IEEE Life Sciences Study

Educational Trends

Revised

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Overview

The life sciences field is dynamic, growing, and evolving. The employment trends and projected growth across a number of occupations in the life sciences field have been strong, with job opportunities for individuals across multiple disciplines including the traditional biological sciences as well as quantitative sciences. The life sciences industry also offer job opportunities for individuals at all levels of education, though there is a substantial need for those with bachelor's and advanced degrees.

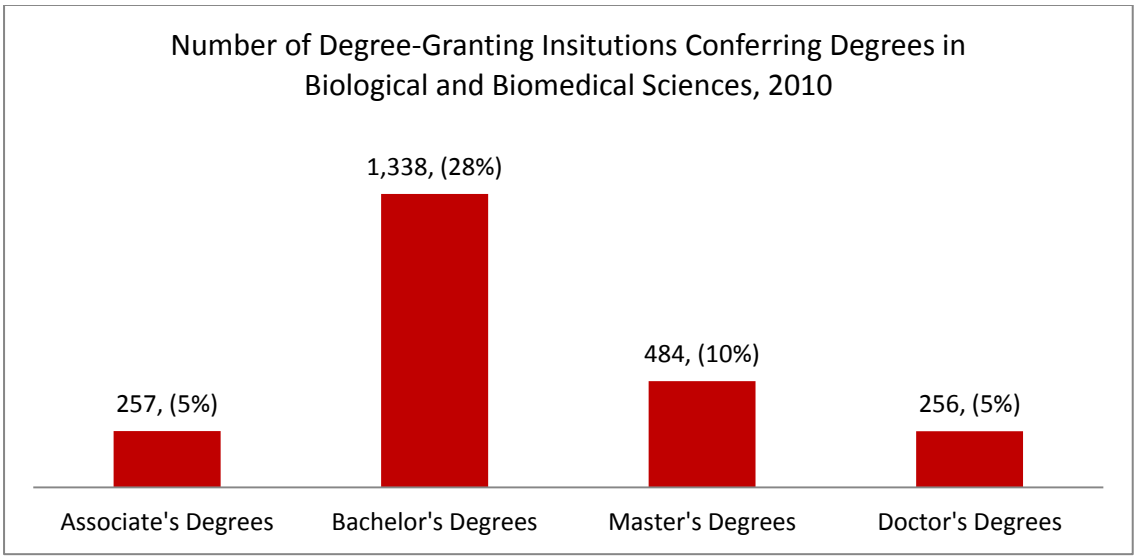
Understanding the educational environment in the life sciences field is challenging with the interdisciplinary nature of this field. Definitions of the disciplines under the life sciences can vary depending on the source of information. In general, the academic environment of the life sciences in the U.S. is strong and growing. The number of institutions offering life sciences related programs and the number of degrees awarded has steadily increased over the past decade in the U.S. Similarly, there is strong growth in the academic setting at the international level, in particular in China and Italy.

Educational and Academic Environment

According to *The Convergence of the Life Sciences, Physical Sciences, and Engineering,* the interdisciplinary nature of the evolving industry challenges the traditional structure of universities, where programs are organized into departments and focus on discrete disciplines.[1] As one association executive explained, "You will see a lot more collaboration in the design and delivery of degree programs, and the blurring of the university departmental structure." Therefore, understanding the educational environment surrounding the field is therefore challenging; definitions of the disciplines included under the life sciences vary depending on the source, and information on enrollment and degrees conferred are not always in agreement. For the purposes of this report, data from the National Center for Education Statistics' *Digest of Education Statistics* was gathered and analyzed to provide a general overview of the academic environment of the life sciences, including the biological and biomedical sciences field, within the United States.

ACADEMIC INSTITUTIONS

There is currently a total of 4,706 degree-granting institutions within the United States.[2] Among these institutions, over 1,300 offer Bachelor's degree programs in the biological and biomedical sciences. There are fewer institutions that offer Associate's, Master's and Doctor's degrees within the biological and biomedical sciences field. The chart below depicts the number of institutions that offer different level degrees in biological and biomedical sciences in the United States.

