



Building a Diverse Genomics Workforce: An NHGRI Action Agenda

—
The **Forefront**
of **Genomics**
—



Letter from the Director

Data show that enhancing the diversity of scientific teams produces better ideas and more creativity. Developing teams of individuals from diverse backgrounds, however, means recognizing that some groups are underrepresented in the biomedical workforce. These groups include individuals from underrepresented racial and ethnic groups, individuals with disabilities, individuals from disadvantaged backgrounds, and women in staff, faculty, and leadership positions in the biomedical, clinical, behavioral, and social sciences research enterprises as well as in healthcare professions.

At present, the genomics workforce lacks diversity and, in fact, poorly reflects the make-up of the U.S. population. To address this in a meaningful way, a serious commitment of attention and



resources is needed. The National Human Genome Research Institute (NHGRI) is prepared to make and sustain such a commitment. Towards that end, in late 2019, I charged an internal working group to develop an NHGRI plan aimed at improving the diversity of the genomics workforce. Chaired by Vence Bonham, J.D., my senior advisor on genomics and health disparities, the working group developed this document: *Building a Diverse Genomics Workforce: An NHGRI Action Agenda*.

This “action agenda” commits NHGRI to meaningfully enhance the diversity of the genomics workforce by 2030. This plan articulates goals and objectives to increase the number of individuals from diverse backgrounds, including underrepresented groups, in genomics. Specific programs and strategies will increase the number of individuals from diverse backgrounds, including underrepresented groups,

who have the necessary training to pursue careers in genomics. New support will help early stage scientists from diverse backgrounds achieve independent research careers and foster pathways to leadership positions in genomics. Enhanced attention will also be given to genomics training for those in clinical and healthcare career tracks. The Institute’s existing training programs that focus on enhancing the diversity of the genomics workforce will also be expanded. Our Institute promises to work with our community to change the culture where needed and create environments that will sufficiently support this new and more inclusive vision of a genomics workforce.

The genomics enterprise is at an exciting juncture with extraordinary career opportunities to improve human health through basic, translational, and clinical research. The realization of genomic medicine will require increasing genomics expertise among different healthcare professionals. NHGRI has the responsibility to facilitate the well-being of the genomics workforce, and that includes attracting a workforce that is diverse.

I endorse this action agenda and am eager to see it implemented across the Institute. As pointed out in the 2020 NHGRI Strategic Vision (“Strategic vision for improving human health at The Forefront of Genomics,” *Nature* 586:683-692, 2020), the Institute sees the development of a diverse genomics workforce as a guiding value — something fundamental to the Institute and to the field.

I am grateful to the working group for their efforts and to those who contributed ideas and information that fed into the process of establishing this action agenda.

Eric Green, M.D., Ph.D.

Director, NHGRI



Background

“The promise of genomics cannot be fully achieved without successfully attracting, developing, and retaining a diverse workforce that includes people from groups currently underrepresented in the genomics enterprise.”

– Eric Green, M.D., Ph.D.

Today, the genomics workforce does not reflect the diversity of the U.S. population. Research has documented that having an inclusive scientific workforce is necessary to increase innovation and creativity and to enhance performance in solving scientific problems.^[1] When the scientific workforce is diverse, the variety of research topics that are explored increases substantially, which leads to more discoveries that benefit the biomedical community overall.^[2]

This document reflects a new NHGRI-formulated action agenda that establishes goals, objectives, and implementation strategies to enhance the diversity of the genomics workforce. For this action agenda, the word “diversity” is used to mean individuals from diverse backgrounds, including individuals from groups identified as underrepresented in biomedical, clinical, behavioral, and social sciences. In the 2019 National Institutes of Health (NIH) [announcement](#) of the agency’s interest in diversity, NIH identified underrepresented groups to include individuals from underrepresented racial and ethnic groups, individuals from disadvantaged backgrounds, and individuals with disabilities, as well as women at senior faculty level.

