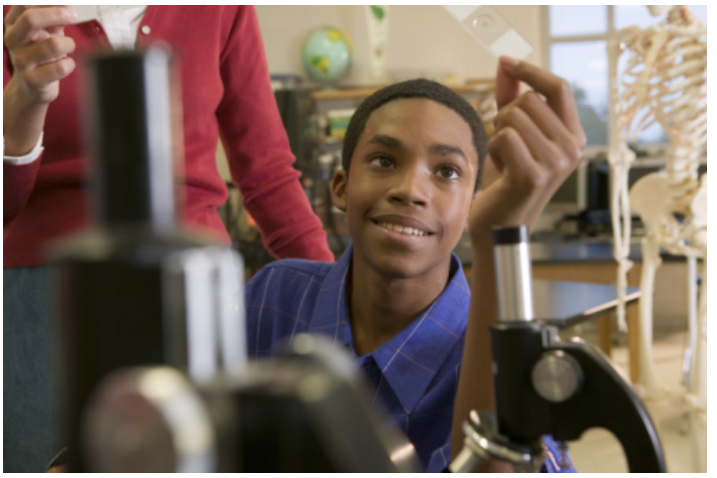


The challenge of boosting supply and diversity in the STEM pipeline are largely due to structural inequalities – not solely results of personal choice. Indeed:

- Nationwide, only 50% of high schools offer calculus, and only 63% offer physics[14].
- Among high schools with the highest percentage of African American and Hispanic students, a quarter do not offer Algebra II and a third do not offer chemistry.
- Fewer than half of Native American and Native-Alaskan high school students have access to the full range of math and science courses in their high school[15].

This is consistent with government statistics showing African American and Hispanic students are:

- 37% of students in high schools
- Only 27% of students enrolled in at least one Advanced Placement (AP) course, and
- Merely 18% of students receiving a qualifying score of 3 or above on an AP exam[16].



Bearing in mind these powerful structural inequalities across US public education, historically overrepresented and historically underrepresented racial/ethnic groups are still: 1) Equally likely to see STEM coursework as career-relevant, 2) Equally confident in their STEM abilities and 3) Largely similar in STEM career interest (with a mere 6-point gap compared to the 38-point gender gap).

Females from groups historically underrepresented in the STEM pipeline are faced with unique challenges. They face the structural challenges their male peers face: acquiring a solid academic foundation in STEM when they on average have access to fewer critical courses. And they face the challenges White and Asian females face: a gender gap in STEM confidence and STEM career aspirations.

These women and girls need strategies tailored for the more complex challenges that young women from historically underrepresented racial/ethnic groups face.

CALL TO ACTION

The nation faces an urgent challenge: how to offer all students secondary education options that equip all interested students – regardless of race/ethnicity – to pursue STEM dreams. Doing this: 1) Increases US potential to compete successfully in the global STEM market and 2) Provides students with the foundation required to achieve their dreams.

SOLUTIONS & STRATEGIES

Data from students suggest two strategies:

1. Support creative learning in all STEM classrooms. Students with the highest and the lowest STEM confidence diverge dramatically in at least one thing: frequent exposure to creative learning in STEM classes. This is true for females as well as males.

2. Address structural inequalities so that fewer African Americans, Hispanics, and Native Americans leave high school unprepared for post-secondary STEM education and careers.

The Research Consortium on STEM Career Pathways recommends approaches and tools to help every student, regardless of race or gender, achieve their STEM potential – and to position the US for success in the technology-driven global economy:

- Identifying and overcoming micro-messaging that threatens STEM confidence[17].
- Building resilient students who persist despite adversity[18].
- Cultivating desire to pursue STEM careers[19].

After-school clubs, teams, maker spaces, and camps can allow students to experiment with STEM concepts and explore the limits of their understanding. This builds confidence and is carried back to the classroom[20].

