



# **K-12 COMPUTER SCIENCE EDUCATION:** **Unlocking the Future of Students**

August 2012



Association for  
Computing Machinery

*Advancing Computing as a Science & Profession*

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# OVERVIEW

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# U.S. Workforce through 2020

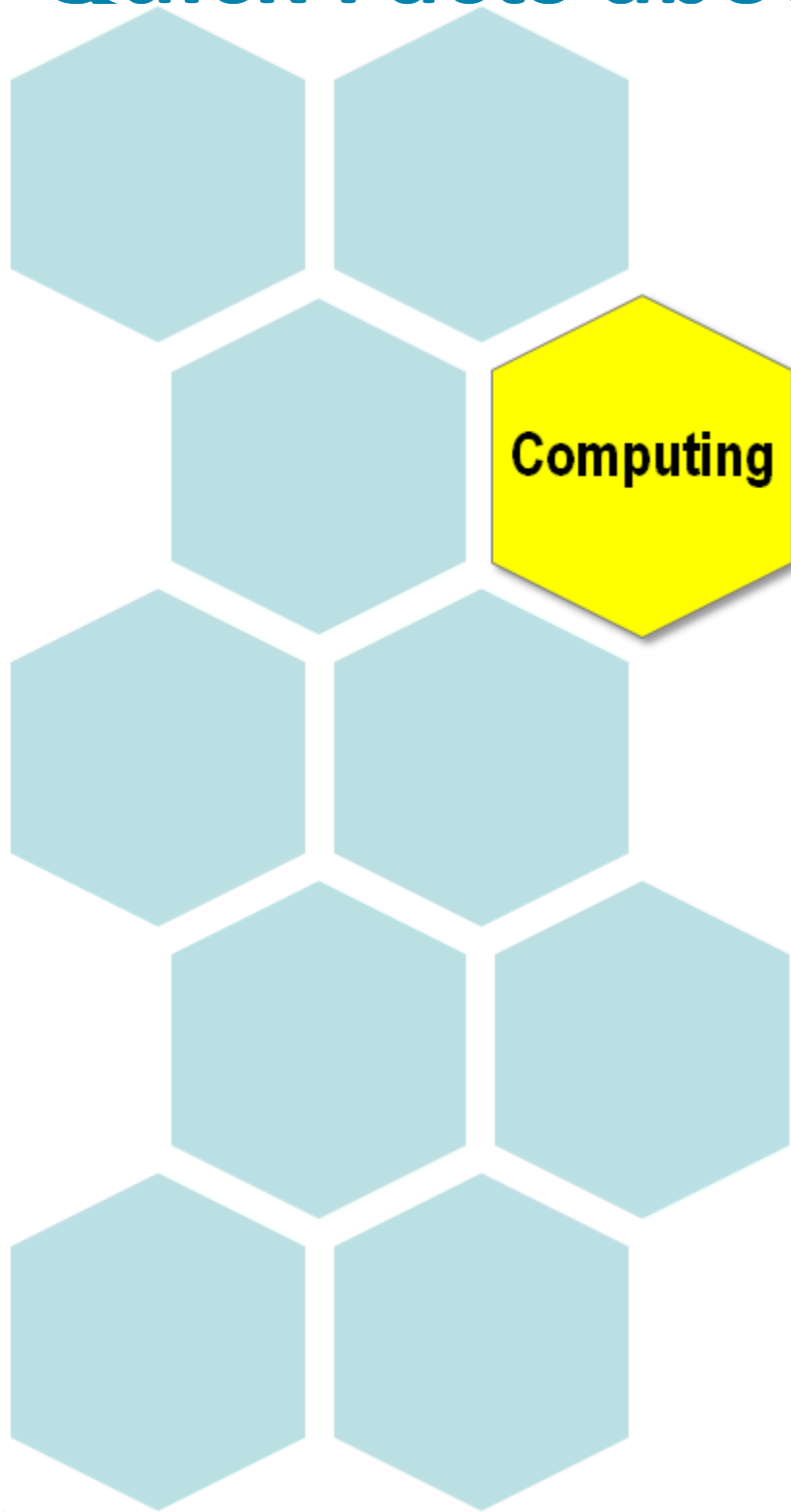
**All Occupations 164 million**

**All STEM Jobs 9.2 million**

**Computing Jobs  
4.6 million**



# Quick Facts about Computing Jobs Through 2020



**Computing and mathematics** is one of the **TOP 10 fastest growing** major occupational groups 2010-2020.

**150,000+** job openings in computing annually.

**1 in every 2** STEM jobs will be in computing in 2020.



# THE BRIGHT FUTURE FOR COMPUTING JOBS

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# U.S. Employment through 2020

## How Computing Stacks Up To Healthcare

**22%** job growth rate

in computing jobs, as **comparable to healthcare** job growth rates 2010-2020.

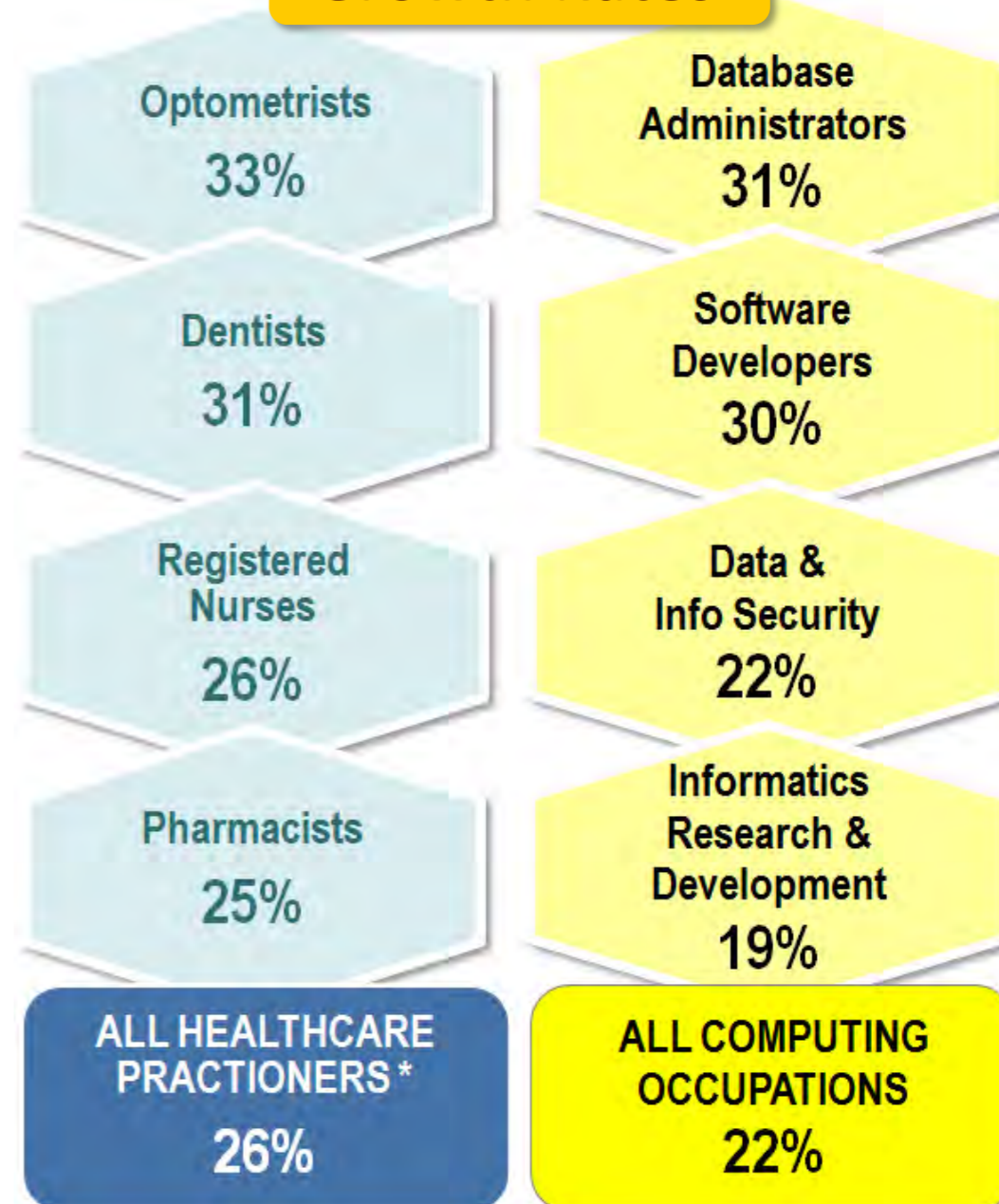
**51,000** projected shortfall

in qualified **health IT workers** 2011-2015.

