Labor Market Trends and Considerations for STEM Graduate Education

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INTRODUCTION

The U.S. economy is at a pivotal moment. Broadly, the rapidly changing nature of technology puts increased emphasis on science, technology, engineering, and mathematics (STEM) fields, while the once-in-a-generation federal investment in the U.S. Economic Development Administration's Regional Technology and Innovation Hubs Program has specifically heightened the need for STEM skillsets in workplaces and regions.

Not surprisingly, data from the U.S. Bureau of Labor Statistics (BLS) shows that the number of STEM occupations is on the rise. BLS's Occupational Employment and Wage Statistics data projected a 10.8 percent increase by 2032, compared with a 2.3 percent increase in non-STEM occupations.[1] Notably, these occupations offer a median annual wage of $101,650, compared with that of $46,680 among non-STEM occupations (BLS 2024b). The wage potential alone makes a compelling case for many Americans to consider a career in STEM, whether weighing short-term professional growth, long-term career stability, or the return on investment of an advanced degree.

This brief is a companion to *STEM Graduate Education: Trends and Existing Interventions to Broaden STEM Graduate Pathways*, which provides a snapshot of enrollment and completion trends in STEM education and offers an overview of existing interventions to increase the number of diverse graduates entering the labor force. This brief summarizes the major trends in the STEM labor market that influence STEM graduate education and provides supporting quantitative data. It concludes with considerations for higher education institutions and related stakeholders interested in better preparing graduate students for in-demand STEM jobs.

1 There are many definitions of STEM occupations. This brief adopts the U.S. Bureau of Labor Statistics' definition of STEM occupations, which refers to "computer and mathematical, architecture and engineering, and life and physical science occupations, as well as managerial and postsecondary teaching occupations related to these functional areas and sales occupations requiring scientific or technical knowledge at the postsecondary level" (BLS 2024c).

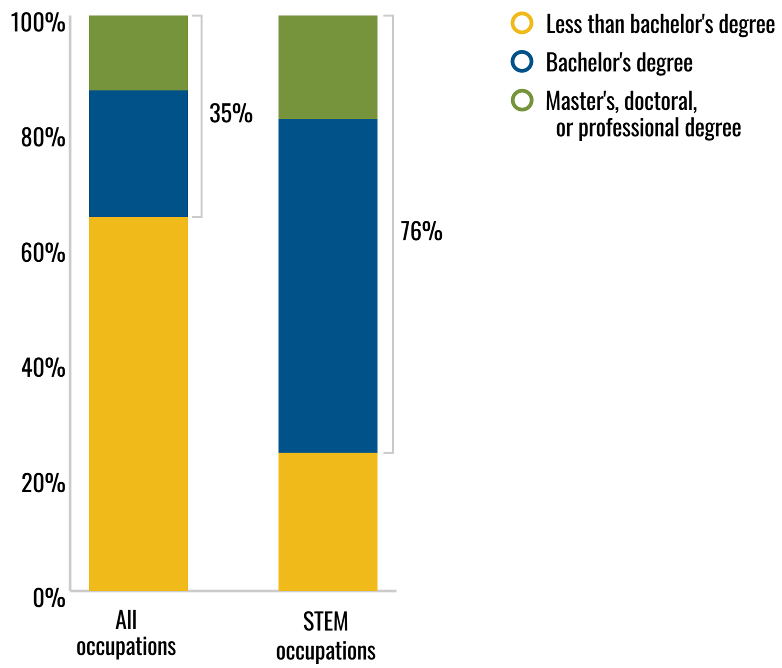
STEM LABOR MARKET TRENDS

The following is a snapshot of select STEM labor market trends. While not an exhaustive list, it gives a broader context of STEM workforce supply and demand.

Extensive Education Requirements

Nationwide, 76 percent of entry-level STEM occupations typically require at least a bachelor's degree, whereas only 35 percent of all occupations do so (see figure 1).

