

Underrepresented Students in STEM

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## Abstract

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African Americans, Mexican American/Latino, and Native American/Alaska Native students have historically been considered a minority in the United States. However, their population growth and influence in the nation is unproportioned to their growth in the fields of science, technology, engineering, and mathematics (STEM). The amount of students graduating from undergraduate school is even lower than those enrolled. Underrepresented students do not only take into account the individual's race and ethnicity, but also the individual's gender. The gap created by the lack of diversity in universities is a potential dilemma to the nation as a whole. This study will look into understanding diversity in STEM fields as well as practices implemented in schools that are effective in being inclusive and increase the rates of degree attainment from minorities in STEM majors.

*Keywords: Mechanical Engineering, STEM, Minorities, Underrepresented Students, Science, Technology, Engineering, Mathematics, Stereotype Threat*

## Importance of Diversity in STEM

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In American culture, science is often seen as a very respected and highly viewed field. Working in the science field can offer many benefits and be quite satisfying for its members. Scientists are often leaders and independent thinkers, who are fortunate enough to understand how things work and why they do what they do. This area is highly underrepresented by African Americans, Latinos and Native Americans, since their rates of participation in science-related fields like Science, Technology, Engineering and Mathematics (STEM) is very small. This paper studies the reasons for the lack of underrepresented students in higher education and their discouragement in pursuing an education in STEM. Currently, the field is highly dominated by one group of people: white men. Given that STEM careers are permeating aspects of our everyday life, it is important that new technology and advancements are applicable to everyone. Therefore, people that contribute to the development of new products or new knowledge have a large impact on the rest of society. Having a diverse group of individuals working together can be more effective to come up with innovative ways to solve a problem or make a product more effective. Working with people that come from many different backgrounds assures a variety of different perspectives in the workforce. This begins with having underrepresented students choose to study and persist in STEM fields.

The underrepresented students in this paper refer to racial minorities and gender minorities in the field of science. At SUNY New Paltz, STEM majors fall under one of the following categories: biological sciences, physical sciences, engineering, and computer science. According to the National Center for Science and Engineering Statistics of 2016, only 17% of all

Bachelor's degrees in the four different fields were awarded to minorities [1]. Table 1 represents the statistics of B.S. degrees awarded to students of color and women of color.

Table 1: Bachelor's degrees awarded by race, sex, and field in percentages (%): 2016 [1]

	Computer Science	Engineering	Biological Sciences	Physical Sciences
All African American/Black	8.68	3.86	7.39	5.45
African American Women	2.20	0.97	5.18	3.00
All Hispanic/Latino	10.14	10.40	12.24	9.40
Hispanic/Latina Women	1.87	2.31	7.54	3.74
Native American	0.30	0.15	0.20	0.20
Native American Women	0.08	0.03	0.11	0.09

Diversity in STEM is crucial for long-term economic growth in the United States. Considering that every year more people of color are born in the country and with half the population being female, it is important to think about how diverse is the scientific workforce. Allowing the workforce to be more capable, enables scientific advancement which is strongly linked to the economic growth of a nation [2]. Regardless of the benefits that diversity invokes for the community, it is essential to help underrepresented students persist and succeed in STEM as students should be able to pursue their interests and achieve academically to the best of their potential. An important point to address is that the efforts devoted to increasing the number of students of color in STEM is not finite, but rather something that needs to be worked on continuously.

## Challenges and Transitions to College

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Through one-on-one interviews with SUNY New Paltz STEM students, they have shared some of the challenges they faced during their transition to college and during their academic career. The problems students shared were consistent with research gathered from other studies. An interactive event took place at the SUNY New Paltz campus as well, inviting members of the AC<sup>2</sup> program (AMP & CSTEP Community), NSBE (National Society of Black Engineers), and SHPE (Society of Hispanic Professional Engineers) clubs. These students shared their experience as minorities in STEM and suggested actions that can be taken in order to improve the experience of future generations. The link to watch the talk is:

<http://newpaltz.mediasite.suny.edu/Mediasite/Play/b5b9793966cc400a8aa0b1c50760fb541d>

Many racial minorities have a hard time transitioning from high school to college in different aspects. One of these aspects is the academic environment they are exposed to. Majority of faculty and peers in STEM fields are white, and few minorities are in positions of power in academia. This can be troublesome as most students of color feel even more intimidated by their professors and find them unapproachable. Participants from the talk mentioned that they also felt unprepared for college and were unfamiliar with the college application process. For the most part, minorities attend public high schools that are not well founded. These schools tend to have a hard time affording textbooks and providing resources to build student's writing skills and expand their vocabulary skills. Having underdeveloped skill sets puts them at a disadvantage for success in college. This often leads to students feeling discouraged and eventually dropping out of their intended major.

One of the biggest challenges faced by students of color is being doubted in their abilities to succeed in STEM. One of the participants for the one-on-one interview mentioned a time when she went to her professor's office hours for help in an assignment, and the first thing the professor asked when the student walked in was, "Why are you here?" This question can be very discouraging for students of color as they already feel that they are in an environment where they are not accepted. Another student from the one-on-one interview mentioned a time where she felt excluded from her peers in class. This student was the only student of color in her computer science class, and when they had an in-class activity where the students asked each other questions, no one asked her a question even after all the students picked to answer responded incorrectly. Students also expressed feeling excluded from study groups formed in their classes. This often leads to students feeling excluded and alone on top of the academic workload they are expected to accomplish. The additional stress many times is a reason behind minorities not persisting with their STEM career.

