STEM Investment Council

February 24th, 2014
8:30 – 2:00 p.m.
CH2M HILL Alumni Center, Oregon State University
725 SW 26th Street Corvallis, OR, 97331
Streaming live HERE

JIM PIRO, Chair

AUBREY CLARK

HERB FRICKE

JESSICA GOMEZ

LISA GRAHAM

DWAYNE JOHNSON

ERIC MESLOW

THOMPSON MORRISON

FRED ZIARI

Staff:
MARK LEWIS

AGENDA

1. **Chair Welcome & Introductions**

2. **Director Updates**
   Mark Lewis, OEIB Director of STEM

3. **STEM Workforce Demand**
   Brenda Turner, Employment Department

4. **STEM degrees and Certificates**
   a) **Oregon Alliance of Independent Colleges and Universities**
      Brent Wilder, Vice- President
      Michael Chambers, Director of Research and Grants
   b) **Oregon University System**
      Vern Mayfield, Institutional Research Systems Analyst
      Marcia Fischer, Director Student to Workforce Initiatives
   c) **Community Colleges and Workforce Development**
      Elizabeth Cox-Brand, Research and Communication Director, Department of Community Colleges and Workforce Development

5. **Pre-College, "Developmental" Math**
   Michelle Hodara, Senior Researcher, Education NW

6. **Outcomes-based Post-secondary Funding Formula**
   Tim Nesbitt, Chair, Higher Education Coordinating Committee

7. **Supporting students of color in post-secondary STEM**
   Ellen Momsen, Director, Women and Minorities in Engineering, OSU
   Marleigh Perez, Program Coordinator, Louis Stokes Alliance for Minority Participation, OSU

8. **Industry-Education Engagement**
   a) Engineering and Technology Industry Council: Laura McKinney, Executive Director & Asst. Vice-Chancellor for Industry Partnerships, OSU
   b) Promising approaches: Marcia Fischer, Director, Student to Workforce

Initiatives, OSU

9. Public Comment

10. Adjourn

All meetings of the Oregon Education Investment Board are open to the public and will conform to Oregon public meetings laws. The upcoming meeting schedule and materials from past meetings are posted online. A request for an interpreter for the hearing impaired or for accommodations for people with disabilities should be made to Seth Allen at 503-378-8213 or by email at Seth.Allen@das.state.or.us. Requests for accommodation should be made at least 48 hours in advance.

STEM Workforce Demand

STEM Investment Council

February 24, 2014

State of Oregon
Employment Department

Employment estimates and projections for over 700 occupations

* Based on employer tax records, employer surveys
* Updated every two years
* 2012 employment and projections for 2022
* 700+ occupations
  * 127 defined as STEM in this presentation

* Data presented today are *not final*
* Official data release is March 12

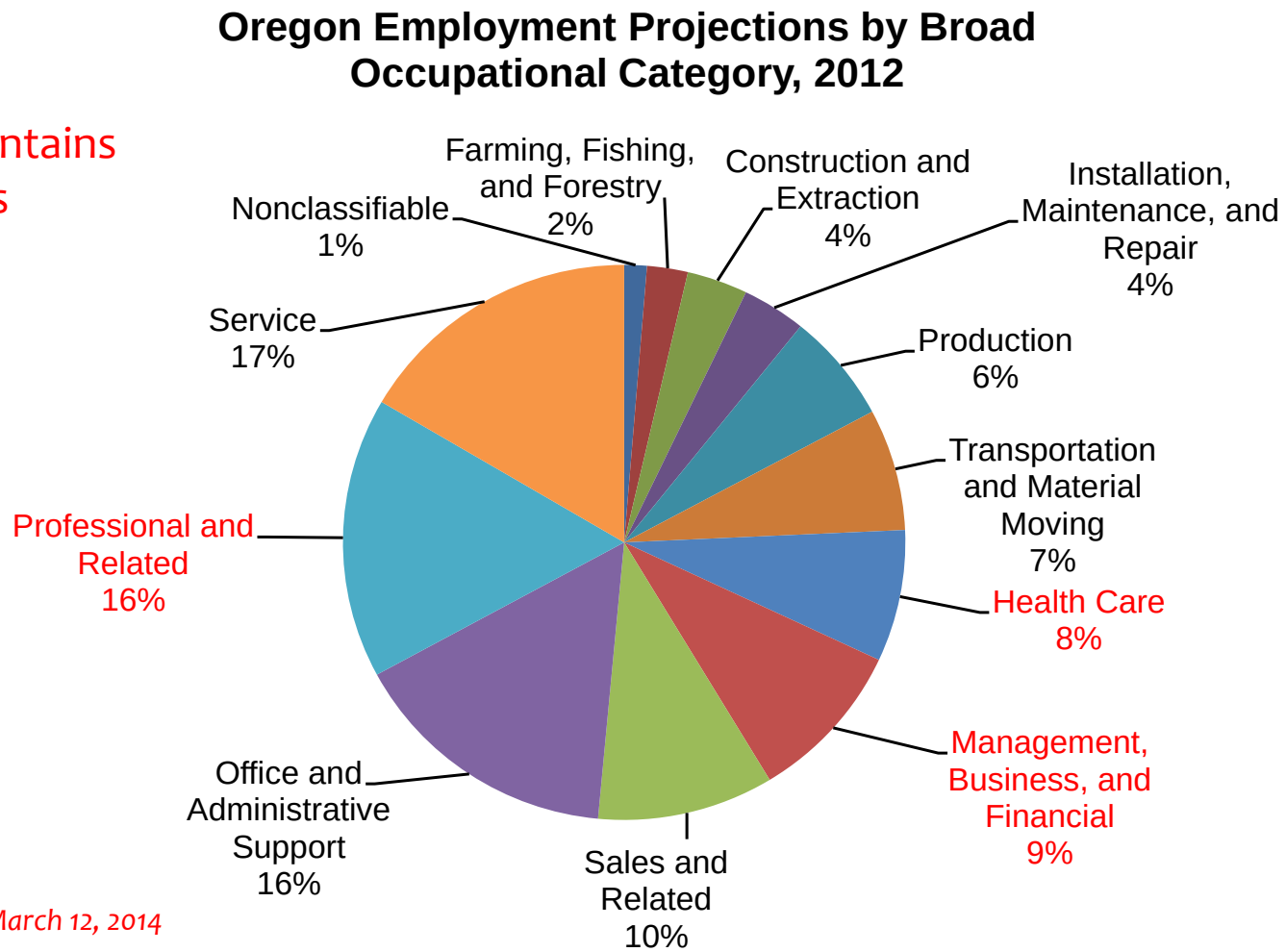
State of Oregon
Employment Department

For the purpose of today's presentation, STEM is defined as:

* Computer occupations
* Engineers and engineering technicians
* Health practitioners
* Life scientists and technicians
* Physical scientists and technicians
* Math occupations
* Architects, surveyors, cartographers and related technicians

Oregon's total employment spread across all sectors

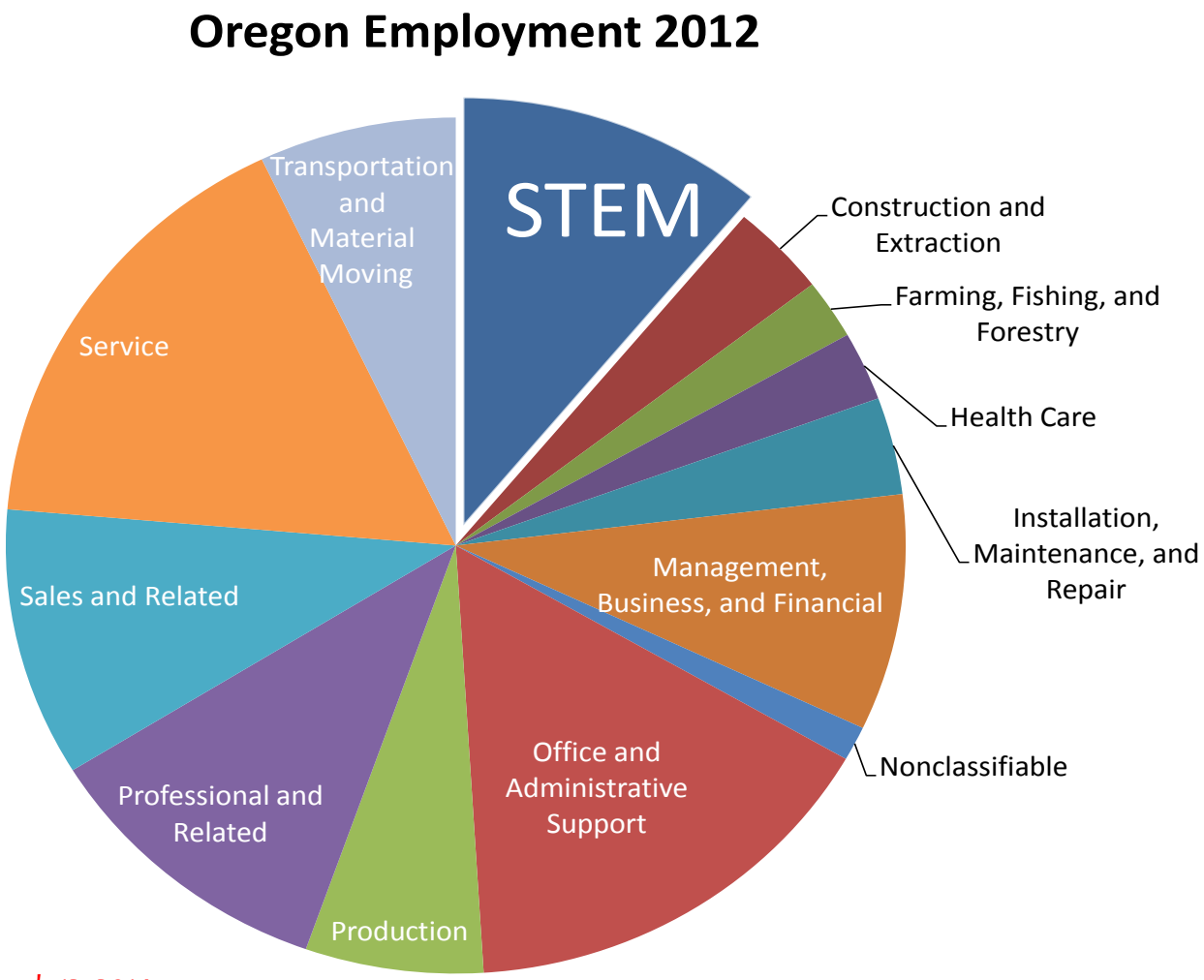
Red indicated sector contains STEM occupations



Oregon Employment	
2012	1,683,320
2022	1,941,712

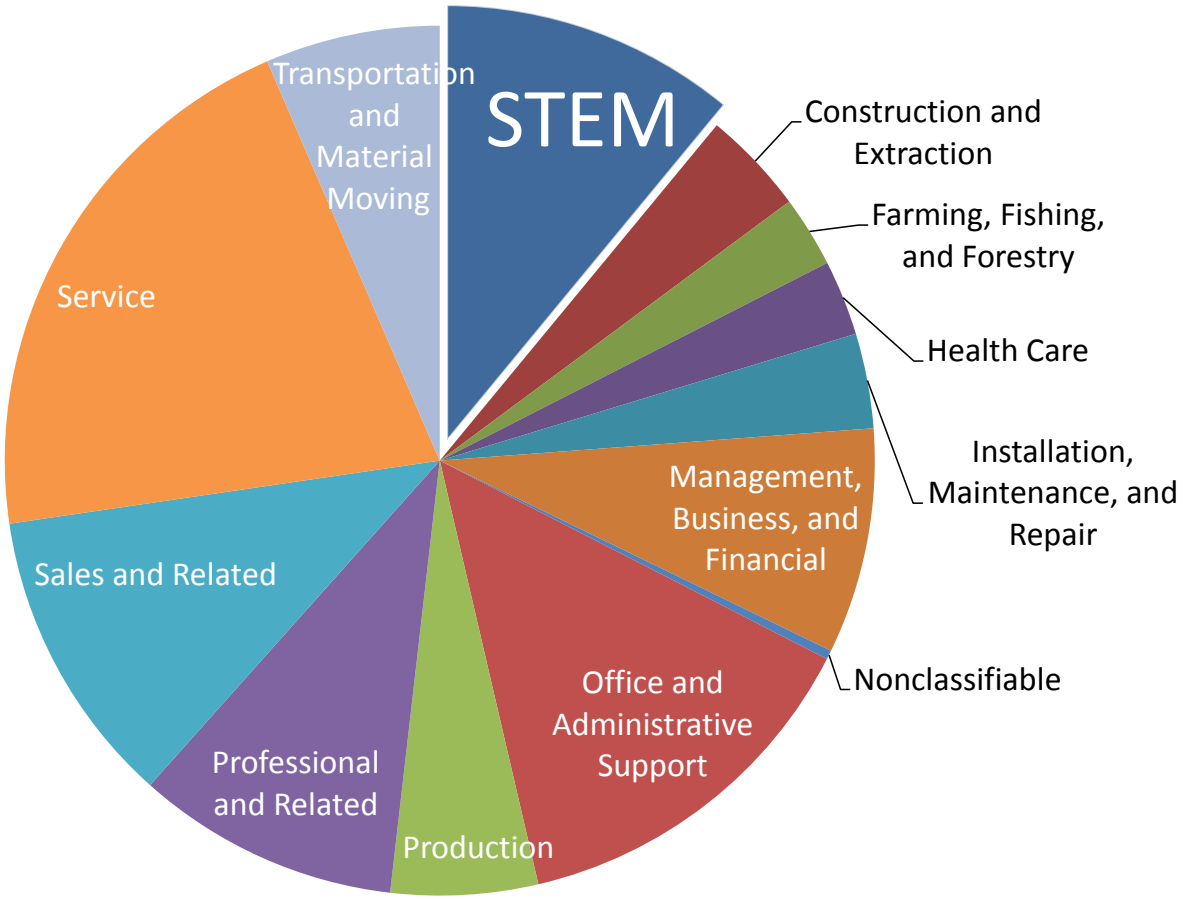
Preliminary data, final data release March 12, 2014

More than one in ten jobs is a STEM job…



Preliminary data, final data release March 12, 2014

… and the same story holds for job openings

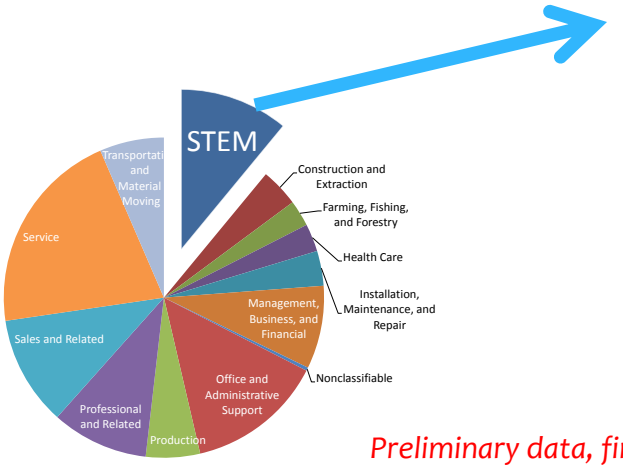


Preliminary data, final data release March 12, 2014

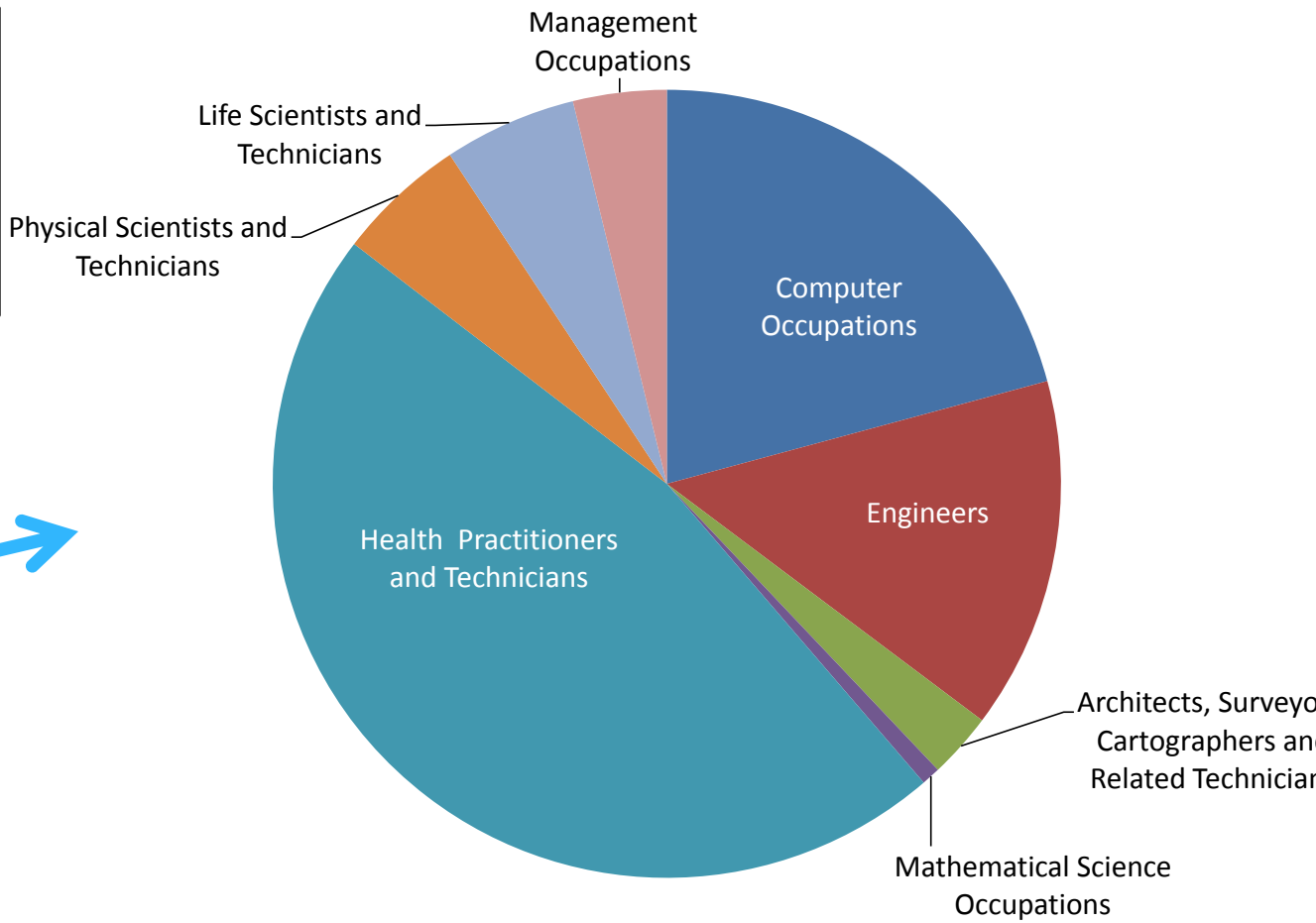
Over 30,000 RNs help push health care into first place among STEM jobs

2012 STEM Employment
186,290

2022 STEM Employment
219,337



Job Openings in STEM Occupations, 2012-2022



Preliminary data, final data release March 12, 2014

Ratio of STEM jobs in Oregon projected to increase slightly

	2012 Employment	2022 Employment	Percent Change	Growth Openings	Replacement Openings	Total Openings
All Occupations	1,683,320	1,941,712	15.4%	260,771	391,924	652,695
STEM Occupations	186,290	219,337	17.7%	33,047	38,659	71,706
Percent STEM	11.1%	11.3%		12.7%	9.9%	11.0%

State of Oregon
Employment Department

Preliminary data, final data release March 12, 2014

Growth projected in all STEM areas

	2012 Employment	2022 Employment	Employment Change	Percent Change
Health Practitioners and Technicians	85,268	101,428	16,160	19.0%
Computer Occupations	40,529	49,041	8,512	21.0%
Engineers and Engineering Technicians	28,457	32,051	3,594	12.6%
Management Occupations	7,637	8,966	1,329	17.4%
Life Scientists and Technicians	9,092	10,367	1,275	14.0%
Physical Scientists and Technicians	8,111	9,211	1,100	13.6%
Architects, Surveyors, Cartographers and Techs	6,134	6,951	817	13.3%
Mathematical Science Occupations	1,062	1,322	260	24.5%
	186,290	219,337	33,047	17.7%

State of Oregon
Employment Department

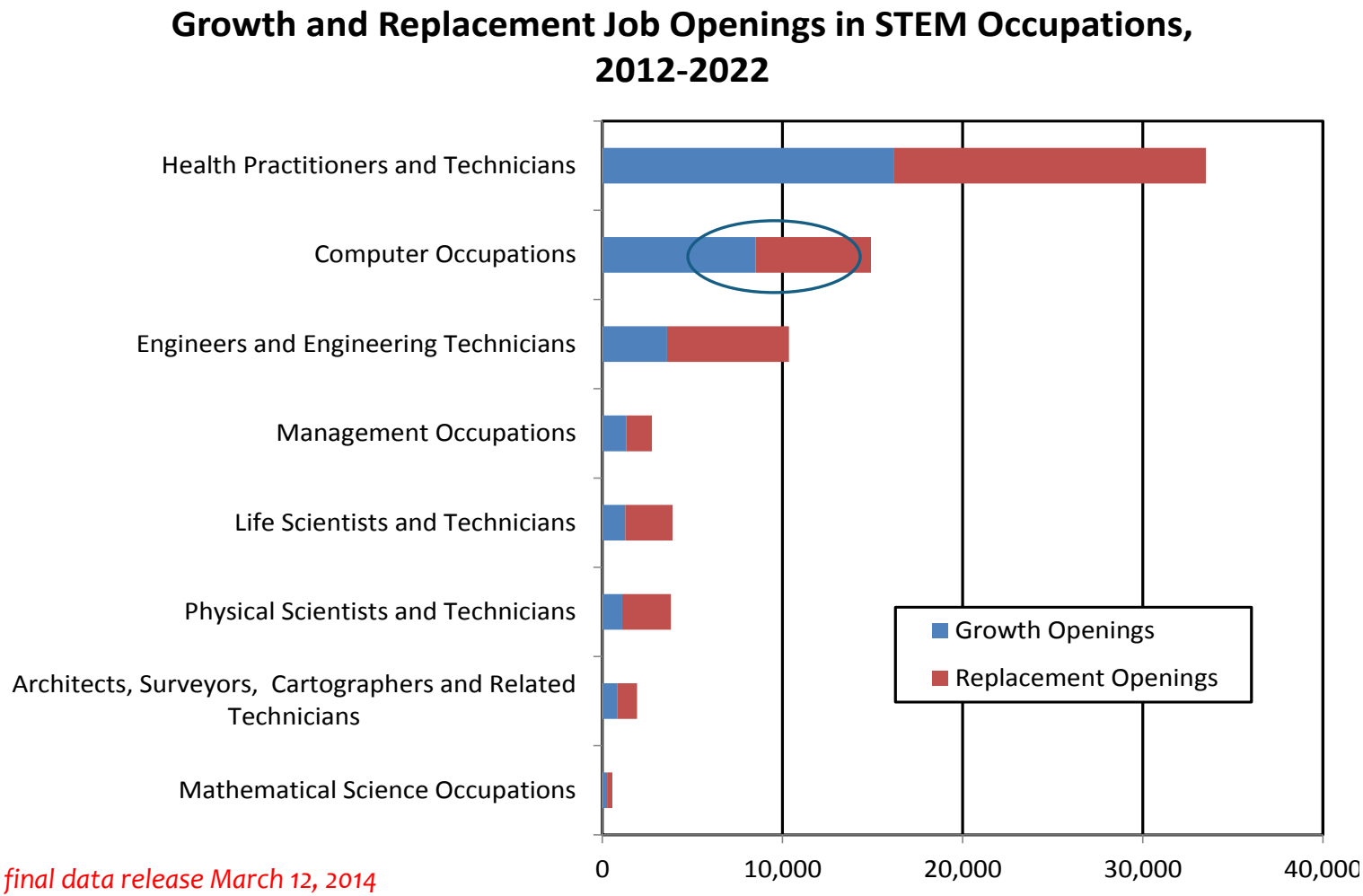
Preliminary data, final data release March 12, 2014

Top demand occupations dominated by health care and computer occupations

	2012 Employment	2022 Employment	Percent Change	Total Openings
Registered Nurses	30,677	35,636	16.2%	10,907
Physicians and Surgeons	8,185	9,862	20.5%	3,726
Computer User Support Specialists	7,779	9,647	24.0%	3,090
Software Developers, Applications	7,563	9,610	27.1%	3,017
Computer Systems Analysts	4,794	6,110	27.5%	2,069
Computer Occupations, All Other	5,003	5,911	18.2%	1,694
Network and Computer Systems Administrators	4,670	5,474	17.2%	1,538
Civil Engineers	3,382	4,049	19.7%	1,489
Dental Hygienists	3,356	3,975	18.4%	1,478
Pharmacists	3,506	4,144	18.2%	1,475
Medical Records and Health Information Technicians	3,014	3,630	20.4%	1,413
Industrial Engineers	3,447	3,832	11.2%	1,393
Computer and Information Systems Managers	3,883	4,682	20.6%	1,338
Pharmacy Technicians	4,699	5,550	18.1%	1,316
Computer Hardware Engineers	3,445	3,993	15.9%	1,291
Mechanical Engineers	2,610	3,006	15.2%	1,287
Physical Therapists	2,362	3,025	28.1%	1,244
Licensed Practical and Licensed Vocational Nurses	2,705	3,242	19.9%	1,197
Biological Technicians	2,626	3,002	14.3%	1,163
Computer Programmers	2,999	3,344	11.5%	1,128

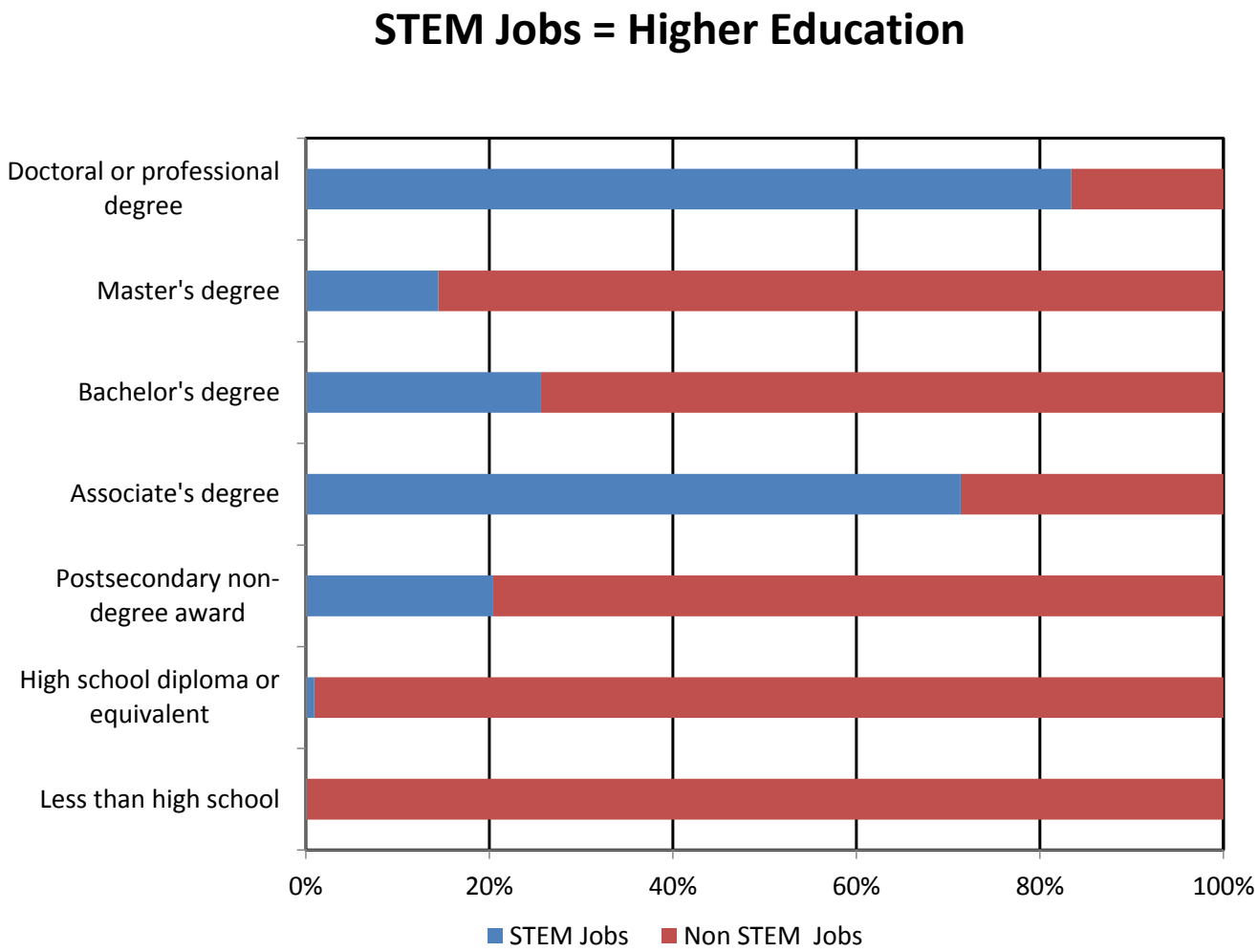
Preliminary data, final data release March 12, 2014

Need to replace workers outweighs growth openings in most areas



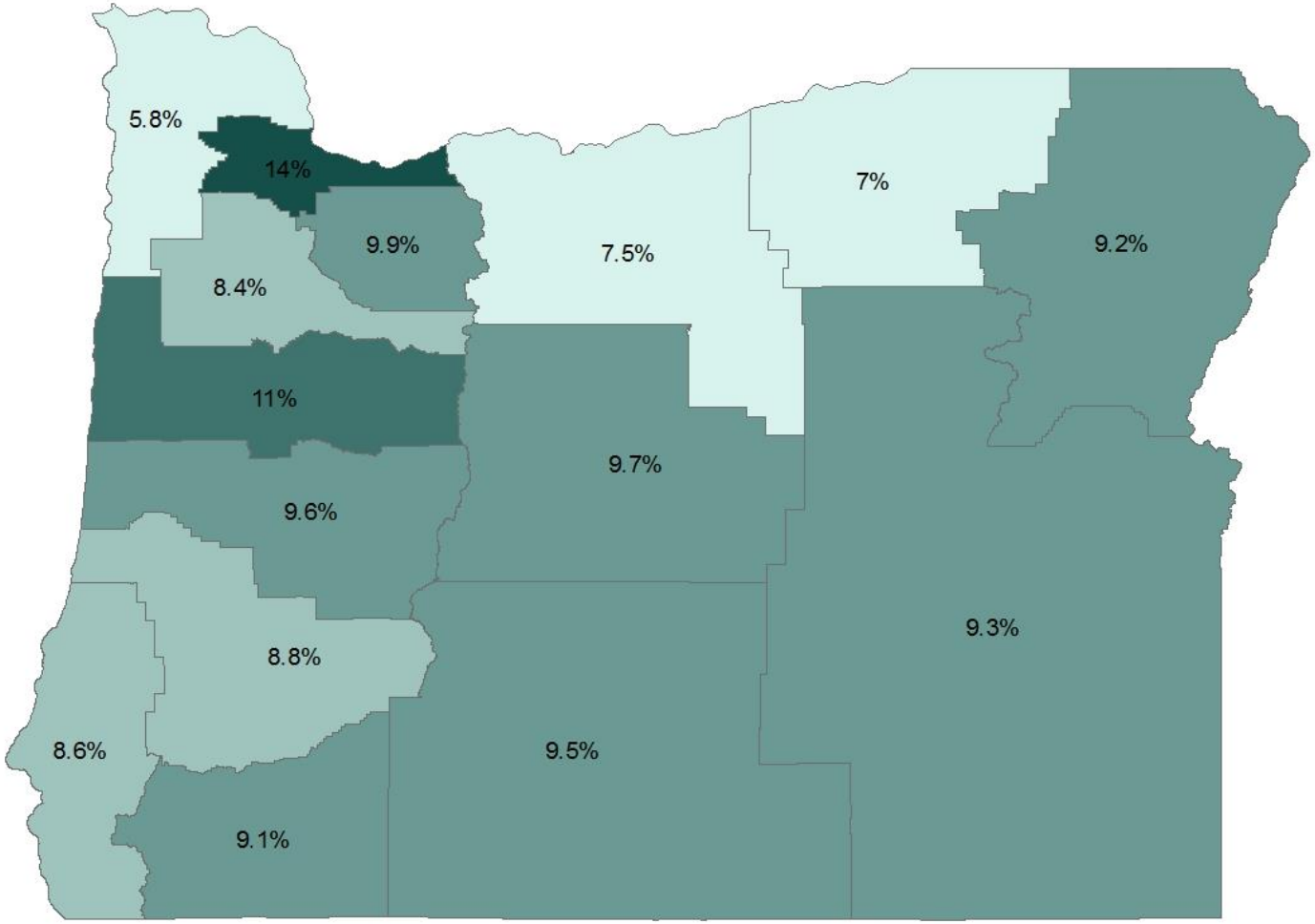
Preliminary data, final data release March 12, 2014

STEM Jobs = Higher Education



Preliminary data, final data release March 12, 2014

STEM jobs found in rural and urban areas – driven by health care



Preliminary data, final data release March 12, 2014

Prioritizing training goes beyond supply and demand equation

* Developed model to inform decision making regarding public investments in training to meet workforce needs
* Ranked all 700+ occupations on 10 factors including
  * Total openings
  * Relative occupational need
  * Average wage
  * Number of vacancies
  * Duration of vacancies
  * Geographic diversity of need
  * Impact of immigration
  * Impact of supply / pipeline shortages
  * Business affirmation of the workforce need
  * Links to "key" industries
* Where do STEM jobs fit in?