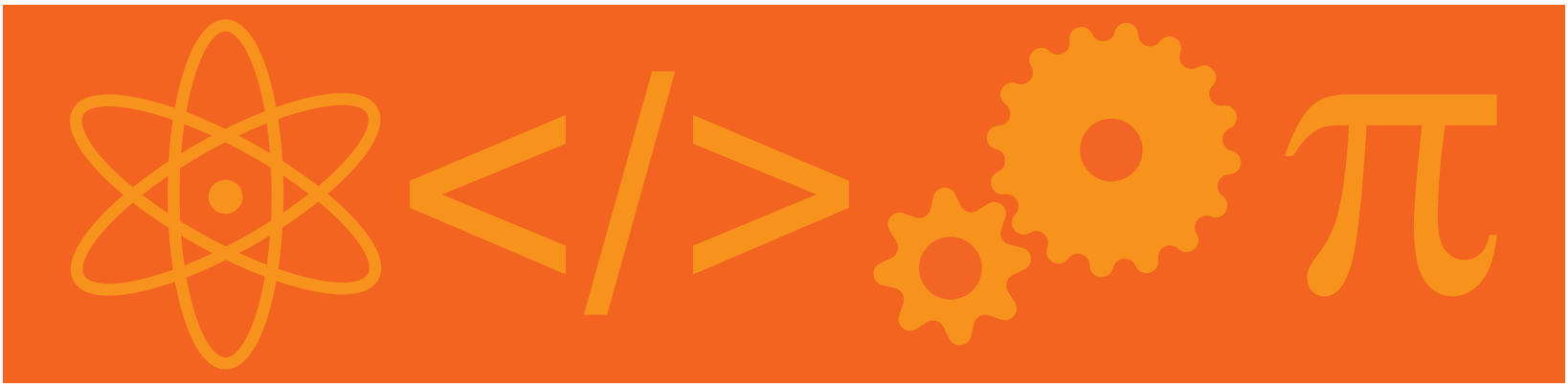
METHODOLOGY

This report is based on data from 7,325 students who responded to in-class surveys administered between March 2015 and May 2015[21]. Surveys were mailed to STEM teachers across the nation. Students generally reflect a cross-section of high school students nationally:

- 49% were female, 51% were male
- 45% were White, 6% Asian, 24% African American, 23% Hispanic, 7% Native American, and 9% preferred not to say. (Students could choose up to two responses.)
- They were distributed across four graduating classes: 2015 (19%); 2016 (29%); 2017 (23%); and 2018 (29%).
- They were from the South (53%), Midwest (18%), Northeast (9%), and West (20%) – roughly equal to the population of US high schools.

ACKNOWLEDGEMENTS

We are deeply grateful to all the high school STEM educators across the nation who administered the surveys, and especially to the students who voiced their points of view on this very important topic. We hope this report contributes to the dialogue about students' career and educational paths. For more information about the work of the Research Consortium on STEM Career Pathways, or to have your students participate in this project in the future, please contact: info@studentresearch.org. We also welcome inquiries from organizations that want to become involved in, or support, this work.



ABOUT THE PARTNERS

Destination Imagination

Destination Imagination (DI) is a cause-driven, 501 (c)(3) nonprofit focused on readying students worldwide for college, career, and life beyond school through opportunities that promote and support creativity, imagination, contextual learning, arts appreciation, STEM-based skills development, and entrepreneurship leading to an engaged and future-ready student population. To learn more, see: www.destinationimagination.org - Twitter: @IDODI

National Girls Collaborative Project

The National Girls Collaborative (NGC) facilitates collaboration, resource sharing, and professional development to strengthen the capacity of organizations to effectively engage girls in STEM, and leverages a network of girl-serving STEM programs and advocates to create the tipping point for gender equity in STEM. For more on the National Girls Collaborative see: www.ngcproject.org Twitter: @ngcproject

National Alliance for Partnerships in Equity

The National Alliance for Partnerships in Equity (NAPE) builds educators' capacity to implement effective solutions for increasing student access, educational equity, and workforce diversity in high-skill, high-wage, and high-demand STEM and career and technical education programs. For more on NAPE, see: www.napequity.org - Twitter: @NAPEquity