## Stereotype Threat

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Stereotype threat is a phenomenon that most students of color in STEM experience in some form and individuals have different ways of perceiving it. Stereotype threat refers to being at risk of confirming, as a self-characteristic, a negative stereotype about one's social group [3]. This often occurs in environments where one is underrepresented. There are three perceptions of stereotype threat, these are: fending off the stereotype, discouraged by the stereotype and resilient to the stereotype [4]. Under each of these categories, there are possible responses that individuals may exhibit.

Fending off the stereotype typically has responses such as invigoration, internal attributions, identity bifurcation, and assimilation [4]. Invigoration is a common response from people that overwork themselves in order to show that the stereotype does not apply to them. These individuals set extremely high goals for themselves leading to internal attributions in the case that they do meet those goals. Internal attributions are when a person blames negative outcomes to their own inadequacies rather than discrimination. This behavior can be a method to protect themselves since they often feel helpless in the face of discrimination. Internal attributions can also lead to depression and cause students to feel overwhelmed when they do not reach those high expectations. In addition to this, individuals may also respond to stereotype threat with identity bifurcation. This occurs when people disassociate themselves from their negatively stereotyped group or social group and maintain aspects that are not frowned upon. Alongside renouncing parts of their social group, individuals respond by assimilating

characteristics of the majority or highly viewed identity group. These assimilations can be physical, cultural or social.

Discouragement by the stereotype has responses such as disengagement, external attributions, anger, and withdrawal [4]. Disengagement is when students do not feel motivated or encouraged to succeed in their classes as they become distant from circumstances where they are evaluated on their performance. External attributions refer to individuals that convince themselves that negative outcomes are not a reflection of their personal abilities but from external causes that is out of their control. This can also be a method to protect their self-esteem as they feel that it is not entirely their fault that they cannot succeed. A very common response resulting from contending with stereotype threat is anger. The anger can be directed at both the discriminator as well to oneself. Withdrawal occurs when individuals maintain a negative attitude towards their classes or their department resulting in uninvolvement, commitment, and satisfaction with their academic environment.

Resilience to the stereotype has responses such as challenging negative group stereotypes, positive distinctiveness, collective action, and redefining criteria for success [4]. Challenging negative group stereotypes is the reaction of individuals that realize the limitations of negative stereotypes on their social identity leading them to challenge those beliefs through educating others. Positive distinctiveness refers to people that make an effort to override negative beliefs from their social group with new and positive ones. Collective action is when individuals realize they are not alone facing these challenges and join forces with others going through a similar situation to change the context. Redefining criteria for success is when people establish

their own meaning of success and live by their own standards, rather than living up to other people's expectations.

## Recommendations

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The following recommendations were suggested by SUNY New Paltz students as well supported by research and studies that proved to close the achievement gap in STEM. These suggestions can also prevent the negative consequences of stereotype threat. One of the highest requested improvements is to provide role models for students of color. Just as it is very important to have a diversified student body, it is also very important to have a diverse faculty. Professors are the first role models for new students in the STEM field; therefore, it is important to have professors of color represent and be in charge in the classroom as well. Role models do not only have to be through hiring more professors of color, but also through bringing in more diverse speakers. At SUNY New Paltz the Harrington STEM Lecture Series are very popular events where speakers' goal is to describe recent advances and share scientific insights. Having speakers come in and be role models for students of color is very important for students to see themselves in their position. Similarly in the engineering department, there are multiple seminars that take place during the academic year that students are required to attend. These events can also be more diversified for students.

One of the recommendations for students to persist in STEM and surpass the challenges of stereotype threat is practicing self-affirmation. There was a study in Stanford University where psychological threat was lessened by having students reaffirm their adequacies. The practice done by an in class writing assignment showed to improve the grades of African American students and reduce the achievement gap by 40% [5]. Emphasizing motivation and

effort can make a significant difference in the classroom too. This refers to professors emphasizing the growth mindset about intelligence rather than coming in with a fixed mindset.

Another suggestion students gave was to require STEM professors to learn about stereotype threat. Many faculty in STEM are not required to have any background in education in order to teach. Therefore, professors should be required to learn about stereotype threat and learn how to interact with students of color. It is important for professors to be mindful of how their actions and what they say is perceived by their students. Alongside this suggestion, professors should also provide feedback that motivates students to improve [6]. This means that when commenting on students' work, professors should provide clear comments. Comments can be regarding the high standards set from the professor, how and where the student did not meet those standards and give the student confidence that he or she can meet that quality of work.

Fostering a sense of belonging in the campus community is also a significant portion for students of colors to feel that they are in the right environment [6]. This method can include having student narratives of successful individuals that have passed a challenging class or have persevered through a difficult time. Having upperclassmen share their experiences, allows underclassmen to internalize that information and see themselves in their shoes seeing the possibility that they can also succeed.

For universities, which are supposed to foster a learning environment and a safe place for students, they must address the racial issues that occur on their campus. There have been many circumstances in institutions where the universities have tried to cover up discrimination that occurs on their campus to protect their reputation. One example is the case of Tiana Young at RPI, where a white student from the alt-right group Turning Point USA wrote a Facebook post

that called for the return of separate water fountains for whites and colored people [7]. The school failed to publicly address the issue, making students of color very upset and consider transferring. Students' voices should be heard loud and clear regarding discrimination in order to foster a welcoming environment for all students.

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