

The White Papers

Changing STEM Career and Higher Education Culture for Women in Engineering and Science



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“The diversity gap results from the lack of Blacks and Women being groomed for senior leadership positions”.

Wendy Hensel Provost, Georgia State University



IN THIS ISSUE

Invited Subject Matter Experts

**Climate Control: Implicit Bias
in Engineering**
Society of Women Engineers

**Diversity in STEM during
Covid 19**
Goodwin/Mitchneck

**Culture in Health Sciences
Changing**
Live @ NIH Q&A

Climate Control: Implicit Bias in Engineering



With women representing only 13% of the engineering workforce and just 21% of the engineering bachelor's degrees in the US, women remain severely underrepresented in engineering. And we know that implicit bias plays a huge role in contributing to that underrepresentation.

To learn more, the Workplace Experiences Survey was launched by the Society of Women Engineers and the Center for WorkLife Law at the University of California, Hastings College of the Law. More than 3,000 participants took part in the survey. Around one-third (897) of respondents left comments—a strikingly high number. The number and tone of comments show engineers' intense interest in, and strong reaction to, the topic of implicit bias in engineering. The survey asked respondents whether they had been met with the basic patterns of gender and racial bias that have been documented, over and over again, in social psychology studies.

Large gender gaps were reported for three patterns of bias

Prove-It-Again. 61% of women vs. 35%¹ of white men reported that they have to prove themselves repeatedly to get the same levels of respect and recognition as their colleagues.

“Women have to look more professional and demonstrate technical prowess at all times to receive the same respect as a male engineer who is just an average engineer.”
(white woman)

Tightrope. Women engineers reported that a narrower range of behavior was accepted in women than men. Women often walk a tightrope, navigating both pressures to behave in feminine ways and pushback for behavior seen as “too masculine.”

- Women engineers were less likely than white men to say they could behave assertively (51% vs. 67%) or show anger without pushback (49% vs. 59%).
- Women (33%) were more likely than white men (16%) to report pressures to let others take the lead; were more likely to report doing more “office housework,” such as finding a time everyone can meet, taking notes, or planning office parties (55% vs. 26%); and were less likely to report having the same access to desirable assignments (65% vs. 85%).

¹ All comparisons are statistically significant based on two sample t-tests, unless noted otherwise. P values of the t-tests are included in the text.

“The overall culture still needs to change. ... Just last year they hired a new female and one of the managers was telling me how happy they were about hiring her because she really clean[s] up after the guys and keeps the lab tidy.” (white woman)

Maternal Wall. Nearly 80% of men said having children did not change their colleagues’ perceptions of their work commitment or competence; only 55% of women did.

“My colleagues assume I am a slacker because I have children, even when I come in evenings or weekends to make up time that I have to miss due to my children. Also I don’t feel like I can talk about my children without being judged.” (African-American woman)

Three separate regression analyses showed that, after controlling for many other variables, women still reported more Prove-It-Again, Tightrope, and Maternal Wall bias. Evidence for the fourth basic pattern of gender bias, Tug of War, was weaker.

Large racial gaps were reported for two patterns of bias

Prove-It-Again: 68% of engineers of color (men as well as women) reported having to prove themselves repeatedly, as compared to 35% of white men.

“Being from an international background, not white bread American raised, we have to work harder.” (Latino man)

Tightrope:

- Engineers of color were less likely than white men to say they could behave assertively (49% vs. 67%) or show anger without receiving pushback (45% vs. 59%).

- Engineers of color were more likely than white men to report pressures to let others take the lead (39% vs. 16%) or do office housework (52% vs. 26%) and were less likely to report having the same access to desirable assignments (55% vs. 85%).