**90%** of physicians

to use **electronic health records** by 2019 as a result of the federal HITECH Act of 2009.

### Growth Rates



\* Healthcare practitioners and technicians




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Sources: Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>. U.S. Department of Health and Human Services (HHS), HITECH Programs, <http://www.healthit.gov>. Congressional Budget Office, Analysis of HITECH Act of 2009.

# Total Employment in STEM in 2020

Science, Technology, Engineering, and Mathematics



<b>STEM</b>	<b>9.2 million</b>
Architecture/Engineering	2.8 million
Computing	4.6 million
Mathematics	0.1 million
Life Sciences	0.6 million
Physical Sciences	0.4 million
Social Sciences	0.6 million

\* Subtotals do not equal 9.2 million due to rounding.



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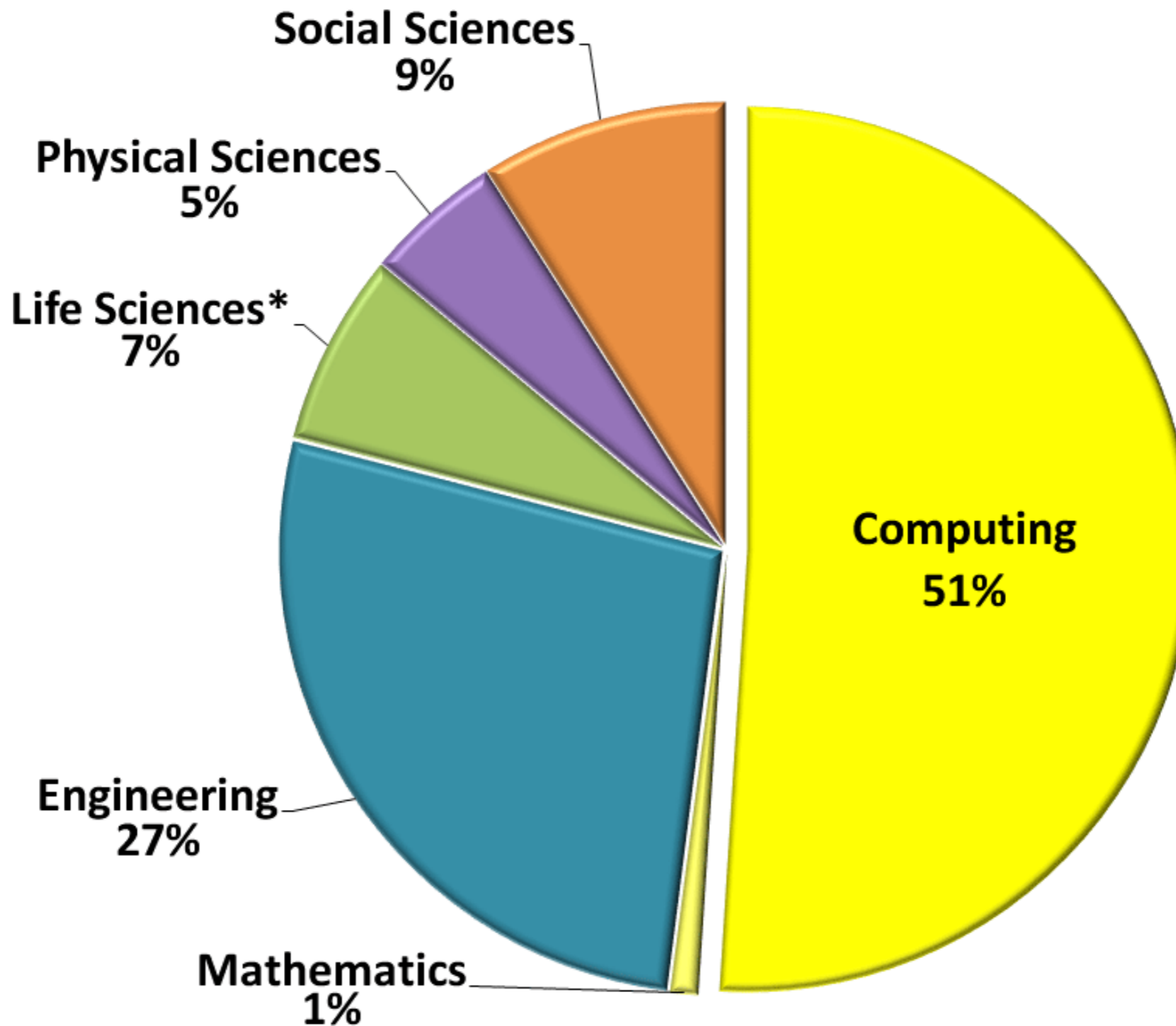
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Source: Jobs data are calculated from the Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>. STEM is defined here to include non-medical occupations.

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# Where the STEM Jobs Will Be

Projected Annual Growth of Total STEM Job Openings 2010-2020



\* STEM is defined here to include non-medical occupations.



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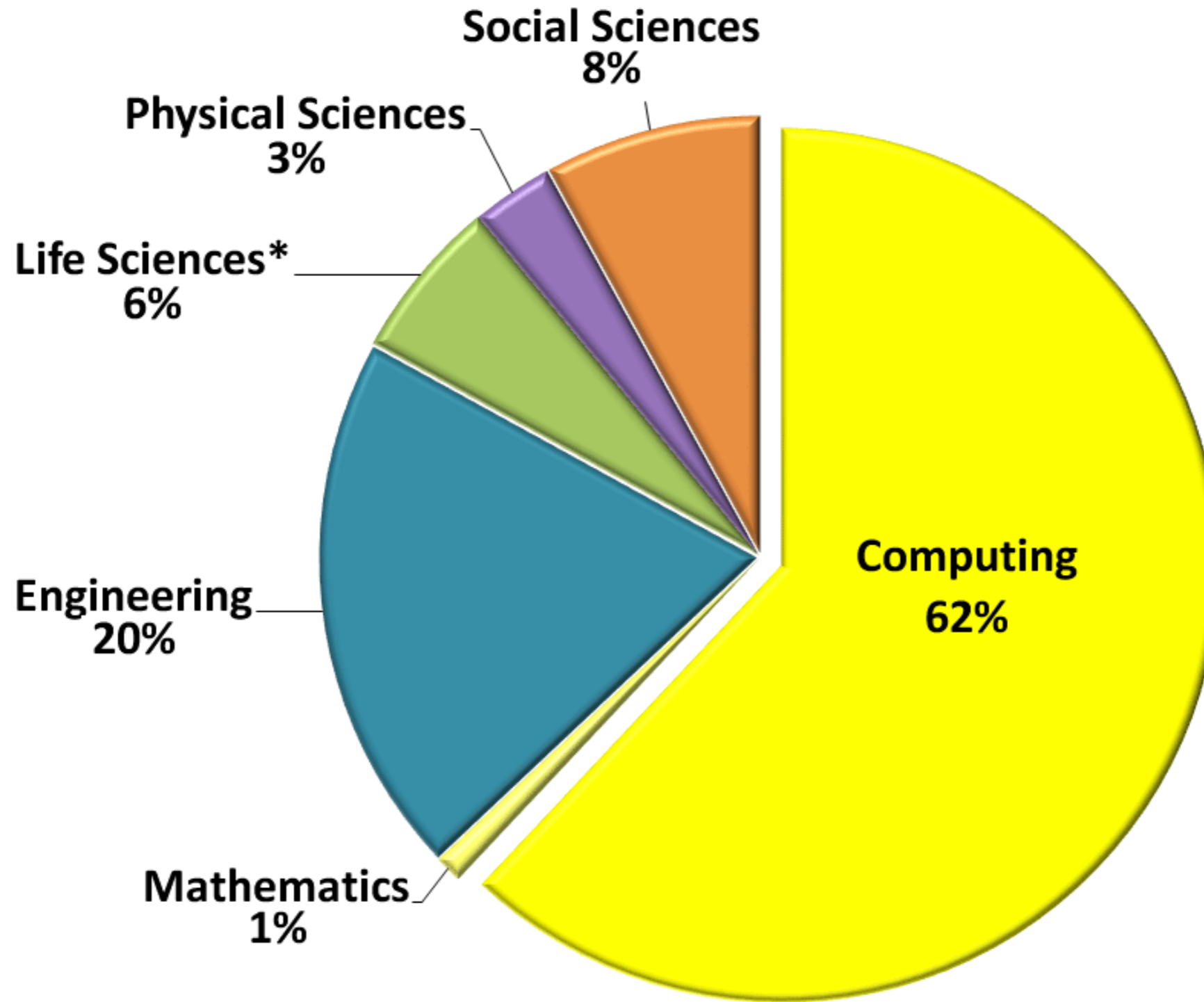
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Source: Jobs data are calculated from the Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>.



