

THE IMPORTANCE OF DIVERSITY AND INCLUSION IN THE FORENSIC SCIENCES

BY IRIS R. WAGSTAFF AND GERALD LAPORTE

To strengthen the forensic sciences, we must engage people from a broad array of scientific disciplines and backgrounds to help provide innovative solutions to complex criminal justice issues.



The benefits of diversity within an organization are well documented.¹ Having people of different races, ethnicities, genders, socioeconomic status, and backgrounds within a workplace can drive innovation, problem-solving, and competitiveness. Research has shown that diverse teams perform better, are more creative, and outperform homogeneous teams.² Increasing diversity in thought, perspectives, and backgrounds allows for new and more complex research questions and problems to be addressed. Research has also documented a direct link between diversity and quality of scientific work as measured by peer review journal citations.³

As the forensic sciences continue to evolve, it is critical that we leverage the skills and expertise of people from all backgrounds to provide innovative solutions to complex issues. According to the Bureau of Labor Statistics, employment in the science and

engineering sectors — which support the forensic sciences — grew by 10.5 percent (817,260 jobs) between May 2009 and May 2015,⁴ compared with 5.2 percent net growth in nonscience-related occupations. This growth outpaces the production of talent currently being trained to fill these jobs. To strengthen the forensic sciences, it is imperative that we train and employ more forensic scientists and foster an environment in which uniqueness and difference are embraced and valued.⁵

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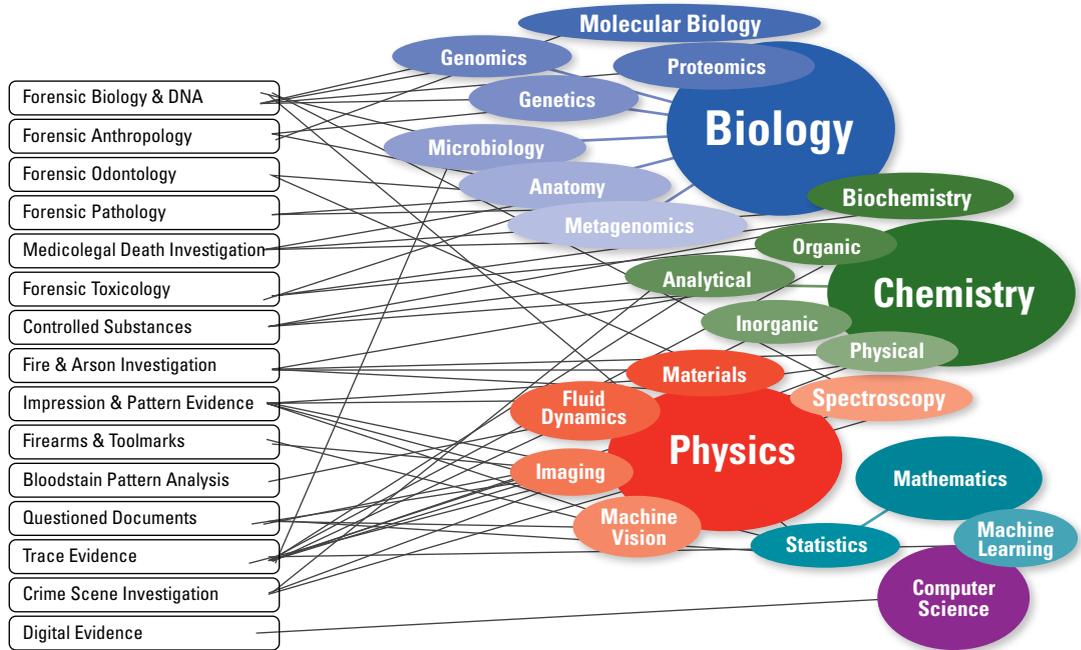
To this end, NIJ is developing strategies and policies to solicit the participation of all segments of the population to fulfill its mission. NIJ is committed to casting a wide net that will allow us to engage the best and the brightest from a broad array of scientific disciplines and backgrounds to support rigorous and innovative research to solve criminal justice problems.