State of Oregon
Employment Department

STEM occupations rank high on prioritization list

	Total Openings 2010-2020	Final Score	Final Rank
Medical and Clinical Laboratory Technologists	1,087	30	1
Physical Therapists	1,077	29	2
Registered Nurses	14,499	26	4
Physicians and Surgeons	3,711	25	5
Occupational Therapists	475	24	9
Computer Programmers	1,575	23	14
Pharmacists	1,537	23	14
Computer Support Specialists	3,762	22	25
Network and Computer Systems Administrators	1,272	22	25
Medical and Clinical Laboratory Technicians	616	22	25
Computer and Information Systems Managers	1,256	21	38
Natural Sciences Managers	650	21	38
Engineering Managers	932	20	47
Computer Systems Analysts	1,641	20	47
Network Systems and Data Communications Analysts	947	20	47
Statisticians	409	20	47
Engineers, All Other	852	20	47
Life, Physical, and Social Science Technicians, All Other	746	20	47
Dentists, General	580	20	47
Radiologic, CAT, and MRI Technologists and Technicians	1,098	20	47

Questions?

Brenda Turner, Occupational Economist
Workforce and Economic Research
Oregon Employment Department
Brenda.P.Turner@state.or.us
503-947-1233

Get the latest workforce and economic research news:
OregonEmployment.Blogspot.com
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State of Oregon
Employment Department

The Alliance

Oregon Alliance of Independent Colleges & Universities

Working Together to Make a Difference

Oregon Education Investment Board
STEM Investment Council
February 24, 2014

Brent Wilder, Vice President
brent@oaicu.org

About the Alliance

Mission

The Alliance's activities find the intersection between the needs and expertise of the sector's institutions, corporate and foundation interests, and the public good.

- corporate/foundation interests
- broader societal needs/public good
- private colleges/universities expertise and needs

Primary Functions

- Support and expand strategic partnerships with businesses, foundations, and public sector agencies and institutions;
- Coordinate advocacy for private, not-for-profit higher education on matters related to public interest and public policy;
- Provide and create structures to encourage inter-institutional collaboration;
- Coordinate services to member institutions that achieve economies of scale and enhancement of programs;
- Generate restricted gift and enterprise income to support The Alliance and its members.

The Alliance

Oregon Alliance of Independent Colleges & Universities

Working Together to Make a Difference

Concordia University
Corban University
George Fox University
Lewis & Clark College
Linfield College
Marylhurst University
Multnomah University
National College of Natural Medicine
Northwest Christian University
Oregon College of Art and Craft
Oregon College of Oriental Medicine
Pacific Northwest College of Art
Pacific University
Reed College
University of Portland
University of Western States
Warner Pacific College
Western Seminary
Willamette University

The Alliance

Oregon Alliance of Independent Colleges & Universities

Working Together to Make a Difference

50% of Alliance students come from Oregon.
50% of Alliance alumni live in Oregon.

Over 123,000 Alliance alumni are known to be living in Oregon.

The Alliance
Oregon Alliance of Independent Colleges & Universities
Working Together to Make a Difference

57% of Alliance undergraduates graduate in 4 years.
67% graduate in 6 years.

57% of Alliance minority undergraduates graduate in 4 years.
64% graduate in 6 years.

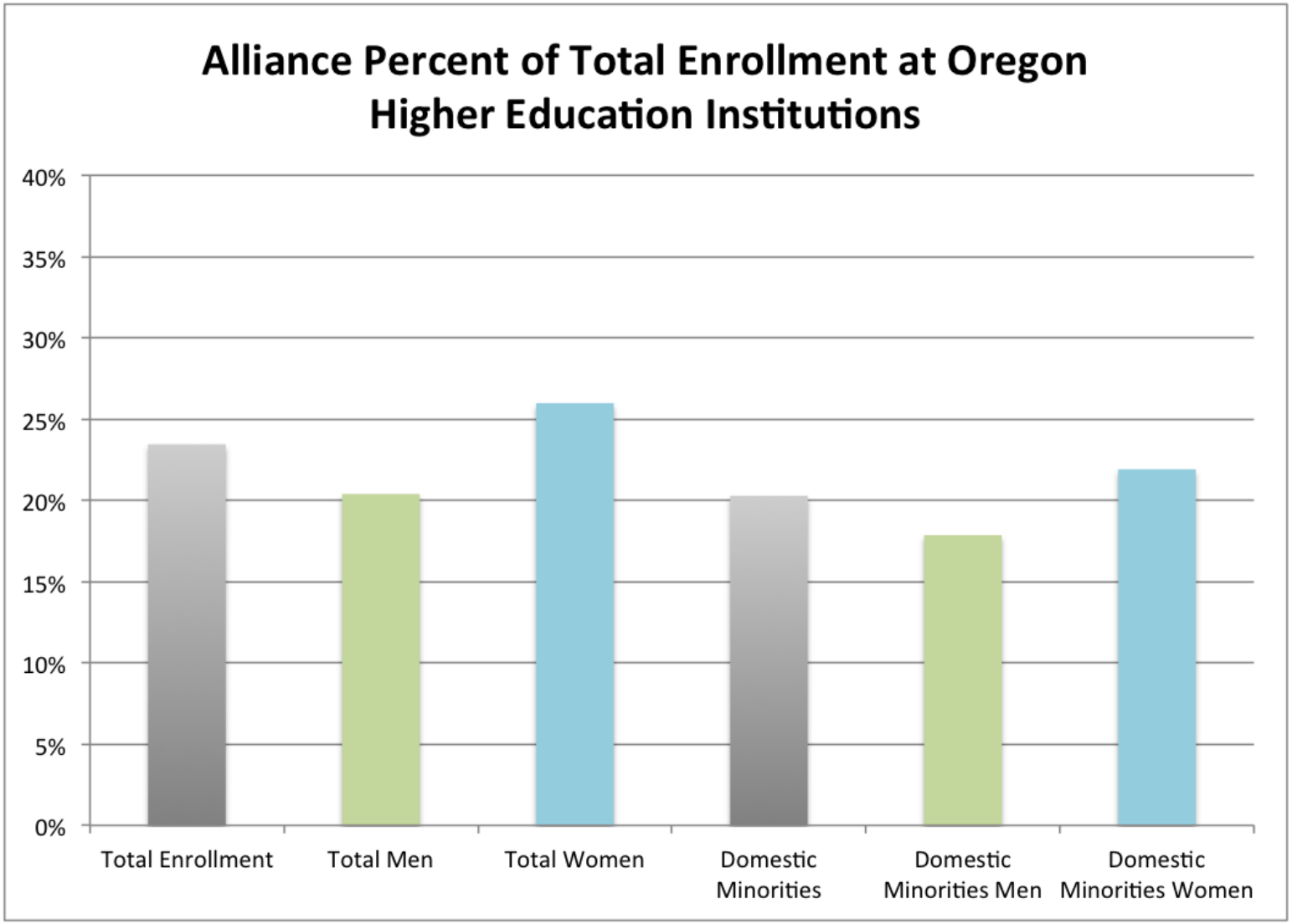
The Alliance

Oregon Alliance of Independent Colleges & Universities

Working Together to Make a Difference

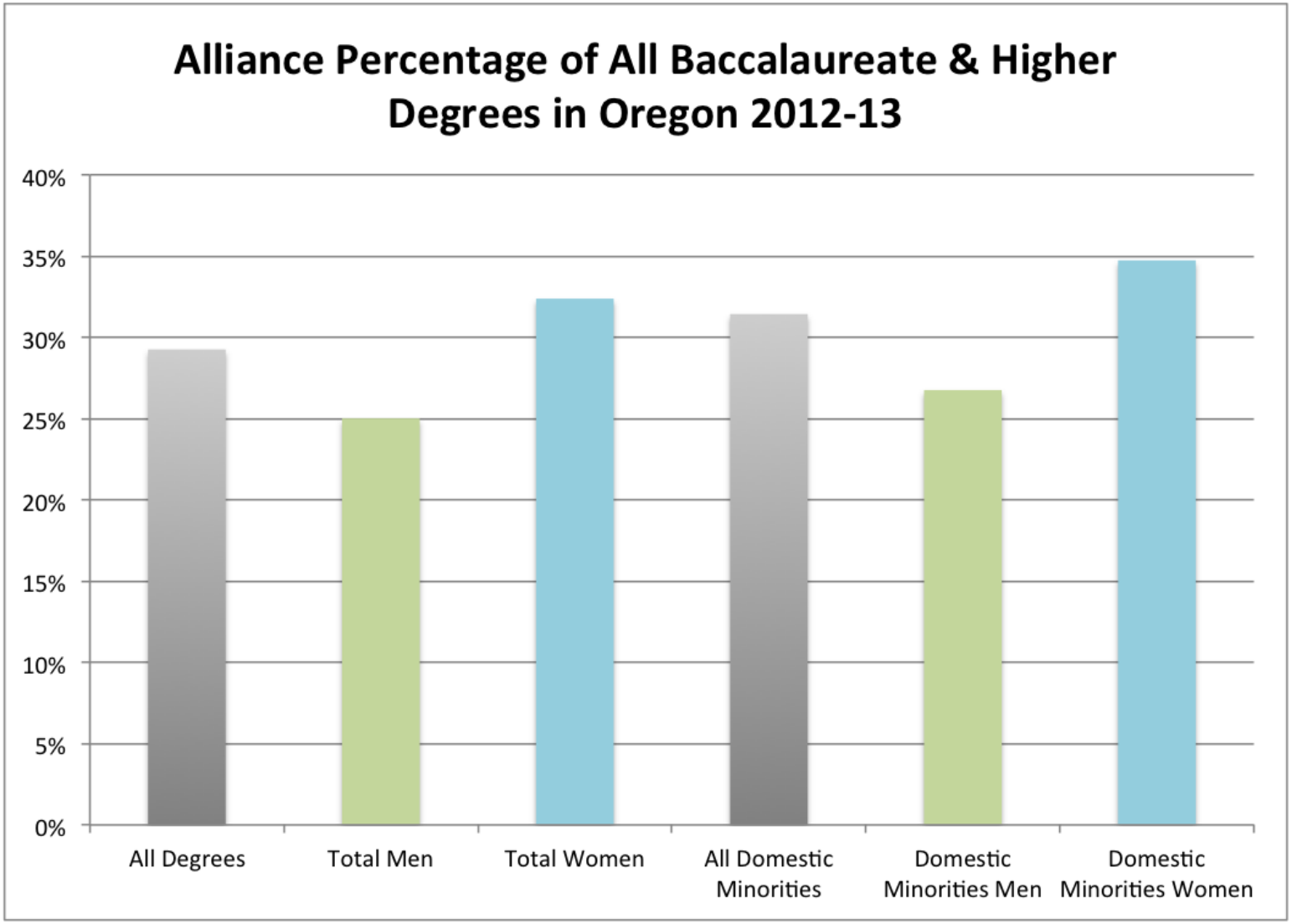
For the 2012-13 Academic Year, Alliance Institutions

- Enrolled 33,423 Students
  - 21,882 Undergraduates
  - 11,542 Graduate Students
- Awarded 9,506 Degrees
  - 5,203 Bachelor's Degrees
  - 3,285 Graduate Degrees



Domestic Minorities:
American Indian/Alaska Native
Asian
Black or African American
Hispanic
Native Hawaiian or Other Pacific Islander
Two or more races

Source: NCES IPEDS 2012-13 Fall Enrollment Data



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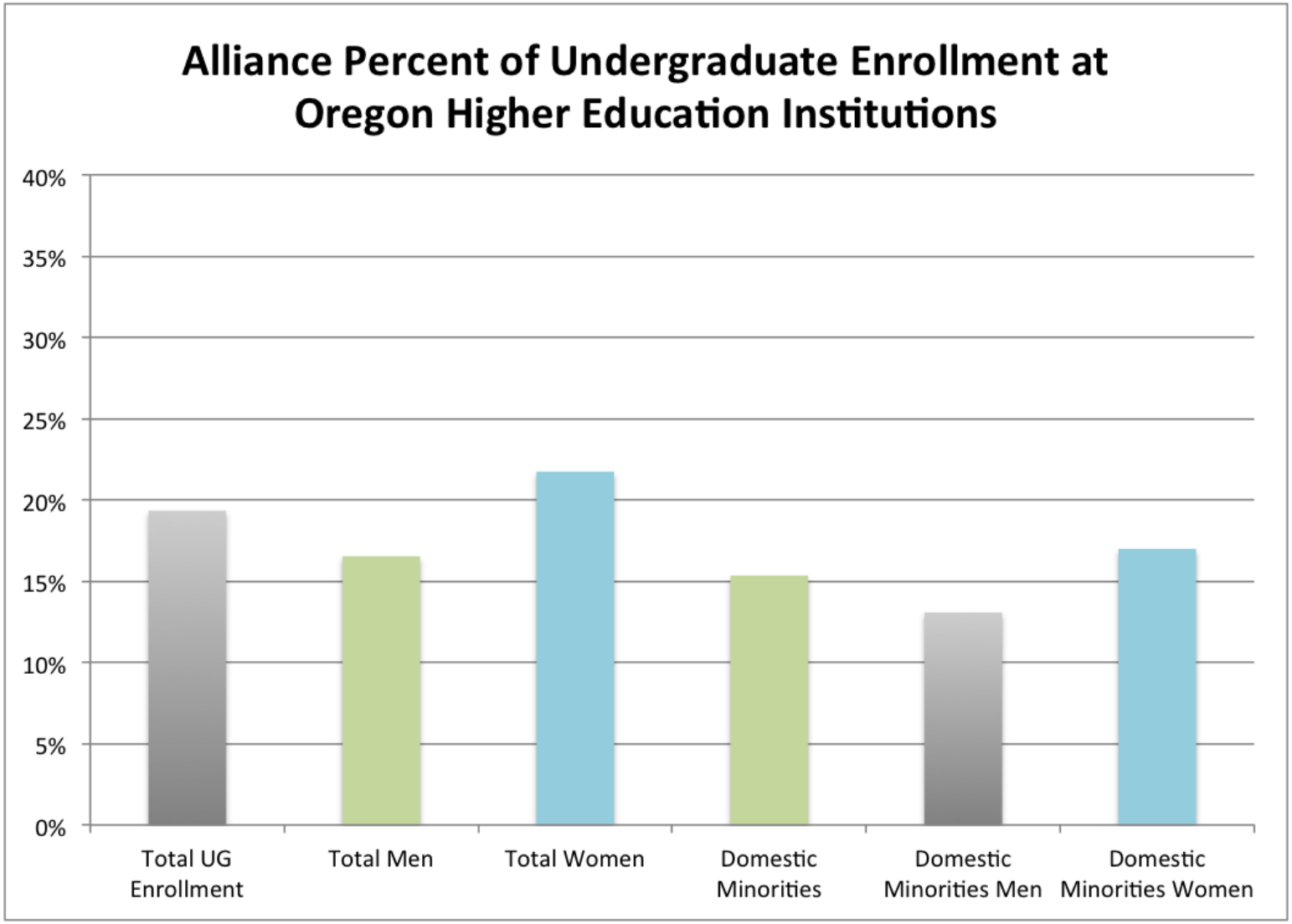

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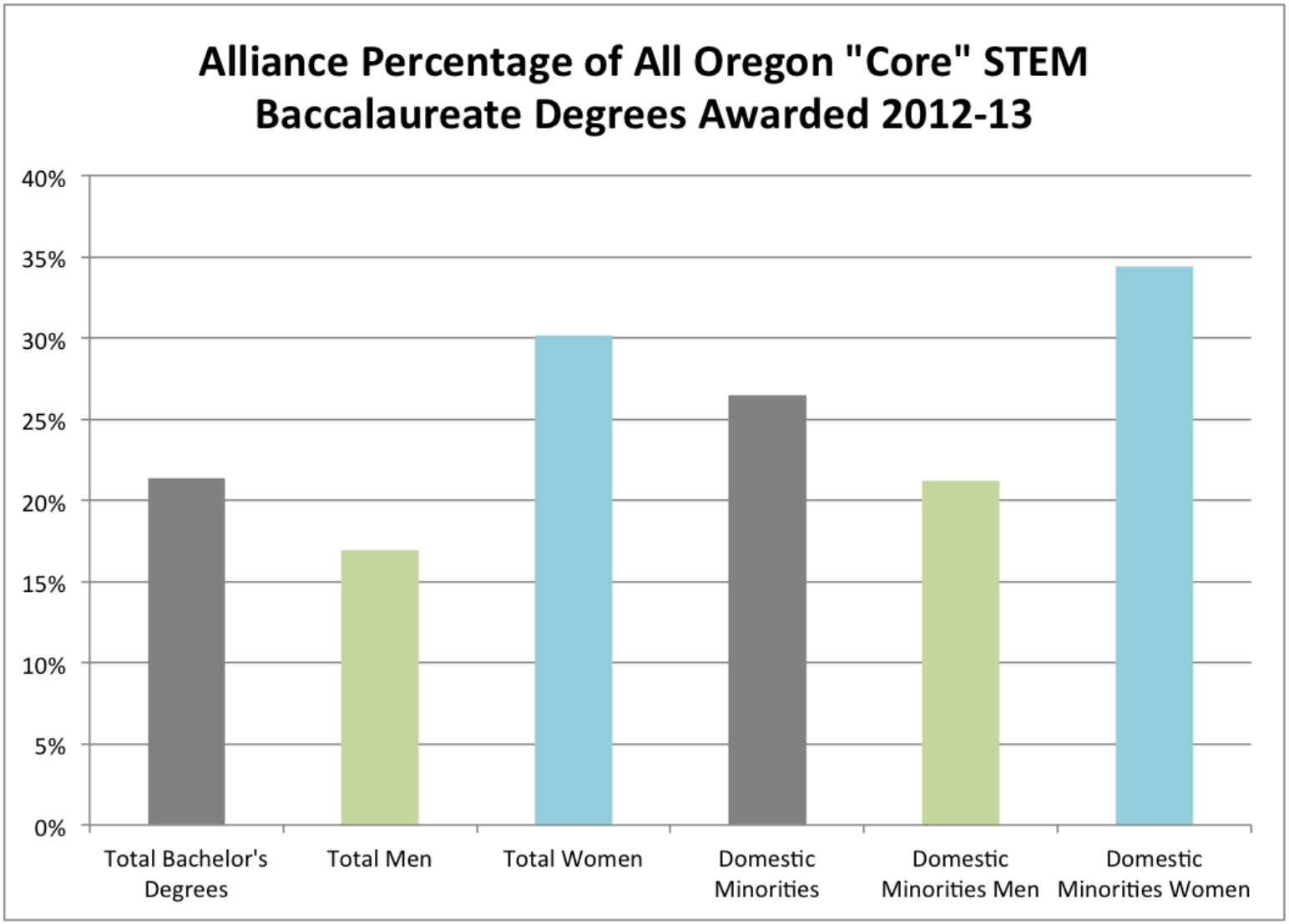

"Core" STEM Degrees:
Computer and Information Sciences
Engineering and Engineering Technologies
Biological and Biomedical Sciences
Mathematics and Statistics
Physical Sciences
Science Technologies

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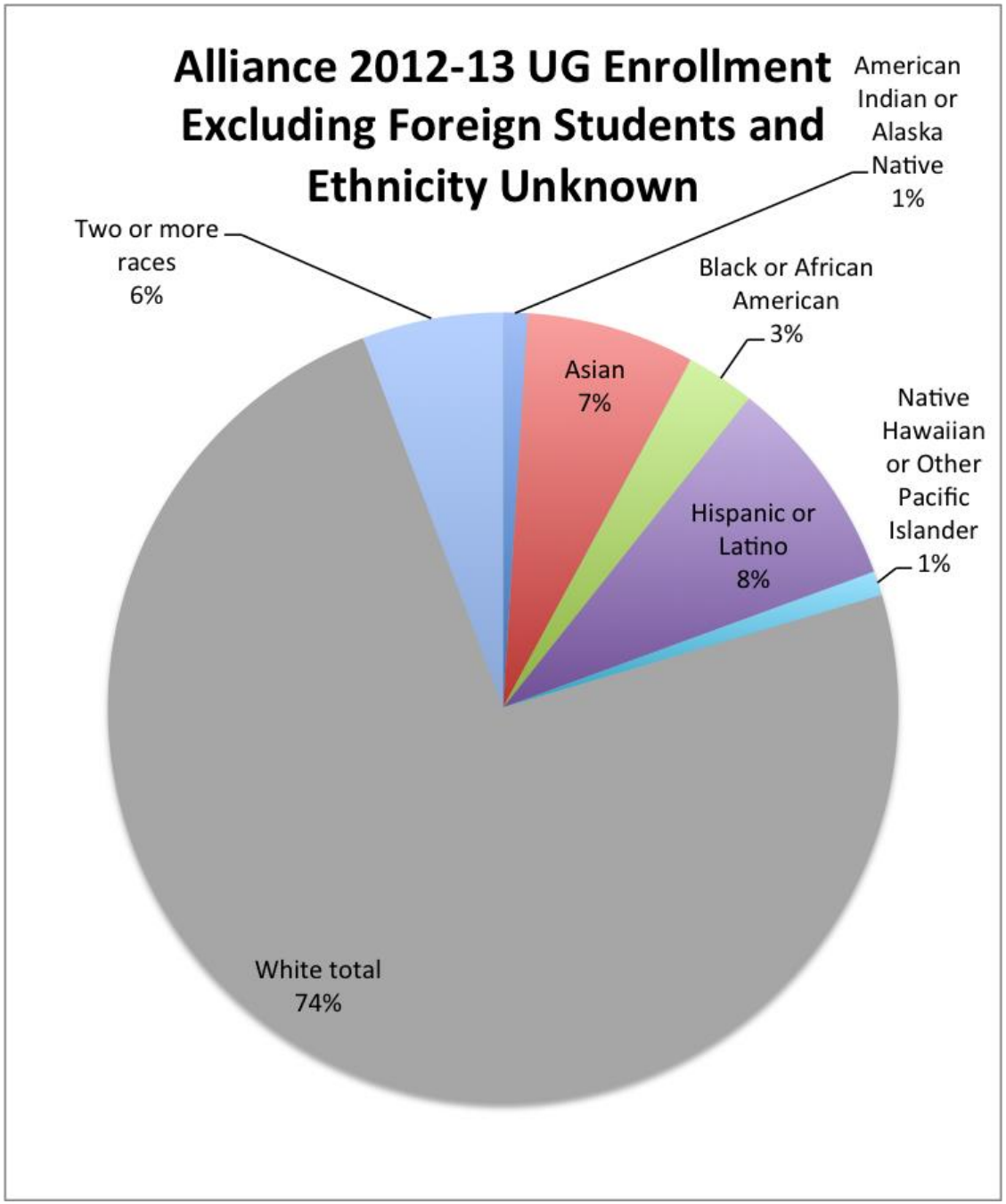

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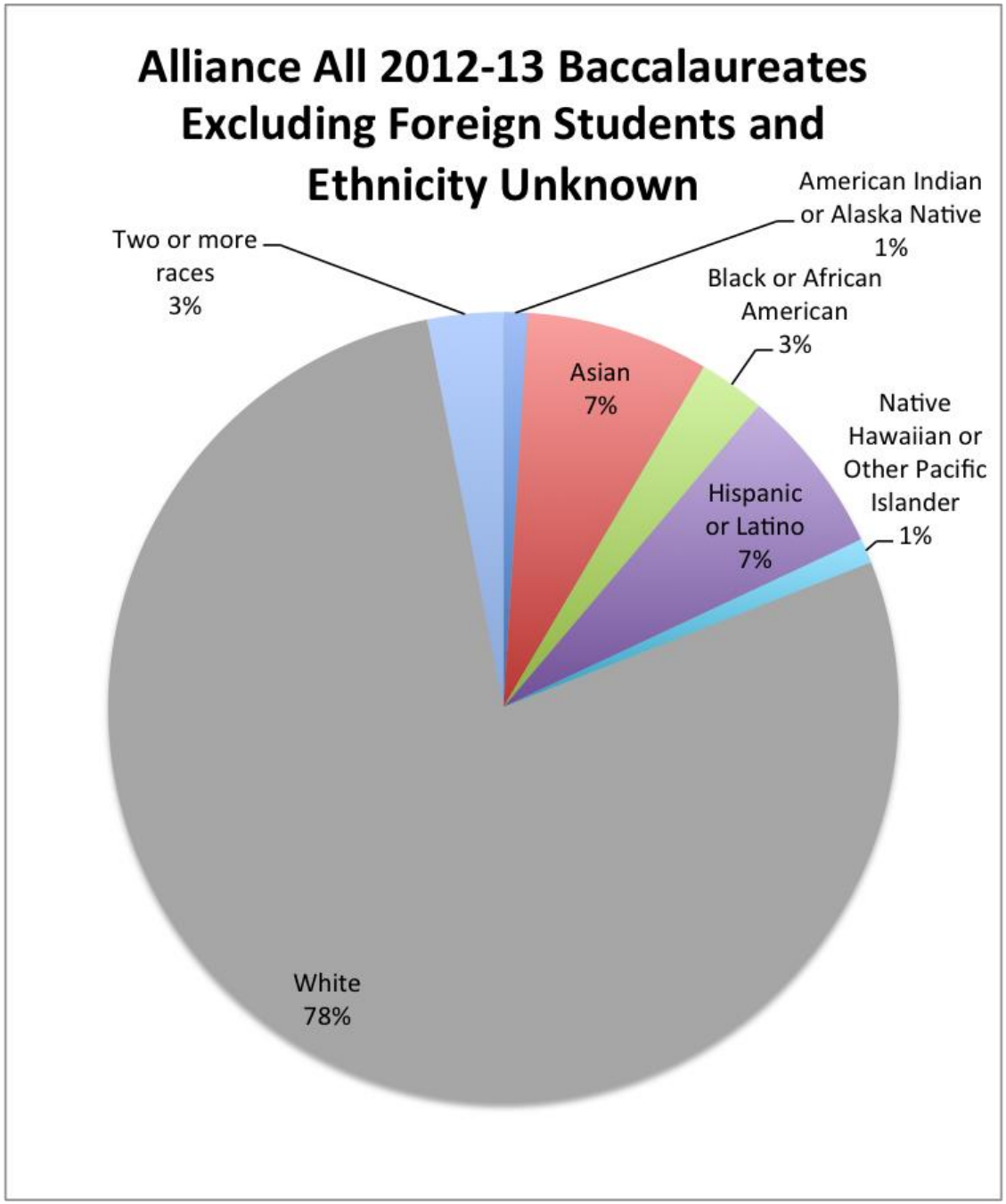