Figure 1. Typical Entry-Level Educational Requirements



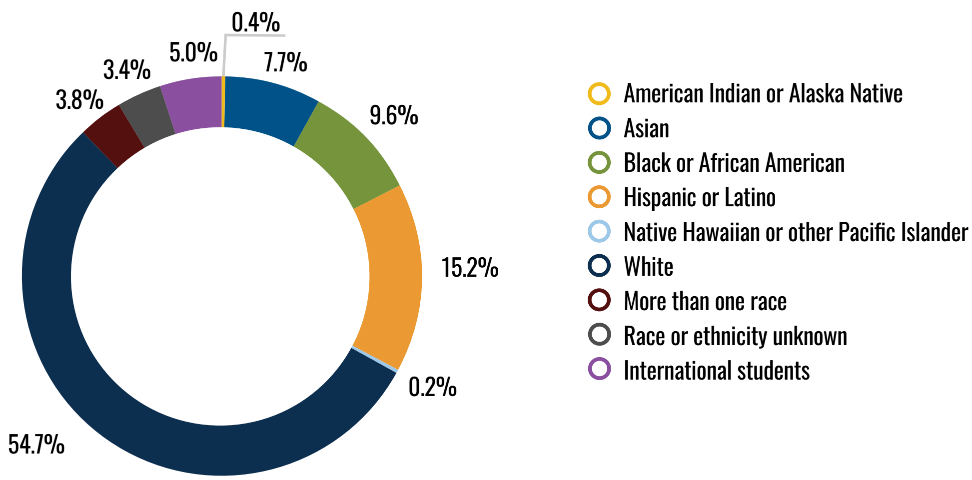
Source: Data from BLS 2024a.

Of a list of 10 STEM occupations that are expected to see higher-than-average growth through 2031 (see table 1, located on page 6), seven typically require a bachelor's degree and three require a master's degree for entry-level roles (Krutsch and Roderick 2022). This requirement translates to approximately 227,600 annual average occupational openings between 2021 and 2031. With the average annual tuition for a traditional four-year bachelor's degree program ranging from $9,750 for in-state tuition at public institutions to $38,421 at private nonprofit institutions, students must weigh if the cost is worth the time it will take to recoup the cost of their education through wages (Hanson 2024).

Racial and Ethnic Disparities

Recognizing that STEM occupations typically require at least a bachelor's degree, it is important to consider existing racial and ethnic disparities in higher education and their ripple effects on the STEM workforce. Looking across all academic fields, ACE's *Race and Ethnicity in Higher Education: 2024 Status Report* (Kim et al. 2024) highlights that only 37 percent of the 2 million bachelor's degree earners in 2021 were students of color (see figure 2).

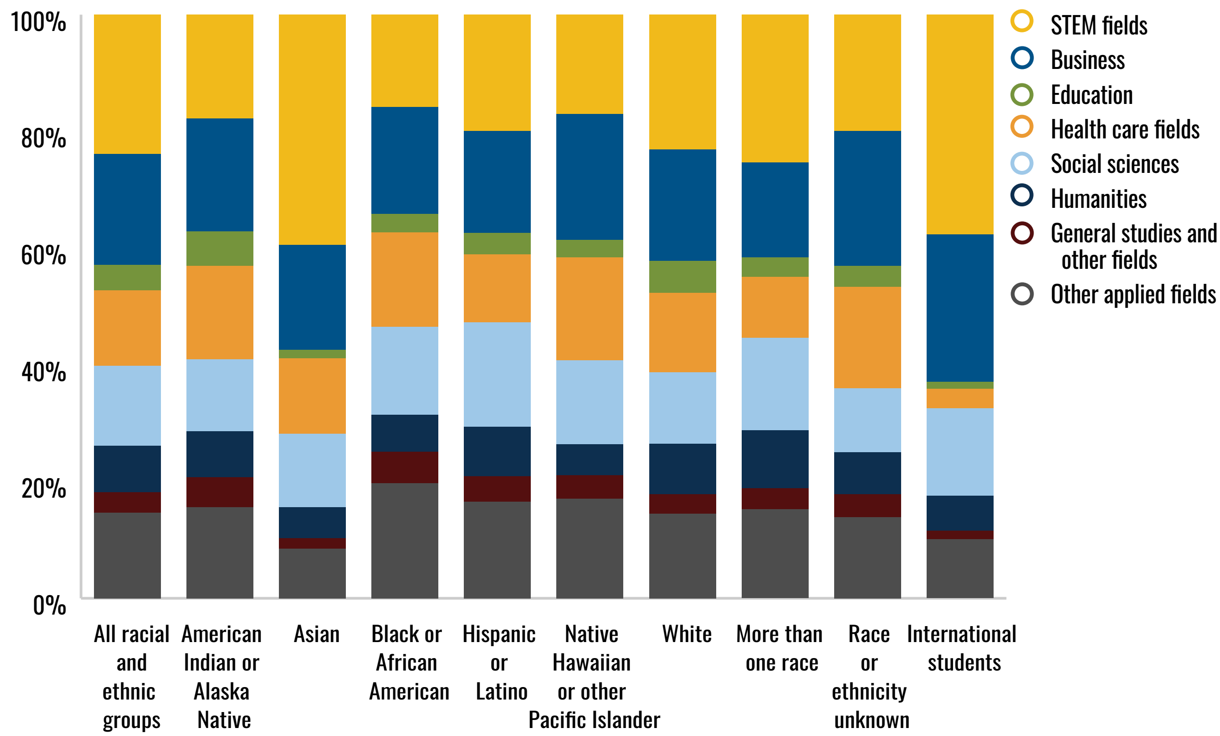
Figure 2. Bachelor's Degrees Across Race and Ethnicity: 2021