The Diversity of the Forensic Sciences

The word “forensic” comes from the Latin term *forensis*, which means “in open court, public, from the forum.”⁶ Forensic science is the application of scientific principles and methods to matters of law and comprises a broad array of science, math, and engineering disciplines, the largest being biology and chemistry. Most forensic scientists obtain a bachelor’s or master’s degree in chemistry or biology and then specialize in a specific area of study, such as toxicology, pathology, or DNA.⁷ These broad scientific disciplines give rise to many forensic subdisciplines that require specialized training and expertise (see exhibit 1).

Forensic scientists work in crime laboratories, police departments, medical examiners’ offices, academia, and research labs. According to the Bureau of Justice Statistics, publicly funded crime labs employed 14,300 full-time forensic personnel in 2014.⁸ In the

Exhibit 1. Most Common Forensic Disciplines



same year, these labs received an estimated 3.8 million forensic requests, 3.6 million of which they completed. At the end of 2014, publicly funded crime labs had an estimated backlog of 570,100 requests for forensic services, and 38 percent of these labs outsourced one or more types of services.⁹

The Bureau of Labor Statistics projects that, between 2014 and 2024, there will be a 27 percent increase in open positions for forensic science technicians.¹⁰ These data and projections indicate a significant need to produce more forensic scientists over the next decade to develop highly discriminating, accurate, reliable, cost-effective, and rapid methods for the identification, analysis, and interpretation of physical evidence. Due to the inherent nature of the forensic sciences and the broad scope and depth of disciplines needed to address various crime-related problems, we must employ research, development, and technology in all areas of science and engineering.

What Is STEM?

The acronym STEM refers to science, technology, engineering, and math. First introduced by the National Science Foundation in the late 1990s and officially accepted in 2000,¹¹ STEM embodies the interrelatedness of the four disciplines as they relate to education.¹² It represents an integrative curriculum that incorporates the 21st-century skills needed for the jobs of the future, such as problem-solving, innovation, and teamwork.¹³ Over the past decade, STEM has evolved to refer not only to an integrative teaching strategy but also to a policy

response and priority of K-12 school districts, federal science agencies, and higher education institutions. STEM generally includes the physical sciences (physics, math, and chemistry), life sciences (biology, anatomy, botany, and anthropology), engineering, and technology. Some federal agencies, such as the National Science Foundation, have a broad view of STEM and include the social and behavioral sciences (psychology and sociology). Other organizations also include architecture, medical sciences, and computer sciences.

In 2007, the groundbreaking report *Rising Above the Gathering Storm* highlighted the importance of STEM and its vital relation to U.S. global competitiveness, national security, and scientific literacy.¹⁴ Since then, there has been continued concern about the steady decline of U.S. dominance in science and engineering. Additional concerns regarding mediocre U.S. performance in science and math compared with other countries, low STEM interest among K-12 students, STEM achievement gaps between racial and ethnic minorities and white students, and low representation of females and minorities in STEM majors and careers continue to shape federal and local science policy throughout the nation.

The Leaky Pipeline

The STEM sectors continue to face challenges in recruiting and sustaining individuals from diverse backgrounds.¹⁵ The “pipeline” metaphor refers to the accepted concept that to produce sufficient numbers of highly qualified STEM professionals for the

Exhibit 2. The “Leaky Pipeline”



Why So Few?

There are several reasons for the underrepresentation of women and racial and ethnic minorities in STEM majors and occupations.¹ These reasons vary based on educational level, scientific discipline, and stage within the STEM pipeline. This lack of representation is not due to lack of ability or interest. Instead, it is primarily due to discouragement at every juncture along the educational and career development pathway, as documented in a 2010 survey conducted by the Bayer Corporation.²

At the K-12 level, it is in the form of teachers who discourage students from diverse backgrounds on the basis of preconceptions and implicit bias. Students at this level are also discouraged by negative stereotypes and images in printed media and textbooks that exclude them and make them feel like they are not worthy of scientific pursuits.³ At the undergraduate and graduate levels, discouragement comes from faculty who act as gatekeepers, and hostile department and campus cultures that lead to feelings of inadequacy and loneliness, which are described by the “solo status” and “imposter syndrome” constructs.⁴ At the professional level, the discouragement is from the often hostile culture in the workplace, particularly in the physical sciences and engineering.⁵

Women of color in STEM are significantly affected, as documented in the report *The Double Bind: The Price of Being a Minority Woman in Science*.⁶ Moreover, since STEM professions often pay more than non-STEM-related jobs, the STEM enterprise is viewed as a means of economic parity for many students who are not only underrepresented in STEM but are also of low socioeconomic status.⁷ Coupled with the fact that many minority and low-income students come from school districts with inadequate science education resources that limit their future aspirations, these students often become discouraged from scientific pursuits. This leads to a limited pool of STEM talent from which the forensic sciences can draw to solve criminal justice problems.