Barriers to diversity in the biomedical workforce occur at various stages of career progression, but additional studies are needed to fully understand those challenges. For example, while the number of doctoral degrees earned by women and individuals from other underrepresented groups in science has increased, this has not led to an increase in the diversity of the biomedical research workforce at later career stages, including those associated with faculty positions and the acquisition of grant funding.^[3-5] Moreover, data on individuals with disabilities are lacking.^[6] The major challenges associated with enhancing the diversity of the biomedical workforce have been documented.^[7-16] A recent study found that Ph.D. recipients from underrepresented groups in the U.S. produce novel contributions in their dissertations, but their novel contributions are too-often devalued and discounted.^[17]

Reducing such barriers to career opportunities in biomedical research for underrepresented groups requires new strategies, programs, and creative approaches that promote workforce diversity, inclusion practices, and leadership in the field.



The NIH identified its interest in workforce diversity in a [2019 statement](#):

Every facet of the United States scientific research enterprise – from basic laboratory research to clinical and translational research to policy formation – requires superior intellect, creativity and a wide range of skill sets and viewpoints. NIH’s ability to help ensure that the nation remains a global leader in scientific discovery and innovation is dependent upon a pool of highly talented scientists from diverse backgrounds who will help to further NIH’s mission.

Research shows that diverse teams working together and capitalizing on innovative ideas and distinct perspectives outperform homogenous teams. Scientists and trainees from diverse backgrounds and life experiences bring different perspectives, creativity, and individual enterprise to address complex scientific problems. There are many benefits that flow from a diverse NIH-supported scientific workforce, including: fostering scientific innovation, enhancing global competitiveness, contributing to robust learning environments, improving the quality of the research, advancing the likelihood that underserved or health disparity populations participate in, and benefit from health research, and enhancing public trust.

NHGRI commits to NIH’s vision and calls on the broader genomics community — including academic institutions, industry, healthcare systems, and professional societies — to join the Institute in committing to substantially enhancing the diversity of the genomics workforce in the coming decade. This action agenda establishes NHGRI goals to develop innovative new programs, support current successful programs, and partner with others to substantially enhance the diversity of the genomics workforce. Overall, the objectives include both reducing barriers to training opportunities in the field and supporting the development and career progression of researchers from diverse backgrounds, including underrepresented groups.

In October 2020, NHGRI published a new Strategic Vision for the field of genomics aimed at accelerating scientific and medical breakthroughs.^[16] That Strategic Vision maintains that the field needs new strategies and programs to enhance career opportunities in genomics, and these must include new and creative approaches to promote workforce diversity, leadership in the field, and inclusion practices. As part of the process that led to the development of the 2020 NHGRI Strategic Vision, the Institute established an internal Genomic Workforce Diversity Working Group (see Appendix for roster of members). The working group was charged with developing a 10-year action agenda for *Building a Diverse Genomics Workforce* (hereafter referred to as the *NHGRI Action Agenda for a Diverse Genomics Workforce*) to guide the Institute’s efforts. To inform the development of this action agenda, the working group gathered stakeholder feedback by [seeking public comments](#) and interviewing leaders from research universities and professional societies as well as early career genomics professionals. NHGRI is committed to funding programs that are designed to enhance workforce diversity, and this will include establishing tangible metrics; partnering with academic institutions, industry, and professional societies; and preparing the next generation to join the research and clinical genomics workforce.

NHGRI has a history of funding diversity training programs. The NHGRI Diversity Action Plan (DAP) program was established in 2002 and has been helpful in diversifying the pool of scientists who are prepared to pursue genomics-related careers. The program was originally associated with NHGRI's large extramural research initiatives, including the Centers of Excellence in Genomic Science, Genome Sequencing Centers, and Model Organism Databases (MODs). Since its inception, the DAP program has included over 1,400 trainees across 20 projects. In 2014, NHGRI expanded the DAP program in several ways in an effort to encourage applicants to propose innovative educational programs that help enhance the diversity of genomics trainees. While DAP proposals are no longer limited to being associated with certain NHGRI programs, they must still fit within the NHGRI's scientific mission.