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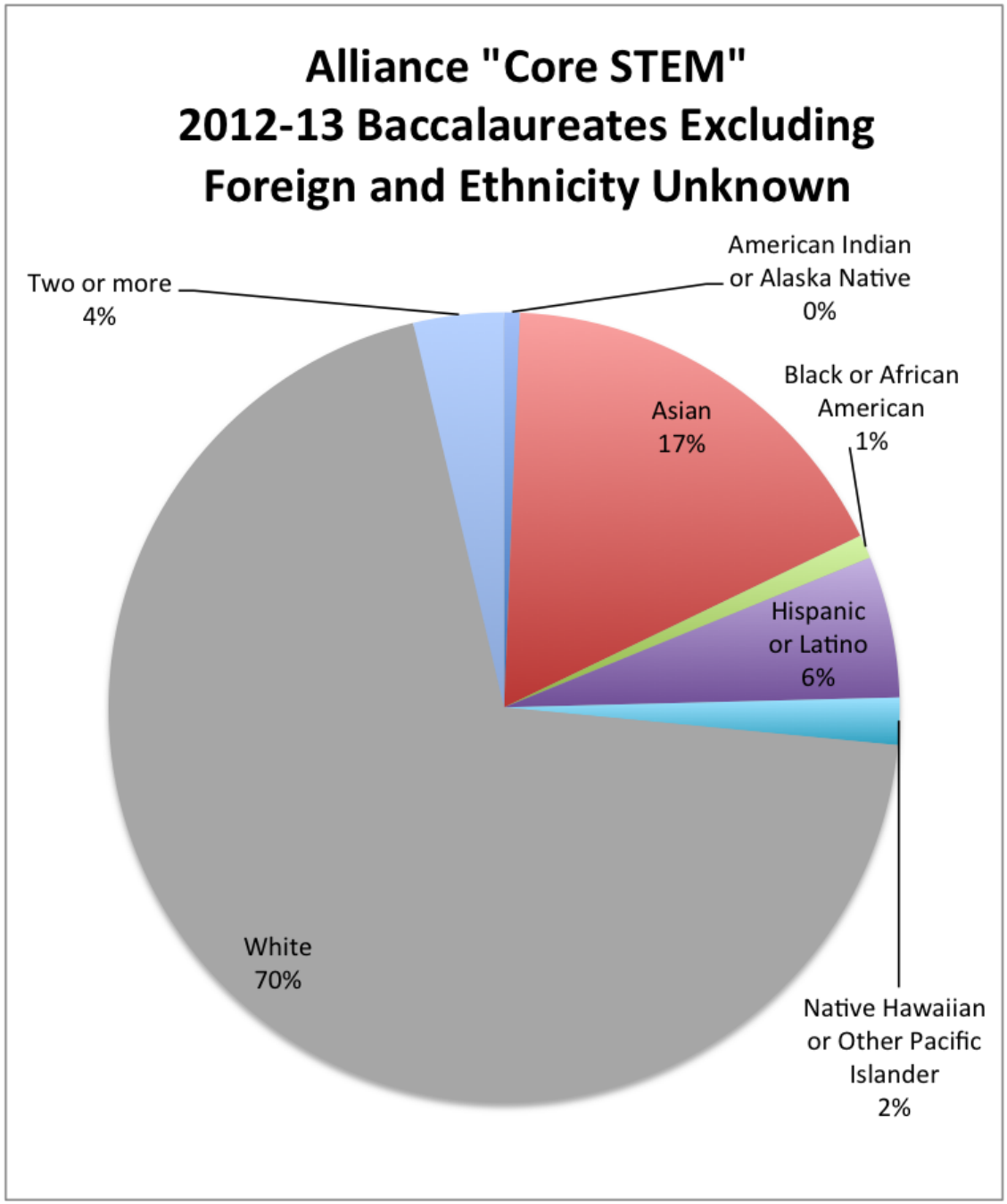

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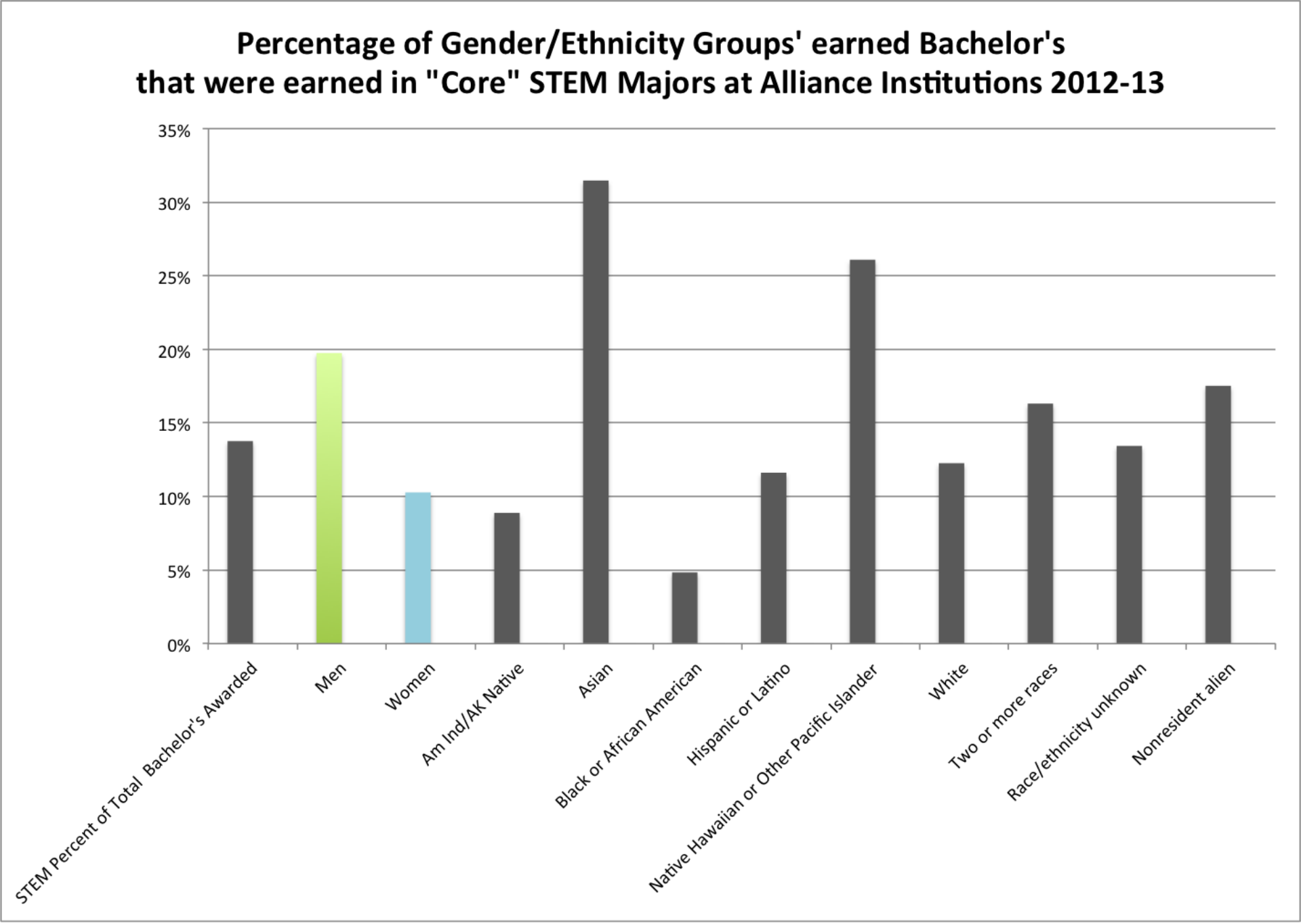

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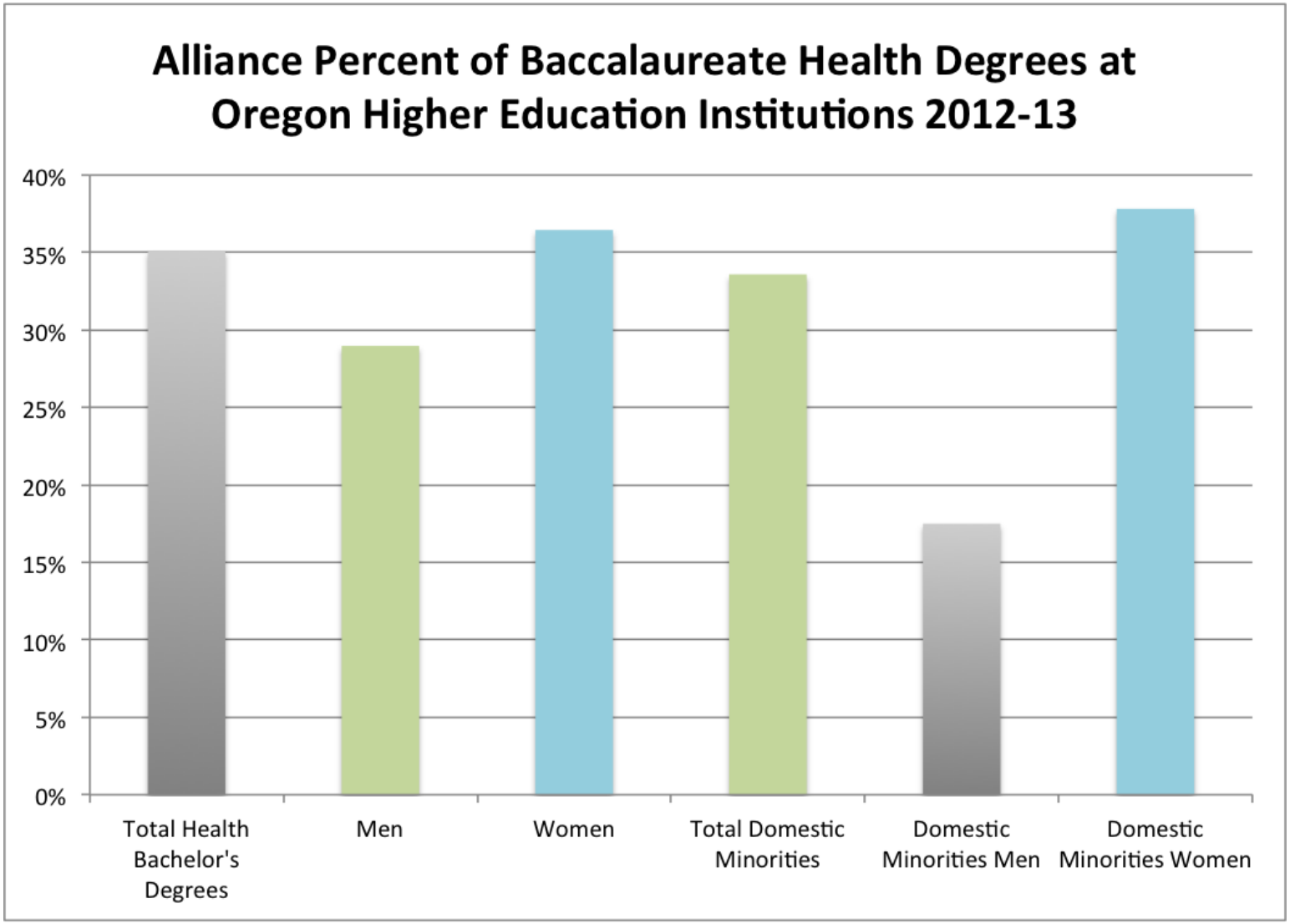

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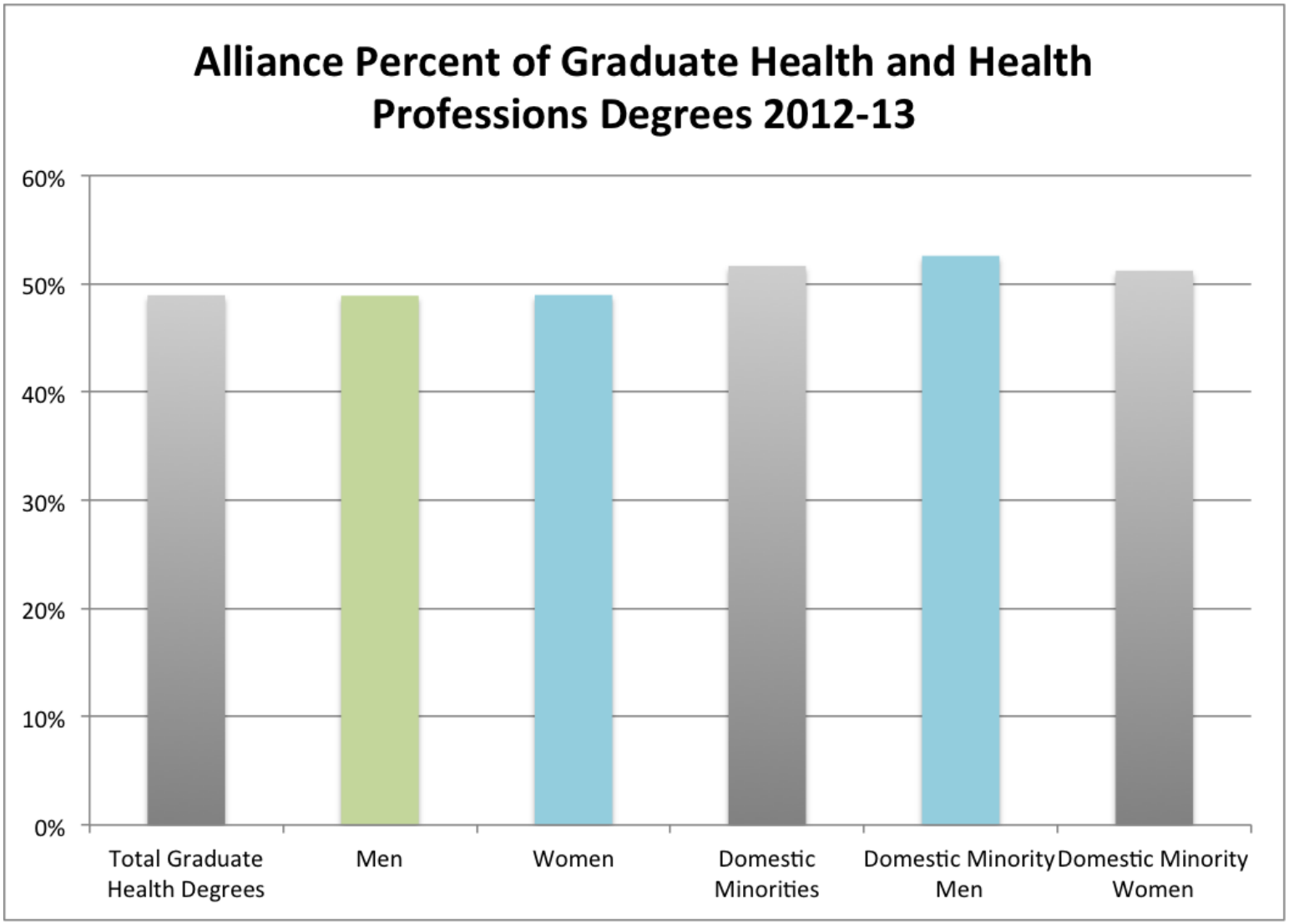

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Source: NCES IPEDS 2012-13 Fall Enrollment Data

Q & A

Questions?

Brent Wilder
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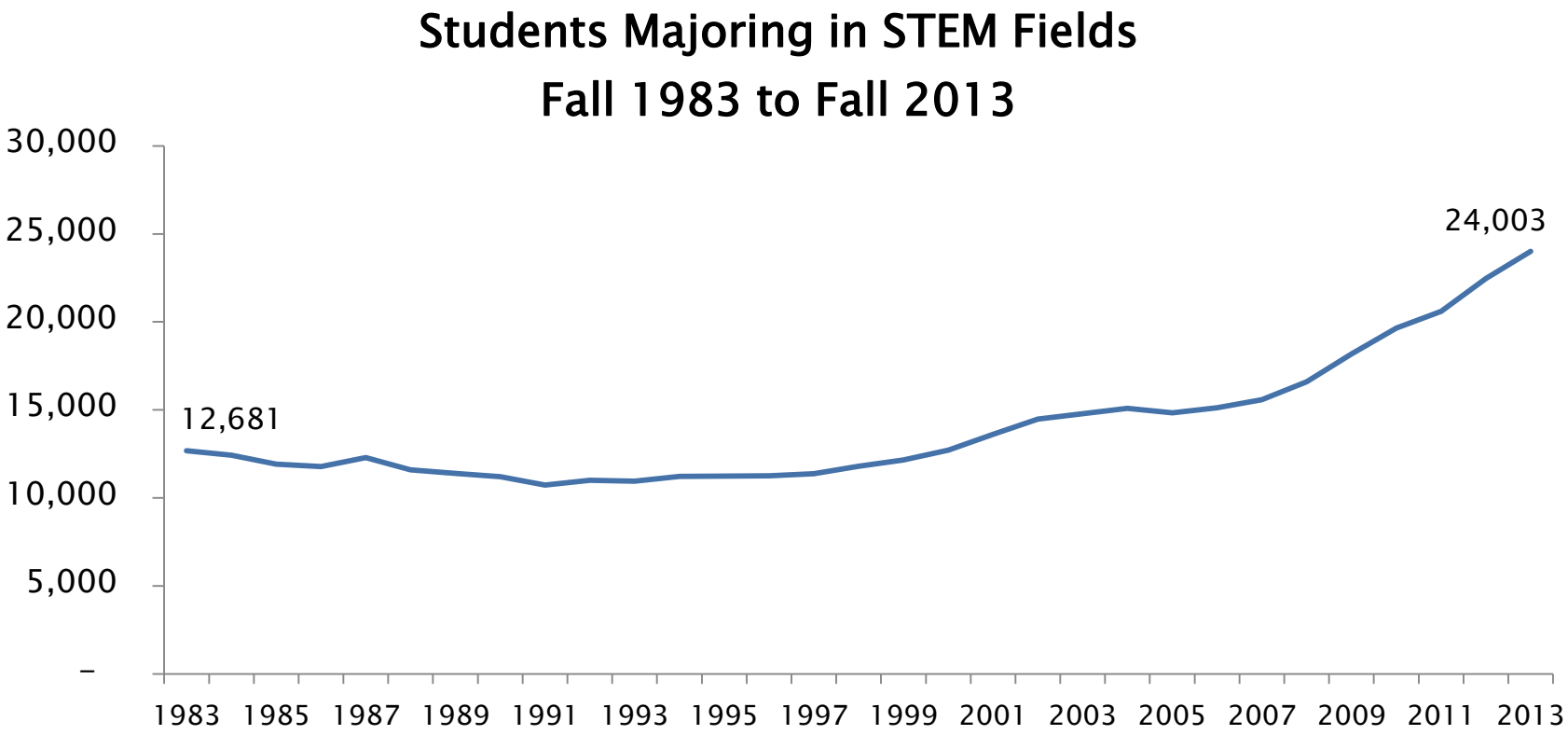
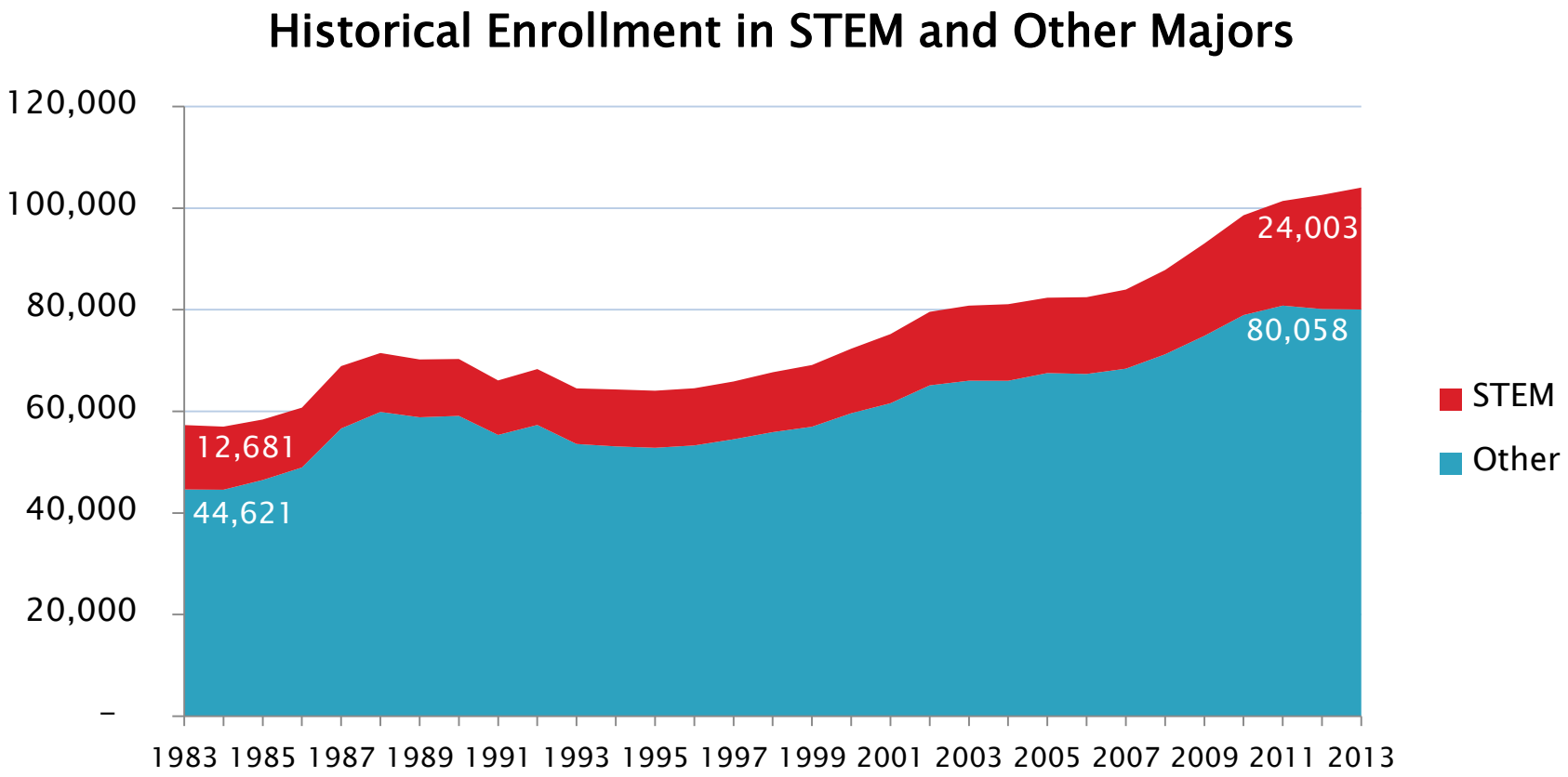
Historical STEM Trends Among OUS Institutions

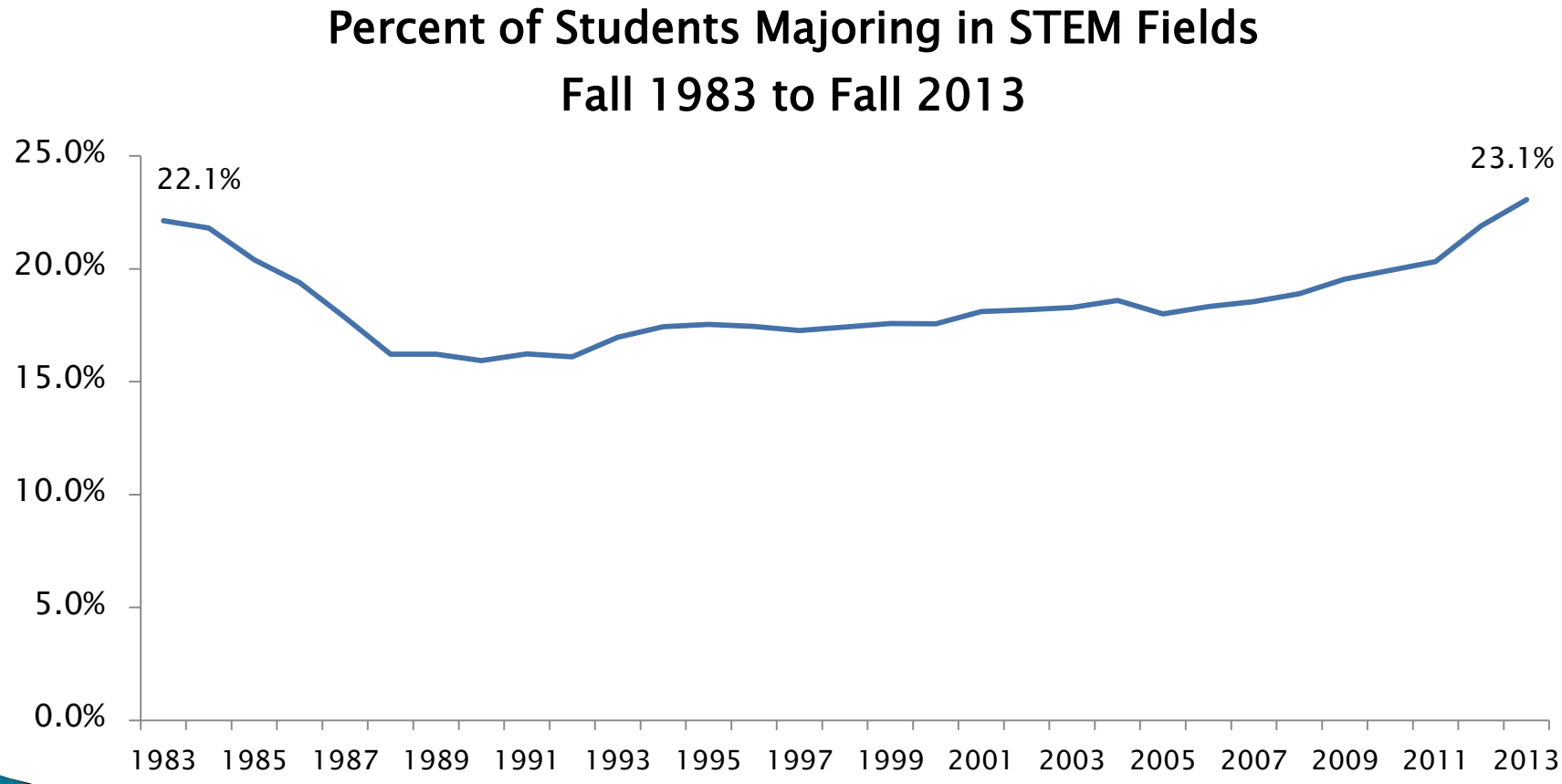
Enrollment in STEM has nearly doubled in the last 30 years