Source: Data from U.S. Department of Education, Integrated Postsecondary Education Data System, 2021. Reprinted from Kim et al. 2024, figure 4.24.
Note: Data reflect bachelor's degrees earned at all Title IV–eligible, degree-granting institutions.

Racial and ethnic disparities across all bachelor's degree attainment extend among STEM bachelor's degree attainment as well. In the 2019–20 academic year, fewer than 20 percent of Hispanic or Latino, American Indian or Alaska Native, Native Hawaiian or other Pacific Islander, and Black or African American bachelor's degree recipients studied in STEM fields (Kim et al. 2024). Figure 3 elaborates on the racial and ethnic breakdown across bachelor's degree programs, including those in STEM.

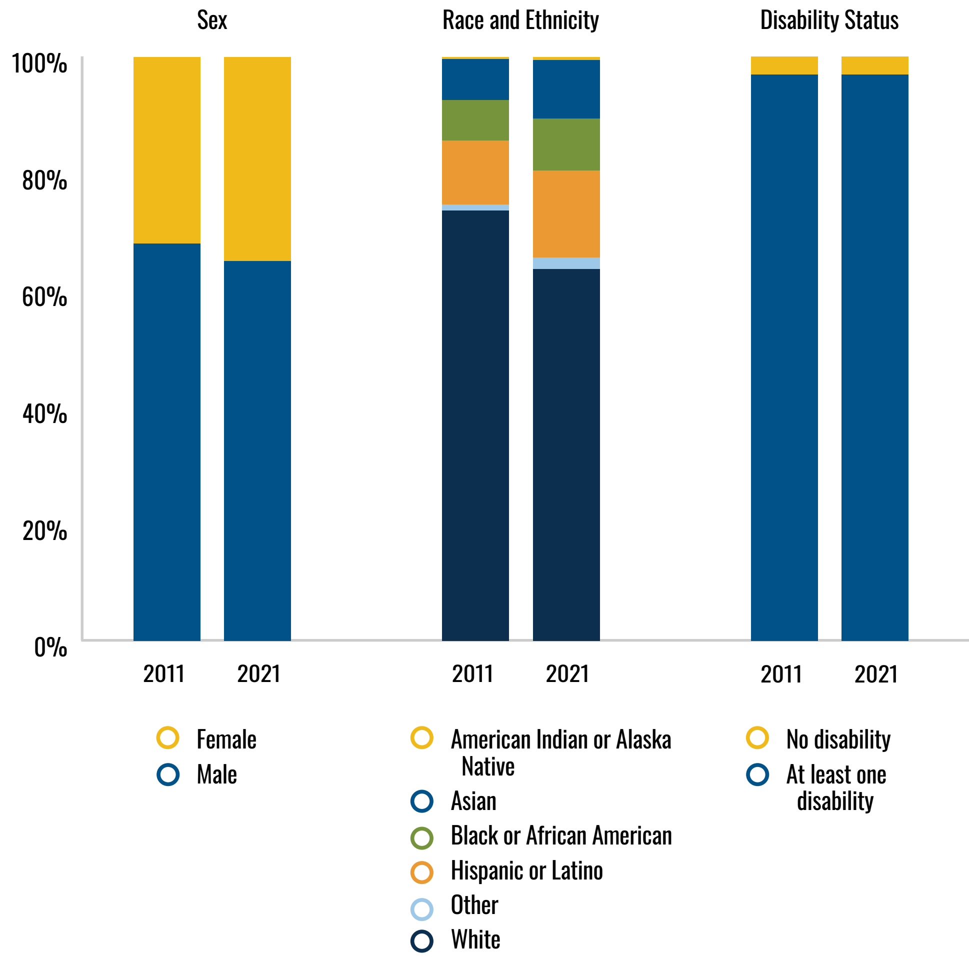
Figure 3. Field of Study for Bachelor's Degree Recipients, by Race and Ethnicity: 2021



