

## **Educational Outcomes from the Maximizing Access to Research Careers Undergraduate Student Training in Academic Research (MARC U-STAR) Program**

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### Abstract

The National Institute of General Medical Sciences (NIGMS) Maximizing Access to Research Careers Undergraduate Student Training in Academic Research (MARC U-STAR) program is designed to enhance the diversity of the biomedical research workforce by assisting undergraduate institutions to provide academic, research and professional development activities to eligible trainees. This study was designed to identify the educational outcomes of MARC U-STAR alumni appointed between 1986 and 2013 (n= over 9,000) at 114 institutions. MARC U-STAR alumni who earned a Ph.D. were identified in the National Science Foundation Doctorate Records File. About 20 percent of MARC U-STAR alumni earned a Ph.D., although data from alumni appointed in the last decade appeared incomplete. Among Ph.D. earners, the vast majority earned the degree in a life sciences field, and MARC U-STAR alumni earned Ph.D.s from the same research-intensive institutions as biological sciences Ph.D. earners overall. To better understand recent outcomes, MARC U-STAR alumni appointed between 2001 and 2005 (n=1,810) were assessed using information from grant reports and public sources. Among recent MARC U-STAR alumni, 70 percent were enrolled in or had earned a subsequent graduate degree in science or health, including 29 percent who earned a Ph.D. or M.D.-Ph.D., 5 percent who earned a doctorate in a clinical/professional field, 13\* 12 percent who earned an M.D. or D.O. and 14 percent who earned a master's degree. Institutions varied in the proportions of alumni who achieved these different degrees. This analysis informs our understanding of the MARC U-STAR program in achieving its goals.

### Introduction

The MARC U-STAR program is part of a larger effort at NIGMS to promote, support and sustain the development of a highly skilled, creative and diverse biomedical workforce. The U-STAR program utilizes the T34 Ruth L. Kirschstein National Research Service Award (NRSA) funding mechanism and is designed to assist undergraduate institutions to provide academic, research and professional development activities to eligible trainees. The goal of the program is to increase the number of undergraduates from underrepresented backgrounds who earn the science baccalaureate and matriculate into and complete a biomedical science Ph.D. program (see the [MARC U-STAR Funding Opportunity Announcement \(FOA\) PAR-16-113](#)). In FY 2014, NIGMS supported 59 MARC U-STAR programs with 597 MARC trainees and a program budget of almost \$17 million.

MARC U-STAR grantee institutions are expected to design 2-year programs for the junior and senior (or final two) years of college that involve trainees in academic enhancement, research training and

professional skills development. Institutions incorporate programmatic interventions widely recognized for promoting persistence in the science baccalaureate, including early research experiences, active learning in introductory courses, membership in learning communities, a research culture on campus and other experiences that contribute to belief in one's capabilities (Graham et al., 2013; Hurtado et al., 2009; Kuh, 2006; Hensel, 2012; Miller et al., 2005; Gazley et al., 2014). In addition to these on-campus enhancements, MARC U-STAR institutions are also expected to provide each trainee with a summer research experience at a research-intensive institution. Trainees receive a stipend and tuition remission during program participation, and the awards provide support for program leaders and programmatic activities.

Participant eligibility is determined by awardee institutions and conforms to [NIH's Interest in Diversity](#), although specific eligibility requirements have changed over the history of these awards. Current eligibility focuses on individuals from groups underrepresented in biomedical sciences identified by the [National Science Foundation \(2015\)](#) and generally includes individuals from certain racial and ethnic groups, individuals with disabilities and individuals with specific educational or financial disadvantage. The MARC U-STAR program encourages appointment of honors students who have high grade point averages or other achievements as designated by their institutions.

The MARC U-STAR program has evolved from its inception almost 40 years ago, and continues to evolve. The MARC Honors Undergraduate Research Training (HURT) program was established in 1977 to develop strong undergraduate curricula in bioscience and to stimulate undergraduate interest in the biomedical sciences. In 1996, the program was recast as the MARC Undergraduate Student Training in Academic Research with the focus on junior and senior level honors students and an emphasis on continuous improvement of program goals and specific measurable objectives. In 2013, the expectation that over half the MARC U-STAR alumni nationally will enter biomedical Ph.D. programs was made explicit in the FOA.

NIGMS performed this retrospective analysis to better understand the educational outcomes achieved by MARC U-STAR alumni and how the program meets the goals described in the FOA. This analysis joins several earlier internal reviews of the MARC U-STAR program resulting from efforts by contractors and NIGMS staff. In 1995, an evaluative study of the MARC HURT program was done through combined efforts of the Research Triangle Institute, KRA Corporation, R.O.W. Sciences, Inc., and NIGMS staff. Among MARC alumni appointed between 1977 and 1986 (n= 1,070), 95 percent earned baccalaureates, 16 percent earned a terminal M.S. degrees, 25 percent earned medical doctorates and 14 percent earned Ph.D. or M.D.-Ph.D. degrees. A subsequent analysis in 2006 by NIGMS-commissioned ORC Macro International, Inc., included survey questions posed to MARC U-STAR alumni appointed between 1997 and 2003 (n=2,672). In this group, 15 percent entered M.S. programs, 13 percent entered M.D. programs and 40 percent entered Ph.D. programs. The ORC Macro report suggested that more MARC U-STAR alumni were entering Ph.D. programs than at earlier periods, but only a small proportion had completed the Ph.D. by the time of the report. Others have provided institutional outcomes from programs that included MARC U-STAR support (Maton et al., 2012; Gewin, 2014; Slovacek, 2012; Schultz et al., 2011). The present report describes the educational outcomes from all MARC U-STAR alumni appointed between 1986 and 2013.