“I feel discriminated not only by my gender but also by my cultural heritage. There are very few opportunities extended to someone like me. I am given the work but not the credit for successful outcome. ... The message I get over and over is that I am capable of getting things done right but I don’t deserve the right to be promoted—even if the additional responsibilities were given to me.” (Latina woman)

Although clearly some Latino engineers reported bias, two separate regression analyses showed that, after controlling for many other variables, Asian- and African-American engineers reported more Prove-It-Again and Tightrope bias than their white counterparts, but the effects for Latinos disappeared.

Age effect shown for one pattern of bias

Regression analysis showed that, after controlling for many other variables, engineers aged 55-64 reported higher Prove-It-Again bias than engineers below 35 years old.

For virtually every workplace process, either women or engineers of color reported experiencing more bias than their men or white counterparts, and a few effects emerged for age.

The survey also asked whether engineers believed that they were fairly treated at work with respect to hiring, promotions,

performance evaluations, access to networking and mentoring, and compensation.

Women respondents were more likely than white men to report:

- As compared to my colleagues, I work more but get paid less (40% vs. 29%).
- I feel I get less honest feedback on my performance than my colleagues (29% vs. 20%).

Women respondents were less likely than white men to report:

- I have had as much access to formal or informal networking opportunities as my colleagues (67% vs. 84%).
- I have been given the advancement opportunities and promotions I deserve (62% vs. 71%).
- My performance evaluations have been fair (77% vs. 83%).

Regression analysis showed that, after controlling for many other variables, women reported experiencing higher levels of bias in hiring, networking/sponsorship, and promotion than their male counterparts.

Engineers of color were more likely than white men to report:

- As compared to my colleagues, I work more but get paid less (48% vs. 29%).
- I feel I get less honest feedback on my performance than my colleagues (35% vs. 20%).

Engineers of color also were less likely than white men to report:

- I have had as much access to formal or informal networking opportunities as my colleagues (64% vs. 84%).
- I have been given the advancement opportunities and promotions I deserve (53% vs. 71%).
- My performance evaluations have been fair (69% vs. 83%).

Regression analysis showed that, after controlling for many other variables, African-American engineers reported higher levels of bias in networking, promotion, and mentoring/sponsorship than their white counterparts. Asian-American engineers reported more bias in performance evaluations than their white counterparts.

Survey respondents also reported age bias: After controlling for many other variables, engineers over 45 reported higher levels of bias in performance evaluations and mentoring/sponsorship than their younger counterparts (below 35 years old); engineers over 55 reported higher levels of bias in promotions than below 35 years old. In addition, engineers with between two and 10 years of experience at their current companies reported hiring bias, compared with those with less than two years of experience at their companies, after controlling for many other variables.

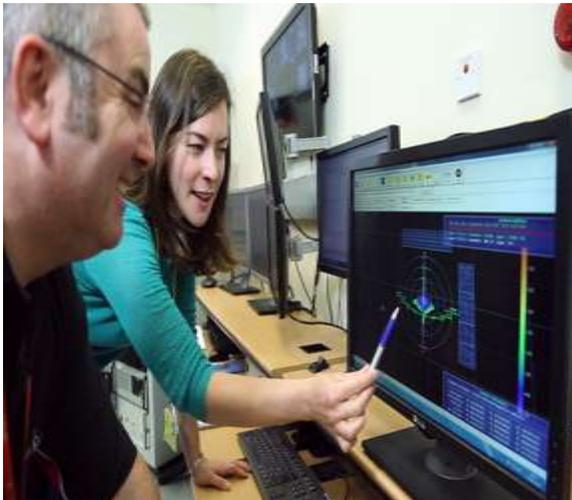
Even small amounts of bias in basic business systems can have large effects. One computer-simulation study found that even if bias accounts for as little as 1% of the variance in performance ratings, bias can have large effects in reducing the

representation of women over time, especially in high-level positions.²

The topic of bias is controversial in engineering

While 16.8% of the comments by male engineers expressed the view that diversity is threatening the quality of the profession and that women now have unfair advantages, or similar sentiments, only 3.6% of male lawyers made these kinds of comments in a similar survey. “Merit is vastly more important than gender or race, and efforts to ‘balance’ gender and race diminish the overall quality of an organization by reducing the collective merit of the personnel.” (white male engineer)

To learn about bias interrupters and see the full study report, visit research.swe.org.



