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**Barriers and Opportunities for 2-Year and
4-Year STEM Degrees: Systemic Change
to Support Students' Diverse Pathways**

with funding from:
National Science Foundation
S.D. Bechtel Jr. Foundation
Alfred P. Sloan Foundation

Study Charge

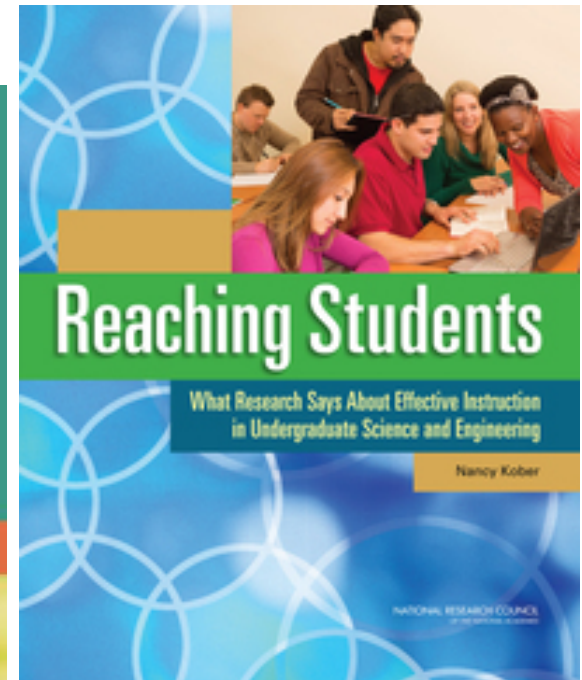
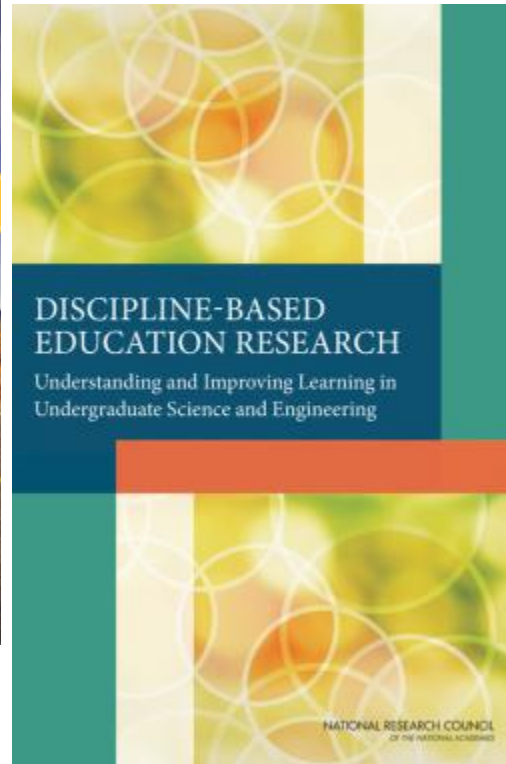
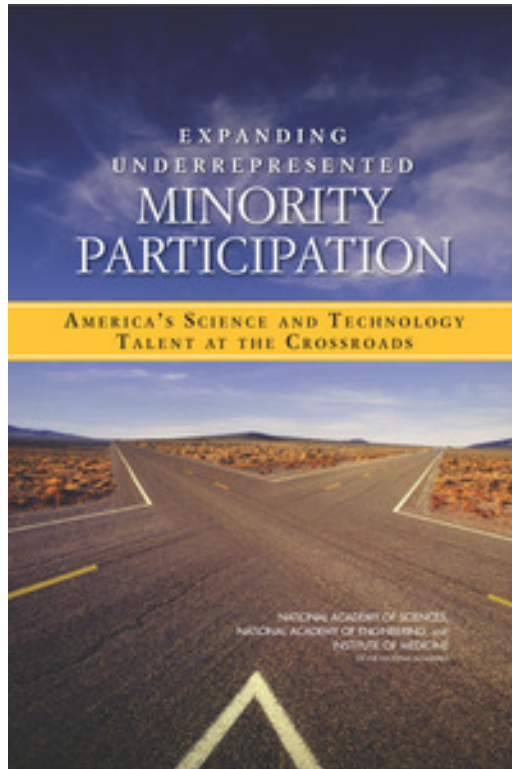
- Review evidence related to barriers facing 2- and 4-year undergraduates who intend to major in STEM and opportunities for overcoming these barriers.
- Provide research-based guidance to inform policies and programs aimed to attract and retain students to complete associate's and bachelor's degrees in STEM disciplines.