## Methods

*MARCAward Information.* Award information for MARC institutions funded between 1986 and 2013 was collected from the NIH IMPAC-II database. IMPAC-II contains information on applications and awards for NIH grants, contracts and training programs, and updates personal and scientific data. FOAs for the MARC U-STAR program include PAR-13-205, PAR-10-119, PAR-07-337, PAR-02-033, PAR-99-150, PAR-98-093 as well as previous periodic announcements.

Earlier appointment and termination information from each MARC U-STAR institution recorded trainees as “undergraduate assistants” and was later transferred to NIH IMPAC-II. The eRA [Commons xTrain electronic system](#) that replaced paper forms has been employed for MARC U-STAR beginning in 2008. Both principal investigator and trainee names were reconciled and a frozen file of approximately 9,000 unique appointees to a MARC U-STAR program was used as a basis for educational outcomes. Because NIH IMPAC-II is continuously updated, the exact number of trainee outcomes can be slightly different, depending on the date of analysis.

*MARCU-STAR Alumni Educational Outcomes.* MARC U-STAR alumni appointed between 1986 and 2013 (n= 9,339) were updated from the NIH IMPAC-II file as of December 16, 2014, and were compared with the NSF Doctorate Record File with assistance from the NIH Office of Extramural Research. This report relies upon an NSF file that included Ph.D. degrees granted only through June 30, 2012.

In a second approach, a subset of MARCU-STAR alumni appointed between 2001 and 2005 (n=1,810) was tracked by grantee reports and individual look-ups in public sources. Grantee reports on MARCU-STAR alumni were compared with websites including Google, Linked In, Scopus, Ph.D. Tree, Intellius and Healthgrades, as well as institutional links. The search was performed between June and December 2015. These public networks were chosen to reflect professional interactions; by contrast, Facebook was deliberately avoided as it is often used for personal networks. In general, the degree data included confirmation of both the degree institution and degree year. Data confirmed from multiple sources were preferred over single entries. In some cases, no educational or career information was available in public sources, and these unknowns are indicated.

*Subsequent Training and Fellowships.* To determine if MARC U-STAR alumni subsequently participated in formal research training in a research field, the NIH IMPAC-II database was searched for subsequent NIH training appointments and fellowships (search performed in 2013). In addition, MARC U-STAR alumni names and institutions were matched with NSF Graduate Research Fellow (GRF) award data (<https://www.fastlane.nsf.gov/grfp/Login.do>). NSF reported 32,937 GRF awardee records between 1985 and 2014. These data were sorted by awardee name and award year, and matched with the MARC U-STAR name and institution list.

*Institution Types.* Undergraduate and graduate institution names were compared with the Carnegie Research Classification Basic 2010 as well as lists of institutions that enroll students from underrepresented groups. In cases in which a university had multiple campuses and a specific campus was not indicated, the main campus affiliation was used. Institutions with enrollment of students from

underrepresented groups were identified, including Historically Black Colleges and Universities (HBCU); Tribal Colleges and Universities (TCU); American Indian Alaska Native-Serving Institutions (AIANSI); Hispanic-Serving Institutions (HSI); Asian American and Native American Pacific Islander-Serving Institutions (AANAPISI); and Predominantly Black Institutions (PBI).

*Additional Limitations.* In this report, educational outcomes from MARC U-STAR institutions and alumni appointed between 1986 and 2013 are described. This approach has allowed many MARC U-STAR alumni from early in this period to have earned degrees, but the approach also blends together outcomes from a program that has evolved over time.

The MARC U-STAR program was not designed as an experiment, so there are no institutions or individuals who serve as controls, although two relevant comparison groups are described. An earlier [NIGMS Diversity Supplement Program](#) assessment provides educational outcomes from diverse undergraduates. An artificial cohort of bachelor's and Ph.D. degree earners was isolated from NSF WebCASPAR data and used to compare the percentage of URM biological sciences baccalaureate earners in a given year with biological sciences Ph.D. earners 10 years later. This very general model assumes students do not switch fields between the baccalaureate and the Ph.D. degree and does not correct for the proportion of all baccalaureates with an interest or aptitude for Ph.D. matriculation and completion.

In addition to the potential data quality issues raised earlier, an important limitation remains that this study reports only educational metrics; any additional benefits from the MARC U-STAR program to students or faculty are not examined.

## Results

Many different institutions have been awarded MARC U-STAR grants over the program history. The initial MARC HURT program was established in 1977 with nine institutions and a goal to develop strong undergraduate curricula and stimulate undergraduate interest in the biomedical sciences. From 1986 and 2013, there were 127 MARC U-STAR grants awarded at 114 unique schools, with an average of 56 active programs per year. Among funded MARC U-STAR institutions, the mean duration of an award at an institution was 15 years.

Institutions with MARC U-STAR programs differ in their characteristics. Over time, fewer baccalaureate and more research universities have had MARC U-STAR awards ([Figure 1A](#)). For example, among MARC U-STAR institutions in 2013, 33 were research universities, 36 were master's universities, 10 were doctoral research universities and 26 were baccalaureate institutions. The Carnegie Research Classification of the institution reflects graduate activity, and does not provide information on faculty research activity or funding. At a particular institution, MARC U-STAR programs are often complemented by another student development program from NIGMS or elsewhere. For example, among 60 MARC U-STAR programs in 2013, 46 also had an undergraduate Research Initiative for Scientific Enhancement (RISE) program, and 6 others had an undergraduate Initiative for Maximizing Student Development (IMSD) program.