# Where the STEM Jobs Will Be

Projected Annual Growth of **NEWLY CREATED** STEM Job Openings 2010-2020



\* STEM is defined here to include non-medical occupations.



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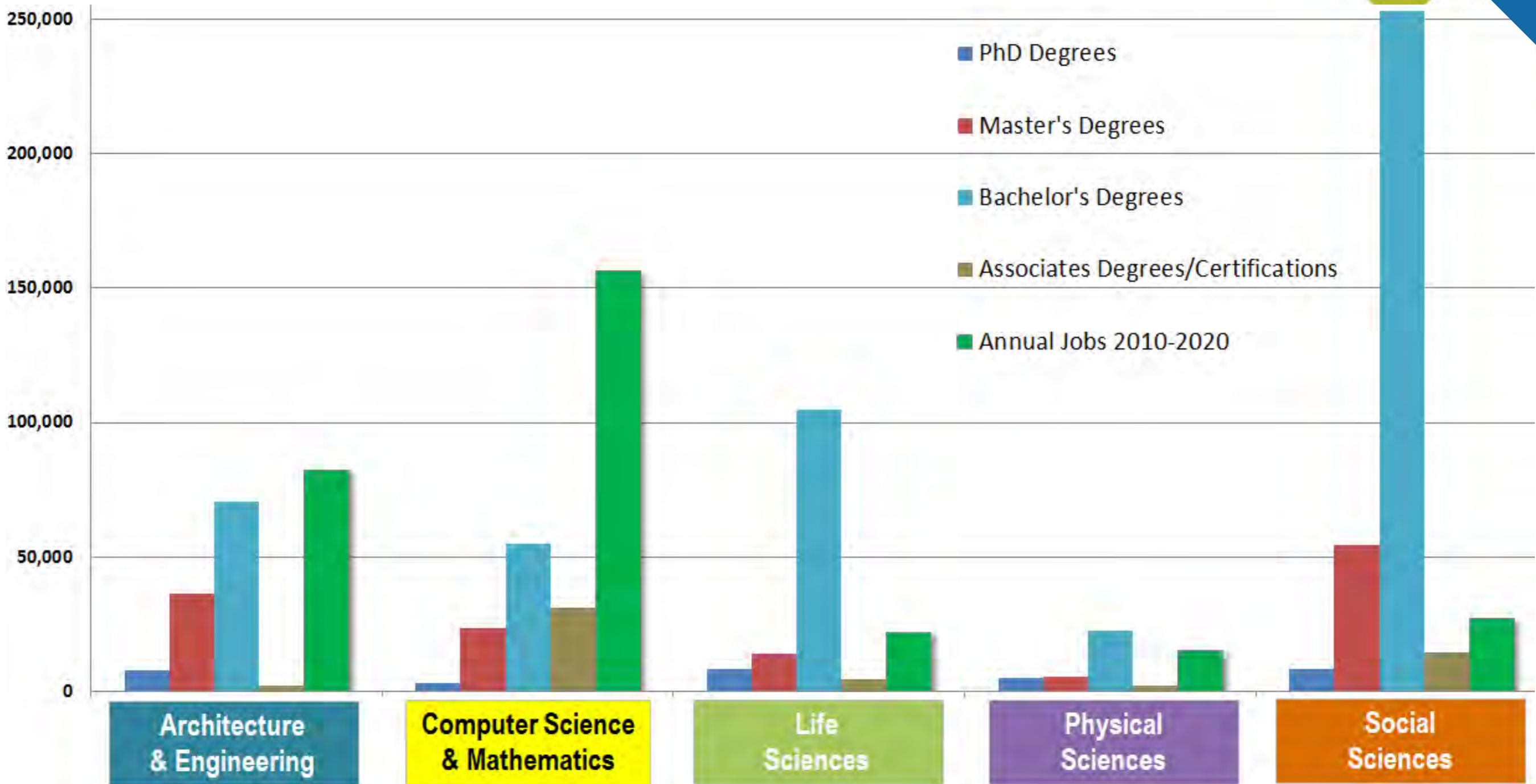
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Source: Jobs data are calculated from the Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>.

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# Where the STEM Jobs Will Be

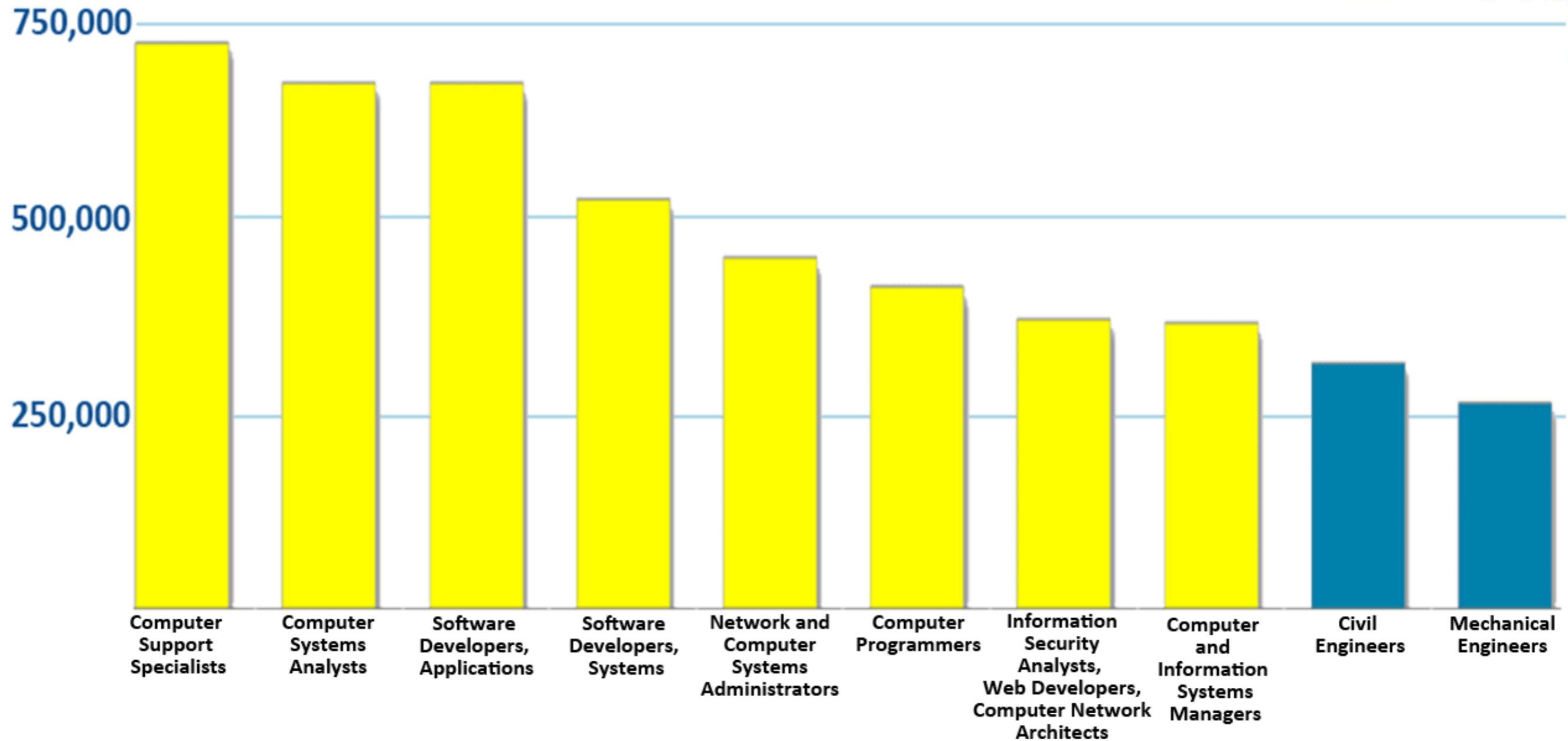
## Degrees vs. Jobs Annually



Sources: Degree data are calculated from the National Science Foundation (NSF), Science and Engineering Indicators 2012, available at <http://www.nsf.gov/statistics/seind12/appendix.htm>. Annual jobs data are calculated from the Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>. STEM is defined here to include non-medical degrees and occupations.