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Major Topics (Chapters)

- Multiple STEM Pathways
- Why students enter, stay, or leave – the culture of undergraduate STEM education
- Instructional practices, departmental leadership, and co-curricular supports
- Why students stay or leave – institutional, state, and national policies
- Leading and sustaining change

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Make-up of student body not the same as 25 years ago

Student Characteristics	1987	2012
Aged 25 and Older	37	40
Enrolled in 2-Year Institutions	43	40
Enrolled Part Time	42	50
Minority	20	42
Employed Part-Time	*	40
Employed Full-Time	26	27
Parents	20	26
Single Parent	7	15
Women	54	57

Students more likely to be from minority groups
and be single parents.

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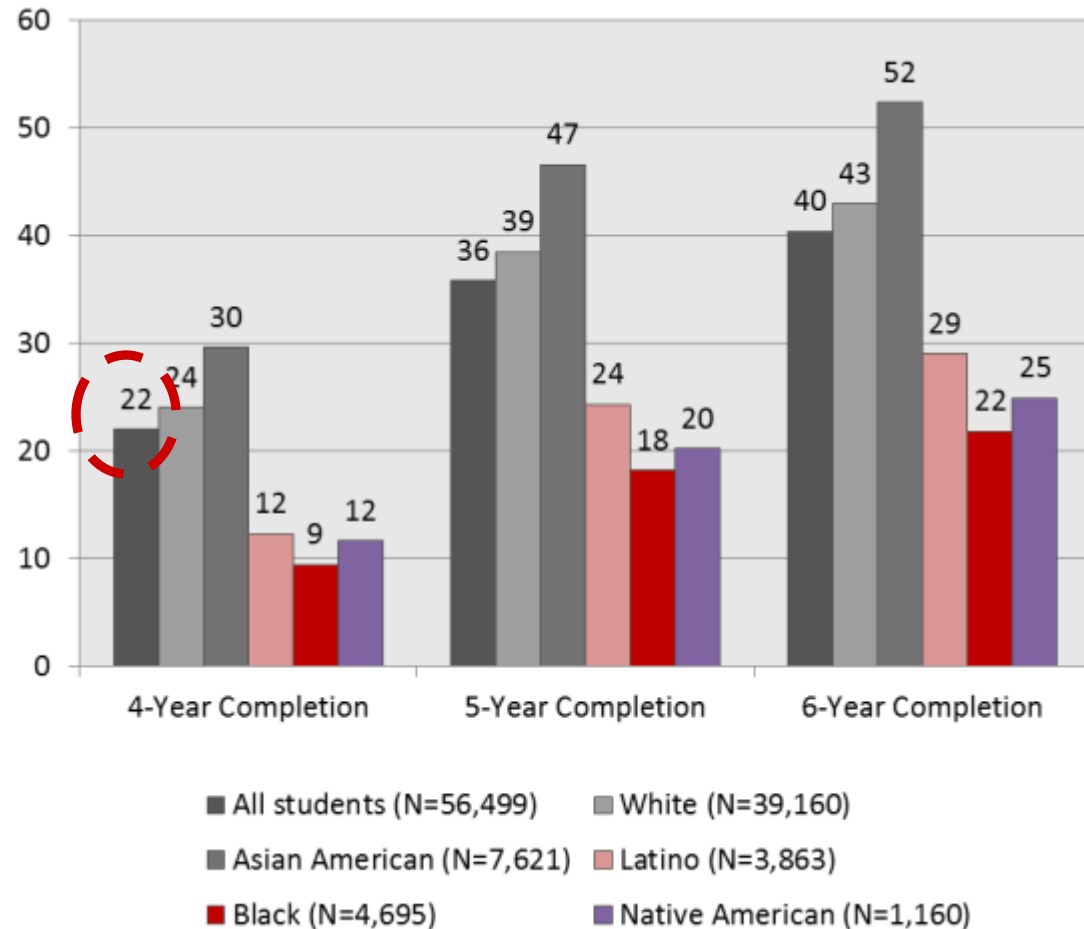
Students taking more complex pathways