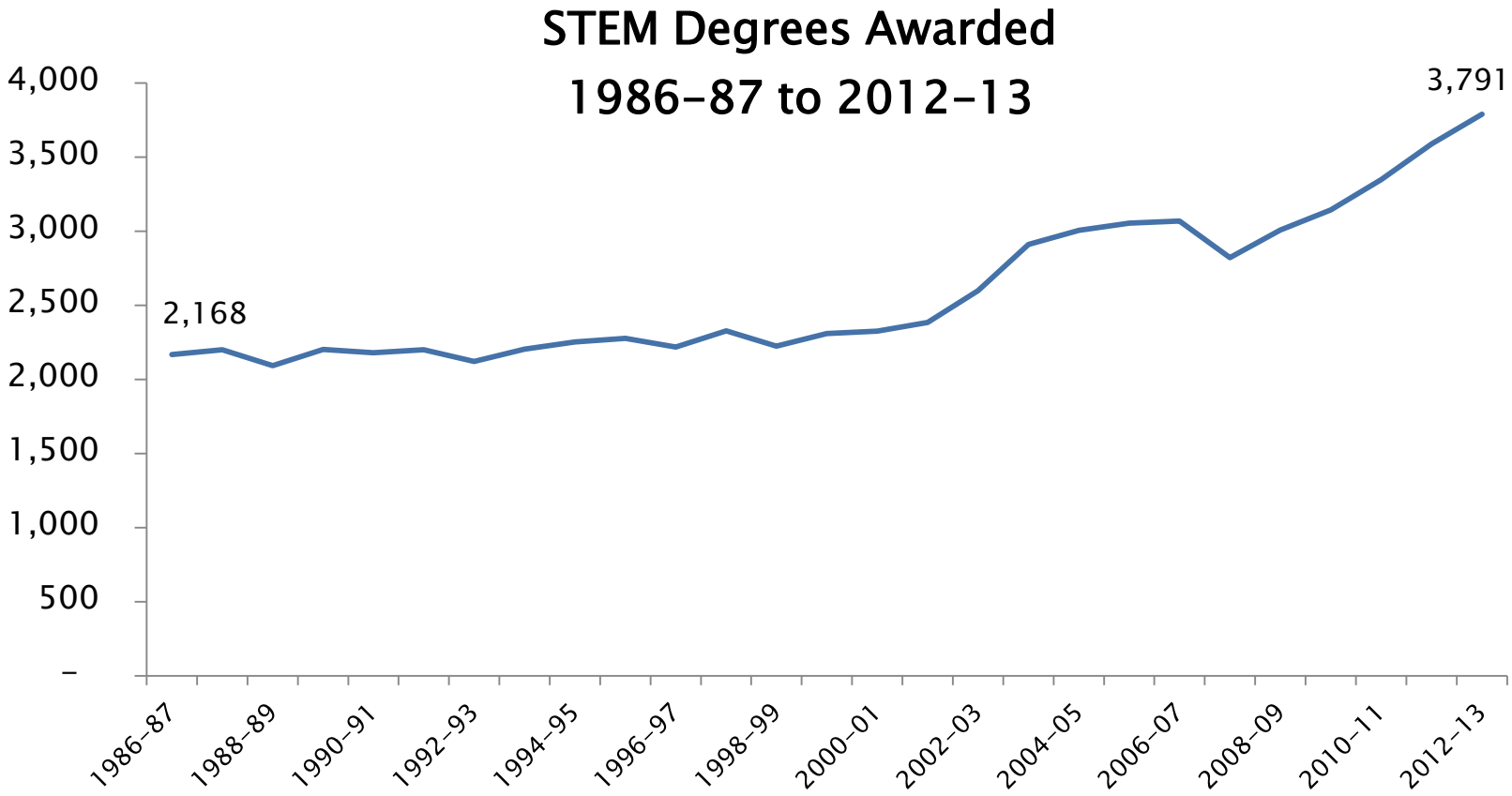
Overall OUS enrollment has seen major growth over the same time period



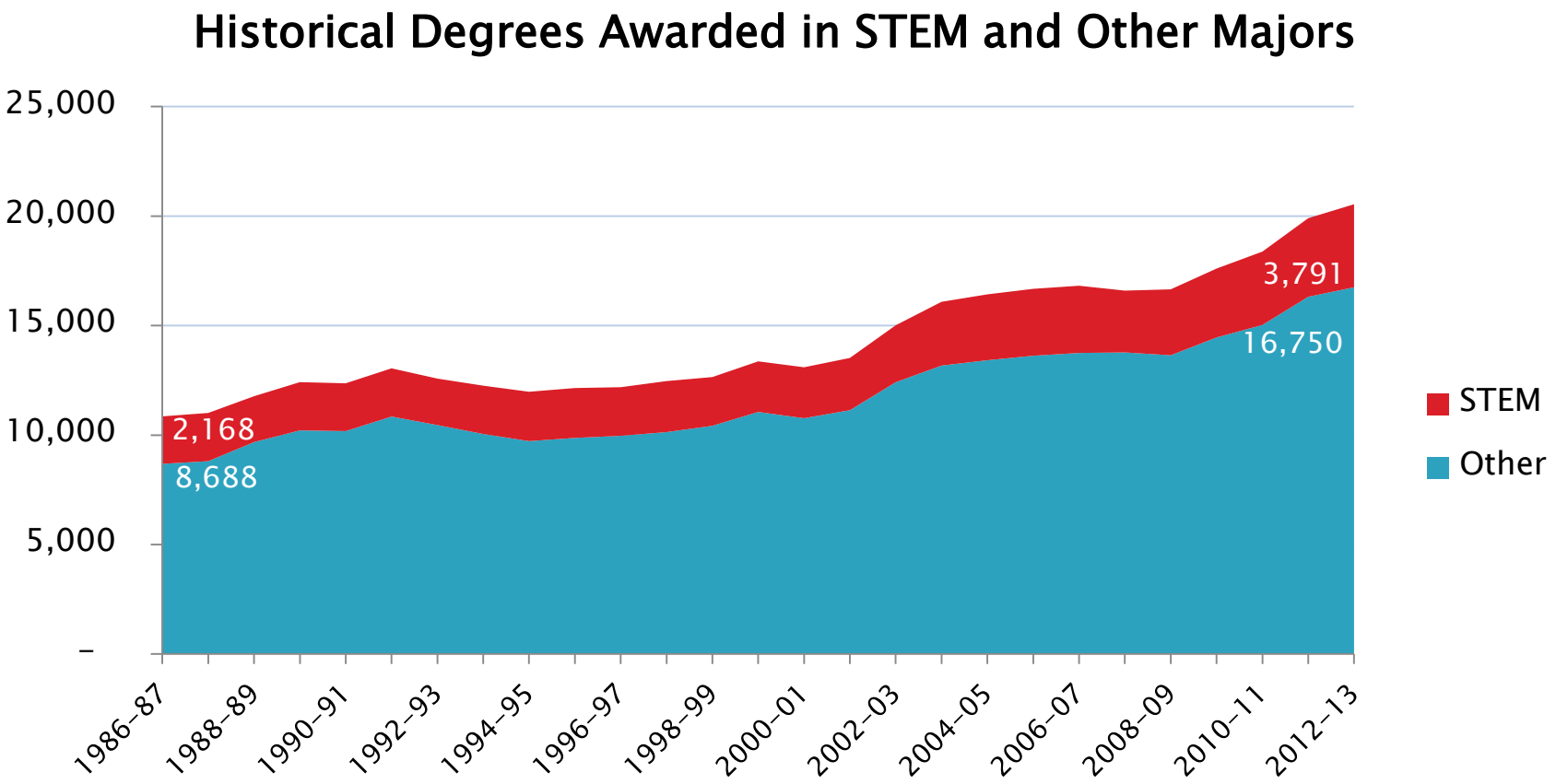
In recent years, more students are enrolling in STEM fields



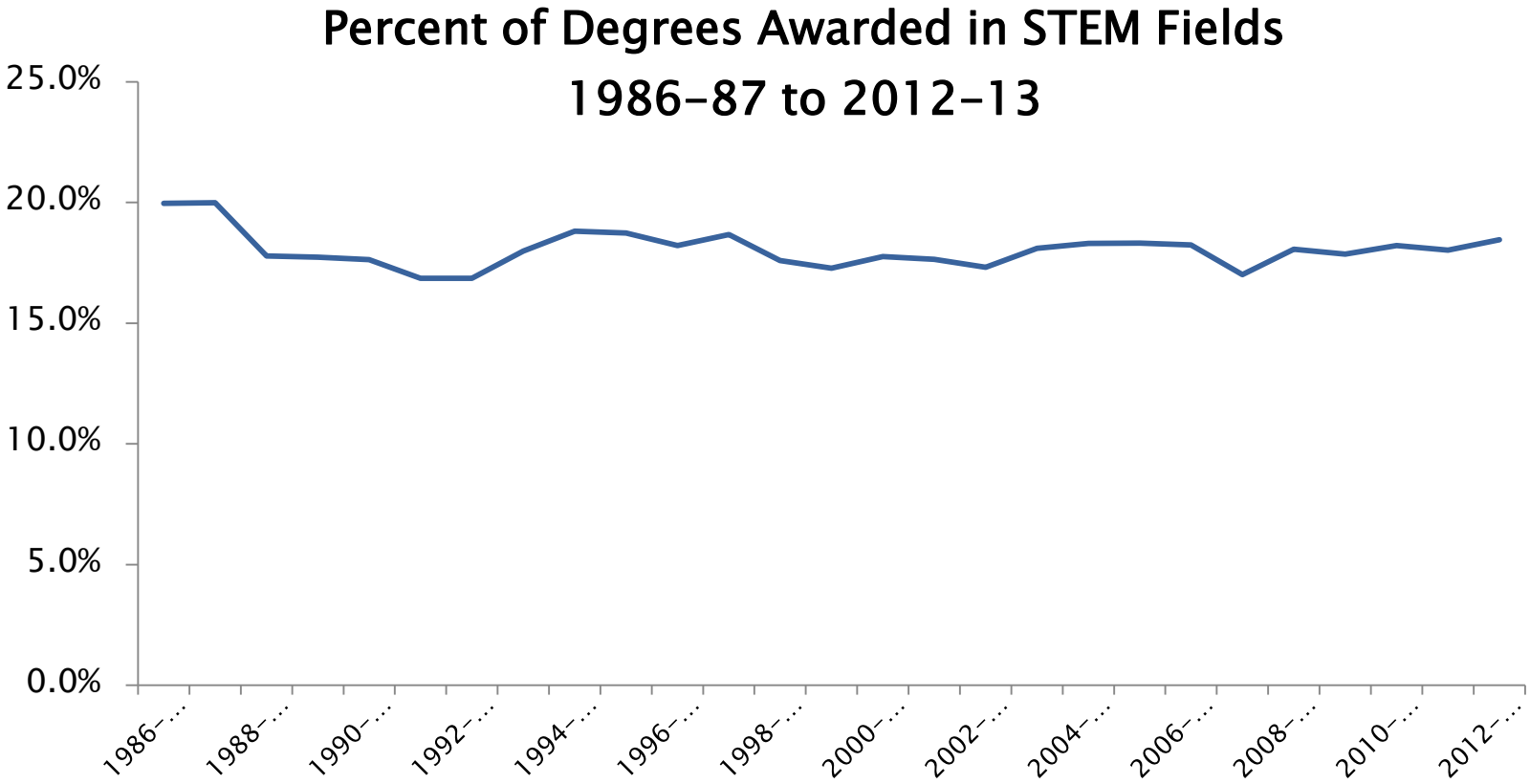
STEM degree production has grown nearly 60 percent since 2001



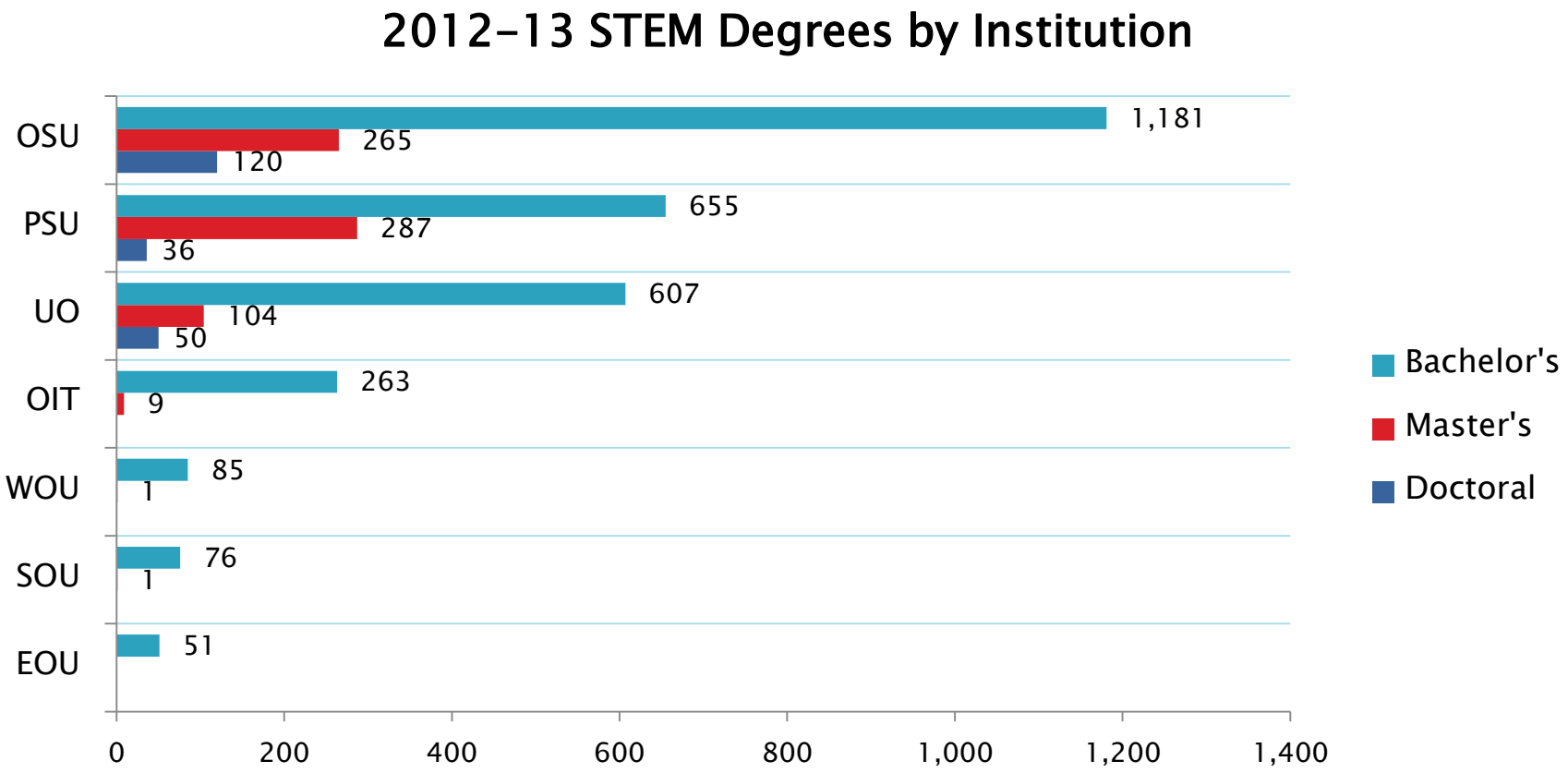
Overall OUS degree production is up significantly since 2000



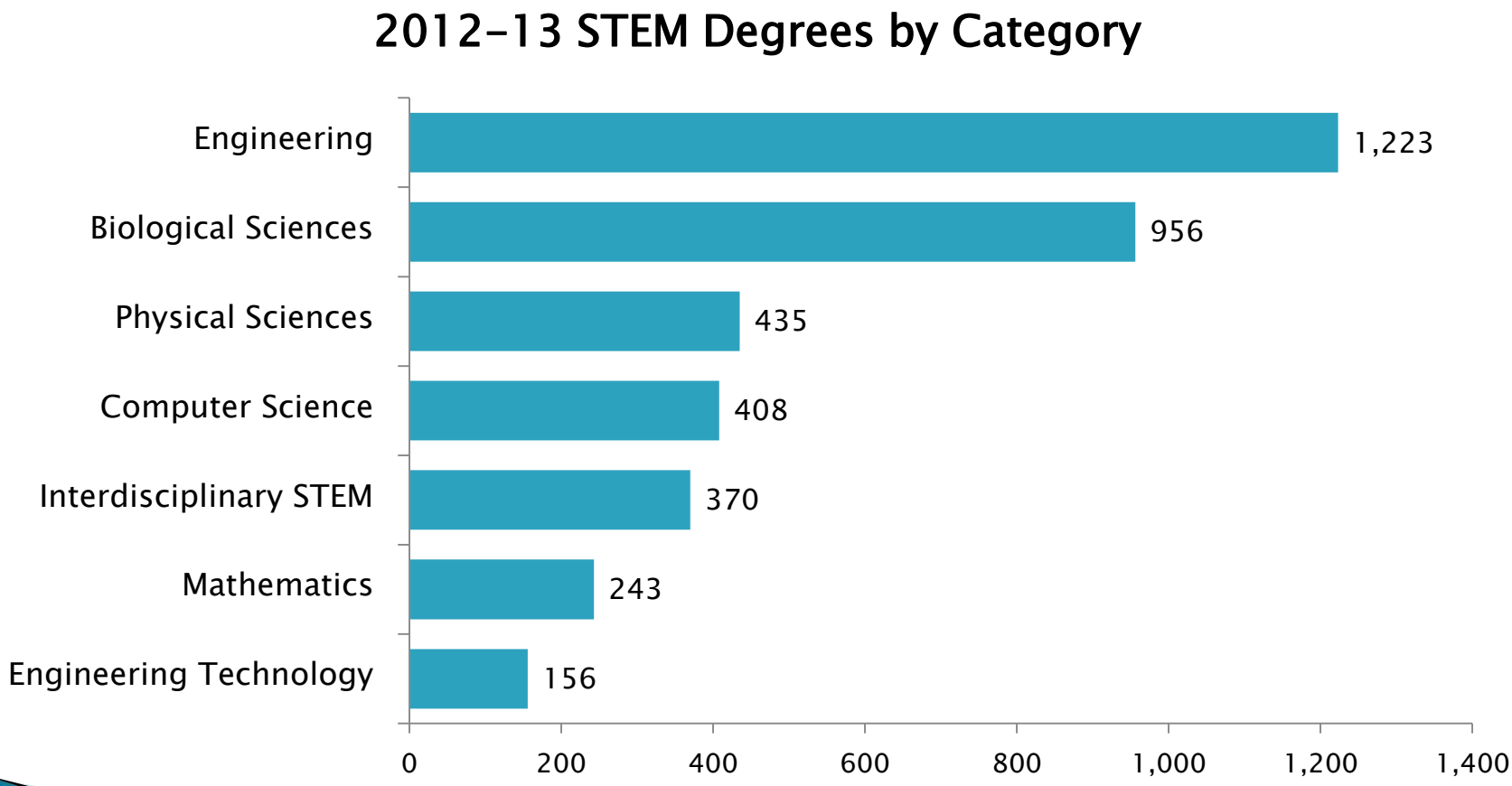
STEM degree production is growing at the same rate as all degrees



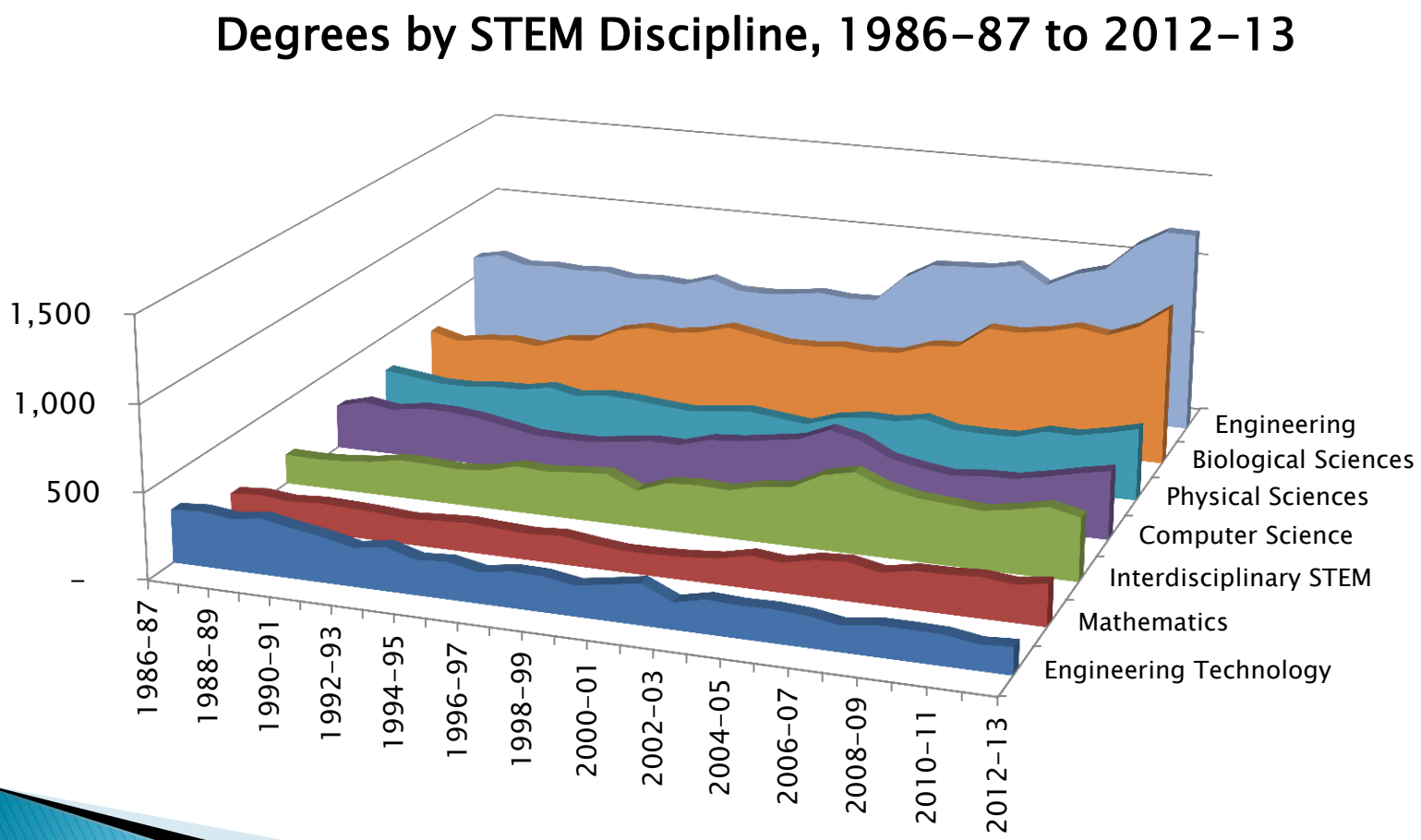
OSU is the biggest producer of STEM degrees among the public universities



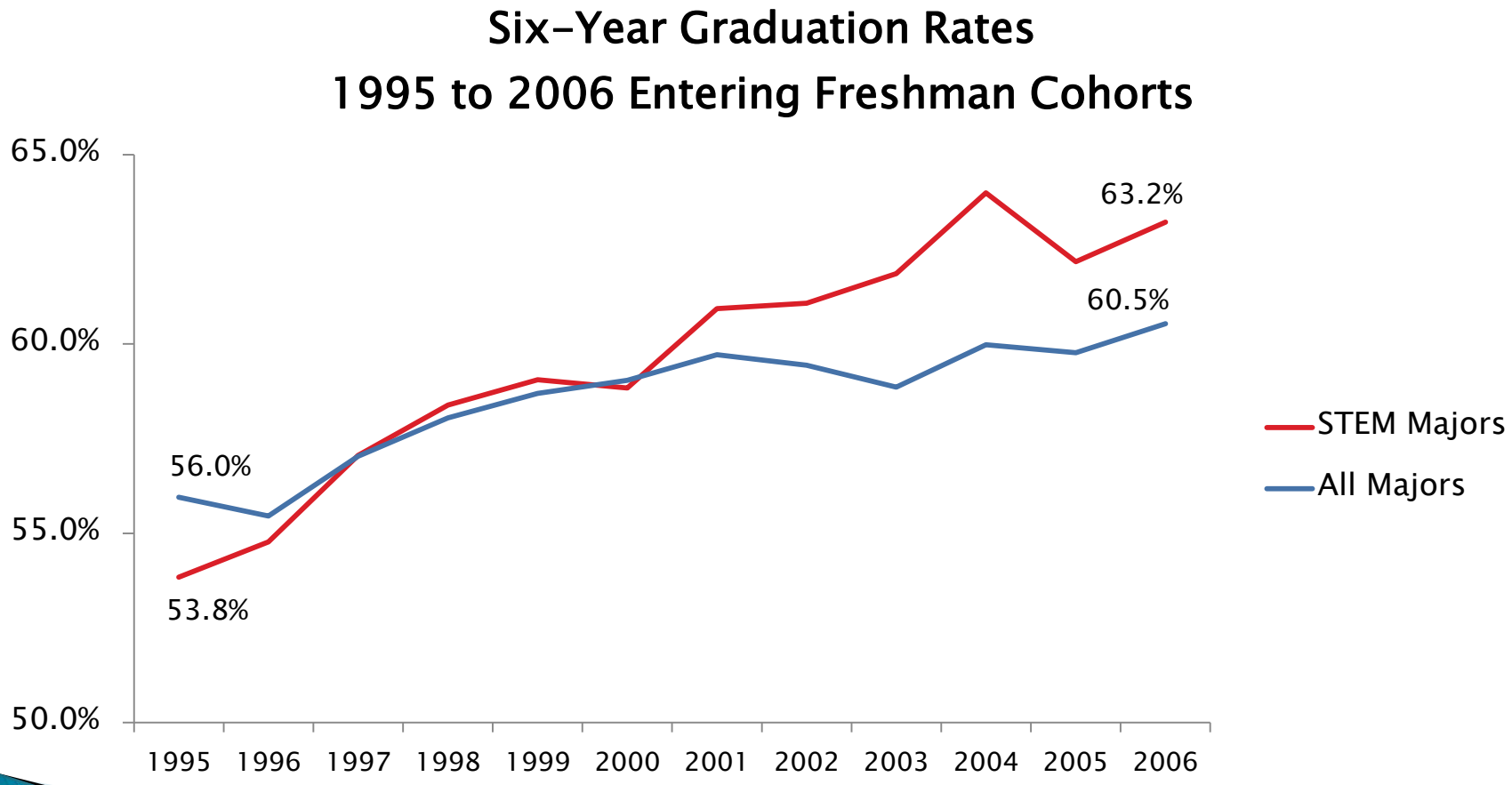
In 2012-13, OUS institutions awarded nearly 3,800 STEM degrees



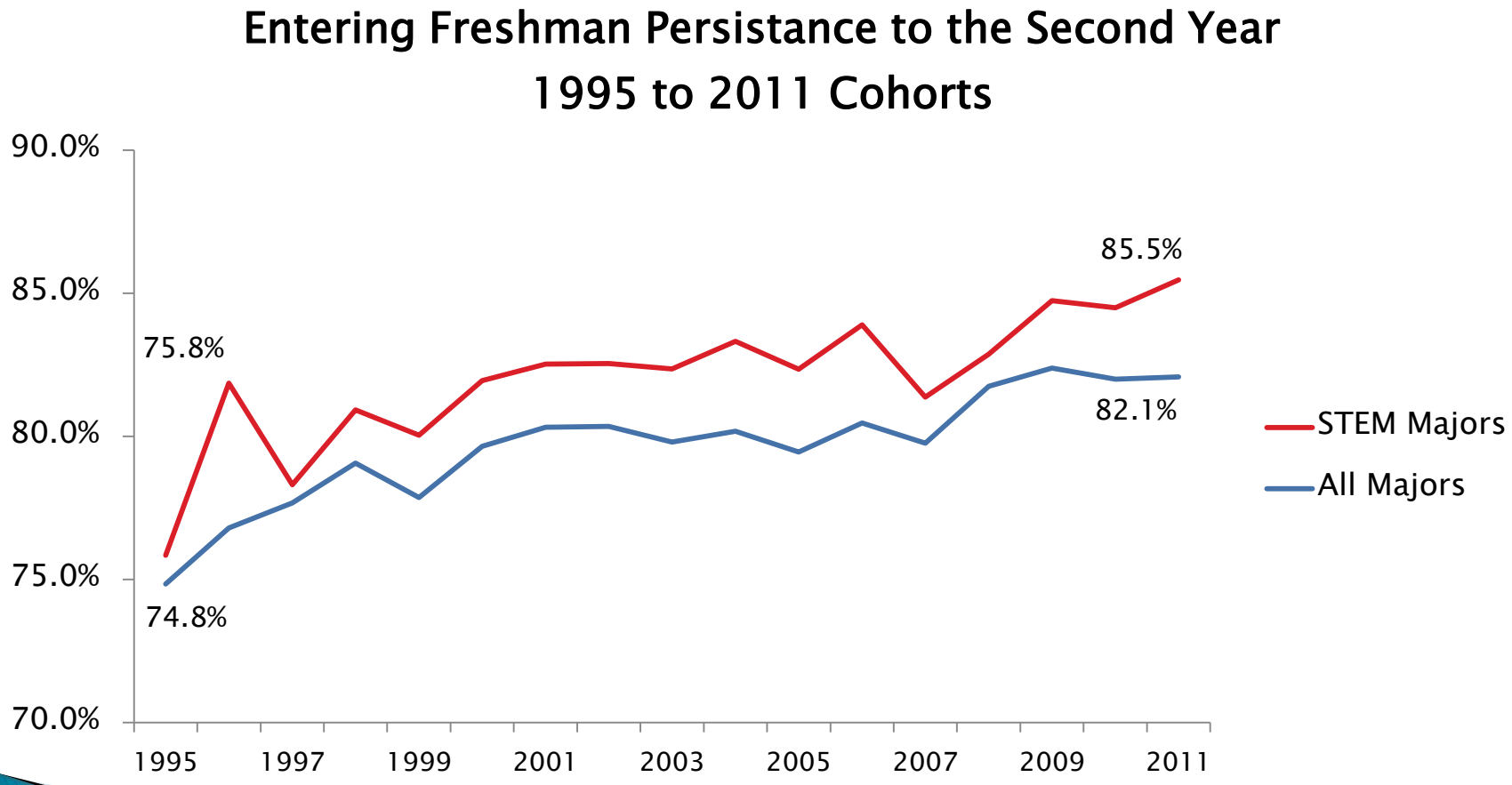
The majority of STEM degrees are in engineering and biological sciences



STEM graduation rates have outperformed overall rates since the 2000 cohort



STEM first-year retention has historically outperformed overall retention



Improving Persistence in STEM Majors—a National Imperative

Students are leaving US STEM postsecondary education , in droves.