Many MARC U-STAR programs are at institutions that enroll substantial numbers of individuals from underrepresented groups. This report describes information on enrollment of students from underrepresented racial and ethnic groups, as there is less available information for other eligible groups such as students with disabilities or students with financial and educational disadvantages. Enrollment of students from underrepresented groups can reflect the historical mission of the school or institutional designation by the Department of Education. In the 1980s, HBCUs were the major institution type with a MARC U-STAR program. Since 1990, however, fewer MARC U-STAR programs have been at HBCUs, and more programs have been at HSIs (Figure 1B). For example, among MARC U-STAR institutions in 2013, 15 (28 percent) were described as HBCU or PBI and 18 (33 percent) were HSI.

The current MARC U-STAR program is designed as a continuous 2-year experience. The mean duration of MARCU-STAR alumni support was 19 months (median= 21 months). While the number of MARCU-STAR programs has been at a steady-state of about 55-60 programs per year for some time, the total number of trainee positions awarded grew by 50 percent from 1986 to 1996 and has remained steady since then. In 2013, there were both large and small MARC U-STAR programs, with an average of 11 students per program per year, and a range from 3 to 42 awarded slots (the latter would support 21 students in a 2-year program).

#### MARC U-STAR Ph.D. Outcomes

The current FOA expects that a majority of MARC U-STAR students nationally will matriculate into a Ph.D. (or M.D.-Ph.D.) program, and educational outcomes for each MARC U-STAR trainee are requested in grantee reports. However, Ph.D. matriculation and earned degrees proved challenging to quantify due to reporting practices and the long tracking period required. While programs provide information on Ph.D. matriculation and attainment, the degree of detail and completeness of the grantee reports varied considerably. Few programs described early termination or withdrawal from the MARC U-STAR program itself, so that unless otherwise indicated, students were assumed to earn the baccalaureate at completion of the MARC U-STAR appointment. Some institutions reported every MARC U-STAR alumnus by name along with details of baccalaureate year and subsequent educational outcomes, as requested. Others aggregated the information and listed only the number of alumni in graduate programs, which might encompass various degrees. Still other programs provided information only on a subset of successful alumni from the institution but provided no information on others. This report worked to identify the outcome of every individual appointed to a MARCU-STAR program.

MARC U-STAR alumni educational outcomes require about a decade to achieve, and thus full information might not appear in a grantee report. NSF estimated the *median* time to complete a biological sciences Ph.D. was 6.3 years, although students from underrepresented groups took about half a year longer (Zeiser and Berger, 2012; Fiegner, 2009). Thus, for a typical MARC U-STAR student appointed in the junior year of college, there might be 2 years to complete the baccalaureate, and at least another 6.8 years to complete the Ph.D. (for a conservative, median estimate of 8.8 years), and this time period may be extended with any intervening employment or an M.S. degree.

MARC U-STAR alumni appointed between 1986 and 2013 were compared with the NSF Doctorate Records File, and the degree and doctoral field of study collected for Ph.D. earners. This analysis relied upon data for Ph.D.s earned only through June 2012. Over this period, a total of 1,277 MARC U-STAR alumni earned Ph.D.s ([Figure 2](#)); of these, 376 earned both an M.S. and a Ph.D. The field of study completed by MARC U-STAR alumni was overwhelmingly in the life sciences. There was an increase over time in MARC U-STAR alumni who earned a Ph.D. doing so in one of the life sciences, from 62 percent (1985 to 1989) to 76 percent (2000 to 2004). At the same time, fewer earned a Ph.D. in physical sciences and engineering or in other fields. When Ph.D.s were compared to the number of MARC U-STAR appointments, the proportion of MARC U-STAR alumni who earned a Ph.D. was about 20 percent in each 5-year cohort, except in the most recent periods that include alumni who are unlikely to have completed a Ph.D. by the time period contained in the NSF report.

The majority of MARC U-STAR alumni who subsequently earned a Ph.D. did so at a research university ([Figure 3A](#)). Seventy-five percent of MARC U-STAR alumni Ph.D.s were earned at Research Universities-Very High, with about 10 percent more at Research University-High and medical schools, respectively. This is similar to where biological sciences Ph.D.s are earned overall, where research universities account for 85 percent of all Ph.D.s. About 19 percent of MARC U-STAR alumni Ph.D.s were earned at institutions that enroll substantial numbers of students from underrepresented groups, with almost 7 percent of the doctorates earned from HBCUs, and almost 5 percent at HSIs. The 1,277 MARC U-STAR alumni who completed the Ph.D. earned their degrees from 191 graduate institutions ([Figure 3B](#)). Of these, 55 institutions each had only one graduate from MARC U-STAR, and the top 12 Ph.D. institutions (defined by number of MARC U-STAR trainees) had 375 MARC U-STAR alumni Ph.D.s among them. In general, MARC U-STAR alumni earned Ph.D.s at the same institutions as science Ph.D. earners, overall.

One measure of MARC U-STAR outcomes is participation in subsequent research training programs. In 2013, the outcomes of MARC U-STAR trainees from 1986 to 2013 were evaluated, and 956 alumni were subsequently appointed to an NIH T32 training grant (this may include predoctoral, postdoctoral or both appointments). An additional 527 MARC U-STAR alumni received a predoctoral fellowship (F30 or F31) and 216 MARC U-STAR alumni received an NSF Graduate Research Fellowship. MARC U-STAR alumni may also have been supported by the NIH Diversity Supplement Program, NIH research grants, the NSF or other institutional or foundation funds.