At an NIH-wide level, NHGRI participates in several extramural programs to promote diversity in the research workforce, including the [Maximizing Opportunities for Scientific and Academic Independent Careers Transition Award to Promote Diversity \(MOSAIC\) program](#), the [Research Supplements to Promote Diversity in Health-Related Research program](#), and the [Ruth L. Kirschstein National Research Service Award Individual Predoctoral Fellowship to Promote Diversity in Health-Related Research](#). A listing of all funding opportunities can be found on NHGRI's Funding to Promote Diversity in the Genomics Workforce website. Additionally, in 2019, NHGRI was pleased to partner with the American Society of Human Genetics to support the [Human Genetics Scholars Initiative](#).



NHGRI has also established informal science and education programs to facilitate the training of secondary school teachers, community college staff, and tribal college and university faculty in genomics.^[19] Developing a pathway that begins with pre-college education programs sets a precedent and illustrates that NHGRI is committed to preparing students to enter the genomics workforce and fostering a genomically literate public.

The promise of genomics cannot be fully achieved without successfully attracting, developing, and retaining a diverse research workforce that includes people from groups that are underrepresented in the genomics enterprise. NHGRI recognizes that this will require the Institute to make a long-term commitment to accelerating the diversity of the genomics workforce.



Overview

To be at the forefront of efforts to enhance the diversity of the genomics workforce, the *NHGRI Action Agenda for a Diverse Genomics Workforce* has the following four major goals:

GOAL 1:



Develop and support initiatives that provide early exposure and access to careers in genomics.

GOAL 2:



Develop and support training programs and networks that connect undergraduate and graduate education to careers in genomics.

GOAL 3:



Develop and support training, career development, and research transition programs that lead to independent research and clinical careers in genomics.

GOAL 4:



Evaluate progress towards achieving greater diversity in the genomics workforce.

NHGRI is committed to both short- and long-term strategies for implementing the goals of the *NHGRI Action Agenda for a Diverse Genomics Workforce*, which includes evaluating progress using defined metrics. The Institute will use this agenda's goals, objectives, and implementation strategies to develop appropriate programs that, if successful, will substantially enhance the diversity of the genomics workforce by the end of this decade.

GOAL 1:



Develop and support initiatives that provide early exposure and access to careers in genomics.

As the population of students in the U.S. education system becomes more diverse, we must invest in steps to ensure they have the opportunity to become part of the genomic workforce. Pursuing a career in genomics usually entails early exposure to and interest in science, technology, engineering, and mathematics (STEM). To achieve meaningful preparation, students need foundational courses to enter undergraduate programs and pursue genomics-related majors. Waiting until students reach post-secondary education is often too late, especially for students with limited access to educational resources. Thus, NHGRI and the field of genomics must invest in programming for these pre-college students and the educators who teach them.

Objectives

1.1: Identify best practices in programming designed to provide early exposure to genomics, including barriers and recommendations to eliminate those barriers

1.2: Support and participate in programs that are designed to encourage individuals of diverse backgrounds to pursue genomics careers, especially for persons from groups who are historically underrepresented in science



Implementation Strategies

- Identify best practices that encourage the pursuit of and early exposure to genomics careers through the support of outreach and engagement programming, resources, and partnerships (1.1)
- Support and design outreach and engagement programs that enlist professional societies, academic institutions, industry, and community organizations to develop new approaches that bring awareness to opportunities and careers in genomics (1.1 & 1.2)
- Create resources and educational campaigns that are designed to bring awareness to opportunities for careers in genomics (1.2)
- Support STEM education, training, and professional development programs for diverse communities that are designed to demonstrate the applications of and breadth of professional opportunities in genomics (1.1 & 1.2)

GOAL 1:

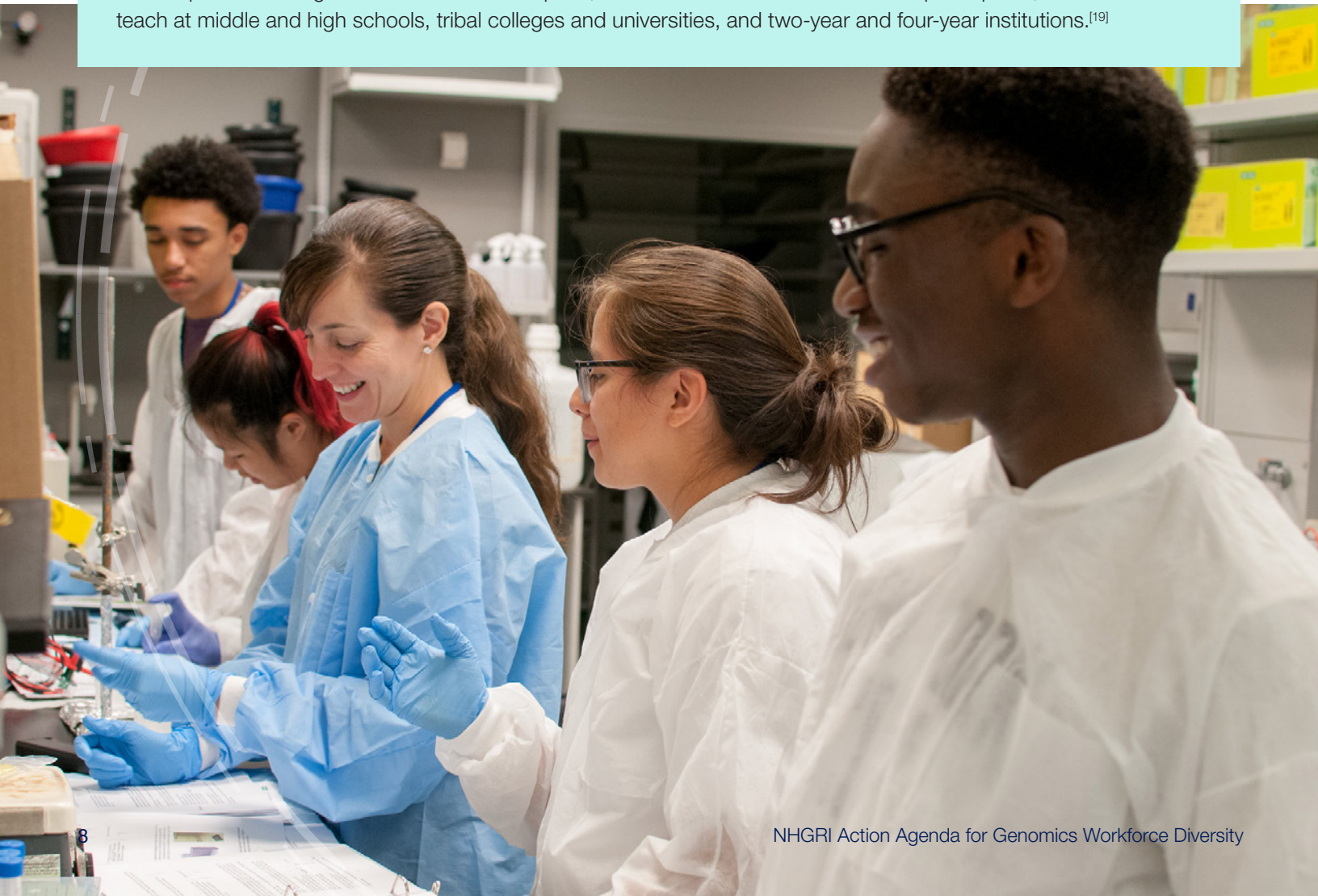
Develop and support initiatives that provide early exposure and access to careers in genomics.