# Where the STEM Jobs Will Be

## Top 10 STEM Occupations by Total Employment in 2020



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Source: Jobs data are calculated from the Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>. STEM is defined here to include non-medical occupations.



# EARNINGS POTENTIAL IN COMPUTING

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# Where the U.S. Jobs Will Be

## Top 10 Major Occupational Groups 2010-2020 and Average Salaries in May 2011

	Major Occupational Group	% Growth 2010-2020	2011 Average Annual Salary
1	Healthcare Support Occupations	35%	\$27,370
2	Personal Care and Service Occupations	27%	\$24,620
3	Healthcare Practitioners and Technical Occupations	26%	\$72,730
4	Community and Social Service Occupations	24%	\$43,830
5	Construction and Extraction Occupations	22%	\$44,630
<b>6</b>	<b>Computing and Mathematical Occupations</b>	<b>22%</b>	<b>\$78,730</b>
7	Business and Financial Operations Occupations	17%	\$68,740
<b>8</b>	<b>Life, Physical, and Social Science Occupations</b>	<b>16%</b>	<b>\$67,470</b>
9	Education, Training, and Library Occupations	15%	\$50,870
10	Transportation and Material Moving Occupations	15%	\$33,200

Sources: Jobs data are from the Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>. Salary data are from BLS Occupational Employment Statistics, May 2011, available at [http://www.bls.gov/oes/current/oes\\_nat.htm](http://www.bls.gov/oes/current/oes_nat.htm).

# Where the STEM Jobs Will Be

## Projected Growth of Selected STEM Jobs 2010-2020

STEM Job	2010 Total Employment	% Growth 2010-2020	2011 Average Annual Salary
Engineering and Architectural Managers	176,800	9%	\$129,350
<b>Computer and Information Systems Managers</b>	<b>307,900</b>	<b>18%</b>	<b>\$125,660</b>
Aerospace Engineers	81,000	5%	\$103,870
<b>Software Developers, Systems and Applications</b>	<b>913,100</b>	<b>30%</b>	<b>\$96,250</b>
Biochemists and Biophysicists	25,100	31%	\$87,640
Civil Engineers	262,800	19%	\$82,710
<b>Database Administrators</b>	<b>110,800</b>	<b>31%</b>	<b>\$77,350</b>
Environmental Scientists	89,400	19%	\$68,810
Chemists	82,200	4%	\$74,780
Anthropologists and Archeologists	6,100	21%	\$59,040

Sources: Jobs data are from the Bureau of Labor Statistics (BLS), Employment Projections 2010-2020, available at <http://www.bls.gov/emp/>. Salary data are from BLS Occupational Employment Statistics, May 2011, available at [http://www.bls.gov/oes/current/oes\\_nat.htm](http://www.bls.gov/oes/current/oes_nat.htm). STEM is defined here to include non-medical occupations.



# PIPELINE OF TALENT IN COMPUTING

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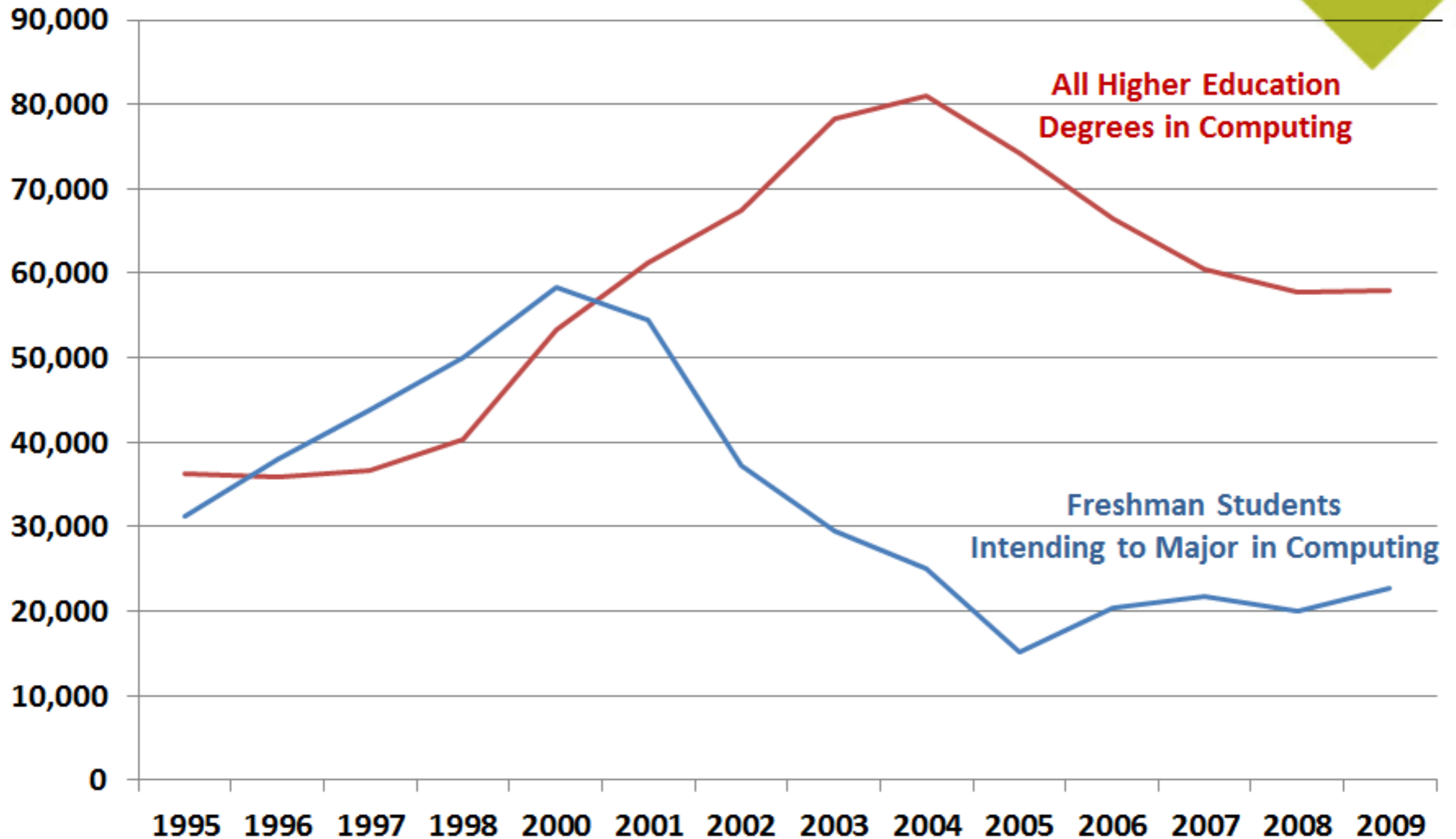


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# Higher Education Pipeline in Computing