- Often transfer among institutions
- Enter & exit at different phases of study
- Concurrently enroll at more than one institution

	2-Year Institutions				4-Year Institutions	
Enrollment Patterns	All STEM	Science & Eng	Tech	Non-STEM	STEM	Non-STEM
Average Enrollment Intensity						
Always Full Time	33	36	32	27	68	65
Always Part Time	13	8	15	22	1	2
Mixed Part Time and Full Time	53	55	53	51	31	33
Constancy of Attendance/Number of Stopouts						
0	47	49	46	50	71	72
1	41	43	39	35	22	21
2+	12	8	15	15	7	7
Institutional Attendance						
Attend Only One Institution	49	33	59	62	75	74
Traditional Transfer	25	41	16	19	NA	NA
Attend Multiple Institutions, Swirling	26	26	25	19	25	26

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Cumulative percentage of 2004 STEM aspirants who completed STEM degrees in 4, 5, and 6 years



“On-time” completion of credential is infrequent: only 22% of students aspiring to 4-year STEM degree achieve their goal.

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Source: Eagan et al., 2014 (Fig 7)

Today's STEM Students

CONCLUSION 1—There is an opportunity to expand and diversify the nation's STEM workforce and STEM-skilled workers in all fields if there is a commitment to appropriately support students through degree completion and provide more opportunities to engage in high-quality STEM learning and experiences.

CONCLUSION 2—STEM aspirants increasingly navigate the undergraduate education system in new and complex ways. It takes students longer for completion of degrees, there are many patterns of student mobility within and across institutions, and the accommodation and management of student enrollment patterns can affect how quickly and even whether a student earns a STEM degree.

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Today's STEM Students

CONCLUSION 3—National, state, and institutional undergraduate data systems often are not structured to gather information needed to understand how well the undergraduate education system and institutions of higher education are serving students.

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Today's STEM Students

RECOMMENDATION 1—Data collection systems should be adjusted to collect information to help departments and institutions better understand the nature of the student populations they serve and the pathways these students take to complete STEM degrees.

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Today's STEM Students

RECOMMENDATION 2—Federal agencies, foundations, and other entities that fund research in undergraduate STEM education should prioritize research to assess whether enrollment mobility in STEM is a response to financial, institutional, individual, or other factors, both individually and collectively, and to improve understanding of how student progress in STEM, in comparison with other disciplines, is affected by enrollment mobility.

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STEM Culture: Students

- Culture of STEM has effect on students' interest, self-concept, sense of connectedness, & persistence.
- New research is needed to understand whether STEM “gateway” courses continue to negatively impact STEM student persistence due to culture of classrooms.

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STEM Culture: Institutional

- Adoption of reformed curriculum and teaching practices remains difficult because of barriers at multiple levels.
- Departments are a critical unit for change.
- Co-curricular supports can provide authentic disciplinary experiences and attend to social-relational aspects of learning influencing student outcomes.

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Institutional Support for Students

CONCLUSION 4—Better alignment of STEM programs, instructional practices, and student supports is needed in institutions to meet the needs of the populations they serve. Programming and policies that address the climate of STEM departments and classrooms, the availability of instructional supports and authentic STEM experiences, and the implementation of effective teaching practices together can help students overcome key barriers to earning a STEM degree, including the time to degree and the price of a STEM degree.

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Institutional Support for Students

RECOMMENDATION 3—Federal agencies, foundations, and other entities that support research in undergraduate STEM education should support studies with multiple methodologies and approaches to better understand the effectiveness of various co-curricular programs.