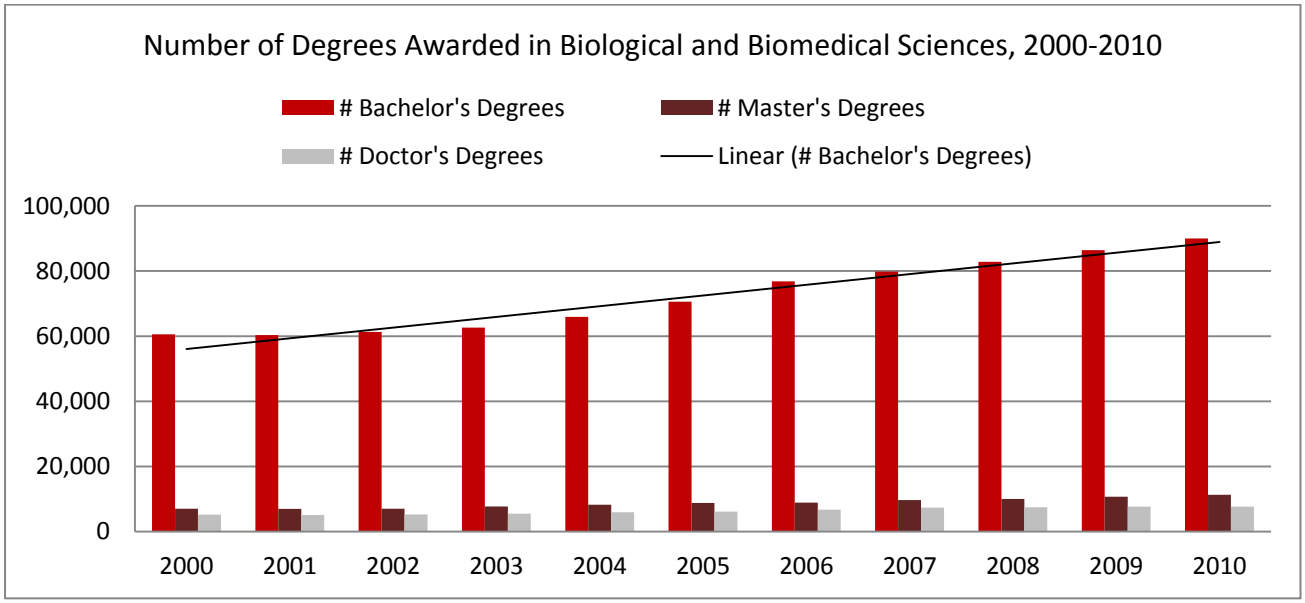


Source: National Science Foundation. Science and Engineering Indicators 2012.

DEGREES GRANTED

The number of degrees produced within the biological and biomedical sciences has steadily increased over the past decade. Not surprisingly, the majority of degrees awarded were Bachelor's degrees; a total of 90,003 Bachelor's degrees in related fields were granted in 2010. More advanced degree types comprised a smaller percentage of the total number of degrees conferred within the biological and biomedical sciences. Regardless, the number of Master's degrees increased from 7,017 in year 2000 to 11,327 in year 2010,

representing an approximate increase of 61%. Similarly, the number of Doctor's degrees increased by 47% over this same time period.