#### Educational Outcomes From Recent MARC U-STAR Alumni

In another approach, MARC U-STAR alumni appointed between 2001 and 2005 (referred to as “Recent MARC U-STAR Alumni”) were examined for subsequent educational degree outcomes using information from grant competing renewals and public sources ([Figure 4](#)). Twenty-nine percent earned a Ph.D. or M.D.-Ph.D., 12 percent earned an M.D. or D.O., 14 percent earned a master’s degree, and 5 percent earned a doctorate in a professional/clinical field. About one-third of the Recent MARC U-STAR Alumni did not appear to have earned a subsequent degree after the baccalaureate, although among this group, some were current graduate students. For 16 percent of Recent MARC U-STAR Alumni, no further information was available.

The MARCU-STAR FOA outlines the expectation that a majority of MARCU-STAR alumni matriculate in a research doctorate program (comprised of Ph.D., M.D.-Ph.D. or professional/clinical doctorates such as public health, chiropody, physical therapy, psychology and similar professional and clinical disciplines), and progress toward this goal was assessed. Ph.D. matriculation was collected from competing grant renewal applications of 29 MARCU-STAR programs reporting on alumni appointed between 2001 and 2005 (omitting new or unsuccessful applications), and this resulted in a grantee-reported 59 percent Ph.D. matriculation rate for recent MARCU-STAR alumni. For this same group of institutions and time period, 40 percent of the MARCU-STAR alumni actually attained research doctorate degrees. These measures suggest that two-thirds of MARCU-STAR alumni who begin a doctoral program ultimately earn the degree. The recent suggestion that programs use of standardized reporting tables that include each appointee for MARCU-STAR may increase confidence in these estimates.

The particular mix of educational outcomes achieved by MARCU-STAR alumni varied across institutions ([Figure 5](#)). For example, at some institutions MARCU-STAR alumni earned many Ph.D.s (up to 59 percent of a school's MARCU-STAR alumni), while at others, MARCU-STAR alumni earned many M.D./D.O.s (up to 31 percent) or professional/clinical doctorates (up to 36 percent). Overall, 70 percent of the Recent MARCU-STAR Alumni had enrolled in a graduate program or earned a subsequent graduate degree in science or health.

### Observations

This report on MARCU-STAR alumni educational outcomes provides several important observations. The report describes the educational achievements of MARCU-STAR alumni over most of the program's history, gained from grantee reports, national data and public sources.

- Some 70 percent of recent MARCU-STAR alumni have enrolled in graduate programs or earned subsequent graduate degrees in science or health, with almost one-third in recent years earning a Ph.D. or M.D.-Ph.D. While the NRSA focuses on research doctorates, alumni with science baccalaureates and master's degrees also make important contributions to the nation's biomedical workforce, and can expect higher salaries than non-science graduates (see [College Measures](#)).
- The overall rate for Ph.D. attainment (29 percent) observed for recent MARCU-STAR alumni is almost twice that seen for undergraduates supported by NIGMS supplements to enhance diversity, and four times higher than that modeled for biology baccalaureates in general. The present data also indicate that, for MARCU-STAR alumni who matriculate in a doctorate program, two-thirds complete the Ph.D., a rate that is higher than the national average in the sciences (DIMAC; Ph.D. Completion).
- Future steps to align program activities with research on science education may increase the impact of MARCU-STAR. In particular, efforts at earlier stages to foster development of a large pool of undergraduates who go on to science careers may be effective.

- This report provides support that the MARC U-STAR program meets the educational outcome goals outlined in the FOA. Future studies may explore any additional benefits from the MARC U-STAR program to students or faculty.

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### References

Maximizing Access to Research Careers Undergraduate-Student Training in Academic Research (MARC U-STAR) (T34) PAR-16-113 <http://grants.nih.gov/grants/guide/pa-files/PAR-16-113.html>, accessed March 2, 2016.

Graham MJ, Frederick J, Byars-Winston A, Hunter AB, Handelsman J. (2013) Increasing Persistence of College Students in STEM. *Science* 341:1455-6.

Hurtado S, Cabrera NL, Lin MH, Arellano L, Espinosa LL. (2009) Diversifying Science: Underrepresented Student Experiences in Structured Research Programs. *Res High Ed* 50(2):189-214.

Kuh GD, Kinzie J, Buckley JA, Bridges BK, Hayek JC. (2006) What Matters to Student Success: A Review of the Literature. Commissioned Report for the National Symposium on Postsecondary Student Success: Spearheading a Dialog on Student Success. National Postsecondary Education Cooperative. [http://nces.ed.gov/npec/pdf/kuh\\_team\\_report.pdf](http://nces.ed.gov/npec/pdf/kuh_team_report.pdf), accessed January 4, 2016.

Hensel, N, editor (2012) Characteristics of Excellence in Undergraduate Research (COEUR). Council on Undergraduate Research. [http://www.cur.org/assets/1/23/COEUR\\_final.pdf](http://www.cur.org/assets/1/23/COEUR_final.pdf), accessed January 28, 2016.

Miller LS, Ozturk MD, Chavez L. (2005) Increasing African American, Latino, and Native American Representation among High Achieving Undergraduates at Selective Colleges and Universities, Consortium for High Academic Performance, Institute for the Study of Social Change, University of California, Berkeley; retrieved from [http://www.uky.edu/ie/sites/www.uky.edu.ie/files/uploads/RM\\_Increasing%20African%20American%20Latino%20and%20Native%20American%20Representation%20.%20.%20..pdf](http://www.uky.edu/ie/sites/www.uky.edu.ie/files/uploads/RM_Increasing%20African%20American%20Latino%20and%20Native%20American%20Representation%20.%20.%20..pdf), accessed February 18, 2016.