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Institutional Support for Students

RECOMMENDATION 4—Institutions, states, and federal policy makers should better align educational policies with the range of education goals of students enrolled in 2- and 4-year institutions. Policies should account for the fact that many students take more than 6 years to graduate and should reward 2- and 4-year institutions for their contributions to the educational success of students they serve, which includes not only those who graduate.

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Institutional Support for Students

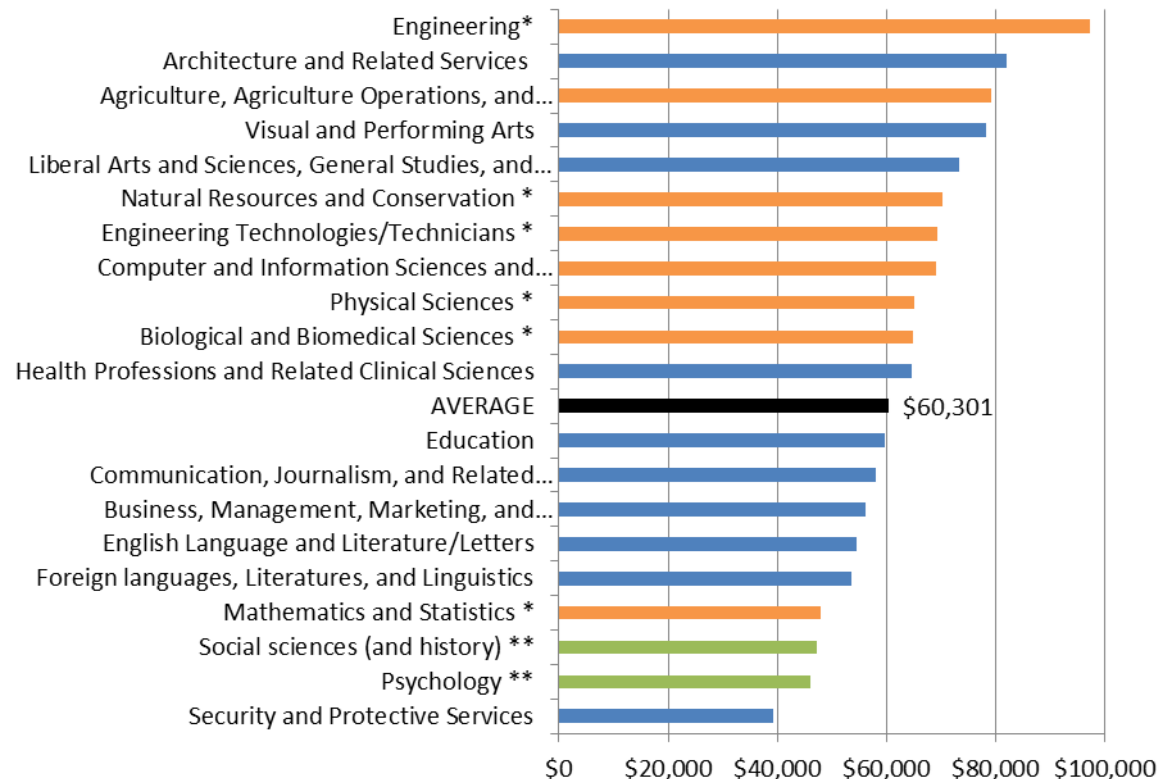
RECOMMENDATION 5—Institutions of higher education, disciplinary societies, foundations, and federal agencies that fund undergraduate education should focus their efforts in a coordinated manner on critical issues to support STEM strategies, programs, and policies that can improve STEM instruction.