Educational Research Center of America

The Educational Research Center of America (ERCA) pursues a mission of helping high school students and their families to identify college- and career-ready pathways relevant to their interests, education, and passions. For more information, visit www.studentresearch.org - Twitter: @ERCAResearch

FOOTNOTES:

[1] See http://www.bls.gov/careeroutlook/2014/spring/art01.pdf

[2] Source: http://www.azquotes.com/author/19498-Carol_S_Dweck

[3] Even agencies across the federal government define STEM differently. The National Science Foundation defines STEM broadly, including social sciences. The Bureau of Labor Statistics defines it more narrowly, but includes accounting, for example. This study is ultimately about the challenges of fueling the STEM pipeline to meet demand now and in the future. Therefore, the definition of STEM used in this study attempts to align with the definition of Immigration and Customs Enforcement (ICE) – which designates certain job categories/ university majors as needing the talents of foreign students and workers. See http://www.ice.gov/sevis/stemlist.htm. Thus, social sciences, health careers, and accounting are excluded from the definition of STEM fields in this report.

[4] Student interests are classified using a two-step process. First, students indicated interest in up to two possible careers interests or goals from a list of 100 choices on the survey. Second, researchers then coded each option as STEM or not STEM careers, Health Science Careers or not, and neither Health Science nor STEM careers.

[5] See: https://www.census.gov/prod/2013pubs/acs-24.pdf

[6] (NSF, Science & Engineering Indicators, 2014) cited in https://ngcproject.org/statistics.

[7] For U.S. Children, Minorities Will Be The Majority By 2020, Census Says in http://www.npr.org/sections/thetwo-way/2015/03/04/390672196/for-u-s-children-minorities-will-be-the-majority-by-2020-census-says.

[8] For U.S. Children, Minorities Will Be The Majority By 2020, Census Says in http://www.npr.org/sections/thetwo-way/2015/03/04/390672196/for-u-s-children-minorities-will-be-the-majority-by-2020-census-says

[9] http://www.usnews.com/news/stem-solutions/articles/2015/02/24/stem-workforce-no-more-diverse-than-14-years-ago. Also see https://www.census.gov/prod/2013pubs/acs-24.pdf. Disparities in STEM Employment by Sex, Race, and Hispanic Origin.

[10] Based on our definition of STEM, careers were assigned to STEM, health, or other categories.

[11] Highest confidence students report being “extremely” or “very” confident of their STEM abilities.

[12] Frequent exposure is defined based on self-reports of “always” or “often” experiencing creative learning opportunities in STEM courses.

[13] Morrell, C. and C. Parker. 2013 (Spring). Adjusting micromessages to improve equity in STEM. Diversity & Democracy 16(2). Available at http://www.aacu.org/publications-research/periodicals/adjusting-micromessages-improve-equity-stem

[14] http://www2.ed.gov/about/offices/list/ocr/docs/crdc-college-and-career-readiness-snapshot.pdf

[15] http://www2.ed.gov/about/offices/list/ocr/docs/crdc-college-and-career-readiness-snapshot.pdf

[16] http://www2.ed.gov/about/offices/list/ocr/docs/crdc-college-and-career-readiness-snapshot.pdf

[17] NAPE Micromessaging to Reach and Teach Every Student Social Learning Theories Unit

[18] Hall, C., Dickerson, J., Batts, D., Kauffmann, P., and Bosse, M., “Are We Missing Opportunities to Encourage Interest in STEM Fields?” Journal of Technology Education, URL: http://scholar.lib.vt.edu/ejournals/JTE/v23n1/hall.html

[19] http://www.engr.psu.edu/awe/misc/arps/arp_selfefficacy_overview_122208.pdf

[20] See www.theconnectory.org to find opportunities by zip code.

[21] A sample from one of several consortia projects.