Gazley JL, Remich R, Naffziger-Hirsch ME, Keller J, Campbell PB, McGee R. (2014) Beyond Preparation: Identity, Cultural Capital, and Readiness for Graduate School in the Biomedical Sciences. *J Res Sci Teach* 51(8):1021-48.

National Science Foundation, 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. Available at <http://www.nsf.gov/statistics/wmpd>.

Notice of NIH's Interest in Diversity NOT-OD-15-053, <http://grants.nih.gov/grants/guide/notice-files/NOT-OD-15-053.html>, accessed February 18, 2016.

Maton KI, Pollard SA, McDougall Weise TV, Hrabowski FA. (2012) Myerhoff Scholars Program: A Strengths-Based, Institution-Wide Approach to Increasing Diversity in Science, Technology, Engineering, and Mathematics. *Mt Sinai J Med* 79:610-23.

Gewin V. (2014) Meyerhoff Expansion Program. *Nature* 511:499-500.

Slovacek S, Whittinghill J, Flenoury L, Wiseman D. (2012) Promoting Minority Success in the Sciences: the Minority Opportunities in Research Programs at CSULA. *J Res Sci Teach* 49:199-217.

Schultz PW, Hernandez PR, Woodcock A, Estrada E, Chance RC, Aguilar M, Serpe RT. (2011) Patching the Pipeline: Reducing Educational Disparities in the Sciences Through Minority Training Programs. *Educ Eval Policy Anal* 33:95-114.

Carnegie Classification of Institutions of Higher Education at [http://carnegieclassifications.iu.edu/lookup\\_listings/institution.php](http://carnegieclassifications.iu.edu/lookup_listings/institution.php), accessed January 4, 2016.

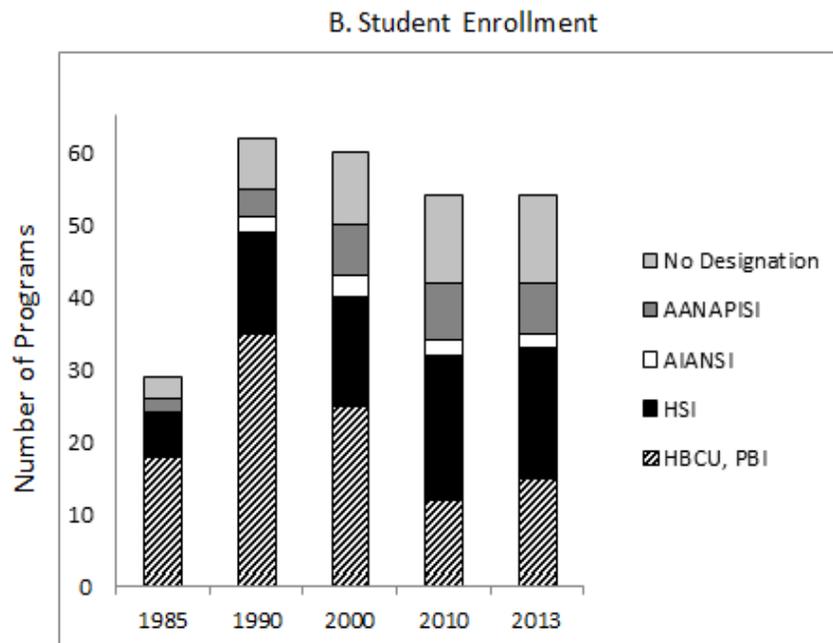
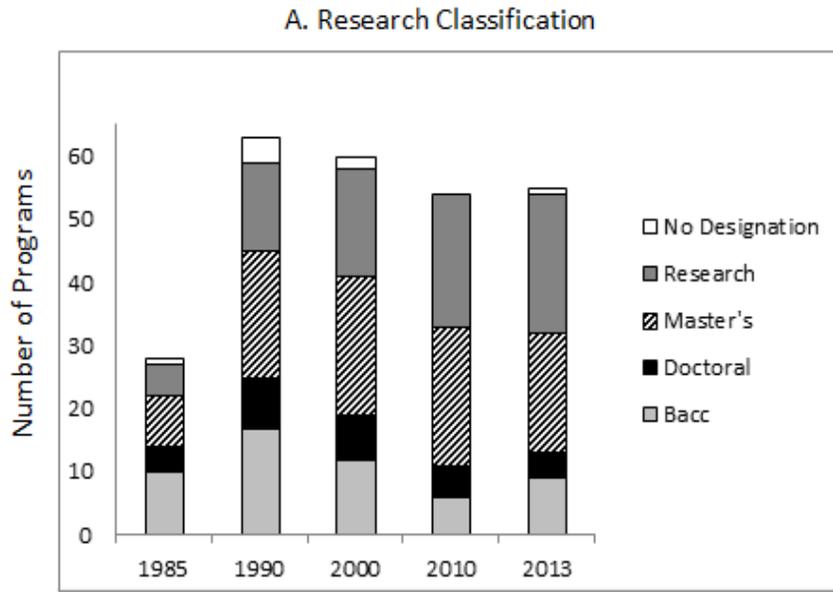
NIGMS Analysis of Supplements to Enhance Diversity (2015) Hall A, Miklos A, Mickey O, Oh A, Shoemaker J. <https://www.nigms.nih.gov/Research/mechanisms/Documents/DSPOutcomesReport5282015.pdf>, accessed January 21, 2016.