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Why Students Stay or Leave: Debt

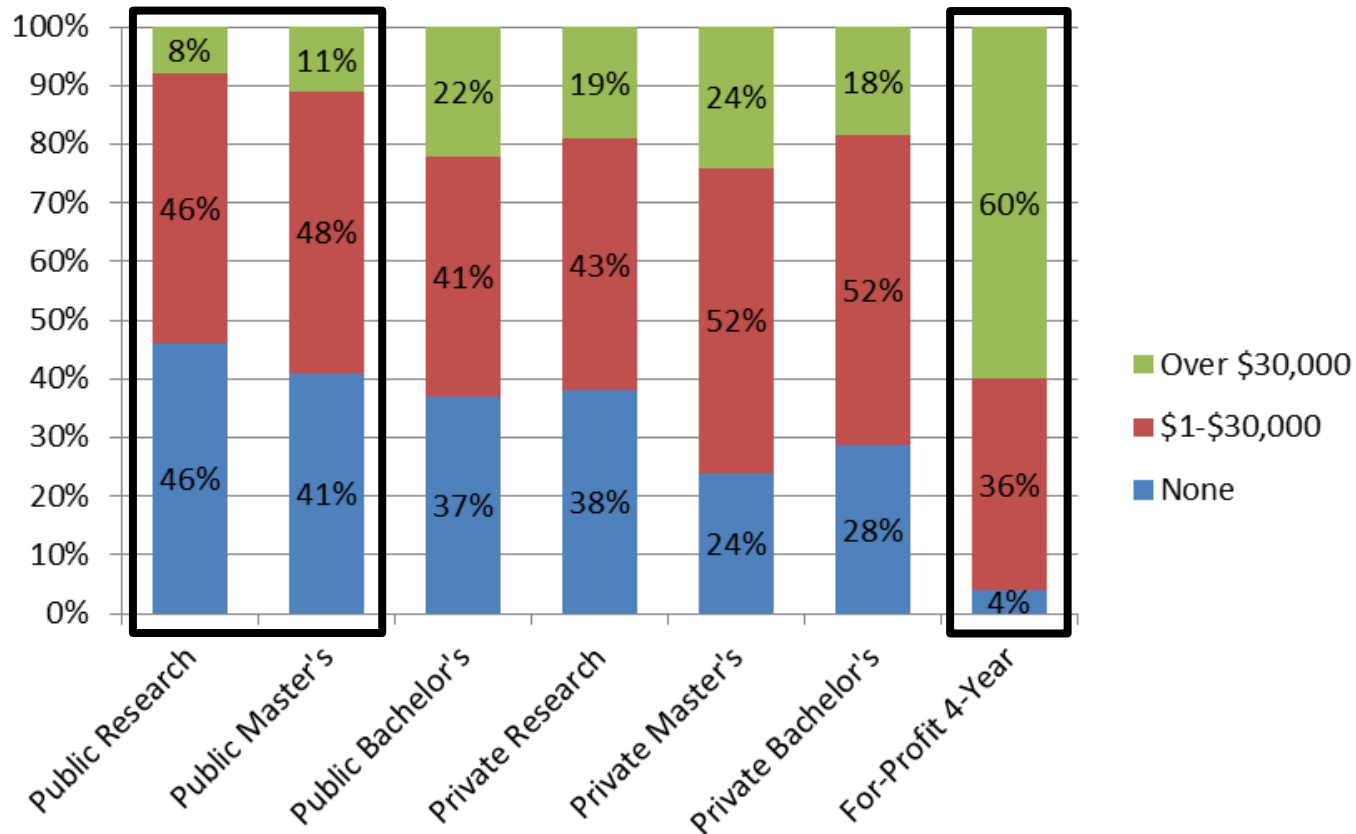
On average, price students pay for STEM degree is higher than price of non-STEM degree.



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STEM degrees in orange.

Percentage of all undergraduate STEM students with various debt levels by type of institution