² Martell, R. F., Lane, D. M., & Emrich, C. (1996). Male-Female Differences: A computer simulation. *American Psychologist*, 51(2), 157-158.

Williams, J. C., & Li, S. Forthcoming. Understanding in-house and law firm lawyers' workplace experiences survey. Center for WorkLife Law, UC Hastings College of the Law.

About The Author/Organization

Karen Horting, MBA.CAE Executive Director and CEO Society of Women Engineers (SWE)



For more than six decades, SWE has given women engineers a unique place and voice within the engineering industry. Our organization is centered around a passion for our members' success and continues to evolve with the challenges and opportunities reflected in today's exciting engineering and technology specialties.

Diversity in STEM for Women During Covid 19

Understanding how the pandemic will differentially impact STEM women, particularly women of color, will be key for institutional leaders to identify and deliver equitable and inclusive solutions in the wake of this crisis. Four major challenges are readily identifiable:

Beyond research resources, studies suggest that women, especially those of color, may face barriers to inclusion in informal professional networks, particularly on their own campuses. To the extent women are out

of the loop when it comes to such informal networks, they may also be excluded from important communications, decision making and opportunities to collaborate that afford a more rapid return to active research productivity.

Remote work is hard for everyone, but it is likely to have a greater negative impact on women faculty members -- particularly those of color. Women report more frequent experiences with incivility, bullying and harassment in the classroom. Because ambiguity and anxiety over course outcomes can exacerbate student aggression toward instructors, particularly in online learning environments, they may be at an even higher risk of experiencing harassment (such as Zoom bombing and student aggression) now that all learning has moved online.

Incivilities and harassment are not limited to student/faculty interactions; as workload and economic ambiguities associated with protracted campus closures increase, women and other historically marginalized faculty also may experience greater incivility from faculty peers. Increased negative interpersonal experiences will take a greater toll on women's well-being and, therefore, their productivity and work satisfaction.

Women faculty performs more hidden labor relative to their male peers, particularly when it comes to mentoring students. Students are more likely to ask women faculty for special favors like course extensions and expect them to provide more emotional support, and these differences in service will probably increase in the current crisis. Faculty women of color may be especially burdened with student requests during the pandemic because underrepresented students -- who more often seek support from faculty members who

share their racial/ethnic identities -- may themselves confront disparate academic and economic outcomes as a result of campus closures.

Even if women faculty want to step back from responding to student expectations, doing so may come at a cost: students evaluate women faculty more negatively for failing to live up to gendered expectations. Hence, women of all backgrounds may be in a double bind when it comes to juggling their professional goals with student expectations for support during the pandemic.

Despite men's increased participation in household labor in recent years, women continue to spend more time on household roles, including childcare, housework and eldercare. Women faculty who are also parents of school-age children face the

challenge of heightened responsibility for negotiating their children's learning outcomes during the pandemic. Because women in heterosexual relationships also assume more responsibility for relational and cognitive labor within close relationships, women faculty may face comparatively greater cognitive demands that undermine attention and productivity, even if their partners assume a greater share of household labor.

Academic leaders have the obligation to anticipate and mitigate such disparities in responding to the pandemic. Inclusive communication continued monitoring for equitable distribution of resources and conscientious attention to differential impacts on the workplace climate is essential. As a first step, academic and scientific leaders should ask:

Who is not at the table now as we work to build plans to recover from this crisis? Engaging campus leaders and experts in diversity, equity and inclusion will broaden participation in decision making and ensure needed attention to faculty DEI concerns.