The Presidents Council of Advisors on Science and Technology reported in February 2012:

> **"Fewer than 40% of students who enter college intending to major in a STEM field complete a STEM degree."**

RETANING more students in STEM fields in US postsecondary education is critically important to meeting STEM goals.

http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-executive-report-final_2-13-12.pdf

When do students leave postsecondary STEM?

- Nationally–

  in lower division–primarily in freshman year
- In Oregon–

  OSU College of Engineering:
  - 2nd half of Freshman Year shows largest drop off
    - Primary reason cited: grades
  - prior to entry to Professional School

  PSU Maseeh College of Engineering and CS
  - In lower division engineering sequence
    - For both Freshmen and transfers
  - Upper division retention to graduation is strong

Why? Some Reasons cited for leaving STEM

(American Educational Researchers Association, 2009)

- TOP 3 REASONS STUDENTS LEAVE STEM FIELDS
  - Poor teaching and advising
  - Curriculum Difficulty
  - Lack of Belonging
- High-achievers: > 3.5 GPA
  - courses uninspiring, low grades discouraging, tend to switch out
- Low achievers < 2.5 GPA
  - difficulty with classes, especially math, tend to drop out

National Center for Educational Statistics: STEM ATTRITION
http://nces.ed.gov/pubs2014/2014001rev.pdf

"weed-out" classes, scheduling,

Other barriers to STEM degree completion

- Achieving cutoffs for professional schools – grades
- Socioeconomic factors/finances
- Length of time to degree completion
- Scheduling complexity –sequential courses
- Systemic barriers—full classes, lack of access to advising, insufficient course sections
- Lack of connection to real STEM careers
- Discouragement in lower division

A Few Words about TRANSFERS

- Transfer students receive a significant number of OUS' STEM degrees
  - ~75% of BS degrees at PSU engineering/CS
- Not all transfer students come in at the junior level in STEM curricula, or with Associates degrees
- Not all STEM Associate degrees articulate well to University STEM programs

Summary

- Oregon's Public Universities are producing approximately 3,800 STEM graduates a year.
- Retention of interested STEM majors is critical to increasing STEM degree production.
- A comprehensive Statewide Study of attrition factors in Oregon postsecondary STEM programs may be helpful in developing strategies for retention.
- Subsequent strategies should be implemented across Oregon's postsecondary institutions.

Department of Community Colleges and Workforce Development

Presented by:

Elizabeth Cox Brand

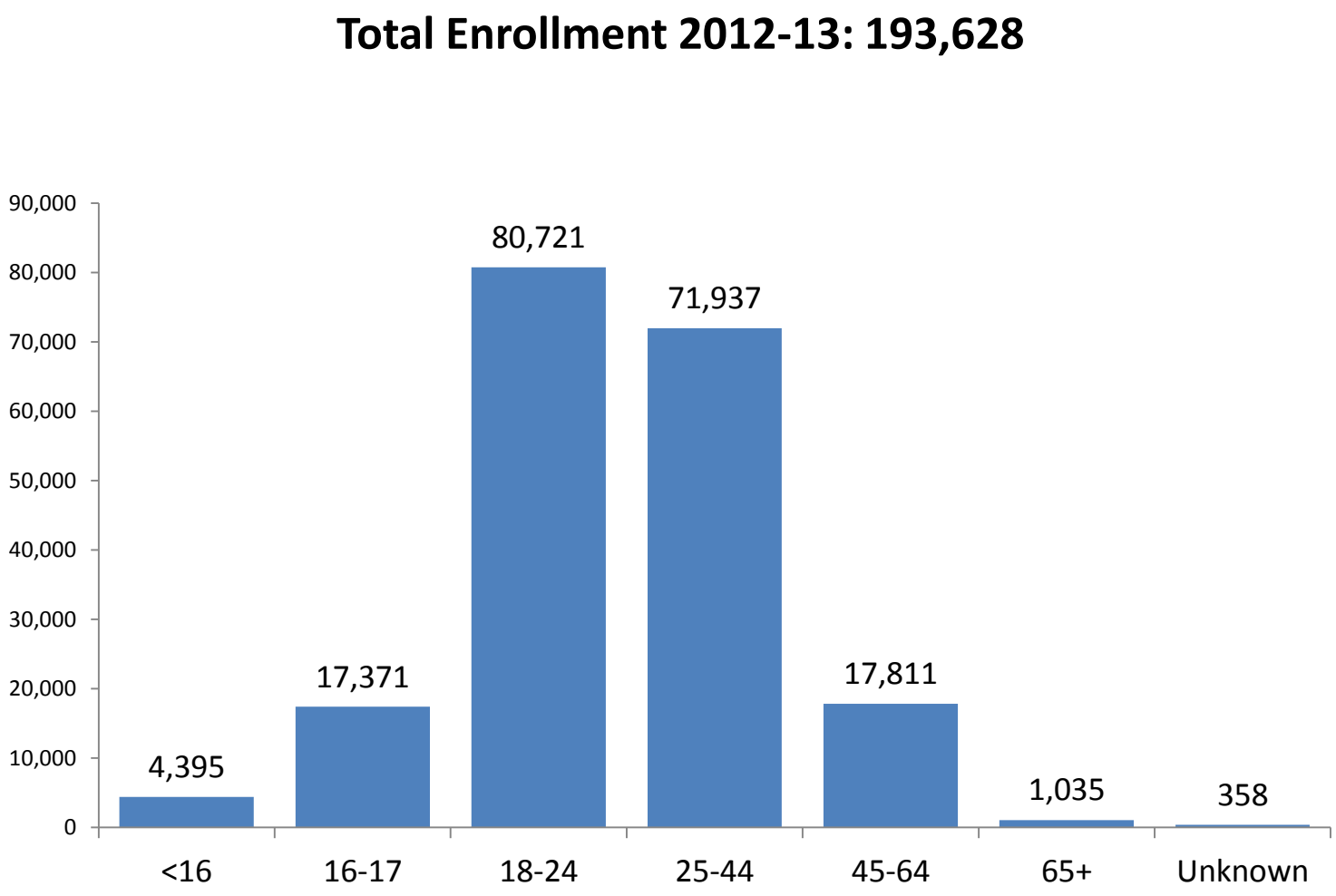
Director, Research and Communications

February 24, 2014

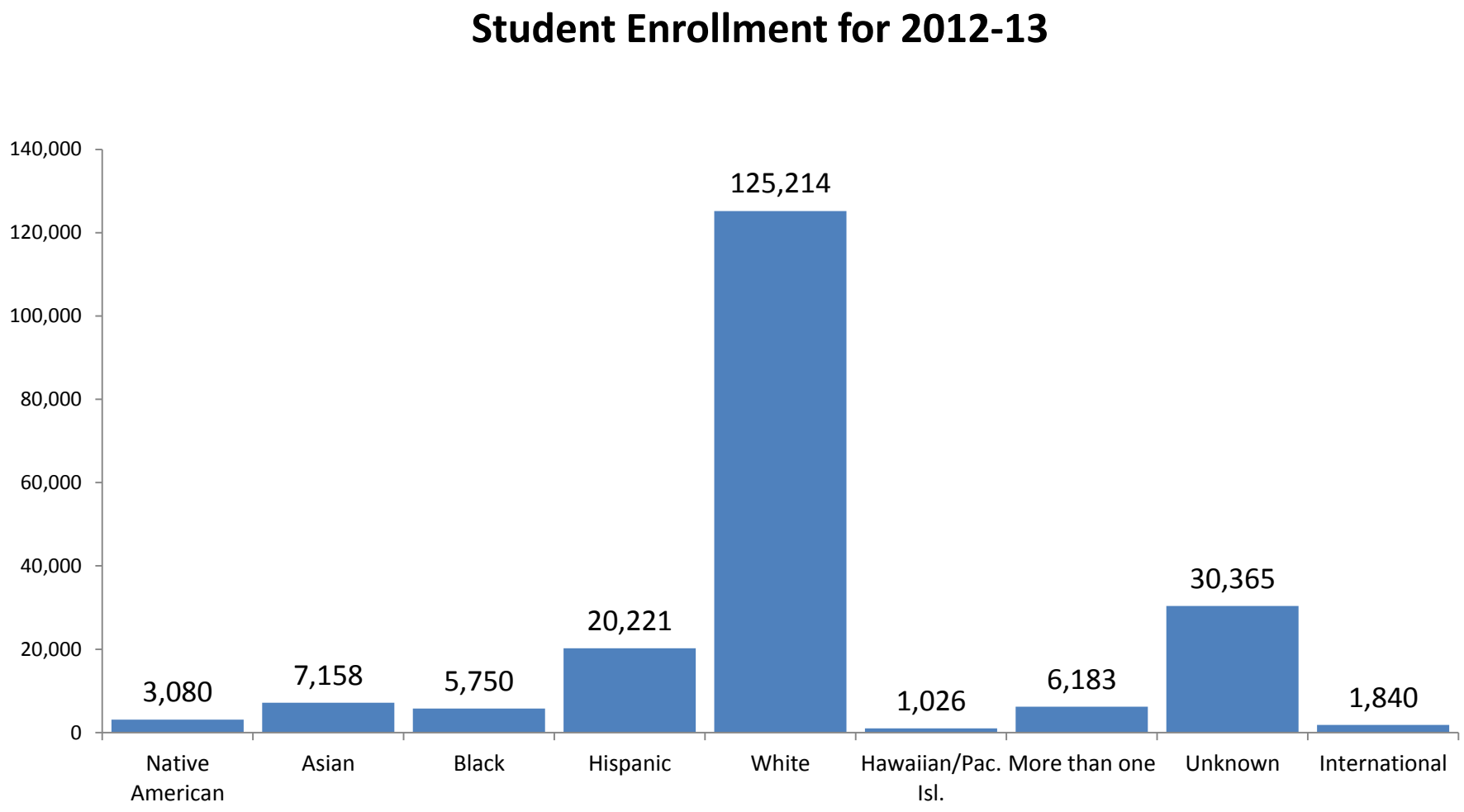
COMMUNITY COLLEGES AND WORKFORCE DEVELOPMENT
WORKSOURCE OREGON

Who are Community College Students?

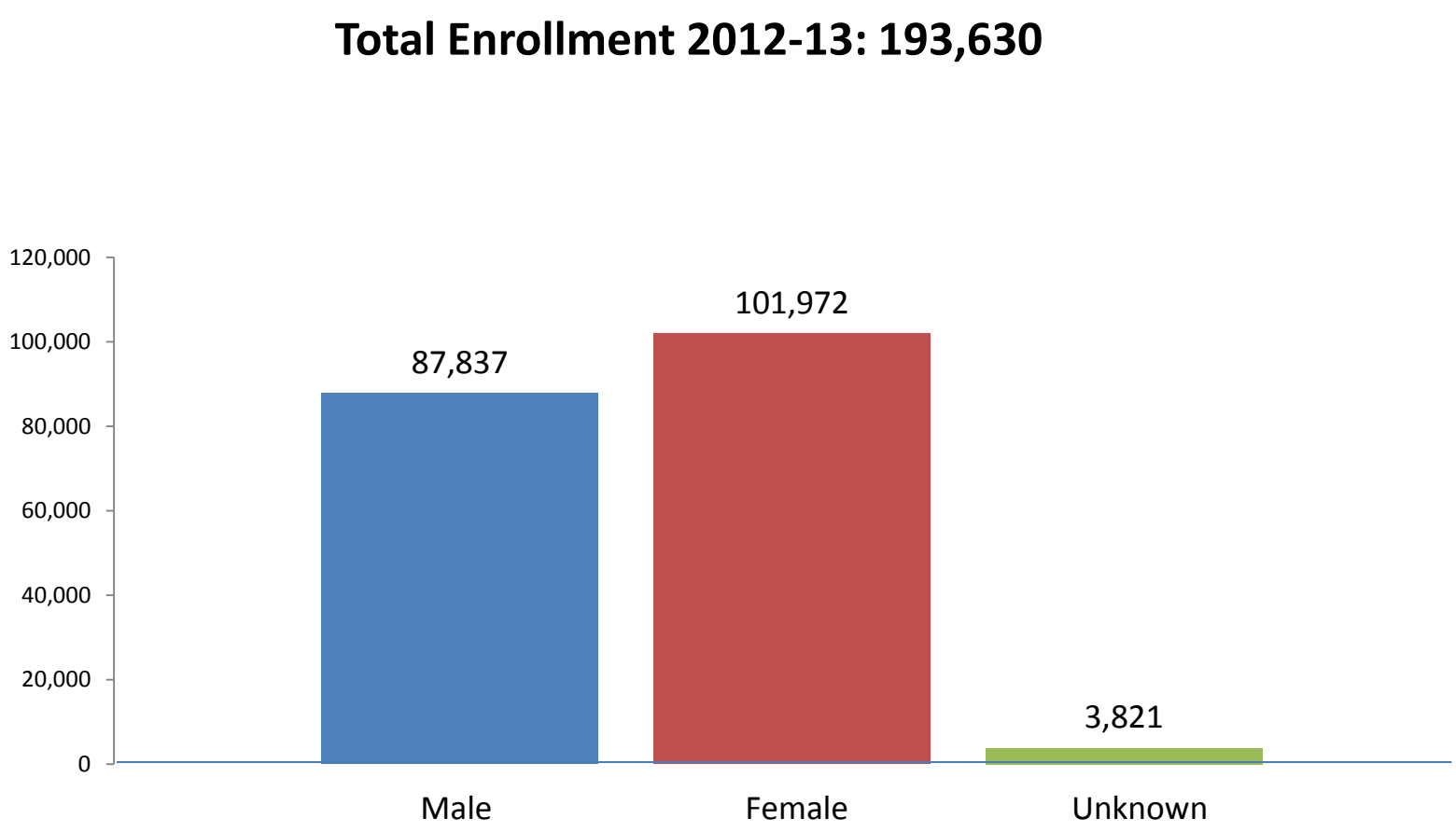
Age of Community College Students



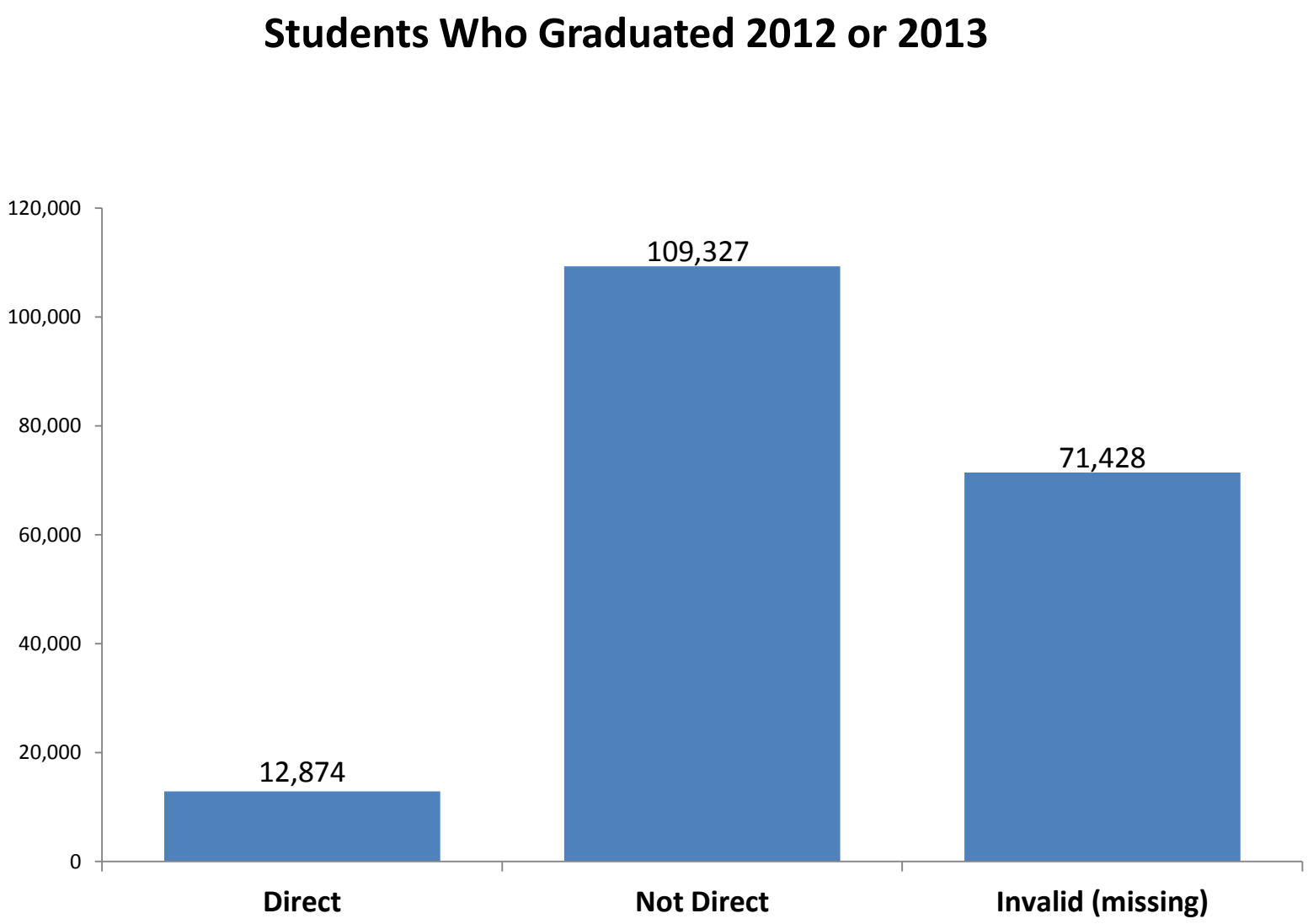
Community College Student Race/Ethnicity



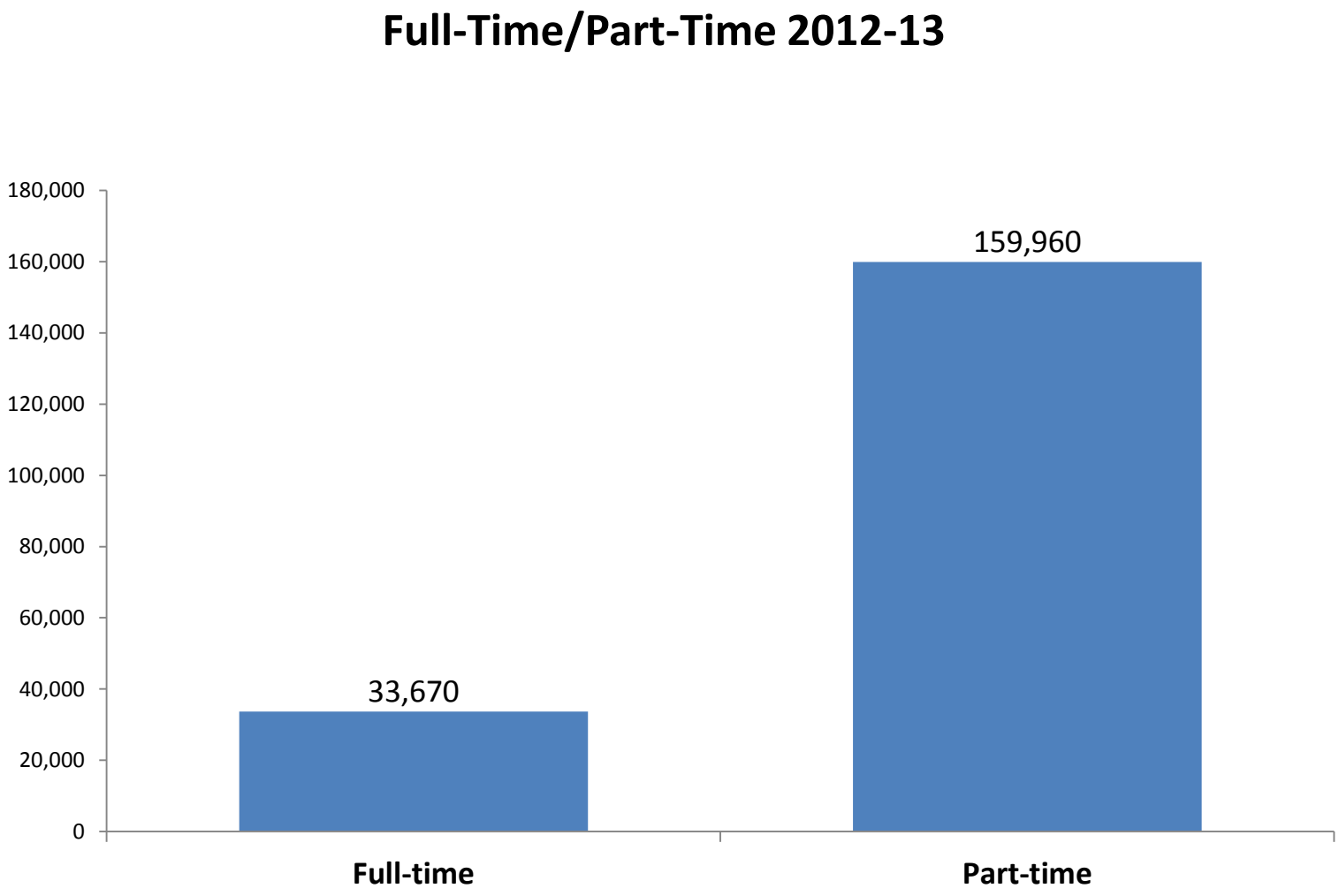
Community College Student Gender



Students Direct From High School



Community College Student Enrollment



First-time Freshman and Developmental Education

All students:

- Any DevEd: 58 percent
- DevEd math: 36 percent

Ages 17-19:

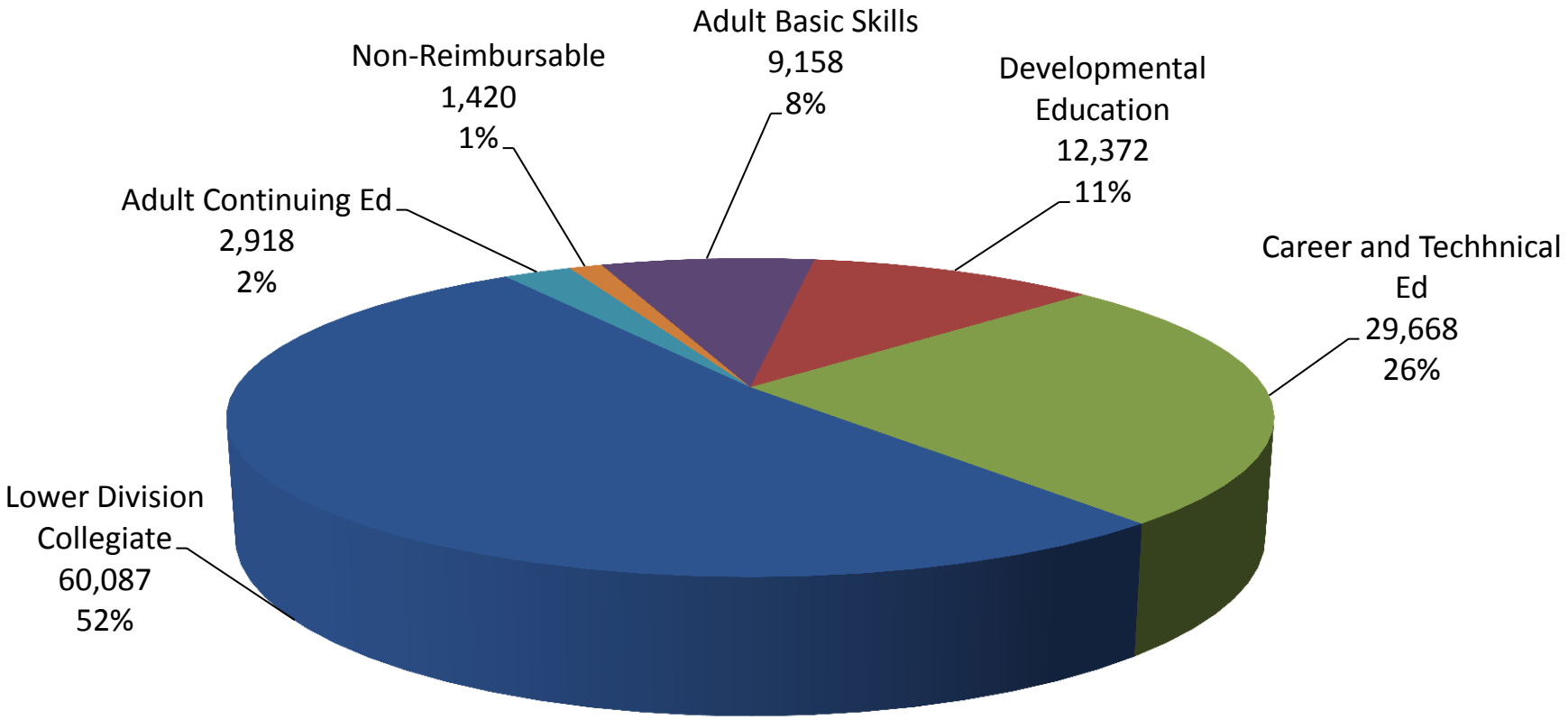
- Any DevEd: 63 percent
- DevEd math: 38 percent

Pell grant recipients:

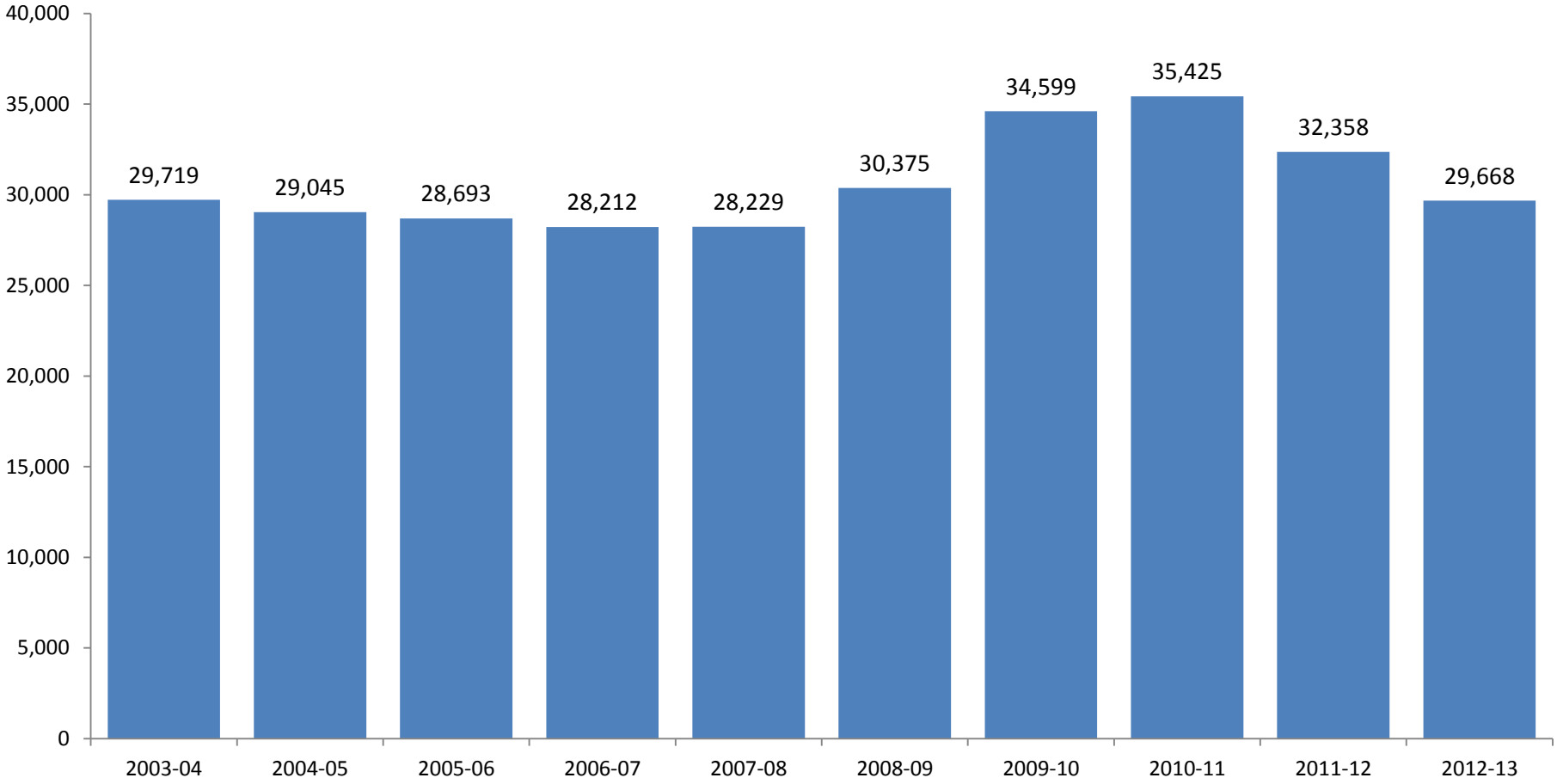
- Any DevEd: 73 percent
- DevEd math: 44 percent

What Does STEM Look Like in Community Colleges?