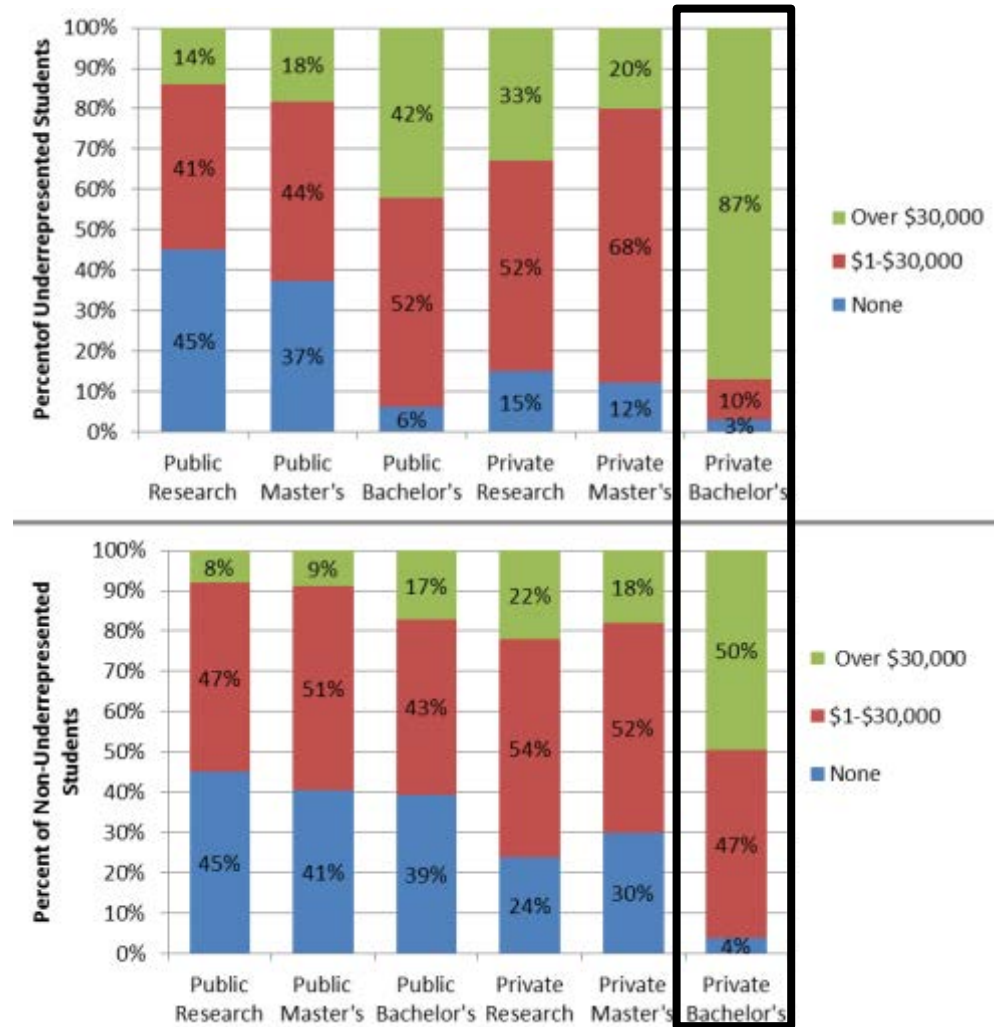


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Source: Kirshtein, 2013c (p1)

Undergraduate debt in STEM by minority status

- Underrepresented students graduate with debt > \$30,000 *especially* at Private Bachelor's
- In all private institutions, non-underrepresented students more likely to be debt free



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Source: Kirshtein, 2013c (p2)

Institutional Support for Students

RECOMMENDATION 6—Accrediting agencies, states, and institutions should take steps to support increased alignment of policies that can improve the transfer process for students.

RECOMMENDATION 7—State and federal agencies and accrediting bodies together should explore the efficacy and tradeoffs of different articulation agreements and transfer policies.

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Systemic and Sustainable Change in STEM Education

CONCLUSION 5—There is no single approach that will improve the educational outcomes of all STEM aspirants. The nature of U.S. undergraduate STEM education will require a series of interconnected and evidence-based approaches to create systemic organizational change for student success.

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Systemic and Sustainable Change in STEM Education

CONCLUSION 6—Improving undergraduate STEM education for all students will require a more systemic approach to change that includes use of evidence to support institutional decisions, learning communities and faculty development networks, and partnerships across the education system.