Indicators of Success

- Create best practices that can be incorporated into future programs designed to encourage the pursuit of genomics careers (1.1)
- Identify new approaches that bring awareness to opportunities and careers in genomics (1.1)
- Participate in and implement outreach programs using best practices (1.2)
- Use and distribute resources from, and participation in, campaigns that are designed to bring awareness to opportunities and careers in genomics (1.2)
- Increase the participation of individuals from diverse backgrounds (or those who teach individuals from diverse backgrounds) in STEM education, training, and professional development programs that are designed to demonstrate the applications of and breadth of opportunities in genomics (1.1 & 1.2)

Since 2003, NHGRI's Education and Community Involvement Branch has sponsored the annual Short Course in Genomics. The course is designed for pre-college and college educators from across the United States who teach genetics, genomics, biology, or other STEM courses. The course supports NHGRI's efforts to enhance the diversity of the genomics workforce through the integration of genomics into secondary and collegiate classrooms, including those classrooms with significant numbers of students from communities that have been historically underserved and underrepresented in genomics. Since its inception, there have been over 250 course participants; these individuals teach at middle and high schools, tribal colleges and universities, and two-year and four-year institutions.^[19]



GOAL 2:



Develop and support training programs and networks that connect undergraduate and graduate education to careers in genomics.

The pathway that leads from early STEM education through graduate-level degrees in genomics has several key transition points. For those community college students and undergraduates from diverse backgrounds, including those from underrepresented groups who are interested in science, attention in the form of guidance and resources must go to where the students are concentrated, which will lead them to and through graduate genomics training programs. NHGRI is dedicated to supporting the development of graduate-level genomics training programs that mentor and support diverse cohorts of students.

Objectives

2.1: Create a systematic network of support for students from diverse backgrounds, including those from underrepresented groups, as they move to and through graduate training programs in genomics

2.2: Ensure that undergraduate minority-serving institutions (MSI) and community colleges are aware of and tightly connected to this network

2.3: Encourage inclusive climates at all leading graduate-level genomics training programs so as to mentor and promote cohorts of individuals from diverse backgrounds, including underrepresented groups



Implementation Strategies

- Ensure that NHGRI's undergraduate and graduate-level training programs work together to provide continuous support to individuals as they move to and through graduate school (2.1)
- Proactively connect STEM programs at MSIs and community colleges to the network of training programs sponsored by NHGRI (2.1 & 2.2)
- Support cohort models of students within and across programs (2.1 & 2.3)
- Ensure that all graduate training programs in genomics that are supported by NHGRI include structured mentorship and career development plans for all participating trainees (2.3)
- Ensure that all graduate training programs in genomics that are supported by NHGRI establish or participate in integrated systems to address potential bias and faculty equity and reduce potential isolation of trainees, including those from underserved and underrepresented groups (2.1 & 2.3)
- Collect baseline data and support ongoing mixed-methods assessments on the inclusion of diverse trainees and research environments at major NHGRI-funded institutions with and without training programs (2.3)

GOAL 2:

Develop and support training programs and networks that connect undergraduate and graduate education to careers in genomics.



Indicators of Success

- Increase advancement of students from NHGRI-supported undergraduate and graduate training programs into postgraduate genomics careers
- At institutions where NHGRI develops new undergraduate training programs, measure whether those institutions consistently place students into graduate training programs in genomics or careers in genomics (including those supported by NHGRI)

“Perhaps the most important reason we have fewer students of color, African Americans and Latinos, in the scientific workforce is that most don’t succeed at the undergrad level. If you look at our report from 2011 on expanding the scientific workforce, science and technology at the crossroads, what we found is that everybody wants to say, well it’s K-12, well it’s grad, it’s whatever. We say no, all those are true but the lowest hanging fruit to make a big difference would be the undergraduate experience.”

– Freeman Hrabowski, President of University of Maryland, Baltimore County



GOAL 3:



Develop and support training, career development, and research transition programs that lead to independent research and clinical careers in genomics.

The transition from formal education to research and clinical careers in genomics often requires overcoming barriers to become an established professional in the field. The retention of trained professionals who specialize in genetics and genomics is a major challenge despite the exciting scientific and health-related possibilities. Identifying key transition and retention barriers and developing intervention programs are first steps in achieving a more diverse genomics workforce.