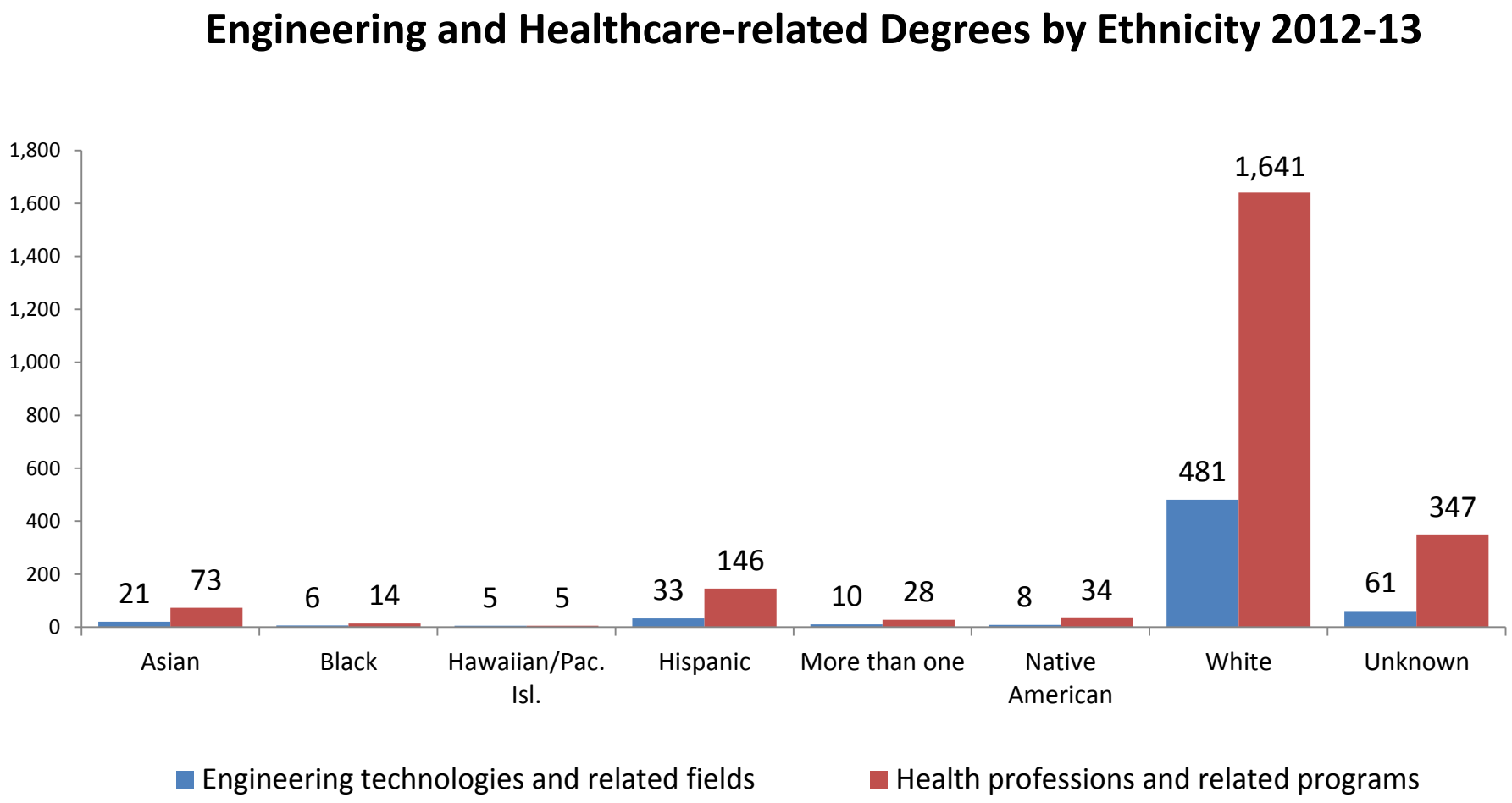
Community College FTE by Program Area 2012-13



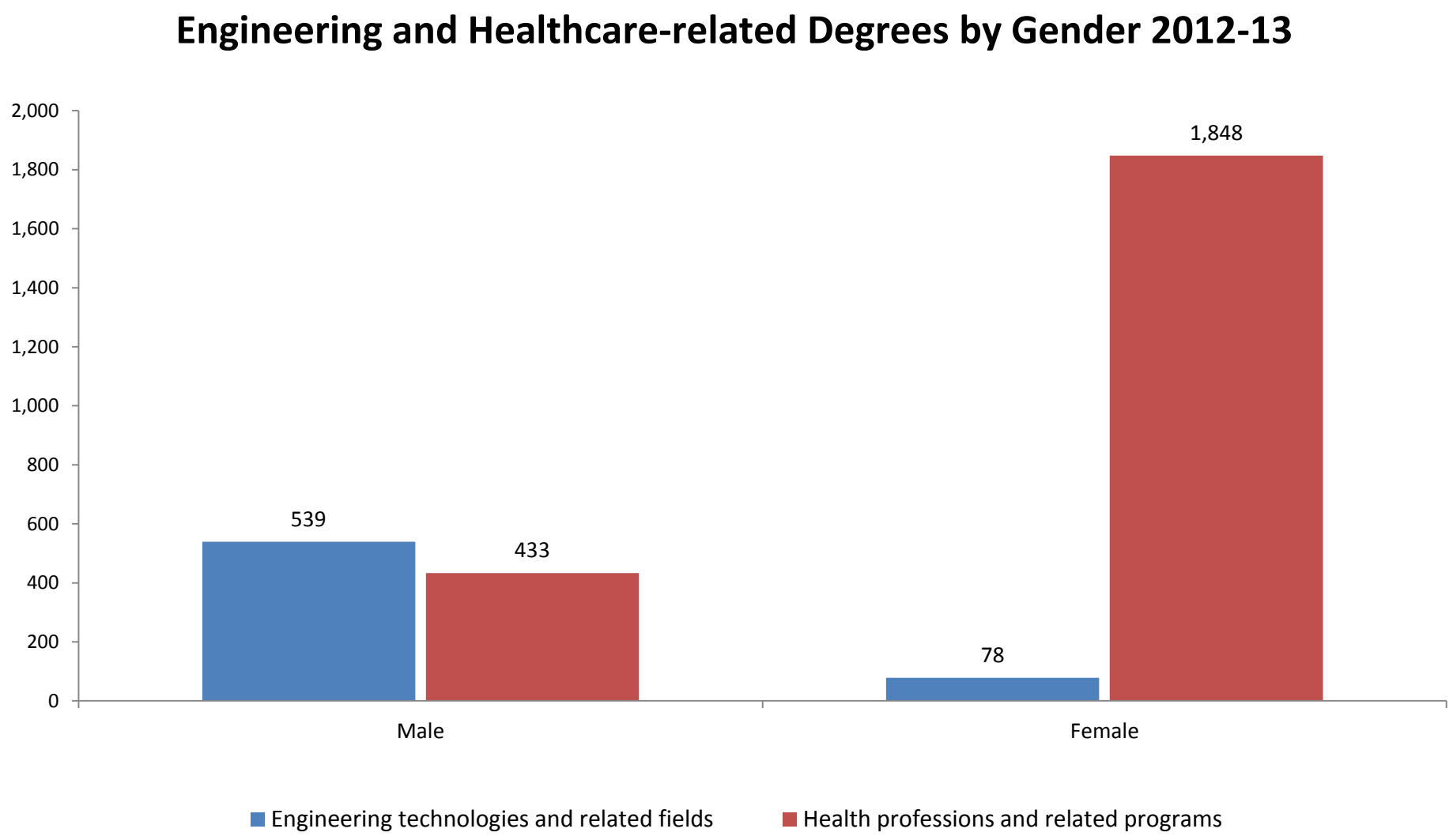
Career Technical Education Enrollment



STEM-related Awards 2013-14



STEM-related Awards 2013-14



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Developmental Education Participation Rates and Outcomes of Oregon Public High School Graduates at the Oregon Community Colleges

Michelle Hodara
Education Northwest

STEM Investment Council
February 24th, 2014

OR CCR Research Alliance

Goal:
Increase Oregon students' college and career readiness and success

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Developmental Education Study Questions

1. Participation rates?

2. Predictors of participation?

3. Progression, persistence, & degree attainment?

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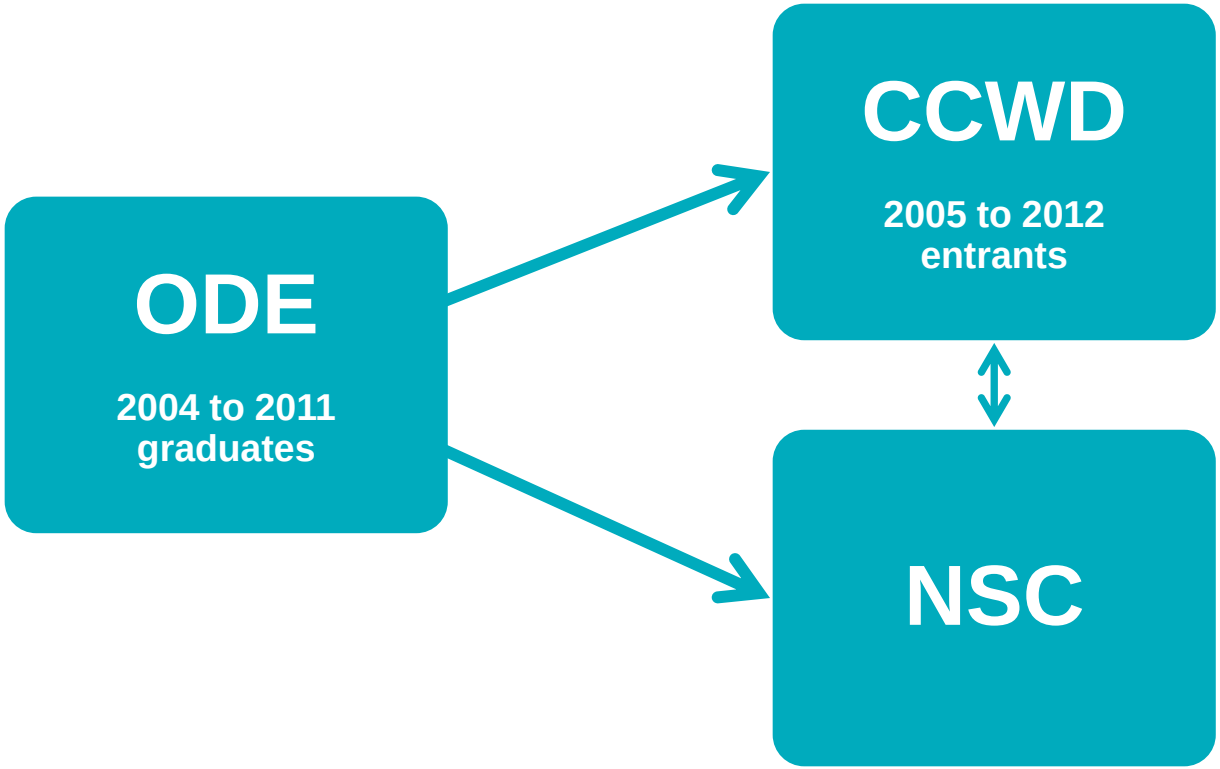
Data Sources and Sample



101,812 Oregon public high school graduates at the Oregon community colleges after high school graduation

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Sample Characteristics

<u>Demographics</u>

- 47% male, 53% female
- Avg. age at entry = 20 years old
- 37% received free-reduced price lunch

<u>Most popular major</u>

- Arts, Humanities, & English (57%)

Developmental Education Study Questions

1. What are rates of developmental education participation at the Oregon community colleges?

Sample: 101,812 students graduated in 2004/05-2010/11 and entered community college 2005-2012

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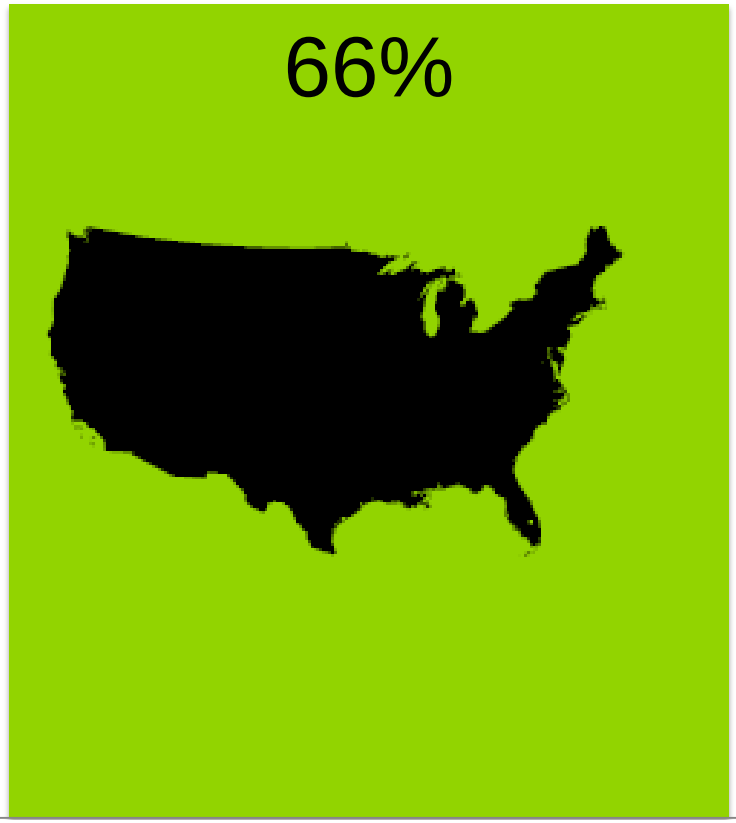
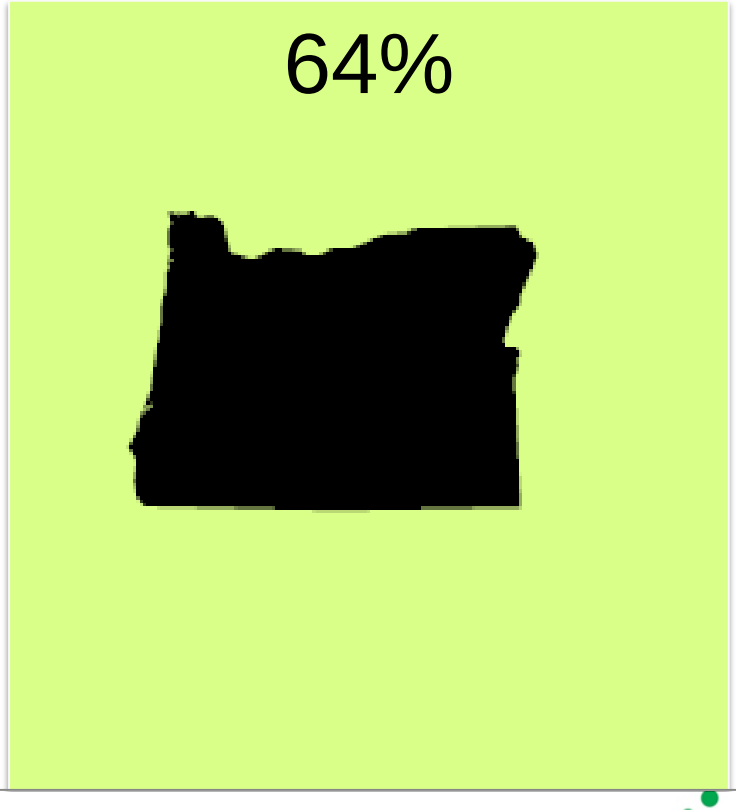
Rates of developmental education participation among HS graduates

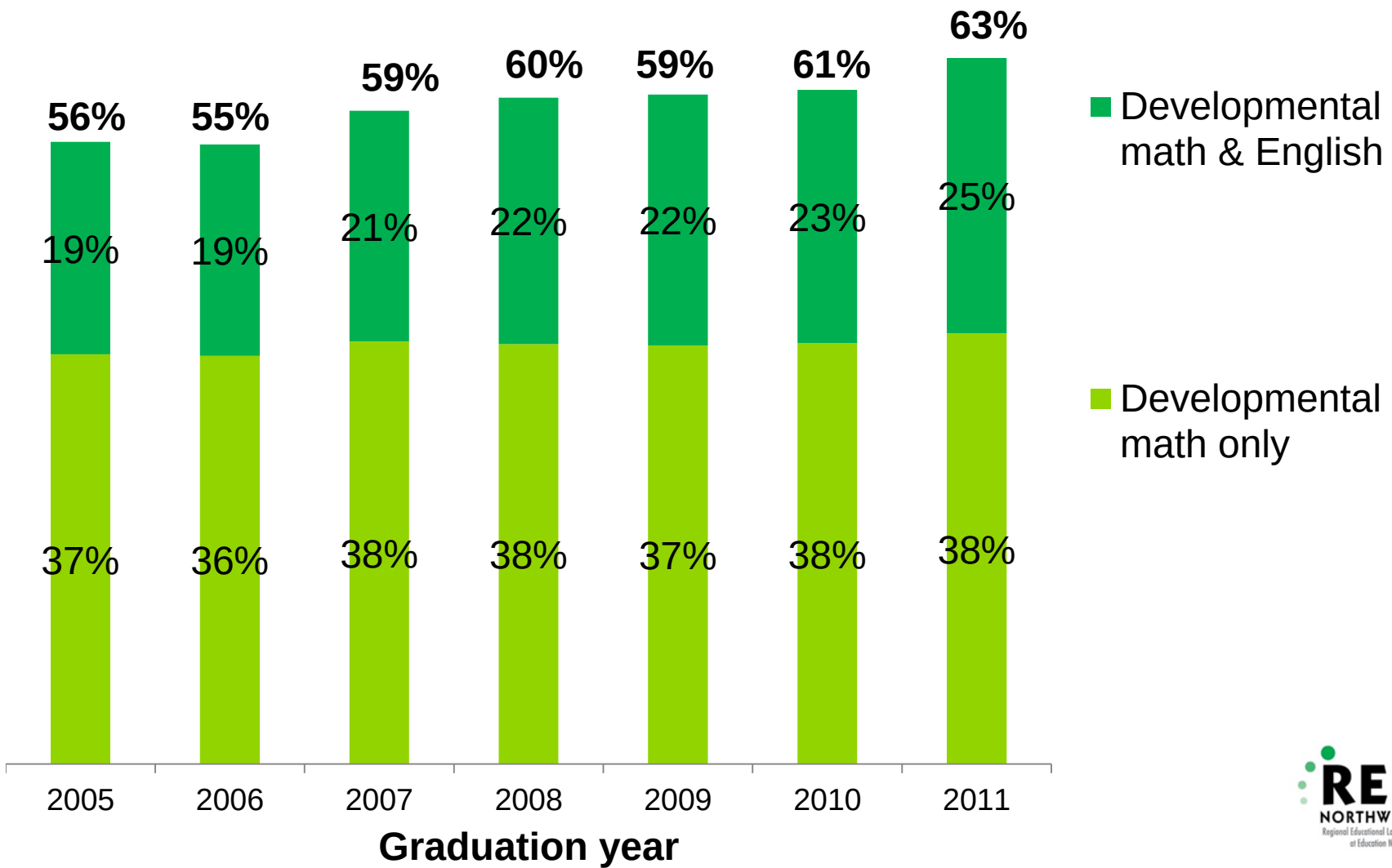
Oregon rate similar to national avg.





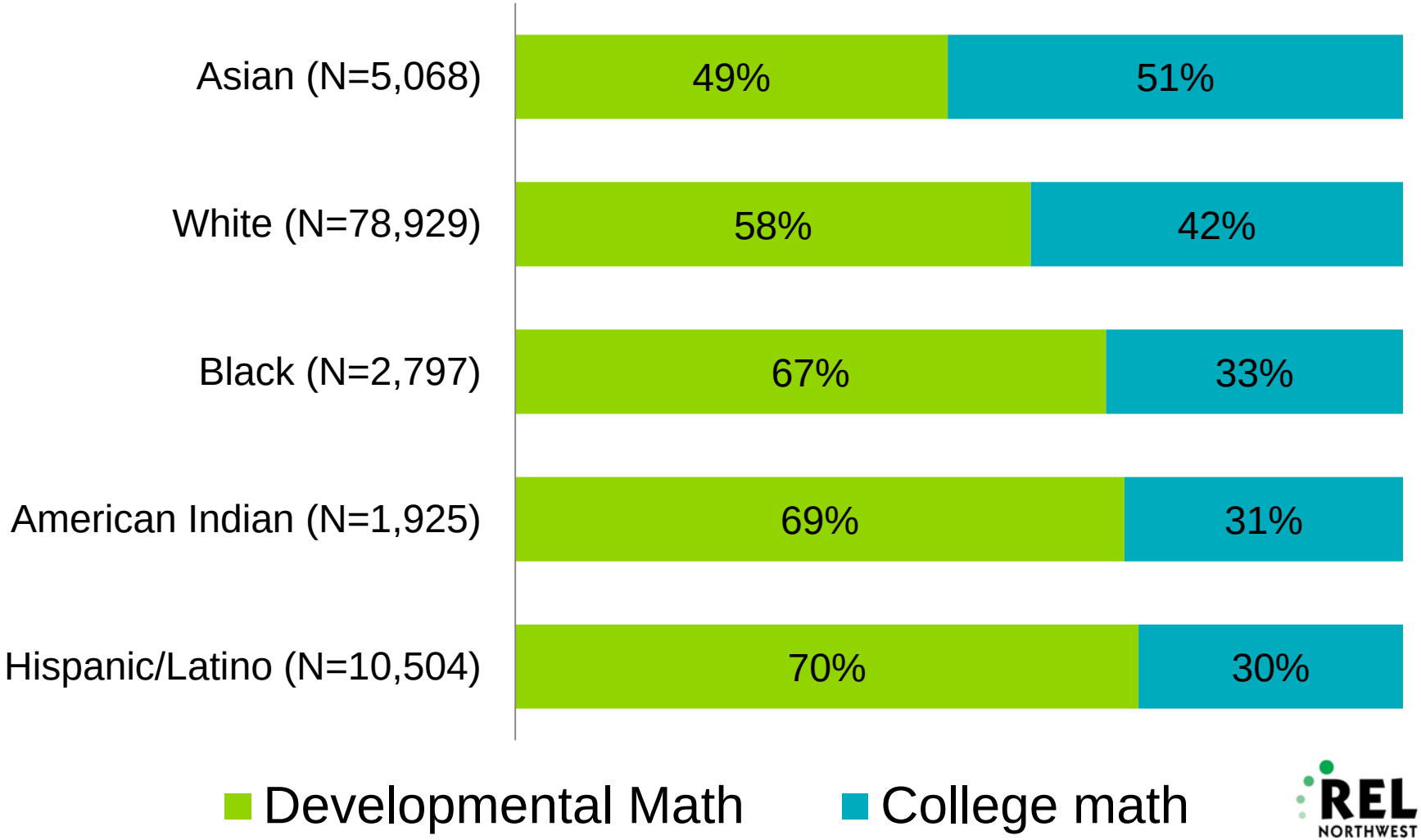
Developmental math enrollment by cohort

Participation in developmental math has increased from 56% to 63% for high school graduates.



Developmental math enrollment by race/ethnicity

Black, Latino, and American Indian students enroll in developmental math at much higher rates than White and Asian students.



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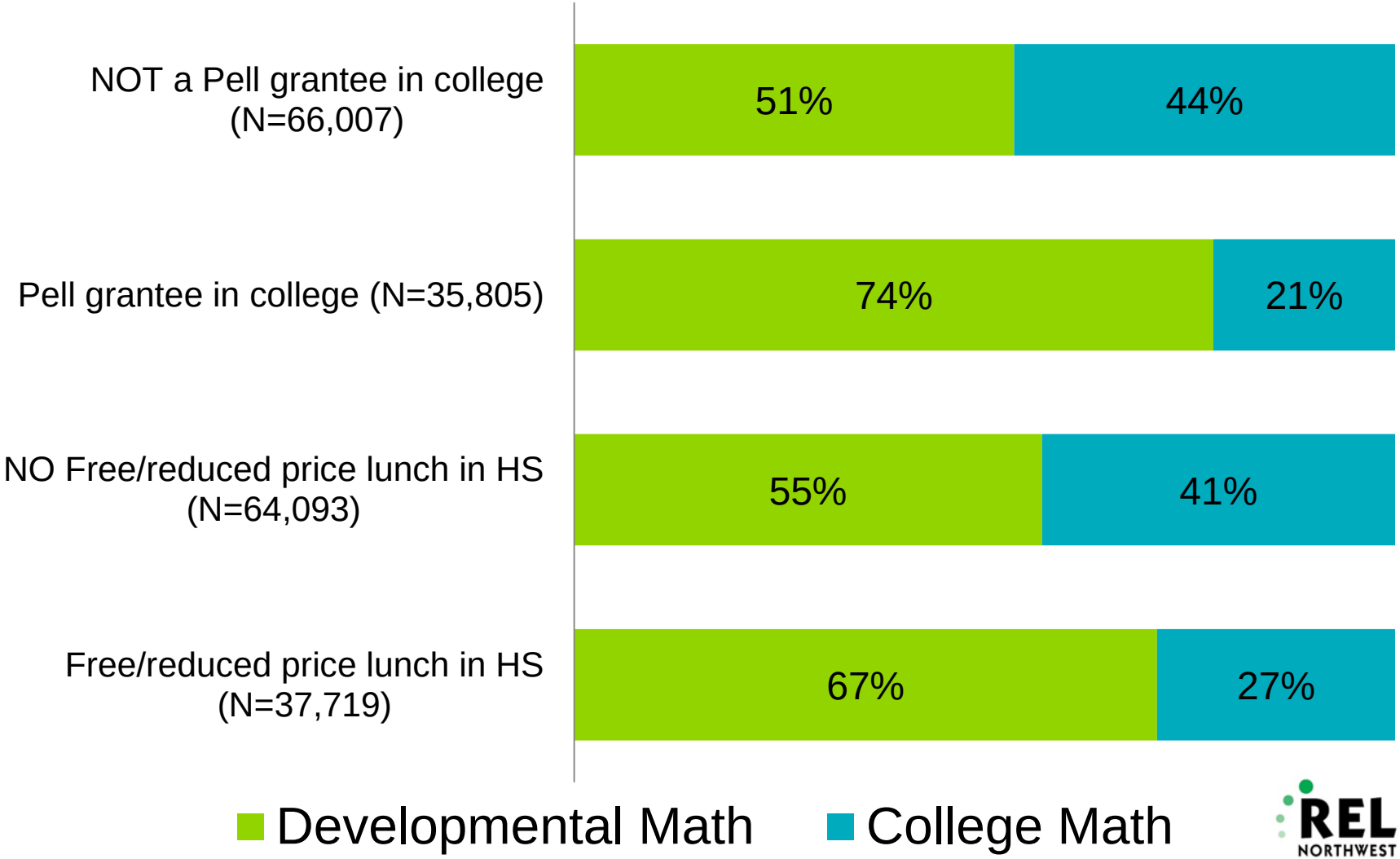
Developmental math enrollment by SES indicators

Almost 3 in 4 Pell grantees enroll in developmental math compared to half of students who do not receive Pell.