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Systemic and Sustainable Change in STEM Education

RECOMMENDATION 8—Institutions should consider how expanded and improved co-curricular supports for STEM students can be informed by and integrated into work on more systemic reforms in undergraduate STEM education to more equitably serve their student populations.

RECOMMENDATION 9—Disciplinary departments, institutions, university associations, disciplinary societies, federal agencies, and accrediting bodies should work together to support systemic and long-lasting changes to undergraduate STEM education.

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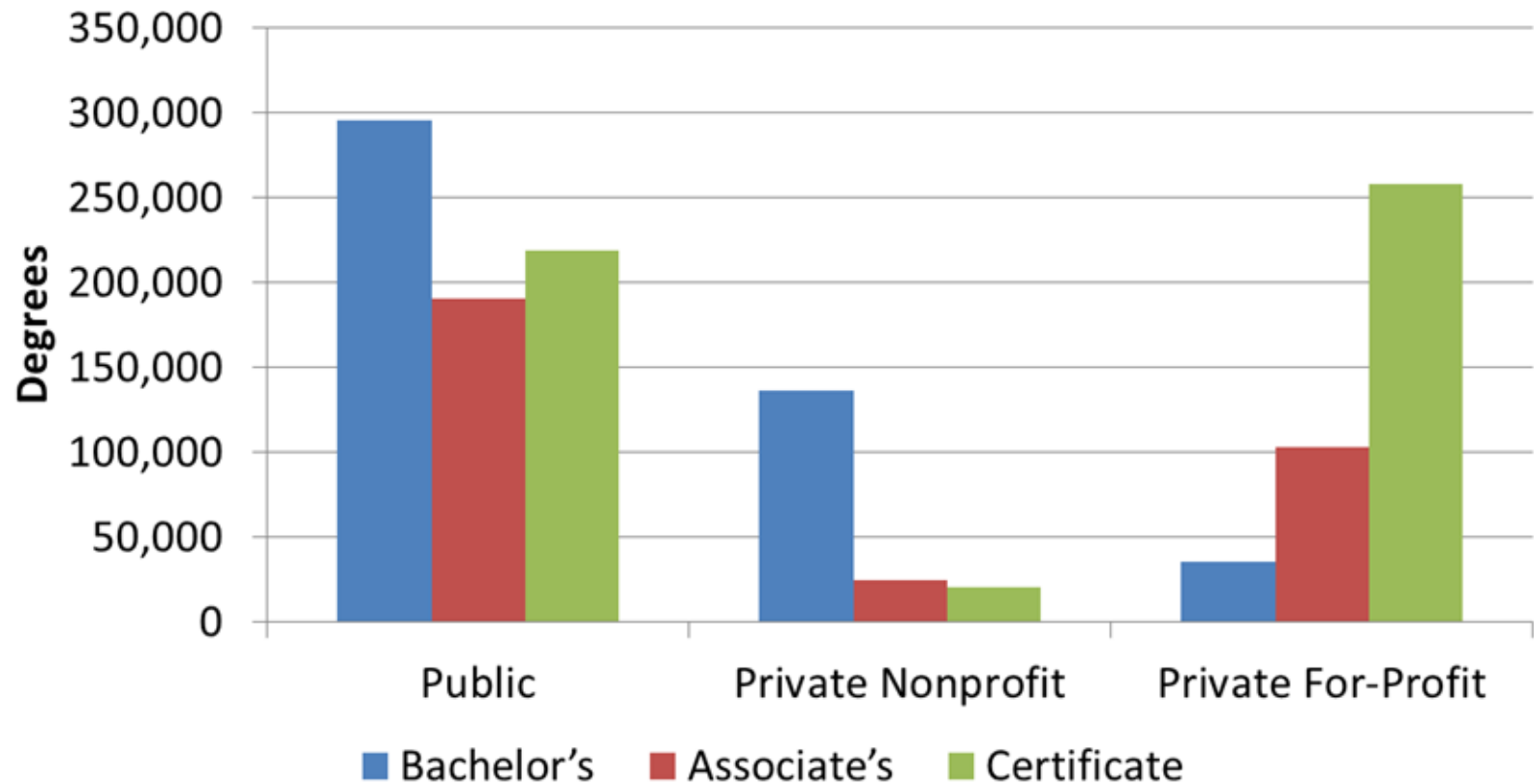
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Extra Slides