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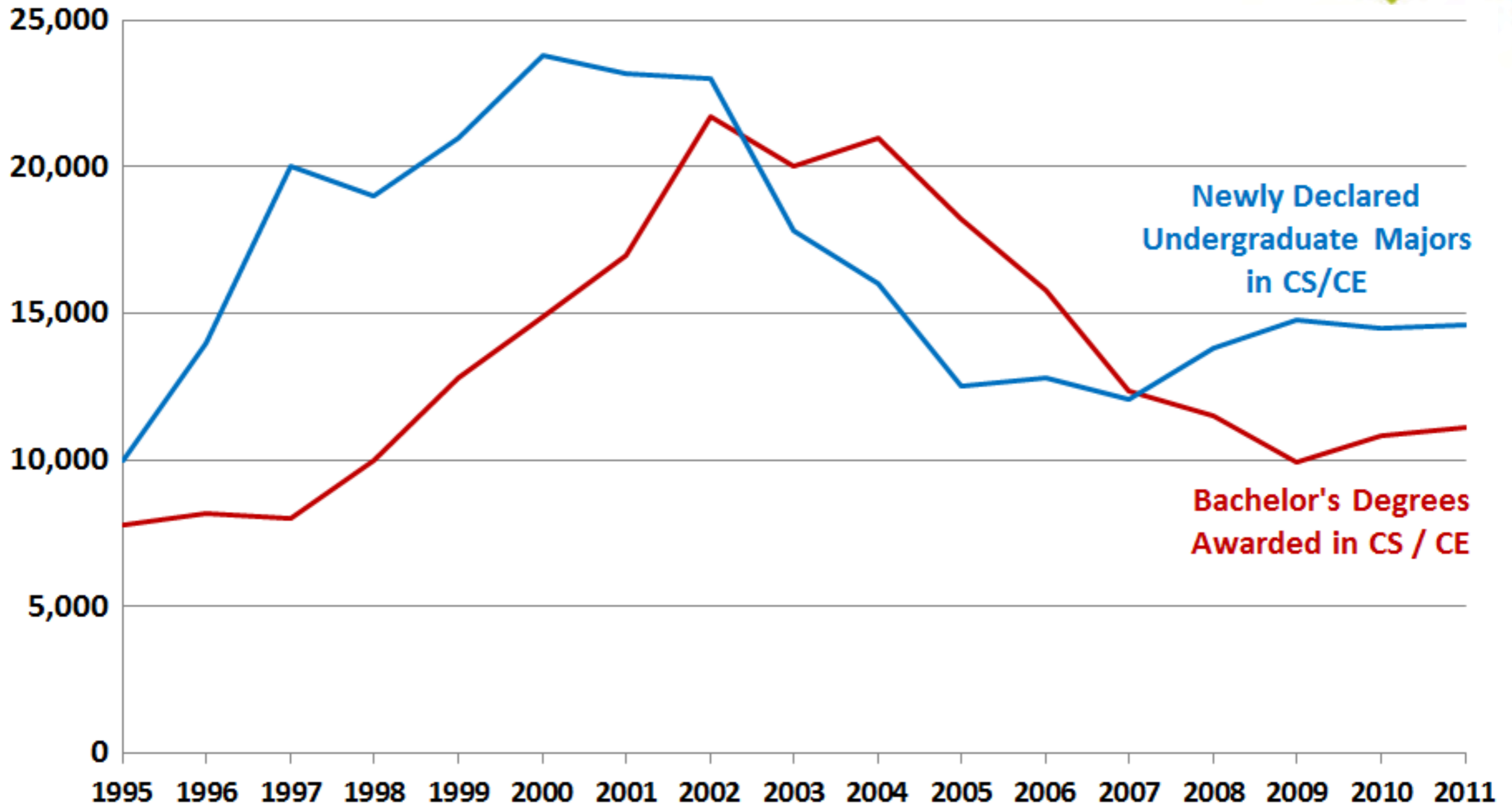
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Source: National Science Foundation, Science and Engineering Indicators 2012 and various years, available at <http://www.nsf.gov/statistics/seind12/>. Data are not available from 1999.



# Higher Education Pipeline in Computing

## CRA Taulbee Survey Results

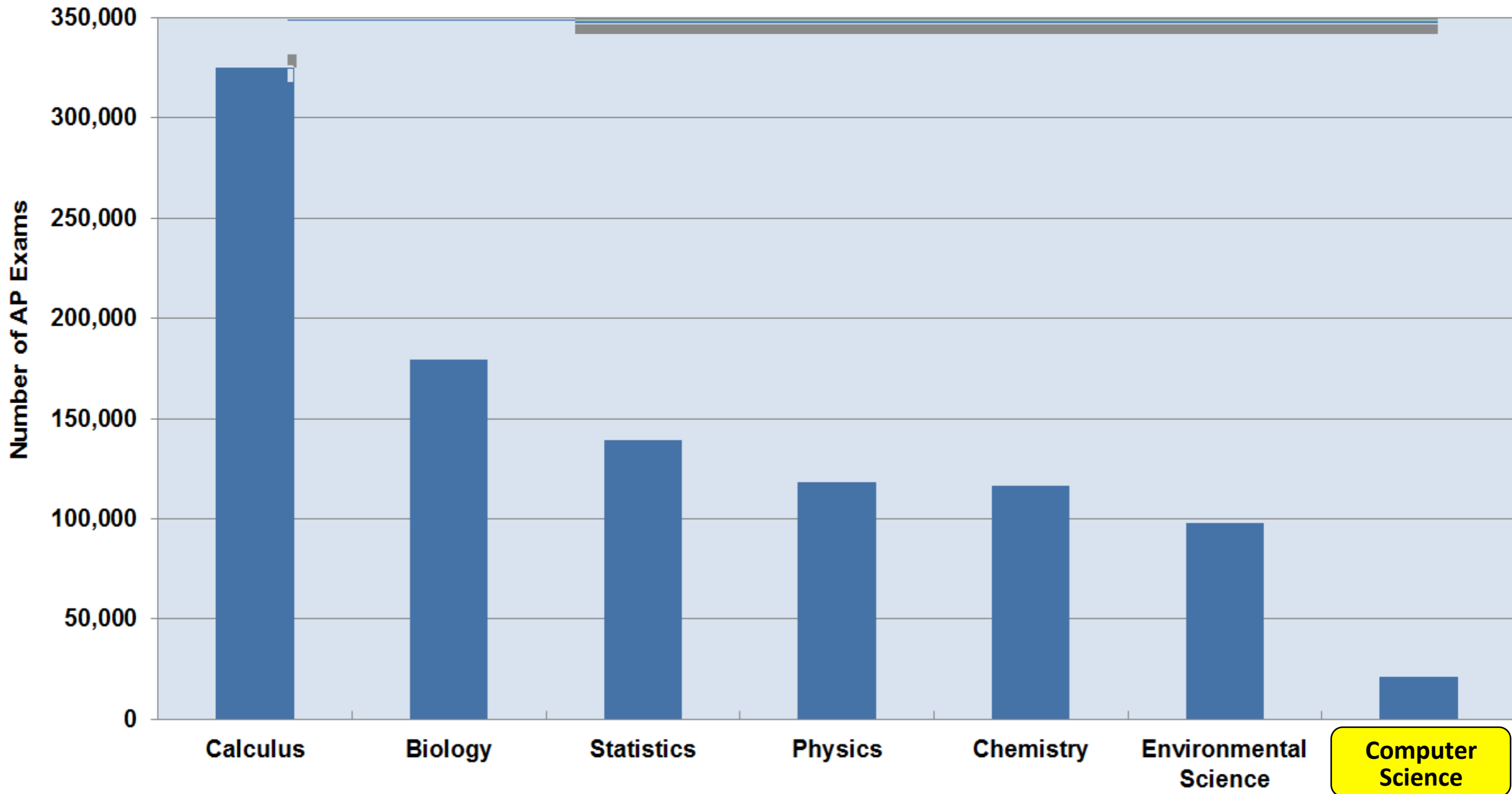


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Source: Computing Research Association, Taulbee Survey 2010-2011, available at <http://www.cra.org/resources/taulbee/> (providing voluntary responses from Ph.D.-granting universities on new enrollments and degrees awarded in their undergraduate CS/CE programs).