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Developmental Education Study Questions

2. What predicts developmental math participation?

Sample: 101,812 students graduated in 2004/05-2010/11 and entered community college 2005-2012

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Findings with Implications for Equity

Predicts student will enroll in developmental math….	Predicts student will start college in college-level math….
• Female • American Indian • Latino • Receiving any type of college financial aid	• Black (after controlling for SES) • Free-reduced price lunch (after controlling for college financial aid)

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Potentially Actionable Findings

Predicts student will enroll in developmental math….	Predicts student will start college in college-level math….
• Delaying college enrollment • Repeating a HS grade • Any OAKs rating that is not "exceeds"	• Enrolling in dual credit course in math, English, trades (CTE), Science, Languages, History, or Social Science

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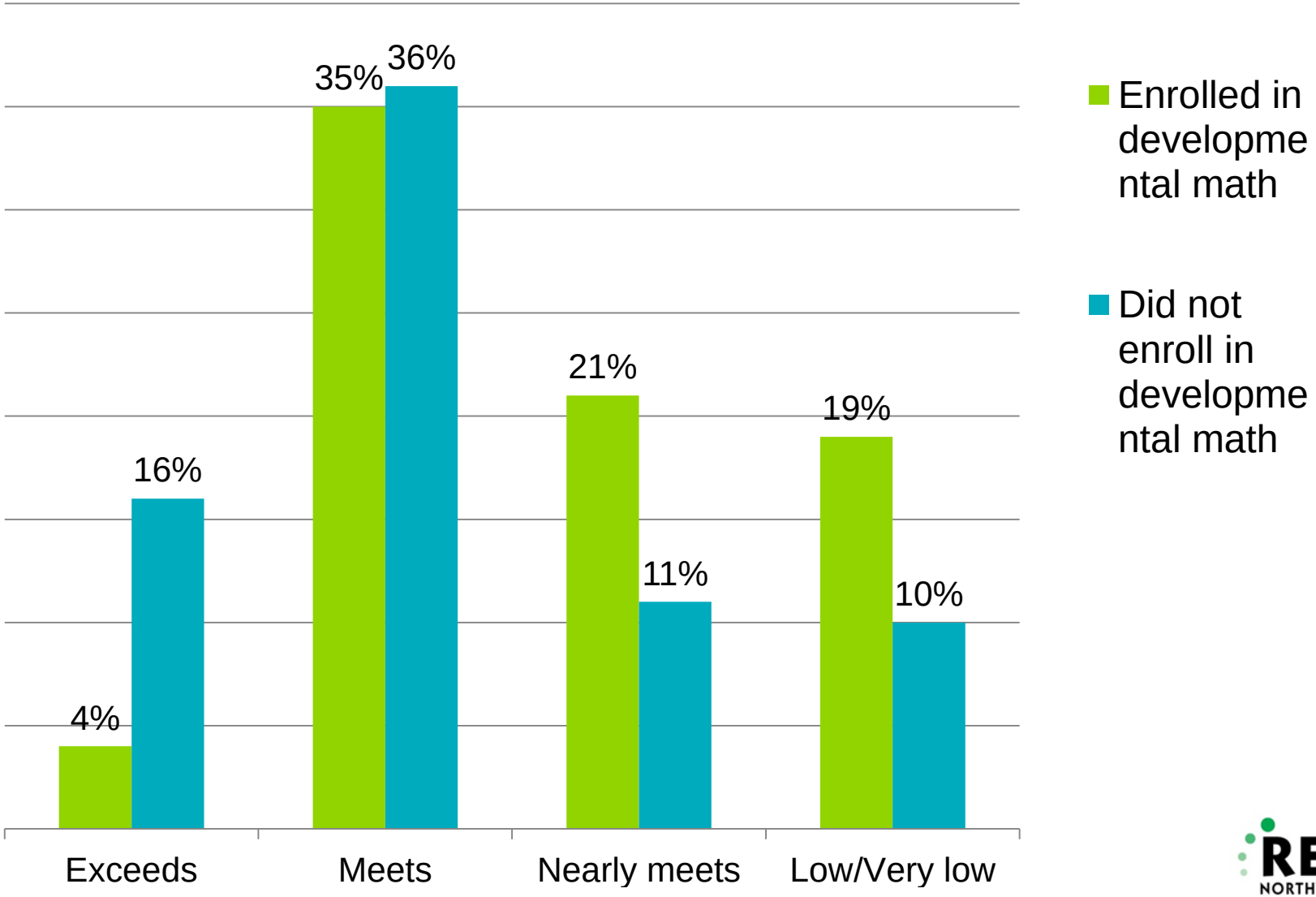
OAKS performance levels



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Developmental Education Study Questions

3. What are long-term progression, persistence, and degree attainment outcomes?

Sample: 58,400 students graduated in 2004/05-2006/07 and entered community college 2005/06-2007/08, tracked to 2012

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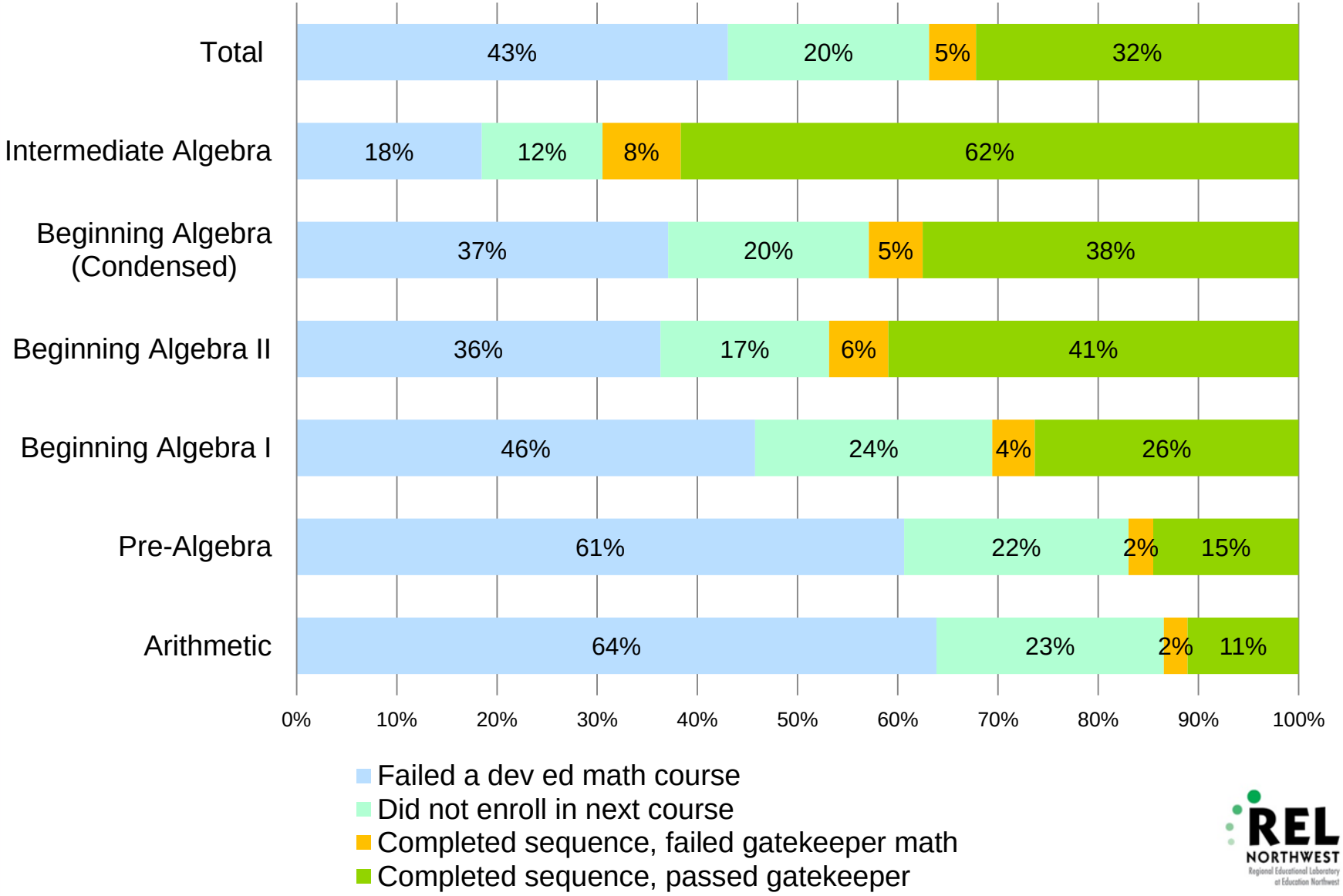
Math course starting level	Student starting level N = 58,400	STEM major starting level N = 1,895	Health major starting level N = 2,512	CTE major starting level N=2,674)
College math (105+)	20%	35%	12%	10%
Intermediate algebra (95)	10%	15%	13%	5%
Beginning algebra (Condensed) (70)	6%	4%	10%	3%
Beginning algebra II (65)	7%	7%	7%	4%
Beginning algebra I (60)	18%	13%	17%	18%
Pre-algebra (20)	12%	5%	14%	12%
Arithmetic (10)	3%	2%	8%	4%
Applied/technical math	1%	<1%	2%	6%
No Math	23%	17%	18%	37%

Progression through developmental math by course starting level

About 1 in 3 developmental math students complete a college math course.



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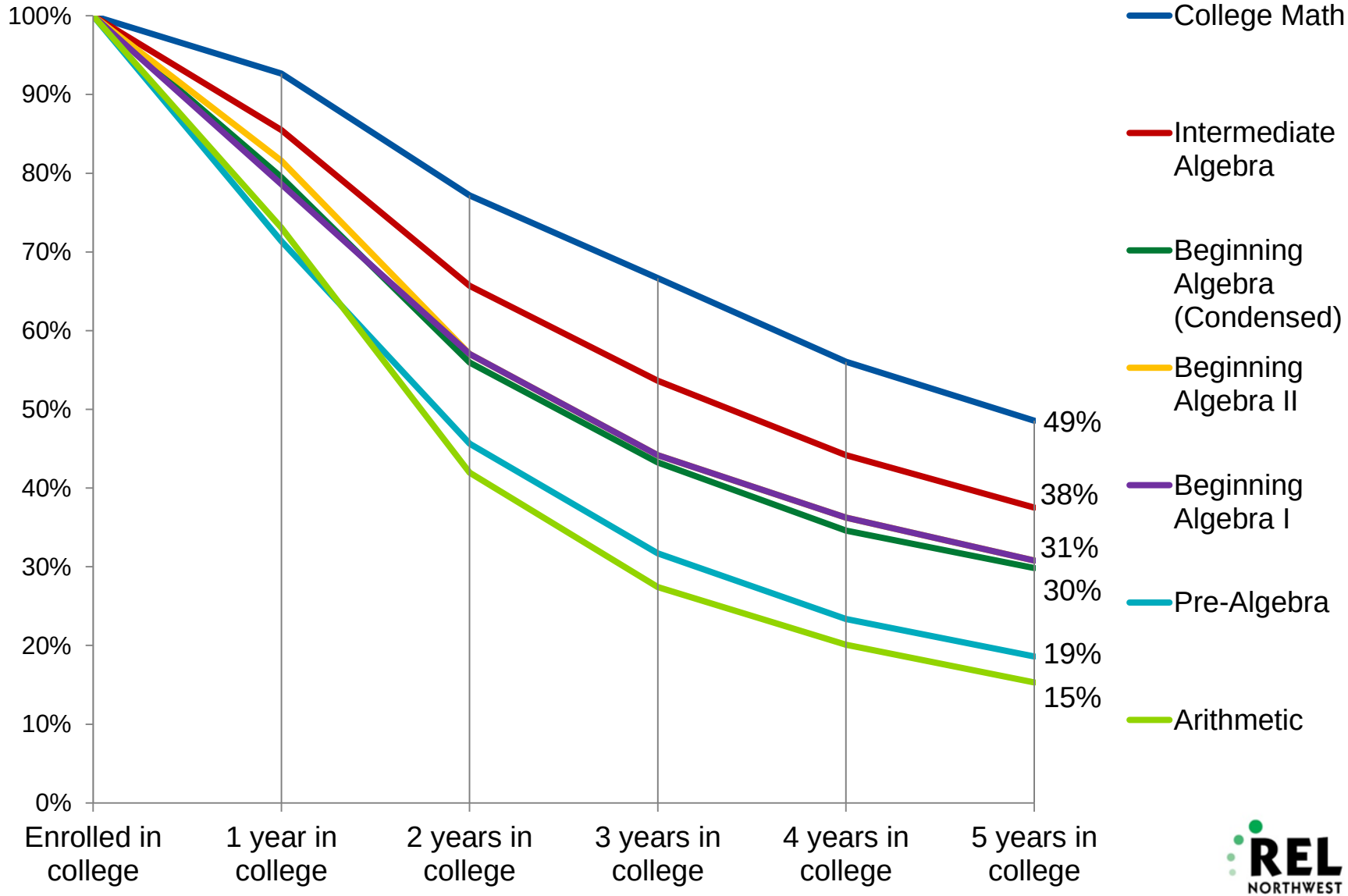
College persistence and/or degree attainment by math starting level

College persistence decreases the lower students start in math.



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Degree attainment by math starting level

A similar proportion of students earn terminal credentials, regardless of math starting level, but AA/BA attainment decreases the lower students start in math.

	Earned a certificate	Earned an AGS	Earned an AAS	Earned an AA/AS	Transferred to a 4-year college	Earned a 4-year degree	Any cred.
College math	1.9%	2.0%	3.2%	15.6%	69.7%	35.6%	**42.8%**
Intermediate algebra	2.8%	2.9%	4.3%	13.5%	47.2%	21.6%	**31.3%**
Accelerated Intro algebra	2.6%	2.1%	4.7%	10.7%	33.4%	14.6%	**24.3%**
Intro algebra II	3.7%	3.1%	5.4%	9.1%	35.9%	14.6%	**25.4%**
Intro algebra I	2.8%	2.9%	4.5%	7.3%	27.9%	11.0%	**20.9%**
Pre-Algebra	2.9%	2.0%	2.2%	4.2%	19.4%	6.7%	**13.7%**
Arithmetic	2.6%	0.8%	2.7%	3.1%	14.5%	4.6%	**11.1%**

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Study lessons

- Developmental math participation is high and increasing
- Regardless of educational achievement, females, American Indian, Latino and low-SES students are more likely to start college in developmental math
- Certain dual credit coursework has a positive association with starting college in college math

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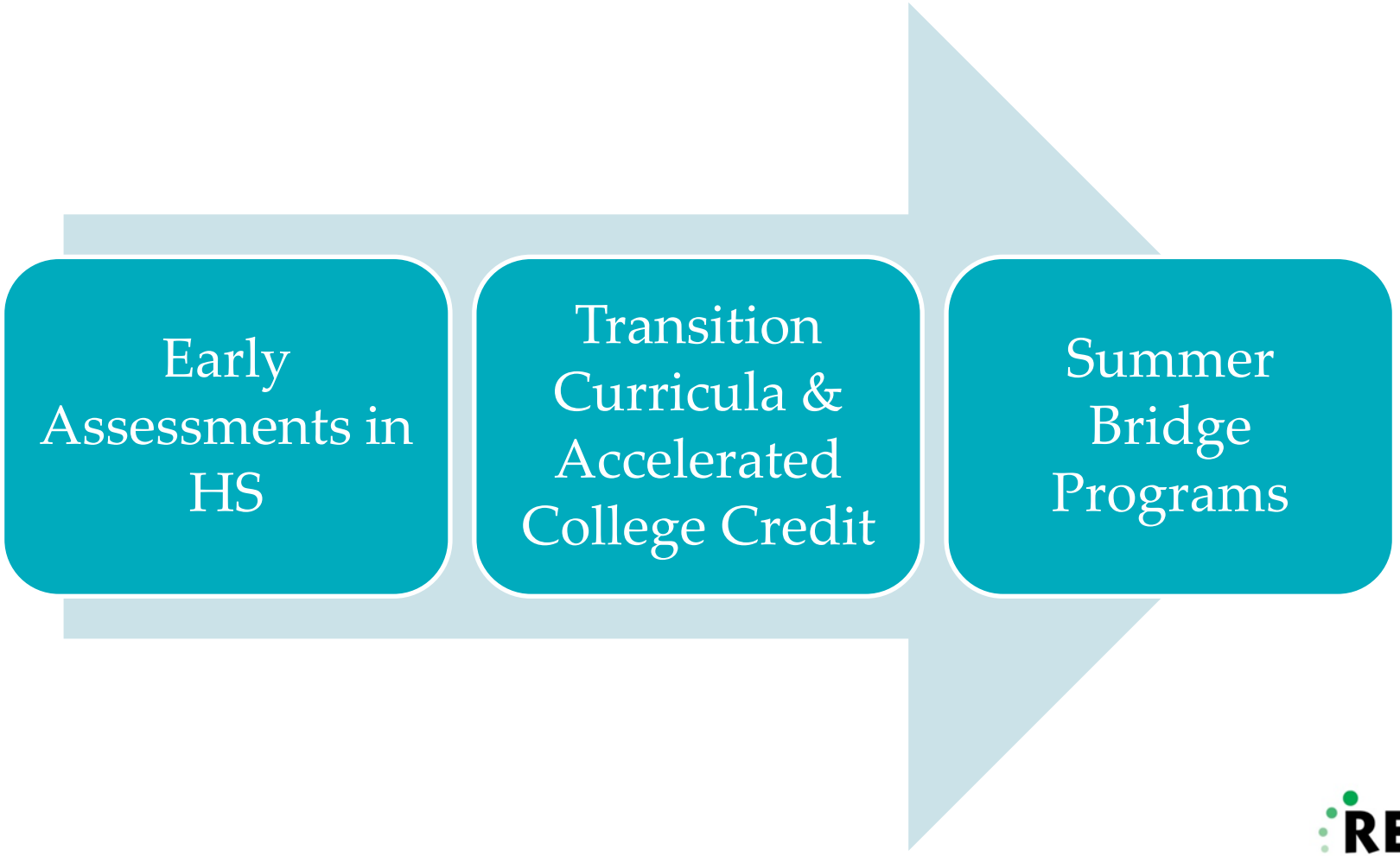
System-level approach to improving students' college math readiness



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Principal's Research Review

Supporting the Principal's Data-Informed Decisions

ISSN 1558-5948 VOL. 9, ISSUE 1 JANUARY 2014

Preparing High School Students for the Challenges of Postsecondary Math

By Michelle Hodara and Rhonda Barton

Math proficiency isn't just a stumbling block toward a high school diploma. A major challenge facing students as they pursue a postsecondary degree is a lack of academic preparedness for college-level math. When newly minted high school graduates arrive on campus, a high percentage of them are referred to developmental math (i.e., remedial courses that do not count toward their degree program).

According to national data on a 2003 cohort of students that was tracked to 2009 (Radford & Horn, 2012), more students participated in developmental math than developmental English: 60% of students who attended a public, two-year college took a developmental math course and 17% took a developmental English course. One-third of students who attended a public, four-year college and 22% of students who attended a private, nonprofit four-year college also took developmental math while fewer than 10% of students at these types of colleges took developmental English.

Beyond posing an obstacle to college math success, being academically underprepared in math can have consequences for students and reduce the probability that they will complete college. It can negatively affect their interest and success in science, technology, engineering, and math (STEM) fields; their opportunities in the labor market; and their lifetime earnings (Baum, Ma, & Payea, 2010; Executive Office of the President, 2012; Jacobson & Mokher, 2009; Rivera-Batiz, 1992).

Improving college math preparation is an important and complex task that calls for

Beyond posing an obstacle to college math success, being academically underprepared in math can have consequences for students and reduce the probability that they will complete college.

Just the Facts

- Accelerated college credit options generally offer high school students a more rigorous curriculum, an early indication of their readiness for college-level coursework at a particular institution or higher education system, and a better understanding of the expectations of college-level work (Speroni, 2011).
- Educators have increasingly implemented ACC programs to support the postsecondary preparation and success of all students, not just the highest-achieving (Lerner & Brand, 2006).
- Early assessment is a fairly widespread practice with 25 states supporting statewide early assessment programs (Barnett, Fay, Bork, & Trimble, 2013).
- According to recent national scans, bridge programs and boot camps, which are similar but often shorter in duration, are relatively common at colleges across the country (Edgecombe, Cormier, Bickerstaff, & Barragan, 2013; Sherer & Grunow, 2010).
- In the 2014–15 academic year, 45 states that have adopted the standards will administer new assessments aligned with Common Core to juniors and the states will set a minimum cutoff score at which students are considered to be college and career ready (Barnett & Fay, 2013).

nassp® national association of secondary school principals

reforms and interventions at both the secondary and postsecondary levels. This research review summarizes rigorous research on three popular strategies for improving high school students' college math readiness and success: accelerated college credit, early assessment, and summer bridge programs.

Accelerated College Credit

Accelerated college credit (ACC) options, such as AP classes, the IB program, dual credit, and dual enrollment, allow students to earn college credit while in high school. ACC options generally offer high school students a more rigorous curriculum, an early indication of their readiness for college-level coursework at a particular institution or higher education system, and a better understanding of the expectations of college-level work (Speroni, 2011). As a result, such options may improve students' transitions to college, decrease the likelihood that they will require developmental classes to access a full college curricula, and reduce the time it takes them to earn a degree.

Educators have increasingly implemented ACC programs to support the postsecondary preparation and success of all students, not just the highest-achieving (Lerner & Brand, 2006). The popularity of these programs is evident in the high percentage of US public high schools that are offering accelerated college coursework. During the 2010–11 school year, 82% of public high schools reported that students were enrolled in dual credit courses, 69% reported enrollments in AP or IB courses, and 59% reported enrollments in both dual credit and AP or IB courses (Thomas, Marken, Gray, & Lewis, 2013).

Florida is one of the few states that funds dual enrollment courses that allow high school students to earn college credits that count toward degree programs at the state's public postsecondary institutions (Speroni, 2011). Students must have a minimum 3.0 GPA and demonstrate college readiness on the state's college placement exam to be eligible to take dual enrollment courses. Speroni (2011) evaluated the effects of the dual enrollment program, in general, and the effects of taking college algebra, specifically—one of the most popular dual enrollment courses—and found that participation in a dual enrollment course did not improve students' high school graduation rate and postsecondary enrollment and completion.

Speroni's (2011) research did show, however, that specifically taking college algebra in high school improved students' college enrollment by 16 percentage points, associate degree attainment by 6 percentage points, and bachelor's degree attainment by 11 percentage points. The findings suggest that although the impact of dual enrollment in general is limited, taking more rigorous math in high school can have a significant impact on students' college access and success.

Early Assessment

Early assessments indicate whether high school students are academically prepared for college-level math and English. Early assessment is a fairly widespread practice with 25 states supporting statewide early assessment programs (Barnett, Fay, Bork, & Trimble, 2013). Typically, a postsecondary state agency in collaboration with the K–12 state agency offers all high school students a statewide assessment that measures readiness for college coursework in that postsecondary system.

In most early assessment programs, however, high schools are left to decide what interventions, if any, to provide to students who are not deemed college ready (Hodara, Jaggars, & Karp, 2012). Only eight states also have statewide "transition curricula," which are English and math courses offered in the senior year to students who are deemed to be not college ready by their performance on the tests. It is more common for K–12 state agencies to lead transition curricula initiatives rather than postsecondary state agencies.

A central component of California's Early Assessment Program (EAP)—developed by the California State University (CSU), the California Department of Education, and the California State Board of Education—is optional early testing on the 11th-grade state standardized exam that assesses students'

Laying an Early Foundation for Math Success

Students at Alice Ott Middle School in Portland, OR, are getting a jump on being ready for more demanding math courses. Alice Ott was recently recognized for its high math and reading achievement and selected by the National Association of Secondary School Principals [www.nassp.org] as one of its nine 2014 MetLife Foundation–NASSP Breakthrough Schools . Despite the fact that 70% of Alice Ott students are low income and nearly 40% are nonnative English speakers, the school got 75% of its students to pass the state math tests last spring.

Today's results are a far cry from 2008 when just over half of the students were at grade level in math. Principal James Johnston and his staff members have been slowly building the math program by introducing a daily 80-minute math class for all students who aren't "exceeding" or "high-achieving" in math. "We've also provided incentives so students who exceed benchmarks in sixth and seventh grade move to prealgebra or algebra and they earn an extra elective so they have math every other day," he explained. Students who are even more advanced are bussed to the local high school for higher-level math classes.

Professional learning teams have also contributed to the school's success. A late start on Wednesdays provides one hour for grade-level teams to study students' data, develop common assessments, and identify supports to meet each student's needs. Johnston and his vice principal rotate among the groups to offer their input. Other pieces of the puzzle include a focus on reducing absenteeism and building parent engagement. Each month teachers are required to make 10 parental contacts by phone and send postcards and e-mails, communicating with families about the good things their students are doing, as well as any problem areas.

"Our mantra is 'champions find a way,'" Johnston said. "My job as principal is to provide the infrastructure for a place that challenges students to do their best regardless of identifying labels."

readiness for college math and English in the CSU system. Through this test, students are identified for participation in EAP and are more likely to work on their math skills in their senior year, increasing their chances of placing into college math as a freshman than those who did not receive additional support. According to a study by Howell, Kurlaender, and Grodsky (2010), California's EAP had a positive impact on placement into college math. High school juniors in the 2003–04 school year who were identified through the test and participated in EAP were about four percentage points less likely to be referred to remedial math at CSU-Sacramento than juniors in 2001–02 (before EAP was developed).

Summer Bridge Programs

Summer bridge programs have a long history in higher education and usually are geared to students who are placed into remediation through testing or to students entering STEM programs who are not prepared for the first college math course in the program (often precalculus or calculus). Bridge programs are typically designed to improve students' math skills, as well as orient them to the college culture, build their study skills, and provide a network of support prior to enrolling. According to recent national scans, bridge programs and boot camps, which are similar but often shorter in duration, are relatively common at colleges across the country

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(Edgecombe, Cormier, Bickerstaff, & Barragan, 2013; Sherer & Grunow, 2010).

A randomized experiment evaluated the effects of the Texas developmental summer bridge program offered to recent high school graduates whose college placement tests showed that they required remediation at two open-admissions, four-year colleges and six community colleges across the state in the summer of 2009 (Barnett et al., 2012). Although the programs at each college varied, they shared similar features: accelerated instruction in math, reading, and writing to prepare students to retake the placement exams; academic support outside of class through individual tutoring; and a college knowledge component provided through a college success course or presentations and workshops. In addition, the programs offered an initial stipend of $150 to improve recruitment efforts and $250 after completion of the program to encourage students to finish.

After agreeing to take part in the study, participants were randomly assigned to the summer bridge treatment or the control group. A higher proportion of students in the treatment group than the control group passed a college-level math course through fall 2010, but by spring 2011 there was no significant difference in the proportion of treatment group and control students who passed college math.

The statistically similar college math pass rates of the treatment and control groups signify that even if the Texas summer bridge program helped more treatment students place into college math, it had no long-term impact on helping them pass college math. Also, there were no statistically significant differences between the two groups in the total semesters registered over the two-year period and the number of college credits attempted and earned. The findings suggest that short-term programs, particularly those that focus on improving placement test performance, may not have a meaningful effect on students' long-term college success.

Conclusion

Presently, the evidence on interventions that are intended to improve college math readiness and success is limited, but promising. Dual enrollment algebra in Florida, early assessment in California, and summer bridge programs in Texas appear to have had positive impacts on students. However, the impact of the Texas summer bridge program faded over time. That suggests that interventions for high school students who are underprepared for college math may need to be more connected and comprehensive to have an enduring impact on educational outcomes.

In a more connected and comprehensive approach, high schools would offer students early assessments to test their college readiness in their junior year and, just as important, provide transition curricula in the senior year to students whose test results show they are not college ready. For students who continue to struggle in math, colleges would offer summer bridges and boot camps that address gaps

in students' math skills and understanding, as well as build their college knowledge and connect them to campus life and a network of support.

The Common Core State Standards provide an opportunity for public secondary and postsecondary systems to offer a connected set of supports for high school students transitioning to college. In the 2014–15 academic year, 45 states that have adopted the standards will administer new assessments aligned with Common Core to juniors and the states will set a minimum cutoff score at which students are considered to be college and career ready (Barnett & Fay, 2013). For students who score below the cutoff, high schools and colleges have the opportunity to work together to develop transition curricula and prematriculation summer programs for students who are deemed underprepared for college math.

Offering ACC, early assessments, and bridge programs often requires partnerships between secondary and postsecondary schools and systems. Although that cooperation demands greater effort, collaborative programs to improve students' college math readiness and success may have a significant and lasting impact on students' math learning before they reach college and their overall success once they arrive there. PRR

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Supporting students of color in post-secondary STEM

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Louis Stokes Alliance for Minority Participation (LSAMP)

Goal: Double the number of baccalaureate degrees awarded to URM in STEM

- Increase pathways to college for URM students while strengthening their interest in pursuing STEM careers;
- Create a culture and community of success for URM STEM majors on four-year college campuses to improve retention and graduation rates; and
- Expand opportunities for URM STEM majors to participate in campus-based and national undergraduate research experiences.

Unique challenges of students of color in STEM

- Social Isolation
- Lack of Academic Preparedness
- Hostile Environment
- Family Influence
- Finances

Predicting Graduation in Engineering

- Most accurate predictor:

  First Term GPA

  Hartman 2013

Programs to assist with a successful High School to College transition are critical to academic achievement

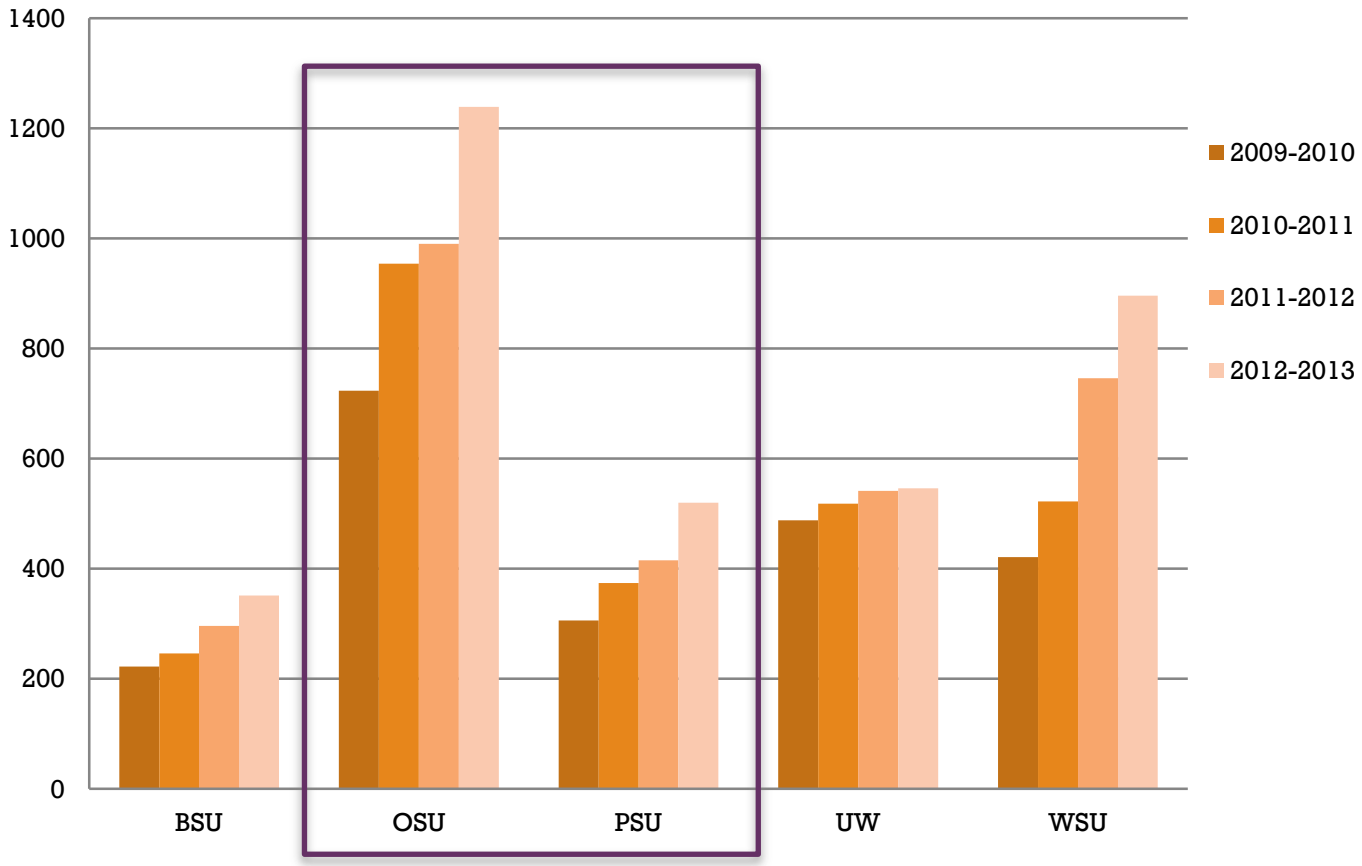
LSAMP: A Culture for Success

- **Summer Bridge and Fall Term Orientation Course** Leadership Development Program: strategies for coping with the physical, social and academic geographies of college life.