Notes

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6. Shirley Mahaley Malcom, Paula Quick Hall, and Janet Welsh Brown, *The Double Bind: The Price of Being a Minority Woman in Science* (Washington, DC: American Association for the Advancement of Science, 1976).
7. Anthony Carnevale, Jeff Strohl, and Michele Melton, *What's It Worth? The Economic Value of College Majors* (Washington, DC: Georgetown University Center on Education and the Workforce, 2011).

workforce, there must be sufficient input of students starting in elementary school (see exhibit 2). The main segments of the STEM pipeline are:

- K-12 education: Students are exposed to STEM concepts through formal and informal activities.
- Undergraduate education: Students major in a broad scientific discipline.
- Graduate education: Students specialize in or master a specific field within STEM that involves conducting and publishing research.
- Career: Students are successfully placed into STEM careers.

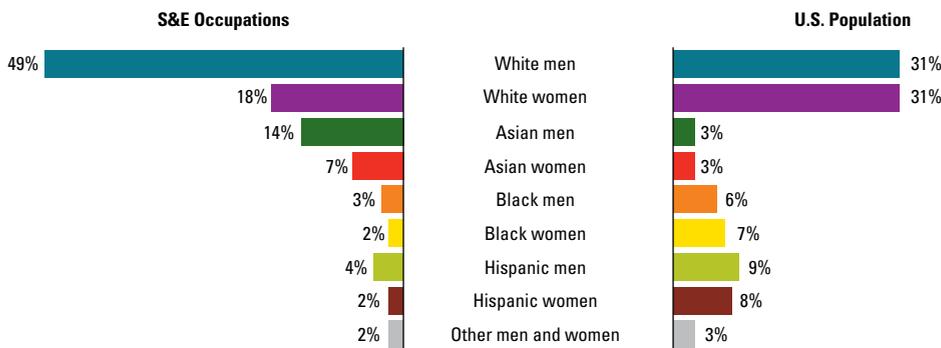
There are many points along this pipeline where students exit for various reasons — a phenomenon generally known as the “leaky pipeline.”¹⁶ This is particularly true for females and underrepresented minorities, including African Americans, Hispanics/Latinos, Alaska Natives, American Indians, Asians/Pacific Islanders, and Native Hawaiians. (See sidebar,

“Why So Few?”) This analogy suggests that there should be mechanisms in place to support and sustain students throughout their educational pathway.¹⁷

The pivotal report *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads* chronicled the challenges of filling and sustaining the STEM pipeline and the impact of the lack of females and racial and ethnic minorities in the STEM workforce.¹⁸ According to the report, the U.S. STEM labor market is projected to grow faster than any other sector over the next decade, and participation by females and racial and ethnic minorities is not only a national priority but is critical to maintaining U.S. global competitiveness in technologically based sectors.

The 2010 census indicates that racial and ethnic minorities are the fastest growing segment of the U.S. population, and projections indicate that, by the year 2044, more than half of all Americans will belong to a minority group.¹⁹ However, these groups continue

Exhibit 3. Science and Engineering Occupations by Race and Gender for 2015, Compared with the Total U.S. Population



Source: Adapted from National Science Foundation (NSF), National Center for Science and Engineering Statistics, *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2015*, Special Report NSF 15-311 (Arlington, VA: NSF, 2017), <http://www.nsf.gov/statistics/wmpd>.