Zeiser KL and Berger AR. (2012) How Long Does it Take? STEM Ph.D. Completion for Underrepresented Minorities. Broadening Participation in STEM Graduate Education; 1-14. American Institutes for Research, [http://www.air.org/sites/default/files/downloads/report/AIR\\_STEM\\_Issue\\_Brief\\_Time\\_to\\_Completion\\_12\\_2012\\_0.pdf](http://www.air.org/sites/default/files/downloads/report/AIR_STEM_Issue_Brief_Time_to_Completion_12_2012_0.pdf), accessed February 18, 2016.

Fiegner MK (2009). Doctorate Recipients from U.S. Universities: Summary Report 2007-2008. Division of Science Resources Statistics, Directorate for Social, Behavioral, and Economic Sciences, National Sciences Foundation.

Doctoral Initiative on Minority Attrition and Completion (DIMAC; 2015), Council of Graduate Schools <http://cgsnet.org/minority-attrition-and-completion-stem-doctoral-programs>, accessed February 18, 2016.

Ph.D. Completion and Attrition: Analysis of Baseline Program Data From the Ph.D. Completion Project. Council of Graduate Schools, 2008. Table 1: Cumulative 10-year Completion Rates by Programs, Broad Field, STEM vs. SSH, and Overall, [http://www.phdcompletion.org/quantitative/book1\\_quant.asp](http://www.phdcompletion.org/quantitative/book1_quant.asp).



**Figure 1. Many Institutions Have Had MARCU-STAR Grants.** The number of institutions with a MARCU-STAR program are shown over time by A) Carnegie Research Classification, and B) Student Enrollment. Abbreviations: Bacc indicates any baccalaureate institutions; M.S. includes all sizes of master’s programs. Institutions with substantial enrollment of students from underrepresented groups, including Asian American and Native American Pacific Islander-Serving Institutions (AANAPISI), American Indian Alaska Native-Serving Institutions (AIANSI), Hispanic-Serving Institutions (HSI), Historically Black Colleges and Universities (HBCU), and Predominantly Black Institutions (PBI) are indicated. For example, institutions designated as HBCU and PBI are shown in dark bars, those designated HSI are back-hatched and those without designation are clear.

Ph.D. Field of Study	Appointed 1985-1989	Appointed 1990-1994	Appointed 1995-1999	Appointed 2000-2004	Appointed 2005 or after
LIFE SCIENCES	152	194	247	259	Too Recent for Full Outcomes
PHYSICAL SCIENCES & ENGINEERING	60	65	71	65	
SOCIAL SCIENCES, PSYCHOLOGY & OTHER	32	43	47	17	
Total Ph.D.s Earned	244	302	365	341	
Total MARC U-STAR Alumni	1161	1447	1589	1775	
MARC U-STAR Alumni with Ph.D.	21.0%	20.9%	23%	19.2%	

Figure 2. MARC U-STAR Alumni Ph.D.s Reported by Mid-2012. The MARC U-STAR alumni appointed between 1986 and 2013 were compared with Ph.D.s earned by June 2012 and reported in the NSF Doctorate Record File. Ph.D.s were most commonly earned in life sciences fields. The number of Ph.D.s earned was divided by the number of MARC U-STAR alumni appointed, in each 5-year cohort, to calculate the percentage who earned Ph.D.s. It is expected that recently appointed MARC U-STAR students would not have earned a Ph.D. by 2012. Data in more recent years appear incomplete due to the long period anticipated between MARC U-STAR appointment and Ph.D. attainment.

A. Institutions Where MARC U-STAR Alumni Earned the Ph.D.			
Research Classification	# Students	Student Enrollment	# Students
Research, Very Heavy	955	HBCU	78
Research, Heavy	125	AIANSI	34
Medical Schools	142	HIS	61
Doctoral Research University	34	AANAPISI	58
Other	21	Any	231
Total	1277		

B. Distribution of MARC U-STAR Alumni Ph.D. Institutions	
	# students
55 institutions with 1 Ph.D. Earner	55
99 institutions with 2-11 Ph.D. Earners	454
25 institutions with 12-20 Ph.D. Earners	393
12 institutions with More than 21 Ph.D. Earners	375
Total	1277

Figure 3. Institutions Where MARC U-STAR Alumni Earned the Ph.D. The institutions from which MARC U-STAR alumni earned a research doctorate reported in Figure 2 were characterized. A) The majority of MARC U-STAR alumni earned their doctorate degrees at research-intensive institutions. Institutions with substantial enrollment of underrepresented students are shown. B) MARC U-STAR alumni earned Ph.D.s at a variety of graduate institutions. MARC U-STAR alumni, like biological sciences Ph.D.s overall, are most likely to earn degrees at research universities (see NSF 2015).