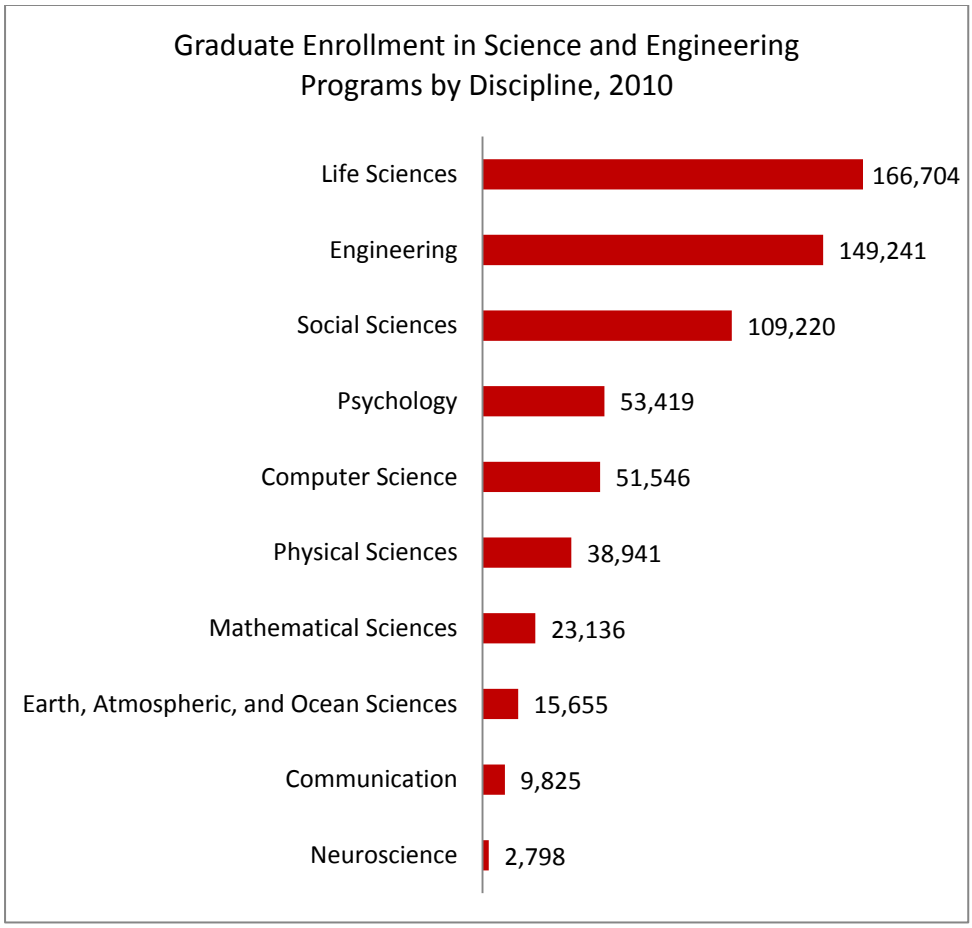


Source: National Science Foundation. Science and Engineering Indicators 2012.

Using a trendline projection, if the rate of change of bachelor's degree remains consistent with the change having occurred between 2000 and 2010, there will be an estimated 121,758 bachelor's degrees awarded in biological and biomedical sciences in the year 2020, and an estimated 154,614 bachelor's degrees awarded in 2030. The linear trendline is based on the equation y=3285.6x + 52760, where in the year 2000 x=1. Additionally the R-squared value of the equation is .958, meaning that the trendline predicts future data points at a confidence level of 95.8%.