Are we capitalizing on the opportunity to embed evidence-based practices for faculty DEI into recovery policies, practices, procedures and programs? Rapid-response leadership teams may be missing opportunities to embed lessons learned from successful faculty DEI programs on their own and other campuses. Reaching out to internal and external resources -- including experienced leaders in the ADVANCE community -- will ensure decision makers are knowledgeable of evidence-based practices as well as any possible pitfalls before decisions are made. It is always easier to implement DEI practices when policies are created than to bootstrap post hoc corrections. Are we focusing on long-term faculty DEI needs when making difficult budget decisions? If we are truly committed to faculty inclusion and success, we must resist the temptation to deprioritize DEI and faculty development efforts during and after this crisis. Short- and long-term recovery plans should prioritize faculty development and DEI programs to ensure adequate funding, staffing and commitment.

In conclusion, the time ahead will be challenging as campus leaders seek to support faculty members during and after the current crisis. But reaffirming our commitment to faculty diversity, equity and inclusion is crucial for ensuring women scientists have a fair shot at returning to productivity and advancing in their careers.

About Authors Goodwin & Mitchneck



Stephanie A. Goodwin - president of Inclusion Works Inc., where she consults with academic leaders and professional societies to promote evidence-based solutions for diversity, equity and inclusion. She has served as program director for a multi-institutional National Science Foundation ADVANCE initiative in Dayton, Ohio.



Dr. Beth Mitchneck - Professor Emerita in the School of Geography & Development at the University of Arizona. She also served as program officer for the National Science Foundation's ADVANCE program to promote faculty diversity, equity and inclusion in STEM and organizational change.

Three Ways to Encourage More Women in STEM

In a global economy, it is a fact proved many times over that a diverse and inclusive employee base has a competitive advantage. But this isn't just a corporate tactic designed to nurture future talent; mentoring and encouraging young minds is a social responsibility and a sincere privilege. So, what actions can individuals and companies take to encourage girls' curiosity in STEM?

1. Partner with the Community

Most girls lose interest in STEM during their teenage years; some studies identify age 15 as a significant drop-off point. We need to be reaching girls before they start losing interest. Companies can partner with local schools and other organizations and institutions to speak to girls about the opportunities in STEM.

Over the years, I've worked with my Jabil team to create some fun and exciting curriculum for the Girl Scouts of West Central Florida's "POWER IT UP" Powered by Jabil summer camp. We've shown girls between the ages 9 and 13 the creative side of STEM through 3D printing activities, solar power, windmill projects and coding. As I mentioned earlier, hands-on projects are crucial to developing STEM-related skills and intelligence. When we work with kids, we often bring kits with electronics that the girls can click together to make circuits. It's a great way for the kids to be able to create a solution for something physical with these easy-to-use, snap-together blocks. We've also done projects for them to generate an alternative energy and had some physical representations of optics and how optics works. They're just simple projects and representations, but it

really helps them understand these scientific principles and removes some of the hesitancy about understanding "hard" concepts. As the concepts become more real, so does the idea that they can meaningfully participate in these areas and it gets them excited about doing it.

Allowing girls to do hands-on STEM activities helps them to see the value in STEM careers. Many young people – men and women – are increasingly citing the ability to make a difference as a driving force in choosing a career path. Exposing younger children to a variety of fields and helping them to see the potential impact on the world through efforts in those fields can only be beneficial as we look to create tomorrow's workforce. This helps them picture themselves in these professional roles someday.

It's also important to just talk to the kids and make sure they know what opportunities are available to them. I've also had the privilege of mentoring at the American Heart Association's 2018 Girls Go Red for STEM event, where 100 middle school-aged girls from underserved neighborhoods were invited to a one-day education event to get hands-on exposure to STEM. I was honored to have the chance to talk with these bright, young women about the career possibilities out there waiting for them.

2 Establish Visible Role Models

One way to encourage female interest is by featuring women who are in STEM2D or have made valuable contributions to STEM2D. According to a study conducted by Microsoft, girls are far more likely to feel

empowered in STEM when they know a woman in a STEM profession.