Source: Data from U.S. Department of Education, Integrated Postsecondary Education Data System, 2021. Reprinted from Kim et al. 2024, figure 4.27.
Notes: Data reflect bachelor's degrees earned at all Title IV–eligible, degree-granting institutions. | STEM fields includes computer and information sciences, engineering and engineering technology, biological and physical sciences, science technology, math, and agriculture. | General studies and other programs includes fields such as liberal arts and sciences, interpersonal and social skills, personal awareness and self-improvement, and multi- or interdisciplinary studies, among others. | *Other applied fields* in this figure includes personal and consumer services; manufacturing, construction, repair and transportation; military technology and protective services; architecture; communications; public administration and human services; design and applied arts; law and legal studies; library sciences; and theology and religious vocations.

Racial and ethnic minorities earn disproportionately low percentages of bachelor's, master's, and doctoral degrees in STEM fields (Kim et al. 2024). In terms of gender, while women have been attending STEM programs at a larger rate in the last decade, the gender gap in STEM education remains pronounced, especially at the graduate level. Correspondingly, the STEM workforce is still predominantly male, White, and without a disability (although representation has improved over time). Figure 4 uses U.S. Census Bureau data compiled by the National Center for Science and Engineering Statistics to effectively capture the lack of gender, racial and ethnic, and disability status representation in the STEM workforce.

Figure 4. Characteristics of the STEM Workforce Ages 18 to 74: 2011 and 2021



Source: Data from Census Bureau, Current Population Survey Annual Social and Economic Supplements, as compiled and cited in NCSES 2023. Adapted with permission.
Notes: *Other* includes Native Hawaiian and other Pacific Islander and more than one race. | Respondents were able to report more than one disability. | Due to rounding, percentages may not sum to 100.

Job Eligibility and Preparation

In addition to educational requirements, STEM occupations often require some level of professional experience or job training. O*NET OnLine, a free database that provides information about occupations in the U.S., uses job zones to describe the level of preparation needed for occupations (O*NET OnLine, n.d.-b). This approach categorizes occupations to help researchers understand the combination of education, related experience, and job training that an occupation typically requires. O*NET OnLine describes its job zones as:

- Job Zone One: "Little or no preparation needed"
- Job Zone Two: "Some preparation needed"
- Job Zone Three: "Medium preparation needed"
- Job Zone Four: "Considerable preparation needed"
- Job Zone Five: "Extensive preparation needed"

The occupations in table 1 are the 10 occupations with faster-than-average growth, as noted in the aforementioned section. Nine of the 10 occupations fall within job zones four "considerable preparation needed" or five "extensive preparation needed" (O*NET Online, n.d.-a). This categorization translates to about four to seven years of professional experience, in addition to a bachelor's or graduate degree. It is reasonable to expect that many STEM jobs require students and workers to build up their professional experience to be eligible for job openings in high-growth occupations.