It is well documented that diversity in STEM drives innovation and discovery, expands the questions that can be probed, and harnesses unique perspectives and skill sets.

to be underrepresented in STEM fields (see exhibit 3). According to the National Science Foundation, women represent approximately 51 percent of the total population, but they represent only about 30 percent of science and engineering fields.²⁰ Within the science and engineering fields, representation of women continues to vary greatly, with approximately 70 percent in psychology and 18 percent in computer sciences.²¹

Additionally, Hispanics and African Americans represent 17 percent and 13 percent of the total population, respectively, but they represent only 6 percent and 5 percent of science and engineering fields.²² A wide gap in educational attainment continues between underrepresented minorities and their white and Asian counterparts, who consistently have higher representation in science and engineering fields than they do in the U.S. population.

Additional data from the National Center for Science and Engineering Statistics indicate that while women continue to see strides in the life and social sciences, they remain significantly underrepresented in the physical and engineering sciences.²³

In 2018, 2.4 million STEM-related jobs will need to be filled.²⁴ Will we be able to meet this growing demand for STEM talent? By diversifying the STEM pipeline, we will be able to draw on the brainpower and talent of segments of the population that have been historically discouraged from scientific enterprise. This will allow us to expand the problems and issues that can be addressed and the questions that can be asked. Research indicates that to improve diversity

in STEM fields, from which forensic professionals are drawn, there must be concerted and intentional efforts to attract students by building pathways to STEM careers.²⁵ We know that underrepresentation in STEM careers is a direct result of lack of diversity in STEM majors.²⁶ We also know that efforts must start early in the K-12 years and must incorporate active learning and guided inquiry.²⁷ By focusing on closing key transition gaps between middle school, high school, college, and graduate school, we can retain and support more students, particularly those from diverse backgrounds. Without a sustained and highly qualified STEM workforce to undergird the forensic sciences, the United States will not be able to compete globally or provide innovative solutions to reduce crime and ensure public safety.

NIJ's Strategic Diversity and Inclusion Initiative

As the lead agency for forensic science research and development and programs dedicated to reducing backlogs of evidence in the nation's forensic laboratories, NIJ's Office of Investigative and Forensic Sciences (OIFS) relies on the knowledge and expertise of a vast array of scientists, forensic practitioners, and criminal justice professionals to strengthen the forensic sciences. OIFS recognizes the need to enhance diversity in the forensic sciences and has undertaken a strategic planning process focused on expanding the pool of diverse talent in the various forensic science disciplines, particularly grant applicants, peer reviewers, and graduate research fellows. This strategic planning process includes three primary areas: assessment, outreach and engagement, and sustainability.

Assessment

To determine the state of awareness and to share diversity goals and planning efforts, NIJ has been participating in a series of workshops focused on the importance of diversity and inclusion for science organizations and how it affects everyday work, particularly with stakeholders. NIJ has also been evaluating the available demographic data on peer reviewers, principal investigators, grant applicants,

and graduate fellows — data that will help NIJ determine areas of opportunity to focus on diversity efforts.

Outreach and engagement

Over the past year, NIJ has worked to expand awareness of the agency to the broader scientific and research communities. For example, NIJ has developed and implemented marketing strategies to expand communications to larger audiences of underrepresented students and professionals. These efforts include collaborating with professional scientific organizations with diverse membership profiles to share opportunities for research and development grants, peer reviewing, and graduate fellowships. Many of the professional scientific organizations — including the American Association for the Advancement of Science (AAAS), the Consortium of Social Science Associations, the National Society of Black Engineers, and the American Chemical Society — have memberships in the thousands and serve as conduits for information for potential candidates who were not being reached.²⁸

To reach a broad range of scientific disciplines, racial and ethnic backgrounds, and educational levels, NIJ partnered with the White House Initiative on Historically Black Colleges and Universities to facilitate two webinars and share opportunities for graduate student and faculty researchers.²⁹ As a result of this strategic collaboration, NIJ was invited to serve on an

“Education and Justice” panel at the 2016 Historically Black Colleges and Universities Week Conference and discuss opportunities in forensic science and criminal justice with undergraduate and graduate students and faculty from around the country.³⁰ The White House Initiative has a stakeholder database of more than 4,000 students, faculty, and administrators involved in all areas of STEM and the social and behavioral sciences. These types of partnerships enable NIJ to reach broader and more diverse audiences in the higher education, research, and scientific communities.