Educational Outcomes of Recent MARC U-STAR Alumni				
Degree			Number	Percent
Ph.D.			504	29.2%
M.D.- Ph.D.			25	
Doctorate (Other)			17	5.2%
D.D.S/D.M.D./D.V.M.			35	
Pharm.D.			42	
M.D./D.O.			212	11.7%
J.D.			11	0.6%
M.A./M.S.			202	14.4%
Master's (Other)			59	
Baccalaureate			632	34.9%
	Grad Student	101		
	Workforce	244		
	Unknown	287		
Term/Dec/Short			71	3.9%
Total			1810	99.9%

Figure 4. Detailed Educational Outcomes From Recent MARC U-STAR Alumni. Recent MARC U-STAR alumni appointed between 2001 and 2005 (n=1,812) were tracked for subsequent educational outcomes using grant reports and public sources including Google, Linked In, Scopus, Ph.D. Tree, Intellius and institutional links with information about alumni (search performed June to December, 2015). Trainees who were terminated/withdrew, were deceased or individuals who participated in MARC U-STAR for less than 5 months (n=71) were removed, for a total study group of 1,740. Research doctorate Ph.D. or M.D.-Ph.D.s are shown. Doctorate (Other) includes a variety of degrees including public health, chiropody, physical therapy, psychology and similar professional and clinical disciplines. Master's (Other) includes any degrees other than M.S. or Master of Arts (and includes M.P.H., M.B.A., M.H.S. and other nurse practitioner degrees). About one-third of the trainees did not appear to have a subsequent degree after the baccalaureate (n = 632); of these, 101 were currently enrolled in graduate school and 244 were in the workforce. It was not possible to find subsequent degree or job information on 16.5 percent (n =287). Overall, 70 percent of MARC U-STAR alumni were enrolled in graduate program, or earned a subsequent graduate degree in science or health.

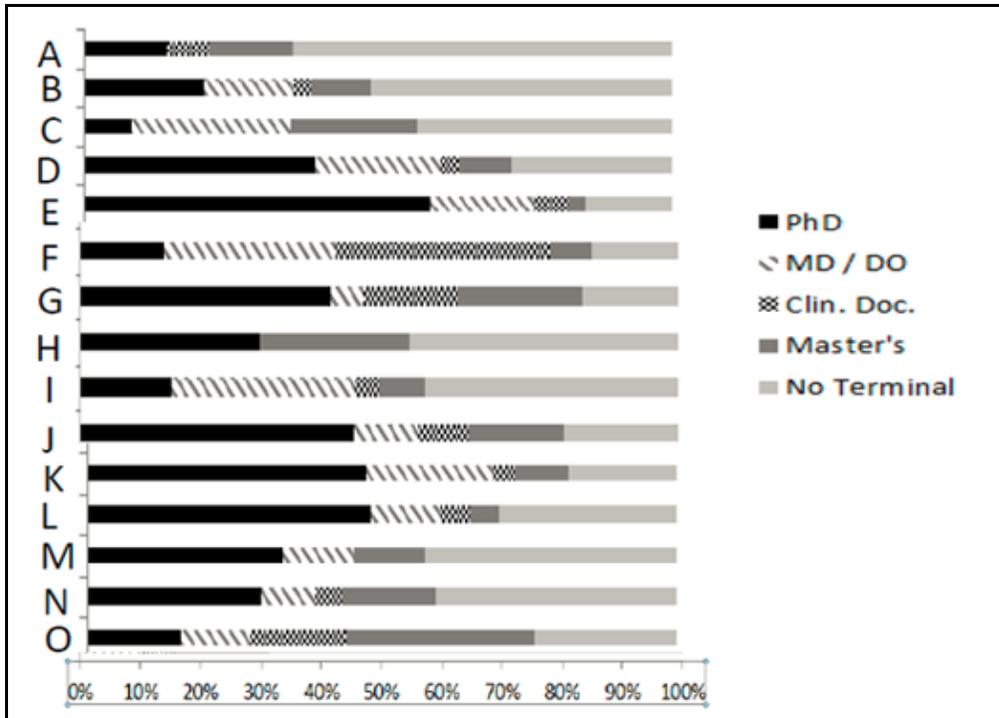


Figure 5. MARC U-STAR Alumni Educational Outcomes Differ Among Schools. The particular mix of educational outcomes earned by MARC U-STAR alumni differed by institution. Examples of educational outcomes from selected MARCU-STAR institutions (labeled A-0) are shown. The percentage of recent MARC U-STAR alumni who earned a Ph.D. is shown in dark bars, M.D./D.O. in backslashes, clinical doctorates in hatched, M.S. in dark gray (see key). Differences may result from institutional strengths or regional networks among various MARC U-STAR programs.

## **Addendum: More on MARC U-STAR Alumni**

March 29, 2016

This report described educational outcomes from more than 9,000 undergraduates at 114 institutions appointed between 1986 and 2013—a long period during which both the program objectives and student eligibility set out by NIH changed.

Trainees are appointed to a MARC U-STAR program by their undergraduate institutions, following guidance in NIH funding opportunity announcements. The program has evolved from one initially focused on racial and ethnic diversity to one in which eligible individuals come from groups described as [underrepresented in biomedical science](#). These include students from certain racial and ethnic groups, students with physical disabilities and students with specific financial or educational disadvantages.

While the details have evolved, the spirit of the MARC U-STAR program remains the same: to assist undergraduate institutions in preparing the next generation of highly skilled, creative and diverse researchers.

In the earliest periods of the program, data were not collected on the demographics of trainees, and thus there are many “unknowns” (Figure 1). A report (Garrison and Brown, Institute of Medicine publication [IOM-85-08](#)) surveyed more than 800 of these early MARC alumni appointed between 1977 and 1984 and reported that among the 421 respondents, participants reported backgrounds including 64 percent Black, 22 percent Hispanic, 7 percent Asian American and Native American/Pacific Islander (AANAPI) or American Indian/Alaska Native (AIAN); 3 percent no response (Figure 2). In more recent periods, trainees might self-report that they were from well-represented groups, from one of several underrepresented groups or choose not to report. From the mid-1990s to the present, the average percentage of self-reported underrepresented minorities was about 85 percent (Figure 1). Among the recent MARC U-STAR alumni (2001-2005) for whom we reported educational outcomes, 42 percent were African-American, 29 percent were Hispanic, 8 percent were AANAPI or AIAN and 9 percent were unknown or withheld.