# High School Advanced Placement Exams 2011



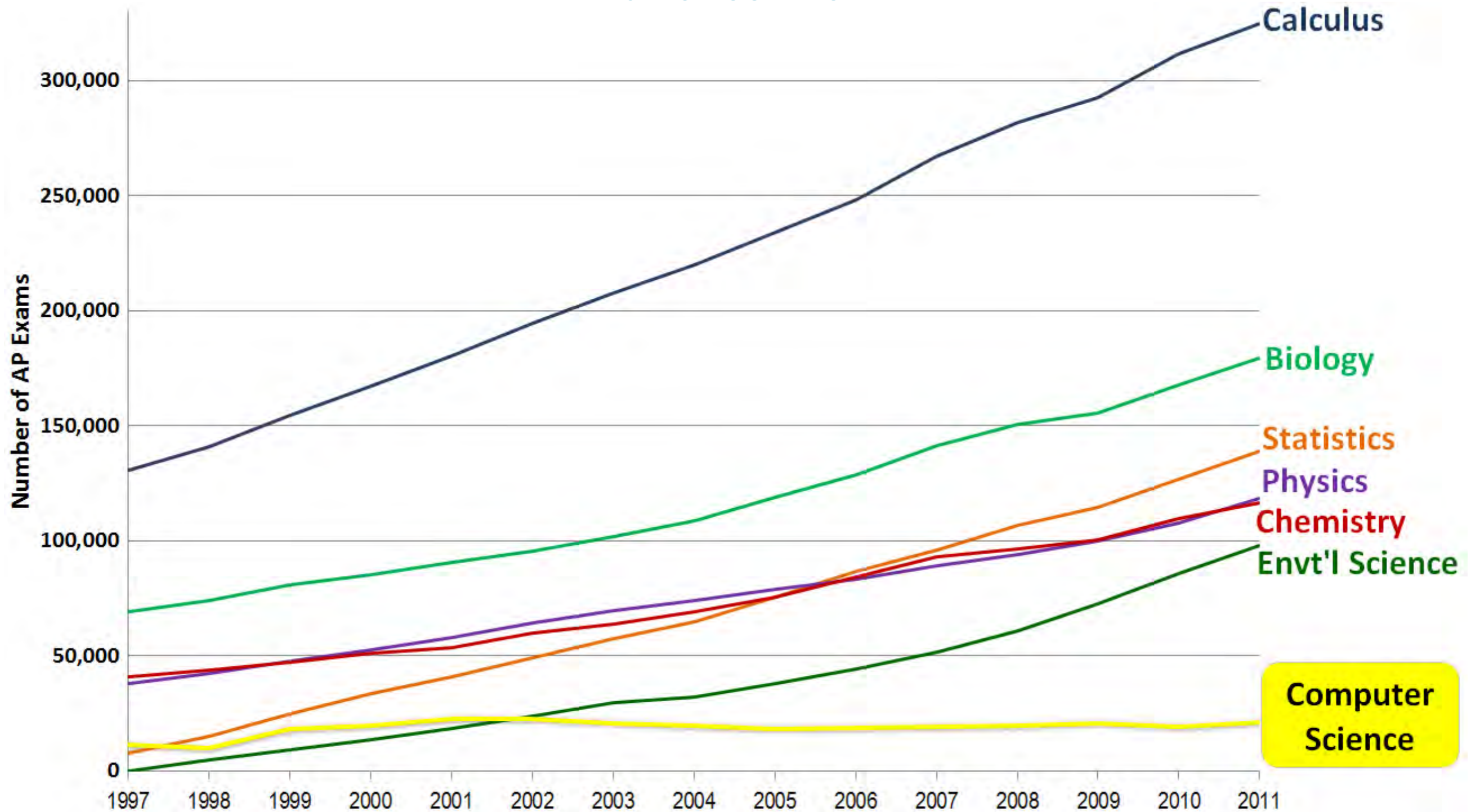
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Source: College Board, Advanced Placement (AP) Exam Data 2011, available at <http://professionals.collegeboard.com/data-reports-research/ap/data>. Calculus represents the combined data of Calculus AB and BC. Physics represents the combined data of Physics B, C:Electricity and Magnetism, and C:Mechanics. Computer Science represents combined data of Computer Science A and B.

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# High School Advanced Placement Exams 1997-2011



Source: College Board, Advanced Placement (AP) Exam Data 2011, available at <http://professionals.collegeboard.com/data-reports-research/ap/data>. Calculus represents the combined data of Calculus AB and BC. Physics represents the combined data of Physics B, C:Electricity and Magnetism, and C:Mechanics. Computer Science represents combined data of Computer Science A and B.

# High School Advanced Placement

**Male**

Exams 2011

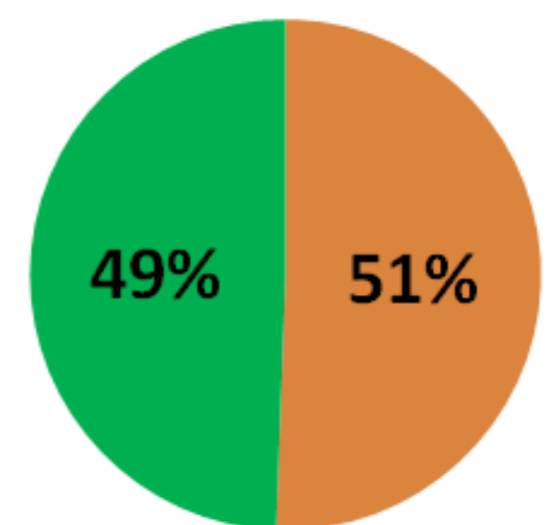
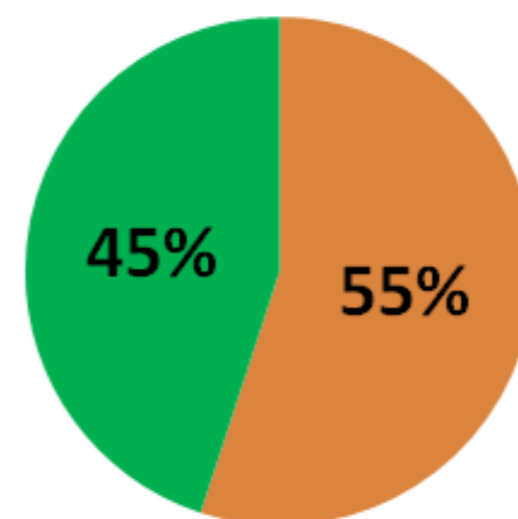
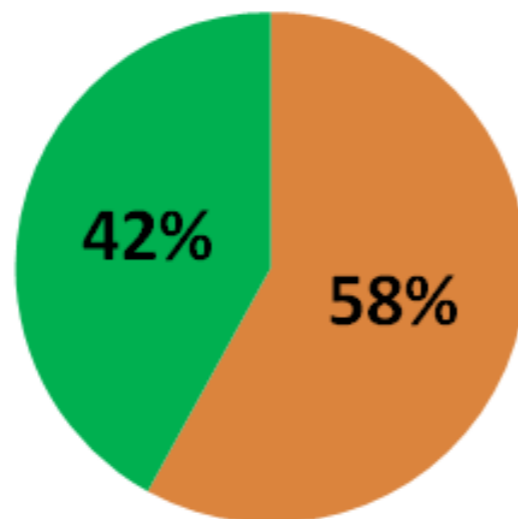
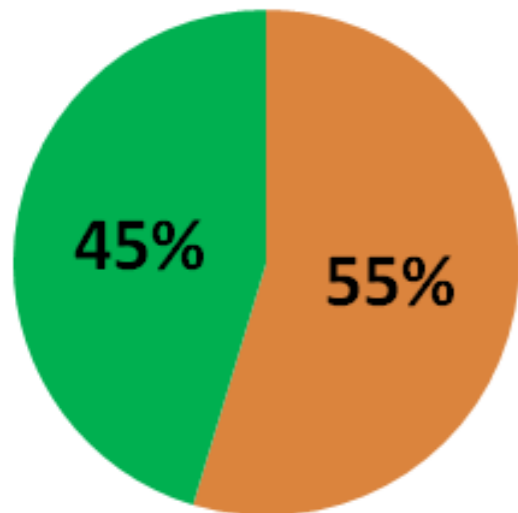
**Female**