LEGO has taken steps to highlight the achievements of women in STEM, rolling out a new set that honors four influential women in NASA: astronomer Nancy Grace Roman, computer scientist Margaret Hamilton and astronauts Sally Ride and Mae Jemison.

But this isn't only applicable to girls; career women need female leaders and mentors to look up to as well. That is why Women in Manufacturing launched the STEP Ahead awards, an annual competition honoring the best of female leaders in the manufacturing industry. To date, this program has recognized more than 900 women, including several Jabil leaders.

3. Just Listen

Women face additional challenges once in the engineering workforce, both self-inflicted and within the work environment.

Specifically, these include situations where women may not speak up as readily as their male counterparts. They may perceive an exclusion attitude or approach where one may not be intended but is a result of the imbalance in the male/female ratio of a group. Women also have an approach to the group dynamic that is different and may not be well understood, so they may be questioned more than men when presenting information. I have seen through the years that the more diverse a group is – including other areas of diversity, such as age, race and background – the less these are areas of challenge.

But this puts some onus on women, too. We need to speak up. In fact, if I were to give one piece of advice to my younger self, it would be to be bolder in voicing my thoughts. Early in my career I was reticent to offer an opinion until I had all the data. Over time, I have found that speaking up earlier is necessary to help shape direction and encourage open dialogue.

In STEM, I found a career where I am free to unleash my natural curiosity and offer creative solutions to problems. Particularly at Jabil, we work with companies across so many markets and teams that are developing next-generation products that there are always opportunities to learn and contribute to solutions. Without question this is a field for people who are intellectually curious.

Women have made remarkable strides over the past few decades; we are making history and smashing glass ceilings in all areas of work and life. We need to keep that momentum going strong. We need to encourage girls to speak up, to ask questions, to believe that by seeking the answers to the mysteries around them, they can become the problem-solvers of tomorrow.

Sadly, all of these fields are lacking in female representation. Just to give you a picture, here are some sobering statistics about women in STEM:

Despite an influx of women boldly stepping into traditionally male-dominated fields, such as law, medicine and business, far fewer women are becoming scientists and engineers. Women make up half of the total U.S. college-educated workforce but only 28 percent of the science and engineering workforce. Women who do enter a STEM field tend to be concentrated in areas like

social science or biological, agricultural or environmental sciences.

The percentage of female computer scientists has been steadily declining since 1995. Women make up less than one-third of manufacturing jobs. Countless studies have shown that workplace diversity makes companies stronger. But the lack of women in STEM is not only a diversity problem – it’s a labor force problem. As our world becomes increasingly digital, we need a greater number of workers who are knowledgeable in technology and science fields.

About the author – April Butterfield



Jabil Vice President of Technology, April Butterfield - April is responsible for leading the design and technology organization within Engineered Solutions Group (ESG).

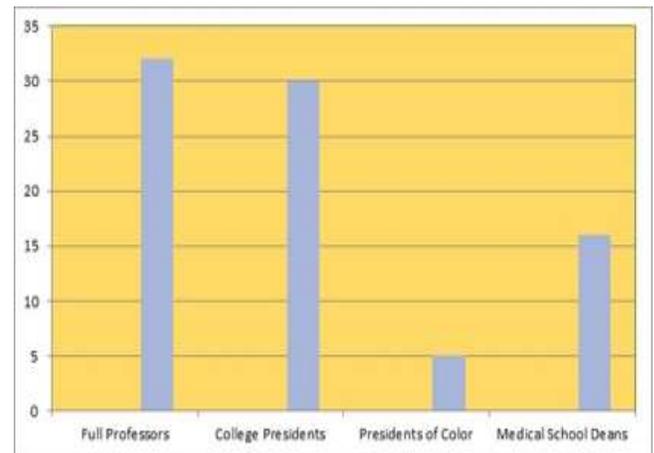
Culture in Health Sciences Changing

A discussion hosted during the growth of the Covid 19 pandemic last year by Dr. Janine Clayton NIH Office of Research on Women’s Health featured several women professionals who are involved in clinical

health science research and bio medical careers. However visible these women are, equity remains a challenge.