NIJ has also expanded its outreach and engagement efforts by participating in conferences that target diverse populations in STEM. Over the past year, NIJ has participated in conferences for the Society for Advancing Chicanos/Hispanics and Native Americans in Science, the AAAS, the National Organization of Black Chemists and Chemical Engineers,³¹ and the American Indian Science and Engineering Society. NIJ also presented at the 2017 Emerging Researchers National Conference in STEM, which is sponsored by the AAAS and the National Science Foundation; it included approximately 1,000 undergraduate and graduate student researchers of color from 10 National Science Foundation research programs.

Participation in these types of events has increased awareness and helped lift the science of NIJ to broader and more scientifically diverse audiences. These efforts will also help expand the pool of

Supporting Innovative Research to Address Complex Criminal Justice Problems

In 2016, Candice Bridge at the University of Florida earned a research and development grant from NIJ to improve rape investigation methods in cases where DNA is limited or nonexistent. Her lab will analyze lubricants and condoms and build a database that will provide another potential connection between the perpetrator and the victim. This work will hopefully help to identify and convict more rapists.

Bridge obtained her Ph.D. in forensic chemistry at age 25 and is one of the first African American females to teach chemistry at her alma mater, Howard University. By funding this work, which will support one postdoctoral fellow and one doctoral student, NIJ is not only helping to advance the careers of early STEM faculty and researchers but is also creating a pathway for students from diverse backgrounds and scientific disciplines to make vital contributions to the forensic sciences.

potential peer reviewers who will be called on to serve on grant review panels, which is the primary mechanism that guides award funding decisions.

Sustainability

NIJ has several research initiatives aimed at building the STEM pipeline and creating pathways for students and early researchers from diverse backgrounds to advance scientific knowledge to solve criminal justice problems. (See sidebar, “Supporting Innovative Research to Address Complex Criminal Justice Problems.”) These include the Graduate Research Fellowship in STEM (GRF-STEM) and the Research Assistantship Program (RAP). Both programs support STEM degree attainment and expand the talent pool in scientific disciplines engaged in criminal justice and forensics-related research.

For decades, the Graduate Research Fellowship Program has been NIJ’s primary vehicle for supporting graduate research aimed at providing solutions for problems related to forensic science and criminal justice policy and practice. The GRF-STEM Program provides awards to accredited academic institutions to support graduate research leading to doctoral degrees in topic areas that are relevant to ensuring public safety, preventing and controlling crime, and ensuring the fair and impartial administration of criminal justice in the United States. This program supports research in a broad array of scientific disciplines, including the life sciences, physical sciences, math, computer sciences, and engineering.

Exhibit 4 shows demographics for the graduate fellowships awarded in FY 2016 and indicates support of various scientific fields that correspond to multiple forensic disciplines. Some of the research studies that were awarded in FY 2016 include:

- Improved detection of kratom alkaloids in forensic toxicology.
- A mechanism-based forensic investigation into the post-mortem redistribution of morphine.
- Developing forensic epigenomic age-estimation tools for diverse populations.