Total AP Tests

Biology

Environmental Science

Statistics

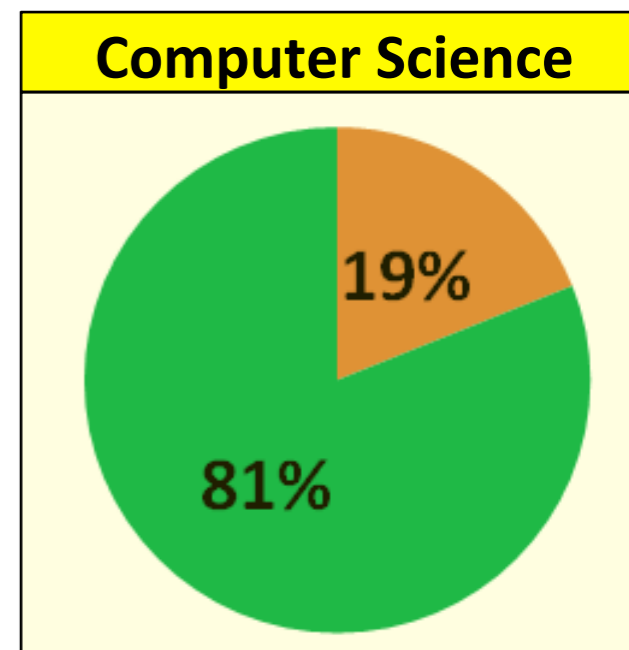
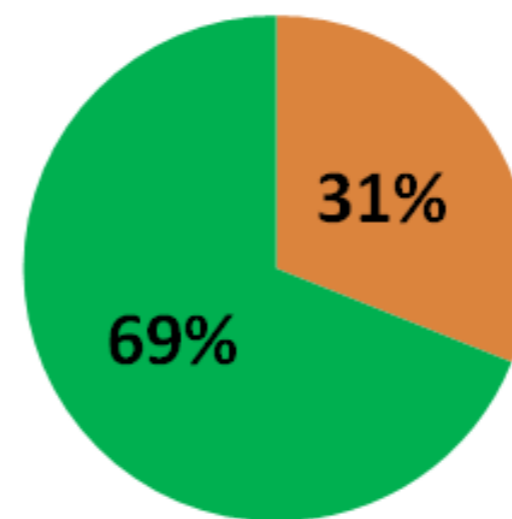
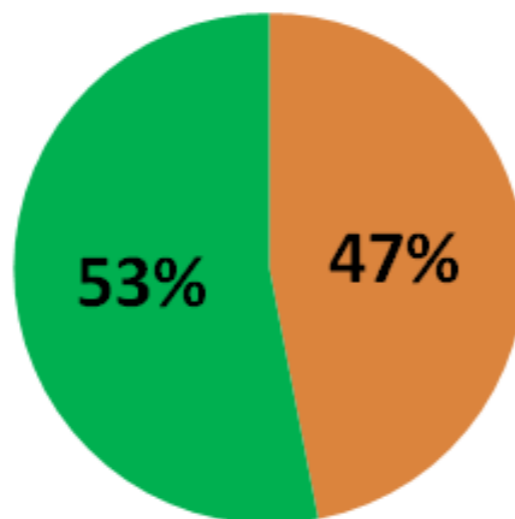
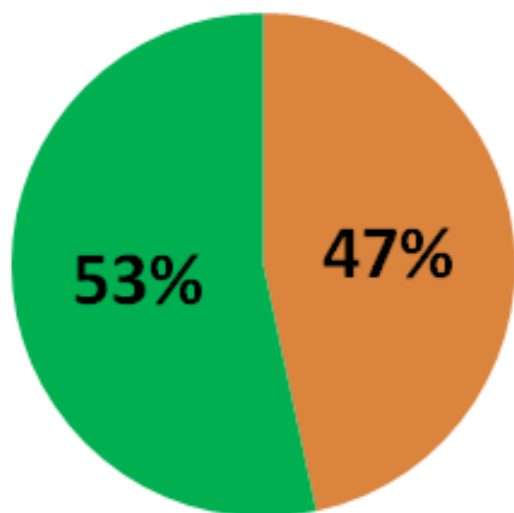