With the achievement of these and other women like them on separate career journeys, it is important to understand that just 16% of medical school department chairs and deans are women. In academia, women hold just 23% of leadership positions. Women of color face even greater barriers since just 2.8% of medical school full professors are Black and available as role models and mentors.

Women in Academic Leadership



Source: American Council on Education 2019

The principle discussion topic question was, “what is it like to be a scientist who happens to be a woman”? Their experiences covered challenges, lessons learned and benefits of women advancing in leadership roles in the field. Biomedicine and life sciences is an area of STEM career that has seen tremendous growth in women’s representation. Since 2006, half of the students in masters and doctoral degree paths are women. These women and their supporting clinical technicians are making

significant discoveries and contributions that improve our health prospects and lives.

Participants



Dr. Xenis Tigno - ORWH Associate Director for Careers. Dr. Tigno's broad research career has included investigations in physics at CERN (the European Organization for Nuclear Research), microcirculation, community-based epidemiology, obesity, diabetes, and aging.



Dr. Kizzmekia Corbett – Viral immunologist at the Vaccine Research Center (VRC) at the National Institute of Allergy and Infectious Diseases, and the scientific lead for the Coronavirus Vaccines & Immunopathogenesis Team at the National Institutes of Health (NIH)



Dr. Rosemarie Ramos - Staff scientist in the Transcreation Lab of NIMHD's Scientific Director. She is a chronic disease epidemiologist and population health scientist with 15 years of NIH training and research experience in health disparities.



Dr. Candice Tanner - Senior Investigator, Laboratory of Cell Biology- Center for Cancer Research, National Cancer Institute. She integrates concepts from molecular biophysics and cell biology to learn how cells and tissues sense and respond to their physical microenvironment, and to thereby design therapeutics and cellular biotechnology.

Some of the women's comments were;

Dr. Kizzmekia Corbett

"I would never have imagined that I would be the scientific lead of one of the coronavirus research teams leading an effort toward a safe and reliable vaccine. I became a scientist as a 16 year old when I conducted my first real lab experiment. I got this chance with the North Carolina Project Seed conducted at University of North Carolina Chapel Hill.

I am not afraid to express my opinion and at times it has added unwelcomed pressure to my work. Recently I have been engaged with online theories calling the pandemic a black "genocide" and condemned I viewed as "systematic oppression" by white people. Speaking for yourself is important because it not only raised your visibility, it can also advance you career."

Dr. Rosemarie Ramos

"As the eldest of four girls in my family, I led the way for my three siblings who also have careers in STEM. I have a love for statistics and policy development that has long term impact on health disparities. I gained good experience while completing my masters and doctorate while living in Pittsburgh. It was there my research examined disparities across different zip codes and trends in emergency room visits and hospitalization due to asthma. From there I landed a post Doc fellowship with NIH and after that returned to San Antonio to work in the health department. Since 2010 I have continued my work in health disparities research. Social emergency medicine is important because it integrates public health concepts such as social

determinants of health within emergence room settings."

Dr. Xenis Tigno

"Part of the ORWH mission is to promote career advancement for women in STEM. We are committed to advancing biomedical research careers for women. We have issues grants to 46 institutions and support more than 700 junior faculty, 75% of who are women. Our mission at NIH is to consider barriers for women in science and to develop strategies to promote entry, advancement, and retention for women in biomedical and research careers. We have established women of color networks to support the process".