Table 1. Job Zones for Select High-Growth STEM Occupations

STEM Occupation	O*NET Job Zone
Data scientists	4
Information security analysts	4
Mathematicians and statisticians	5
Web developers	3
Software developers	4
Software quality assurance analysts and testers	4
Epidemiologists	5
Operations research analysts	5
Computer and information research scientists	5
Actuaries	4

Source: Information from O*NET Online, n.d.-a.

The Rise of Nondegree Credentials

Degree and experience requirements across STEM occupations mean that students face opportunity costs around time and money when assessing whether to pursue STEM careers. Students may be more likely to opt into STEM degree programs which clearly demonstrate that graduates will gain the knowledge, skills, and abilities valued by employers value who are hiring for STEM positions. As higher education institutions confront this reality, many have begun offering nondegree credentials as a way to make students more competitive in today's job market.

While small-scale microcredentials are a fairly nascent concept, they can be a game changer if they are offered for credit, are recognized by the industry, and allow students and educators to complete a STEM curriculum at a different pace than the typical bachelor's or graduate degree program. However, it is currently difficult to capture the universe of nondegree credentials—especially newer innovations, such as digital badges or massive open online courses—as well as their labor market value. Table 2 provides some context as to how many credentials are offered across the U.S.

Table 2. U.S. Postsecondary and Secondary Credentials: 2021

Credential Provider	Number of Credentials Conferred
Postsecondary educational institutions	350,412 degrees and certificates
Massive open online course (MOOC) providers	13,014 course completion certificates, microcredentials, and online degrees from foreign universities
Nonacademic providers	656,505 badges, course completion certificates, licenses, certifications, and apprenticeships
Secondary schools	56,179 diplomas from public and private secondary schools, alternative certificates from secondary schools, and high school equivalency diplomas

Source: Data from Credential Engine 2022.

Many higher education institutions have expanded microcredential offerings, but it will take additional work around articulation agreements and industry validation to ensure that these credentials are valuable for students.

CONSIDERATIONS FOR HIGHER EDUCATION INSTITUTIONS

As higher education institutions strive both individually and together to address the many big questions about how STEM will impact their work, they may consider:

- **Adopting flexible approaches to STEM education delivery.** Flexible STEM education delivery can meet current and prospective students where they are. While different modes of delivery may challenge academic institutions to innovate new ways of structuring STEM bachelor's and graduate curricula, this approach can also help institutions as they respond to the increased pressures of preparing more students for a rapidly evolving industry landscape. Flexible program options will ideally allow more students from diverse backgrounds to access quality education at a more realistic price point, and they may even help to make the case for employer tuition benefits.
- **Engaging in industry collaborations.** Industry collaborations allow higher education institutions to bridge the gap between businesses and higher education, which often use different languages to describe the knowledge, skills, and abilities that are needed for in-demand STEM jobs. Two-way transparency around job requirements and degree programs is essential to ensure alignment, strengthen partnerships, and better support students. By engaging in regional partnerships with industries, institutions can supplement publicly available data with real-time insights into shifting talent needs in order to understand changing skillsets and how they intersect with STEM fields.
- **Designing institutional policies and interventions to diversify STEM fields.** The high barriers to entry across many STEM jobs exacerbate existing workforce disparities, but institutional-level policies and interventions designed for underrepresented students in STEM can help to alleviate the situation. Intentional choices, whether they are systemic or program-specific, can help students to persist in STEM programs and increase degree attainment. Whether these efforts are mentorship, financial support, or other ideas yet to be implemented, they are crucial not only for equity but also for enriching the STEM workforce with diverse perspectives and experiences, ultimately driving innovation and progress. See the companion brief, *STEM Graduate Education: Trends and Existing Interventions to Broaden STEM Graduate Pathways*, for more information.

The evolving landscape of the STEM labor market presents both opportunities and challenges. The demand for skilled professionals in STEM fields is rising, yet the barriers to entry—including extensive educational requirements and systemic racial disparities—remain significant. Institutions that strive to prepare students for these high-growth careers must adapt by offering flexible education delivery, fostering cross-sector collaborations, and designing targeted interventions to diversify the STEM workforce. By addressing these challenges, higher education can play a pivotal role in shaping a more inclusive and competitive STEM landscape.

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