Calculus

Chemistry

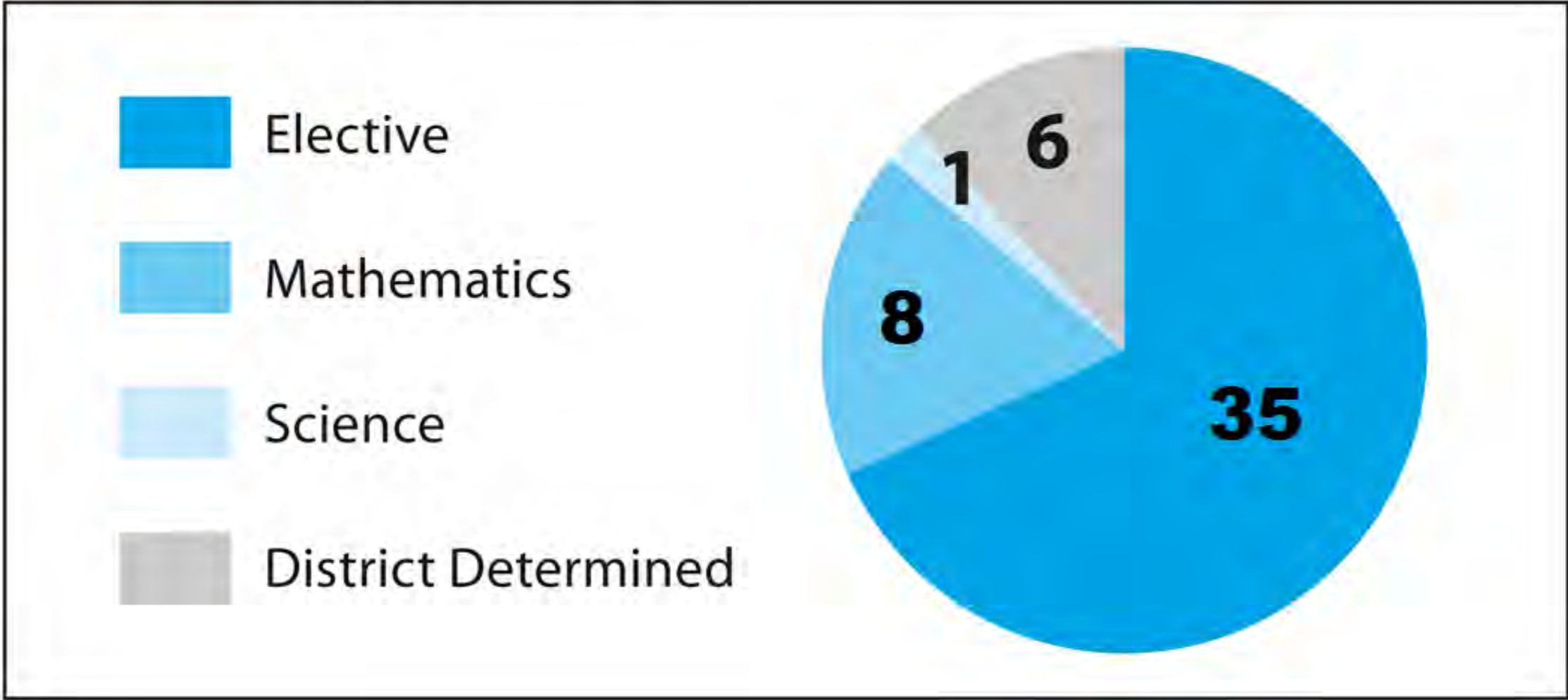
Physics

Computer Science



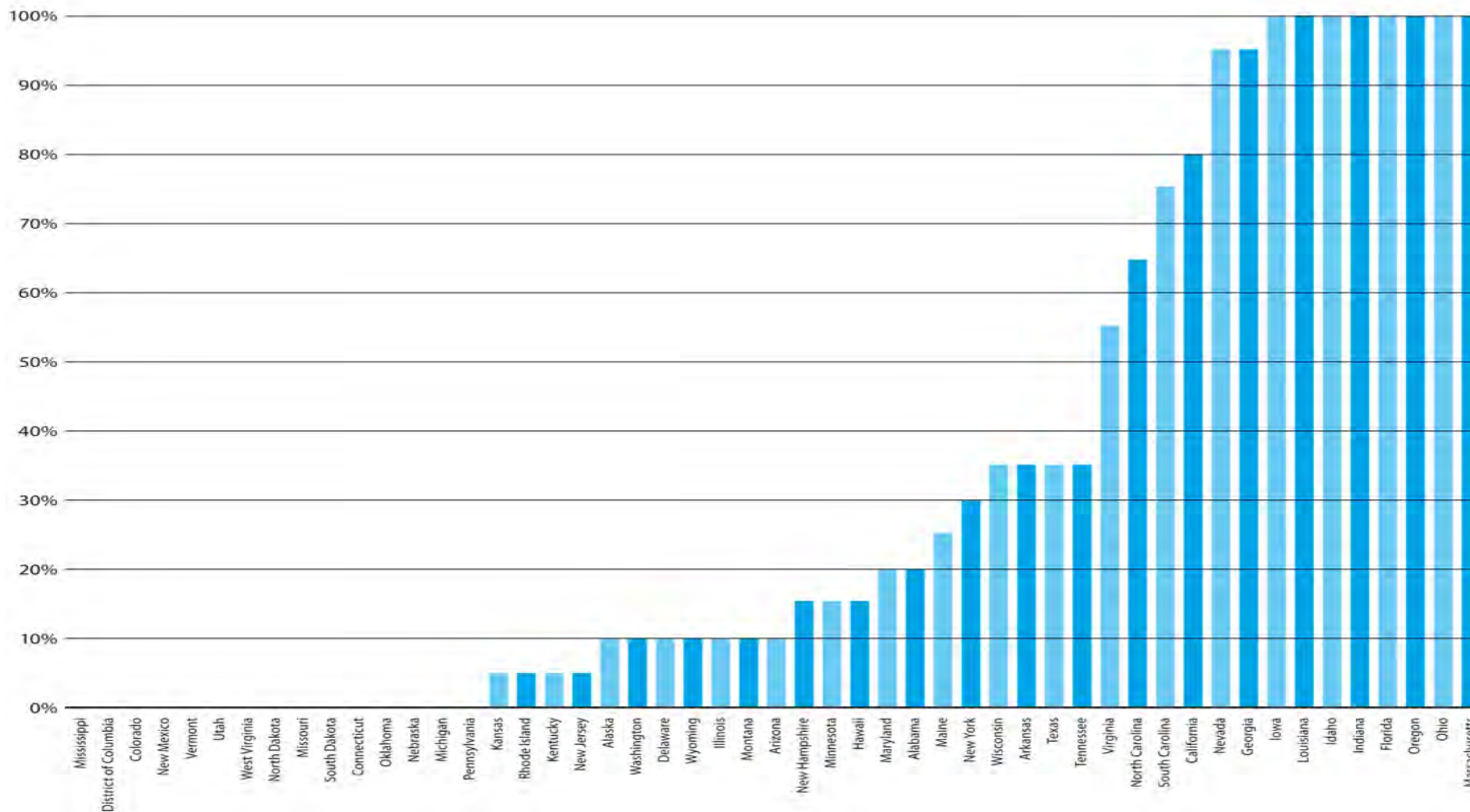
# How Computer Science “Counts” In K-12

**FIGURE 12** How Computer Science Courses Count Toward Graduation Requirements



# Findings: Standards

## Percentage of Secondary School Computer Science Standards Level II and Level III Adopted by State



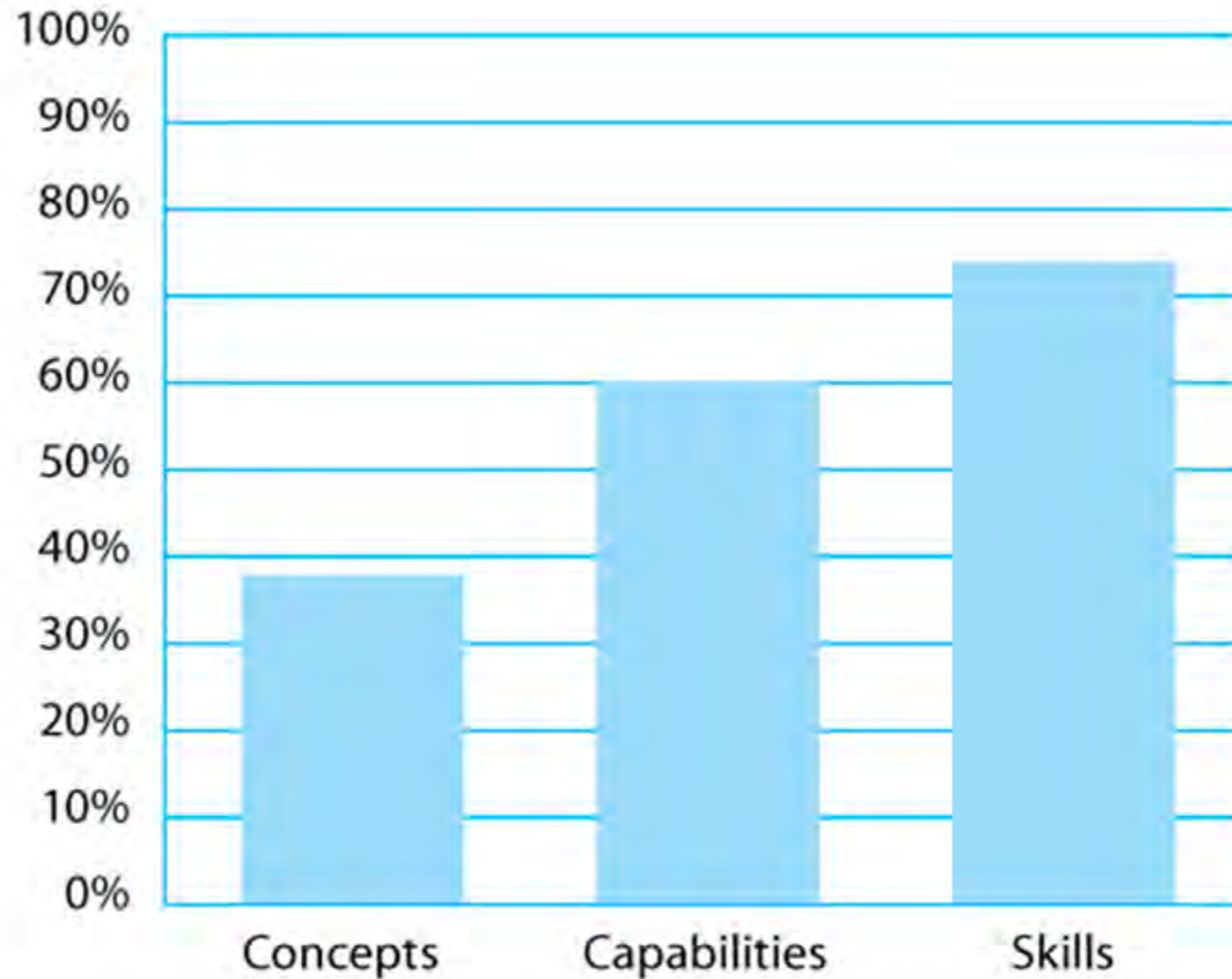
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Source: ASSOCIATION FOR COMPUTING MACHINERY & COMPUTER SCIENCE TEACHERS ASSOCIATION, RUNNING ON EMPTY: THE FAILURE TO TEACH K-12 COMPUTER SCIENCE IN THE DIGITAL AGE (2010), at page 8, available at <http://www.acm.org/Runningonempty>.

# Findings: Standards

## National Snapshot: Adoption of Computer Science Standards\*



\*categories of computer science education standards



# Diminishing Access to Computer Science Courses

U.S. Department of Education  
High School Transcript Study  
1990-2009

1990

2009

PERCENTAGE OF HIGH  
SCHOOL STUDENTS  
EARNING CREDITS IN  
COMPUTER SCIENCE COURSES

25%

19%



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Source: U.S. Department of Education, National Center for Education Statistics, High School Transcript Study, various years, 1990-2009, available at [http://nationsreportcard.gov/hsts\\_2009/](http://nationsreportcard.gov/hsts_2009/).



# Exposure to Computer Science Matters

- Students that take AP CS are 8 times more likely to major in CS.
- In the summer of 2010, Google surveyed a sample of its US employees about exposure to CS prior to college.
  - Nearly all CS majors (98%) reported being exposed to CS prior to college, compared to less than half of non-CS majors (45%). The nature of the exposure varied from reading about CS, after-school programs or camps, to middle or high school CS classes.
  - Those who went on to major in CS were more likely than non-majors to have had a CS class offered in their high school.
  - CS majors were more likely to have known that CS was a possible career path when they were in high school.



# Conclusion

**K-12 computer science education will open more economic opportunities than any other subject for the 21<sup>st</sup> Century.**

The **future is bright** for students entering in **this field** or gaining this critical knowledge to **apply to almost any field of employment.**

Jobs in computing are among the **fastest growing of any profession** and **pay higher wages.**

**Despite these opportunities, significant barriers exist** to exposing students to computer science in **K-12** and **keeping them in the computing education pipeline.**

**We need to put computer science within the core of a student's education.**