Dr. Candice Tanner

"My group is comprised of scientists as well as trainees. Some are high school interns just learning about research others postdoctoral fellows. It is important for them to know that discoveries can be made at any stage of an academic career. We use pre-clinical models to mimic aspects of human disease then develop instrumentation and experiments that can lead to discovery. I attended South Carolina State and have undergraduate degrees in electrical engineering and physics. My start at an HBCU prepared me with a phenomenal education.

One of the roadblocks for women is not having a support group or committed mentor that is available to others. So, put in the work to find a cheerleader who can give you fair criticism and be our advocate when you need it".

What does it mean to you being a woman in tech?



Melin Edomwonyi is Digital's new UX Director, one of the UK's leading WordPress agencies which increases the number of women on the board to two.

Melin says, her appointment means that there's a lot of work to be done so that this sort of question doesn't need to be asked in future. Questions such as 'what does working in tech mean to you?' rather than 'what does being a woman in tech mean to you?' should be asked instead.

"A position like the one I have can be quite challenging sometimes, but so much easier and enjoyable when you have a team that supports you and respects you for the work that you do. That makes unpleasant experiences less important".

A Different Path

It's no secret that women are underrepresented in tech. The road to gender parity is a slow-moving and bumpy one, especially in tech — but one such barrier to entry is the idea that you have to have majored in a STEM field to go on to work in

the industry, which is becoming more and more untrue.

"More and more college students are discovering that the true value of their education is not defined by their major," says **Christine Cruzvergara**, VP, Higher Education & Student Success at Handshake.

"College students without STEM degrees aspiring to work in the technology field should embrace and lean in to the skills and assets, including the ability to synthesize information, think critically, and communicate well, that they bring to the table. The unique perspective that these students bring to problem solving and finding creative solutions is just as valuable to employers as theoretical domain expertise, and deserves to be highlighted and emphasized through the recruitment and hiring process."

An example of a woman, who fits that description going a different path, is **Iris Nevins**, Software Engineer at Mailchimp.



Iris's first job was in finance selling life insurance and investments. After that, she moved into community organizing, then teaching, then software engineering. While teaching, Iris continued grassroots

organizing. Wanting to help organizations become more tech savvy, she started teaching herself how to code. She decided to become a software engineer realizing what coding was and that the ability to build/design software is pretty much a super power. Eventually Iris left teaching to pursue software engineering full-time. coding and that the ability to build/design software is pretty much a super power. Eventually Iris left teaching to pursue software engineering full-time

Black Women Named Deans – Colleges of Engineering

In June, Dr. Harriet B. Nembhard, the Eric R. Smith Professor of Engineering and head of the School of Mechanical, Industrial and Manufacturing Engineering at Oregon State University in Corvallis, Oregon, was named dean of the University of Iowa College Of Engineering. Dr. Nembhard was among COE deans featured in Stem News Chronicle, Vol. 9 Issue 4 in 2020.



Dr. Harriet B. Nembhard

At Ohio State University, roboticist Dr. Ayanna Howard the Linda J. and Mark C. Smith Professor and Chair of the School of Interactive Computing in the College of Computing at Georgia Tech was named Dean College of Engineering. She also held a faculty appointment in the School of Electrical and Computer Engineering where she functions as the Director of the Human-Automation Systems Lab



Dr. Ayanna Howard

From our Editorial Review Board

The future of work and a growing economy is dependent on the participation of women in STEM careers in business and as leaders in higher education. Although women have made great strides in the workforce, it is no secret that inequality persists when it comes to jobs.

Unfortunately, when it comes to the science, technology, engineering, and math fields where women account for only 28% of employees, this is hardly a new topic of discussion. However, the conversation around women in STEM remains reinvigorating in the broader context of social justice, diversity, and inclusion in the workplace. We believe it important to use this platform to address this issue head-on from the perspective of several with standing on the issue of inclusion of women and the culture within which they support our technically based economy.

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- Dr. Sally Creel - STEM & Innovation Supervisor, Cobb County Schools
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