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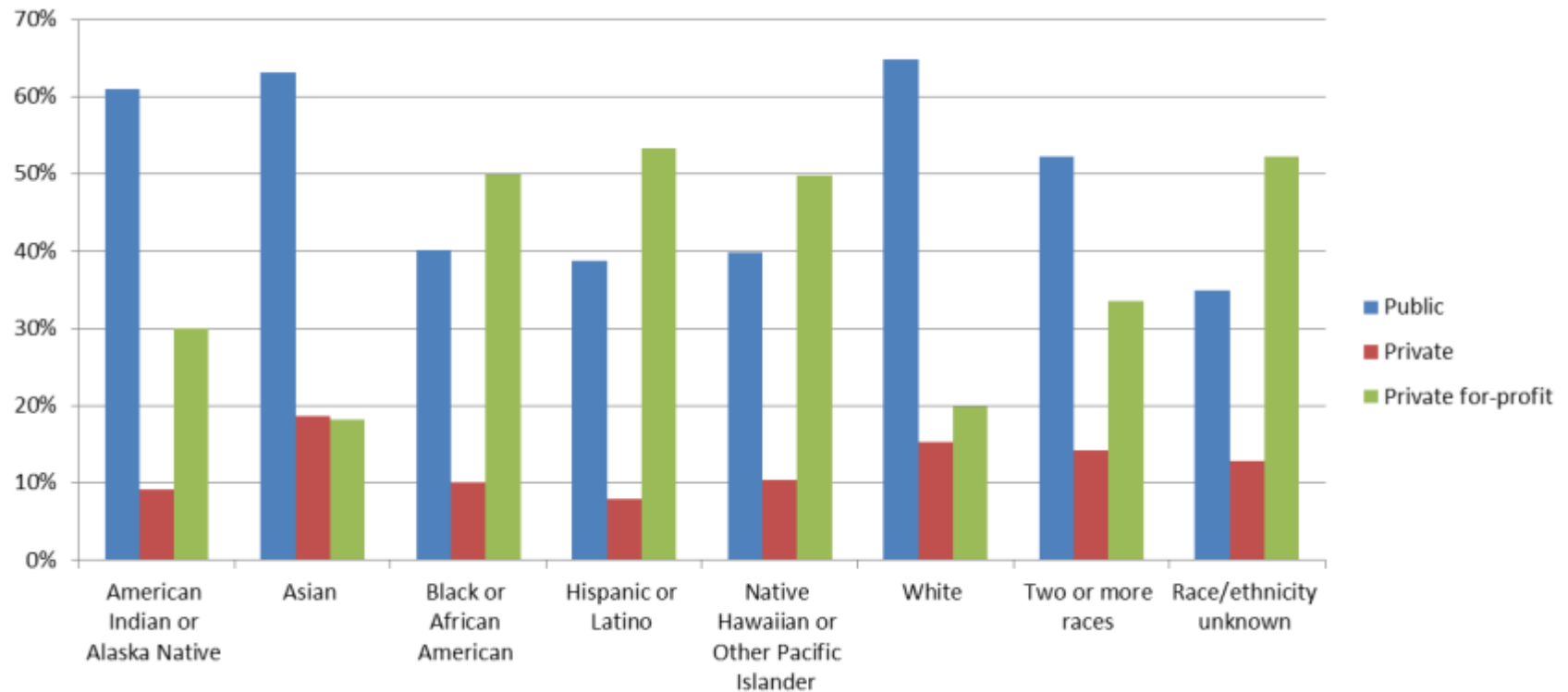
Degrees awarded in 2012 in STEM fields in Public, Private Nonprofit, and Private For-Profit Institutions



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Source: Kinser, 2014

STEM degrees in 2012 from Public, Private Nonprofit, and Private For-Profit, by students' race and ethnicity



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Source: Kinser, 2014