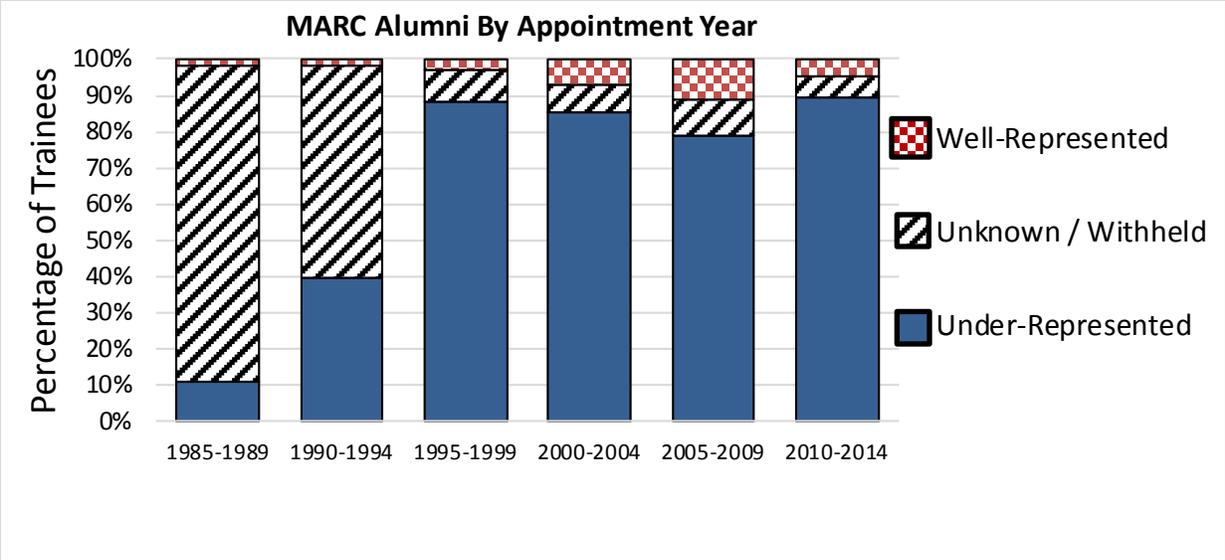


Figure 1. MARC Alumni By Appointment Year. The percentages of MARC alumni are reported as: [under-represented in the biomedical sciences](#) (solid blue bars), unknown/withheld (dashed bars) or well-represented (checked red bars).

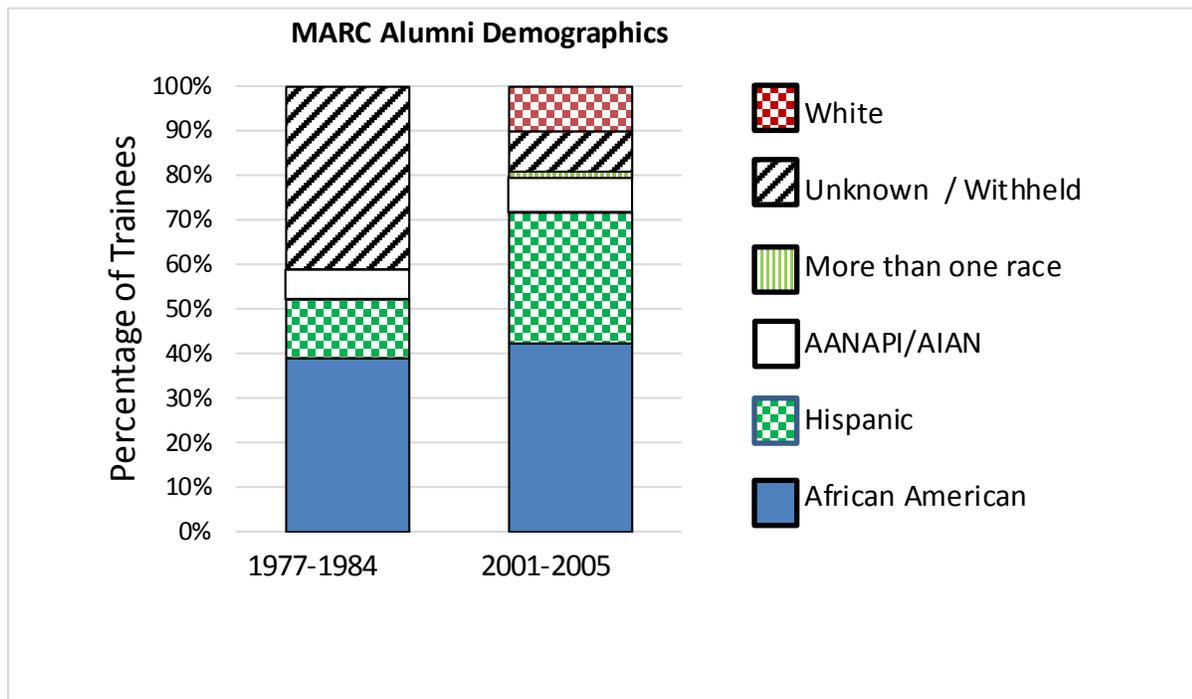


Figure 2. MARC Alumni Demographics in Two Cohorts. The percentages of MARC alumni are reported for the 1977-1984 cohort in the [IOM-85-08](#) report and for the 2001-2005 cohort described in this report.