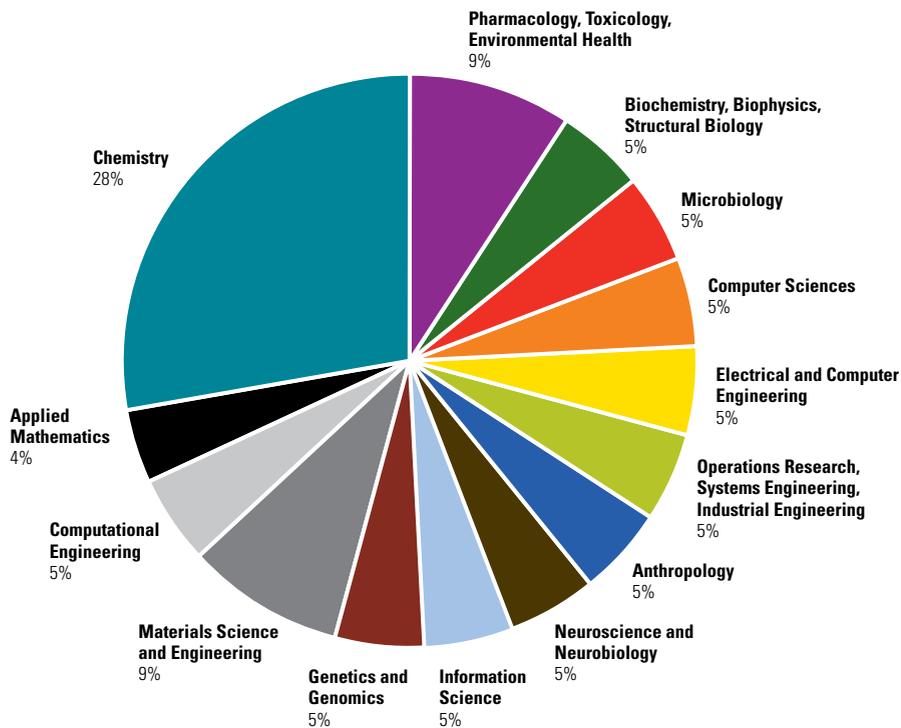
- New concept for fingerprint analysis: bioaffinity-based systems utilizing amino acids.
- Nanostructural characterization of ballistic fiber degradation.
- Characterization of personal and condom lubricants using DART-TOFMS and comprehensive GC-MS.
- Nanoparticles for chemical imaging of latent fingerprints.³²

By supporting graduate student research in these areas, NIJ addresses some of the persistent barriers to completing STEM doctoral degrees — lack of funding and research opportunities. Moreover, NIJ is strengthening forensic science policy and practice by advancing technology, improving analytical sensitivity and selection, and enhancing processes to accurately identify crime scene evidence.

RAP has historically supported students in the social and behavioral sciences to address issues related to violence, victimization, corrections, and sexual assault. NIJ recently expanded the program to include support for students in STEM fields, allowing the Institute to support student development and research in additional areas related to science and engineering, including digital forensics and multimedia analysis, data science applied to crime justice, body armor for female law enforcement officers, geospatial and crime mapping, and forensic analyses on sexual assaults. RAP involves an onsite residency at NIJ for a minimum of 20 hours a week. The benefits of this residency include interacting with criminal justice researchers who can serve as mentors, provide authentic career advice, and help students develop the skills needed to be successful in the workforce.

As NIJ develops and implements its diversity and inclusion strategic initiative, it will continue to engage, collaborate, and partner with stakeholders throughout the scientific, educational, and research communities. For example, NIJ has committed to serve an active role on the American Academy of Forensic Sciences Diversity Committee to help broaden the pool of students and practitioners in the forensic sciences. The NIJ Diversity Working Group is also actively

Exhibit 4. FY 2016 Graduate Research Fellowship Attributes



developing and implementing the strategic diversity initiative and will work with leadership to advance these efforts.

Diversifying the Future

As the forensic sciences continue to evolve, it is imperative that we value and leverage all segments of the population to tackle complex criminal justice problems. It is well documented that diversity in STEM drives innovation and discovery, expands the questions that can be probed, and harnesses unique perspectives and skill sets. While diversity in gender, race, and ethnicity is critical in broadening the pool of forensic and criminal justice researchers, diversity in scientific disciplines is equally important as we seek to take advantage of more interdisciplinary approaches to problem-solving.

NIJ remains committed to engaging the best and brightest talent to assist with advancing scientific knowledge for criminal justice purposes. To achieve this goal, we must cast a wide net and leverage all of the available human capital. These efforts are critical to attracting and sustaining STEM talent to address both current and future needs in the forensic sciences.

About the Authors

Iris R. Wagstaff, Ph.D., was a 2015-2016 AAAS Science and Technology Policy Fellow at NIJ. **Gerald LaPorte**, B.S., B. Commerce, M.S.F.S., is the director of NIJ’s Office of Investigative and Forensic Sciences.

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For More Information

Learn more about the Graduate Research Fellowship in STEM at NIJ.ojp.gov, keyword: fellowship.

Learn more about the Research Assistantship Program at NIJ.ojp.gov, keyword: rap.

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 32. For a complete list of research topics funded for fiscal year 2016, see <https://www.nij.gov/funding/fellowships/graduate-research-fellowship/Pages/past-fellows.aspx>.
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