Objectives

3.1: Identify and reduce barriers for individuals from diverse backgrounds who want to enter research and clinical careers in genomics

3.2: Facilitate the inclusion and retention of individuals from diverse backgrounds in research and clinical careers in genomics

Implementation Strategies

- Provide research funding to understand the unique barriers that underrepresented groups encounter when entering genomics research and clinical careers, and test interventions to eliminate such barriers (3.1 & 3.2)
- Build collaborations with academic institutions who train diverse student populations (3.1)
- Collaborate with professional societies, academic health centers, and clinical genetic programs that support the professional development of diverse genomics professionals (3.2)
- Support programs that expand the inclusion of diverse genomics professionals in the clinical and research workforce (3.2)
- Ensure that NHGRI staff members serve on trans-NIH workforce diversity committees/workgroups to enhance collaborations among NIH workforce diversity programs (3.1 & 3.2)
- Provide guidance to institutions and grantees to maintain inclusive climates to mentor and promote cohorts of genomics professionals from diverse backgrounds, including underrepresented groups (3.2)

Indicators of Success

- Increase the number of new or augmented research and clinical professional programs in genomics at MSIs (3.1 & 3.2)
- Enhance the diversity of the genomics research and clinical genomics workforce (3.1 & 3.2)
- Produce evidence-based interventions to reduce or eliminate barriers to entering and remaining in genomics-related positions (3.1)

“Although the dearth of underrepresented minority (URM) faculty members in medical schools typically has been framed as a ‘pipeline’ problem — i.e. a lack of available URM talent — our analysis shows that the rate of Ph.D. production for scientists from URM backgrounds has increased significantly over the past 33 years, and at a faster rate than that of well-represented (WR) scientists. Despite this progress, there was no statistical linkage between the size of the pool of URM talent, and the number of URM assistant professors hired in basic science departments of medical schools.”

– Gibbs KD et al., *eLife*, 2016 ^[5]

GOAL 4:



Evaluate progress towards achieving greater diversity in the genomics workforce.

NHGRI has a long-standing interest in enhancing the diversity of the genomics workforce. Going forward, it will be important to evaluate the Institute's investments in this area to determine their effectiveness and, in turn, to guide changes and improvements that maximize their impact.

Objectives

- 4.1:** Establish a relevant set of metrics for evaluating NHGRI diversity training and career development programs
- 4.2:** Use these metrics to develop tracking protocols for all individuals supported by these training programs
- 4.3:** Assess all NHGRI training and career development programs, including diversity-targeted programs, with periodic reports to leadership

Implementation Strategies

- Use lessons learned from NHGRI's extramural training Data Analysis and Coordinating Center (DACC) and guidance from NIH leaders in training evaluations to help establish success metrics (4.1)
- Develop and implement plans to longitudinally monitor and track all trainees by program, both institutional and individual; use existing NIH reporting and tracking tools to the extent possible (4.2)
- Consider how to create comparison groups to track participating programs and individuals (4.2)
- Support assessments conducted by the staff who oversee the Institute's training programs (4.3)
- Seek advice from NHGRI's external advisory groups on metrics, tracking, and evaluation plans (4.1 & 4.2)
- Provide annual reports to NHGRI leadership and provide updates to relevant external advisory groups when warranted (4.3)

Indicators of Success

- Establish procedures to collect and evaluate data (4.1, 4.2, & 4.3)
- Conduct evaluations that guide changes/improvements to programs to further achieve greater diversity of the genomics workforce (4.3)

"NIH should develop quantitative metrics, evaluation details, and time frames to assess NIH's efforts to diversify its scientific workforce against its diversity strategic plan goals, and take action as needed."

– Government Accountability Office (GAO) Report ([GAO-18-545](#))

Conclusion

NHGRI is prepared to work in partnership with the genomics community to enhance the diversity of the genomics workforce. This will require a long-term commitment, attention to the goals and objectives discussed in this action agenda, and continuously working with the broader community to develop new implementation strategies and evaluate the success of NHGRI's programs.



Appendix

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Funding to Promote Diversity in the Genomics Workforce

Genomic Workforce Diversity Working Group Members

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