- **Mentor Program:** Peer and Faculty Connections

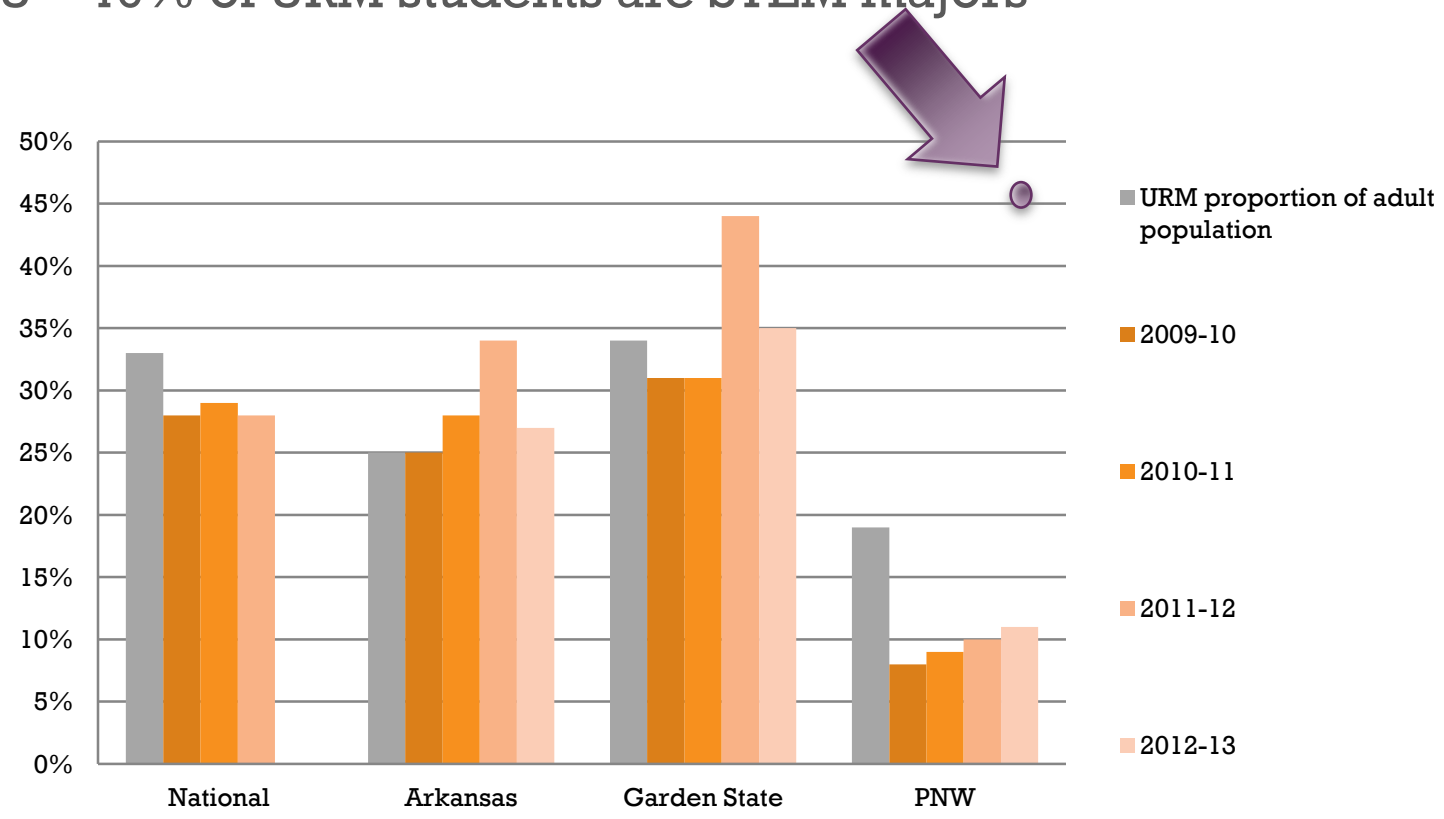
- **Undergraduate Research Opportunities:** Strengthening commitment to scientific careers

URM STEM Enrollments



URM as % of all STEM Students

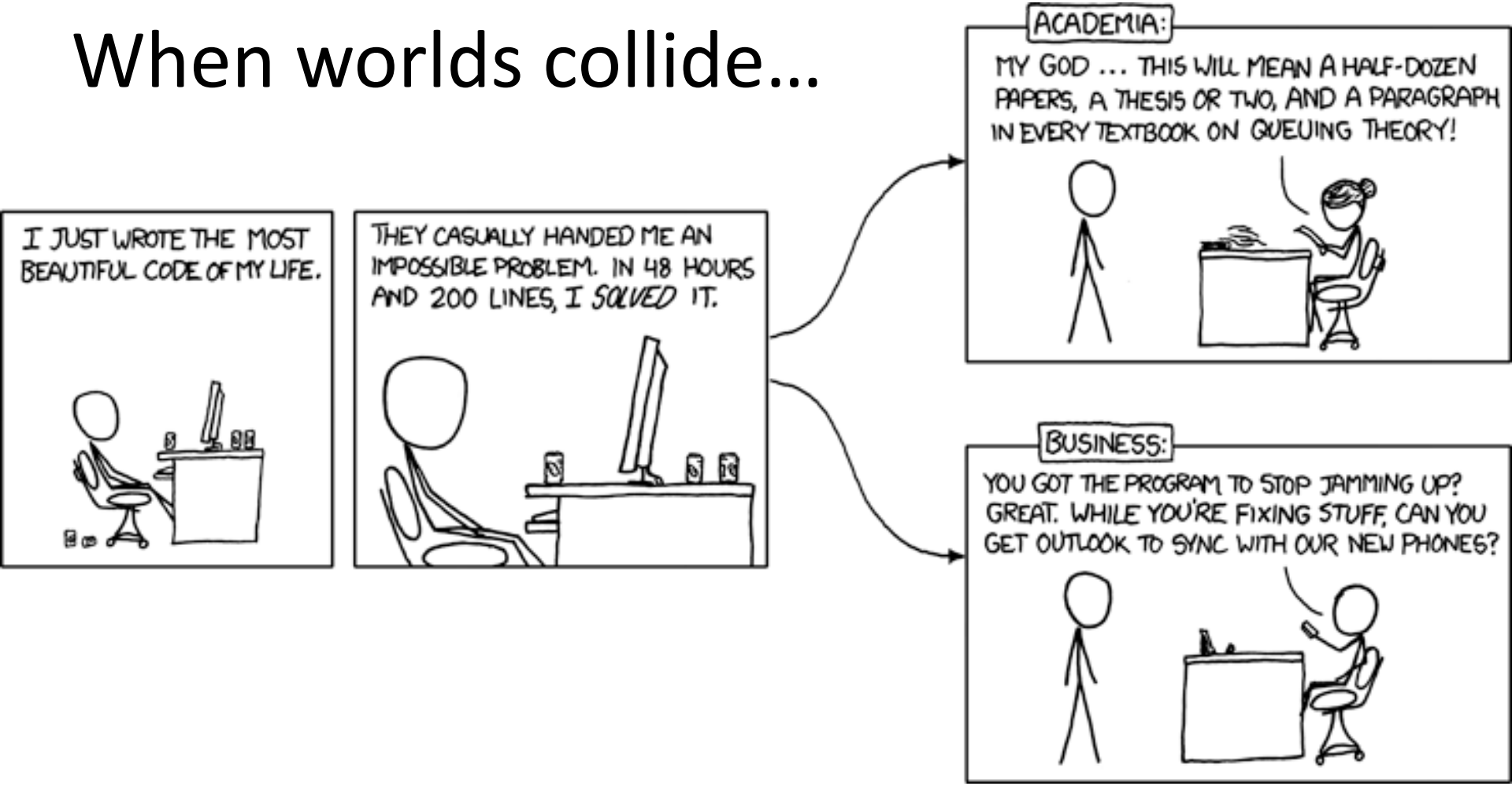
- OSU – 46% of URM students are STEM majors



ETIC

An industry-higher education collaboration for STEM-educated citizens...

When worlds collide…



- Any successful collaboration must start with an understanding and appreciation of the value of the differences in culture.

xkcd.com This work is licensed under a Creative Commons Attribution-NonCommercial 2.5 License.

*Actually, we see the same challenges…

"…a dawning awareness that America's future will depend on an unprecedented determination to develop human talent as broadly and fully as possible:

- **In an era when knowledge is the key to the future**, all students need the scope and depth of learning that will enable them to understand and navigate the dramatic forces—physical, cultural, economic, technological—that directly affect the quality, character, and perils of the world in which they live.
- **In an economy where every industry—from the trades to advanced technology enterprises—is challenged to innovate or be displaced**, all students need the kind of intellectual skills and capacities that enable them to get things done in the world, at a high level of effectiveness.
- **In a democracy that is diverse, globally engaged, and dependent on citizen responsibility**, all students need an informed concern for the larger good because nothing less will renew our fractured and diminished commons.
- **In a world of daunting complexity**, all students need practice in integrating and applying their learning to challenging questions and real-world problems.
- **In a period of relentless change**, all students need the kind of education that leads them to ask not just "how do we get this done?" but also "what is most worth doing?" "

**College Learning for the New Global Century*:
A Report from the National Leadership Council for Liberal Education and American Promise

And value the same qualities…

Students becoming well-rounded citizens—prepared with crucial, life-long skills—to work to solve the complex problems we face together.

*And value the same qualities…

Moreover, employers are calling with new urgency for graduates who are broadly prepared and who also possess the analytical and practical skills that are essential both for innovation and for organizational effectiveness:

- "**Employers do not want, and have not advocated for, students prepared for narrow workforce specialties**. . . . Virtually all occupational endeavors require a working appreciation of the historical, cultural, ethical, and global environments that surround the application of skilled work." (Roberts T. Jones, president, Education Workforce Policy, LLC)
- "Intel Corp. Chairman Craig Barrett has said that 90 percent of the products his company delivers on the final day of each year did not exist on the first day of the same year. To succeed in that kind of marketplace, U.S. firms need **employees who are flexible, knowledgeable, and scientifically and mathematically literate**." (Norman R. Augustine, retired chairman and chief executive of Lockheed Martin Corporation)
- "[The] curriculum needs to help students develop . . . **leadership, teamwork, problem solving, time management, communication and analytical thinking**." (Business-Higher Education Forum)
- "[Business leaders are] **frustrated with their inability to find '360 degree people**'. . . ." (Findings from 2006 focus groups among business executives)
- "**Integrated capabilities** are the key to this industry's future." (Keith Peden, senior vice president of human resources, Raytheon Company, 2006)

**College Learning for the New Global Century*:
A Report from the National Leadership Council for Liberal Education and American Promise

And value the same qualities…

University mission statements:

- **Oregon State University** promotes economic, social, cultural and environmental progress…by **producing graduates competitive in the global economy**…
- **University of Oregon**… with a goal of helping the individual learn to **question critically, think logically, communicate clearly, act creatively, and live ethically** ; the establishment of a framework for lifelong learning that leads to productive careers and to the enduring joy of inquiry energizing the state's economic, cultural, and political structure
- **PSU:** values intellectual inquiry in its undergraduate and graduate programs… **creates opportunities for the application of knowledge to real-world problems**. ;
- **OIT:** To foster student and graduate success, the university provides an intimate, hands-on learning environment, focusing on **application of theory to practice.**

Oregon is not weird

- What is happening here in higher education is happening elsewhere…

- Reading
  - To understand the insides of higher education and the coming market system: *Saving Alma Mater*; James Garland

  - To see how university structure arose and how it can change: *The Innovative University: Changing the DNA of Higher Education,* Clayton Christensen

  - To have the best summary of a way forward: *College Learning for the New Global Century*: A Report from the National Leadership Council for Liberal Education and American Promise

Education is a shared responsibility

- Leverage the community: success for students relies on **learning from the best of both industry and higher education**. This is **especially true** in higher education, as students prepare for careers.
  - Each is good at different things, and both are important.
  - May need changes in perspective and pedagogy to engage industry where they are the best teachers.

- Recognize the changing social contract between industry and higher education.
  - In research…
  - In education…

- Acknowledge that we need new ways to work together.

Building effective platforms for sharing responsibility in education

- **Crucial elements for success:**
  - Influence: we believe we can make a difference
  - Support: we have the tools to help us do so

- **Build agile, "generative" platforms**:
  - Provide ***clear direction to outcomes*** and the ***tools to build results***.
  - Then leave it to the community to engage and decide how to do the work.

- **The Engineering and Technology Industry Council, ETIC, is an example** of a successful generative platform that enables shared responsibility in higher education. ETIC has been producing results for 15 years in Oregon.

Mission Focus

- Meeting urgent industry needs
- Upgrading existing talent
- Providing opportunity for new talent

Investment Quality

- Providing greatest benefits
- Avoiding duplication of existing resources
- Sharing resources across institutions
- Minimizing cost to the public

Results

- Measuring performance
- Leveraging private investment

What are the ETIC tools?

- **Legislature** provides money to invest in engineering education under the guidance of the industry council.
- **Council** provides the industry viewpoint on priorities and quality of investments, based on outreach to the industry community.
- **Higher education** provides their talents to create programs to deliver to the needs.
- **Industry and the community** provide private funding and resources.

Now, what value has been created?

- Most of all, the collaboration between industry and higher education, leading to responsiveness to needs. It has been agile…and generative.

- Tangible outcome: ***enabling Oregon's high tech community to grow*** through:
  - Significant increase in engineering graduates from all of the universities in critical needs areas over the past 14 years.
  - Access to high quality faculty that contribute to the both education and research needs of the state's industry.
  - Collaboration across universities to meet industry needs.
  - Increased commitment to seeking funding from private sources to achieve public good.

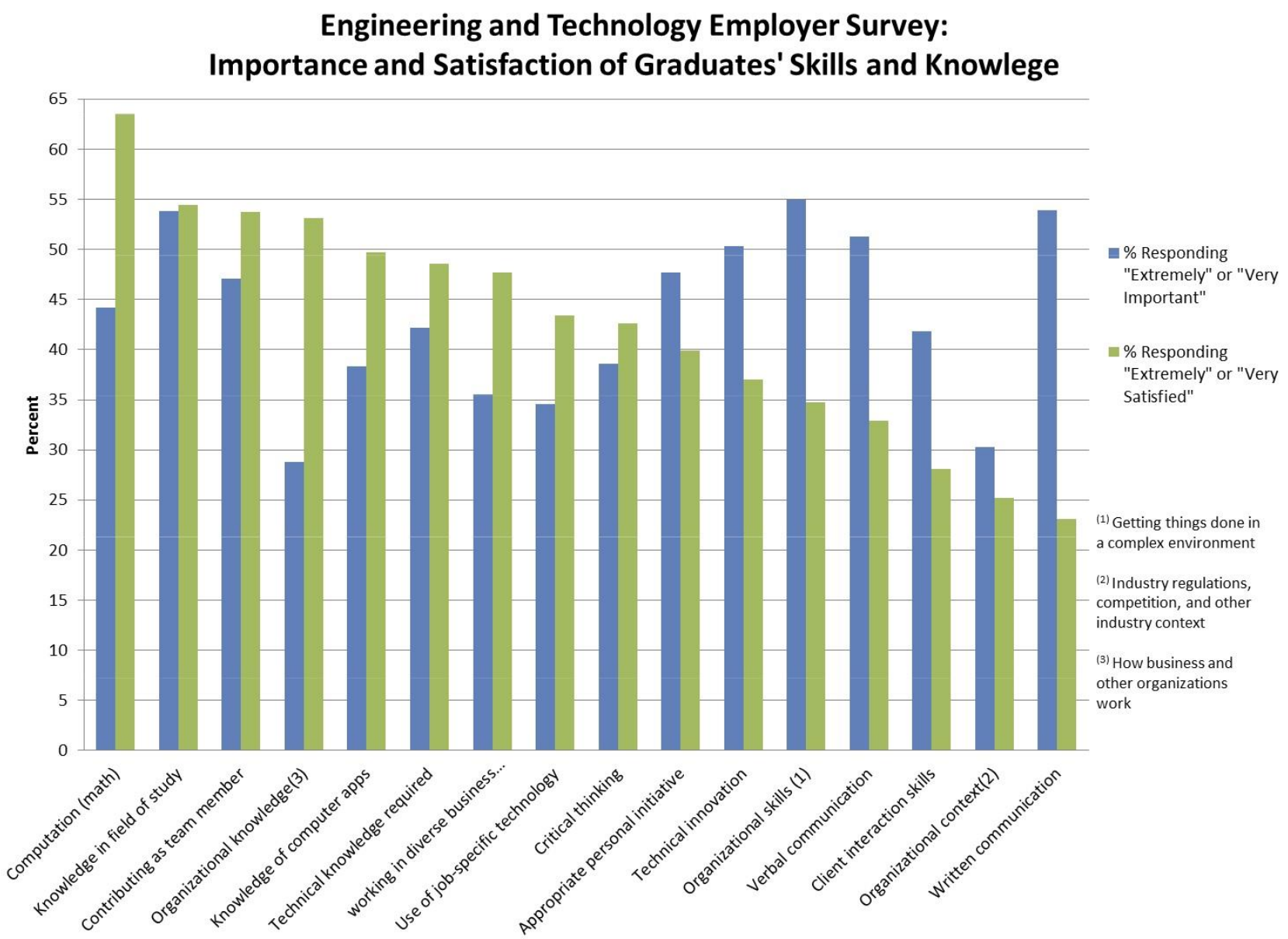
- Mutual influence and understanding that spreads well beyond the ETIC council itself!

What is next?

- Since ETIC is generative, it can shift to address new needs areas as they arise, and use different techniques to achieve results.

- ETIC has identified upcoming areas of critical need for global competitiveness that are specific to industry focus areas: cybersecurity, big data, the “internet of things”, energy…

- In addition, an industry survey showed that we have **significant needs for crucial skills**—outside of the technical discipline areas—that are lacking.


Engineering and Technology Employer Survey:
Importance and Satisfaction of Graduates' Skills and Knowlege
Percent
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Computation (math)
Knowledge in field of study
Contributing as team member
Organizational knowledge(3)
Knowledge of computer apps
Technical knowledge required
working in diverse business...
Use of job-specific technology
Critical thinking
Appropriate personal initiative
Technical innovation
Organizational skills (1)
Verbal communication
Client interaction skills
Organizational context(2)
Written communication
% Responding "Extremely" or "Very Important"
% Responding "Extremely" or "Very Satisfied"
(1) Getting things done in a complex environment
(2) Industry regulations, competition, and other industry context
(3) How business and other organizations work

Educating for T-Shaped people

- STEM skills are the deep technical knowledge.
- The personal responsibility and initiative, critical thinking, teamwork, ability to innovate across disciplines, written and oral communication, global perspective… are the crossbar.
- We need both for STEM technical knowledge to be fully realized in solving problems.

One last thought:
on being a strategic minority investor…

- Shift in mindset: the state no longer is the primary investor in higher education.

- Question becomes how to best use those state dollars strategically to connect the universities and industry in ways that are mutually beneficial and serve students well?

- ETIC has set a model for how to do this… and there are others.

Summary

- ETIC is an example of a 15-year successful platform that unites industry and higher education in educating citizens for the economic benefit of the state and its people.

- We have much yet to do, but we have industry engaged and we are aligned about what we value. We need flexibility and the tools to get there.

How else are industry and higher education collaborating today?

- Curriculum: Industry Advisory Boards.
  - Required by ABET accreditation.
  - Common in community colleges.
- Content: Adjunct faculty.
- Participation:
  - Individual faculty outreach.
  - Internship programs.
- Joint work:
  - Individual faculty research projects.
  - IU CRC model.

PROMISING APPROACHES TO INCREASING STEM SUCCESS IN OREGON'S UNIVERSITIES

Marcia Fischer

Director, Student-to-Workforce Initiatives

Industry Partnerships

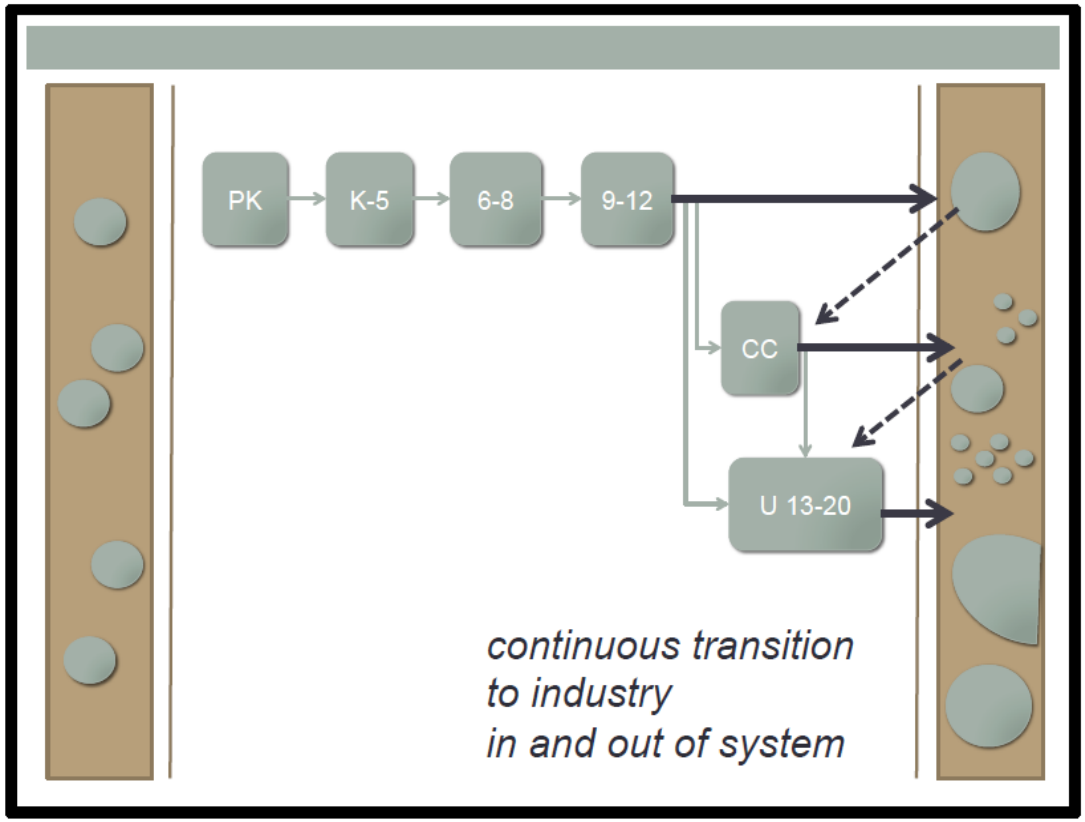
Oregon University System

February 24, 2014

Industry-Education Partnerships Impact STEM Postsecondary Student Success

- Internships /relevant work experience
  - FT summer internships, FT academic year (co-op model) internships, PT internships, PT jobs, externships (in some STEM programs), Apprenticeships
- Industry professionals mentoring students
- Industry provides site visits for classes/student organizations
- Industry provides Scholarship/Fellowship support
- Adjunct faculty from Industry enrich the curriculum
- Industry provides speakers in seminars or in course sections
- Industry-advisory boards
  - *vital role in keeping content current*
- Industry provides equipment and software in labs
- Industry provides advocacy with foundations and government

Students-to-Industry and Industry-to-Students in STEM



Internships

- MECOP /CECOP –Multi-campus, multi-major, multi-year co-op program, driven by industry. www.mecopinc.org
  - 30+ year history, started at OSU
  - Currently operates with OSU, PSU, Oregon Tech and UP
  - Places 500+ students per year in 6-month internships –usually summer +1 academic term
  - Each student participates in two 6 month internships, with different companies
  - 100+ companies and agencies participate
    - SIGNIFICANT INDUSTRY COMMITMENT

    Highly Competitive selection process for students

    many slots go to students selected out of high school (MECOP "pre-select")
- PCEP --Part-time internships, multi-year, rotating between companies, with one campus/program: http://web.cecs.pdx.edu/~pcep/
- Individual Company-run Programs --multiple position opportunities are posted at multiple campuses, selected students participate with others in program
- Individual company internship postings—looking for one or two interns.

- **What is an internship?** For definitions from National Association of Colleges and Employers. *https://www.naceweb.org/advocacy/position-statements/united-states-internships.aspx*.
  - *Most internships in STEM are paid.*

Undergraduate Research

Early exposure to undergraduate research has been shown to increase STEM student motivation and success

Formal undergraduate research programs: academic year or summer

- Exposes students to significant research questions
- Develops strong faculty-student relationships
- Prepares students for potential graduate school
- Develops communications and presentation skills
- Dependent upon funding from faculty grants, foundations, college or industry

Curricular Research Experiences gaining traction as best practice in STEM postsecondary education

- Smaller scale research experience designed into courses as early as freshman year
- Emphasize interdisciplinary topics and collaboration
- Excellent effect on retention reported in research
- *Can be expensive to implement*

CAPSTONE projects provided by industry provide similar benefits. Industry provides a real problem for team of senior students to solve, provides mentoring, collaboration with students and faculty advisors.

Promising Approach—Post-baccalaureate STEM degrees

Recent rise of Post-baccalaureate students in STEM

- OSU's online Post-baccalaureate Computer Science Program
  - BA/BS holders –including those with undergraduate degrees in the liberal arts- may attain a CS BS from OSU, in as little as 1 year
  - strong industry endorsement and placement rate
  - Currently enrolling >700 students

- At PSU, Post-baccalaureate students are the fastest growing segment of engineering/computer science enrollment.
  - Post-bac enrollment at PSU engineering has grown 150% over the past 5 years
  - New programs designed specifically for postbacs are under development.

Liberal arts graduates with strong soft-skills can make good "T-shaped professionals," once equipped with strong technical base.

Removing Barriers to STEM Success--Improving STEM Pedagogy

American Association of Colleges and Universities (AAC&U) Themes for Transforming STEM Postsecondary Education

- **Research, Development, and Assessment of Undergraduate STEM Teaching and Learning:** enhancing undergraduate STEM learning through implementation of engaged pedagogies and high-impact practices including, but not limited to, integrative, interdisciplinary, and discovery-based learning.
- **Inclusive Excellence in STEM Higher Education:** theory-driven models and innovations directed toward the recruitment, retention, and persistence of students from underrepresented groups in the STEM disciplines.
- **Recruiting, Supporting, and Rewarding STEM Faculty:** strategies for revising STEM curricula and enhancing teaching and high-impact practices, as well as innovative mechanisms for acquiring necessary resources (if applicable) for implementing new strategies.
- **Advancing Institutional Change Strategies for STEM Reform:** campus-wide institutional change efforts toward undergraduate STEM education reform. While there is a pervasive need to provide opportunities for students to participate in research, collaborative assignments, and other innovative engagement practices, oftentimes the culture of STEM departments is not conducive to the implementation of modern pedagogies

A campus approach to improving STEM pedagogy

Portland State recent grant application:

Outcomes:

- A 5-10 percent decrease in the DFW (students who receive a grade of D, F, or Withdraw) rate in key science and mathematics courses
- -A 5-10 percent increase in sequence retention in key science courses
- -More students in key science courses experience positive interpersonal relationships and collaborations, express engagement in science disciplines, and develop a positive science identity

Strategies:

- a) changing classroom pedagogy to student centered active learning approaches;
- b) reforming and assessing curricular materials with technology-based guided learning
- c) redesigning teaching laboratories to emphasize interdisciplinary project based work;
- d) creating pathways to degree completion that build community and lead to highly qualified graduates.

Improving STEM outcomes in the university environment requires commitment and investment.

More promising approaches

- Expand STEM “Bridge Programs” for entering freshmen and/or transfers
  - shown to build student confidence, develop community, and provide other support structures critical to student success.
  - Often targeted to special populations
  - Funded expansion necessary to serve more entering students.
- Provide holistic advising early and throughout STEM postsecondary education.
  - Professional Advising in Postsecondary STEM education is often sporadic
  - Faculty are not always best holistic advisors
- Provide early, ongoing, intentional Career Development in STEM
  - Best when integrated throughout undergraduate curriculum
  - Career development activities must include those most confident of STEM choice.

Summary: Enhancing Postsecondary Success in STEM --a Shared Responsibility

Industry plays critical role with postsecondary STEM education

- Advising curricula and careers
- Supporting students and faculty
- Transitioning students to STEM workforce
- Providing continuing education opportunities for existing workforce

Successful STEM employees are lifelong learners. Industry and postsecondary education partner for STEM success throughout the learning cycle.

Together, we can create a culture of success for STEM postsecondary students in Oregon.