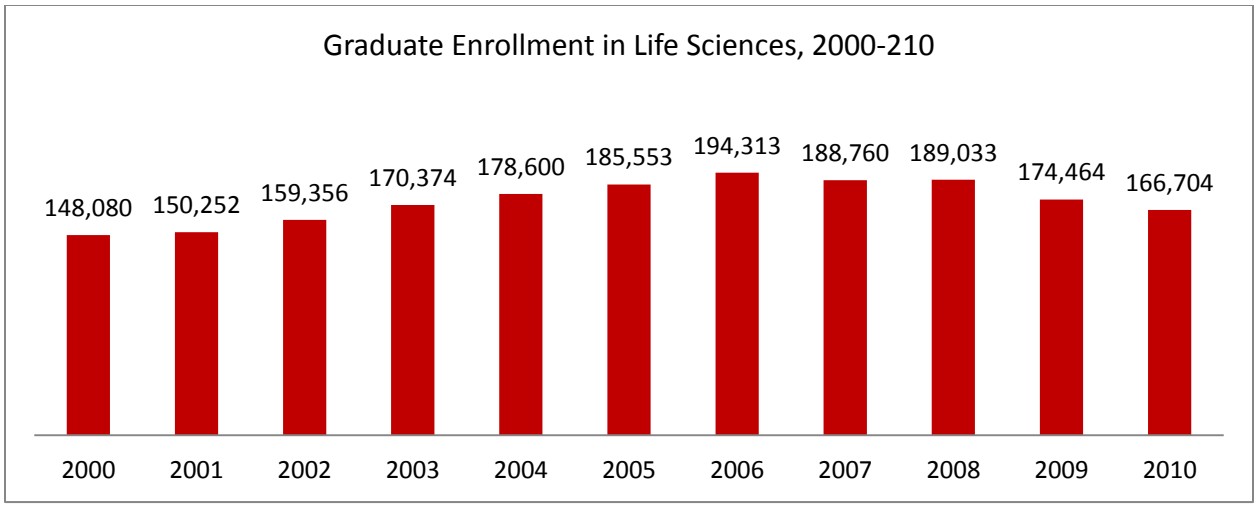
GRADUATE PROGRAM ENROLLMENT

In 2010, a total of 632,620 students were enrolled in science and engineering graduate programs.[3] A comparison of enrollment between the broad disciplines within science and engineering reveal the relative size of various graduate programs within the United States. According to the *Digest of Education Statistics*, the fields of life sciences and engineering enrolled the largest numbers of students, while the fields of neuroscience and communication enrolled the least number of students.



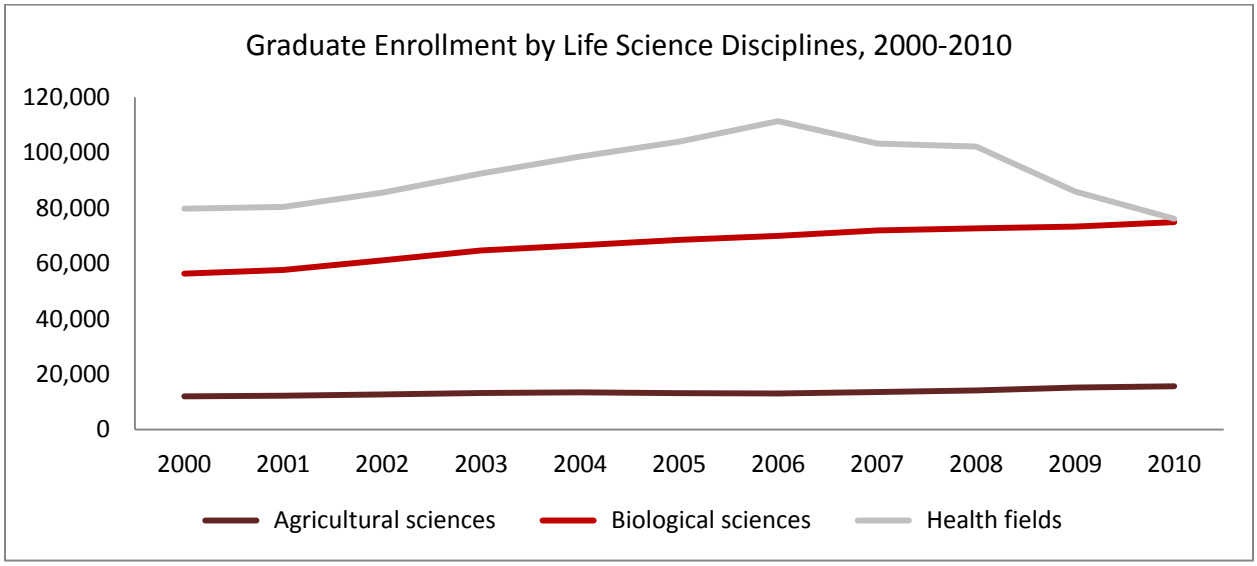
Source: National Science Foundation. Science and Engineering Indicators 2012.

Further analysis of the broader life sciences discipline shows that graduate enrollment numbers steadily increased from 2000 to 2006, and began to experience a slow decline in numbers when the recession began in 2007. In 2010, the life sciences enrolled a total of 166,704 students. This represents an approximate increase of 13% from 2000 enrollment numbers, but a decrease of 14% from enrollment numbers in 2006.



Source: National Science Foundation. Science and Engineering Indicators 2012.

Because the National Center for Education Statistics includes the agricultural sciences, biological sciences and health fields within its definition of life sciences, it is important to look at enrollment trends across each of the three disciplines under the life sciences umbrella. The health field, for example, has enrolled the largest number of graduate students over time; however, enrollment in the heath field has been more volatile when compared to the agricultural and biological sciences. After a period of growth, the health field experienced a drastic decrease in enrollment numbers between 2006 and 2010. Alternatively, the biological sciences have enrolled graduate students at a sustained, yet growing pace since 2000.

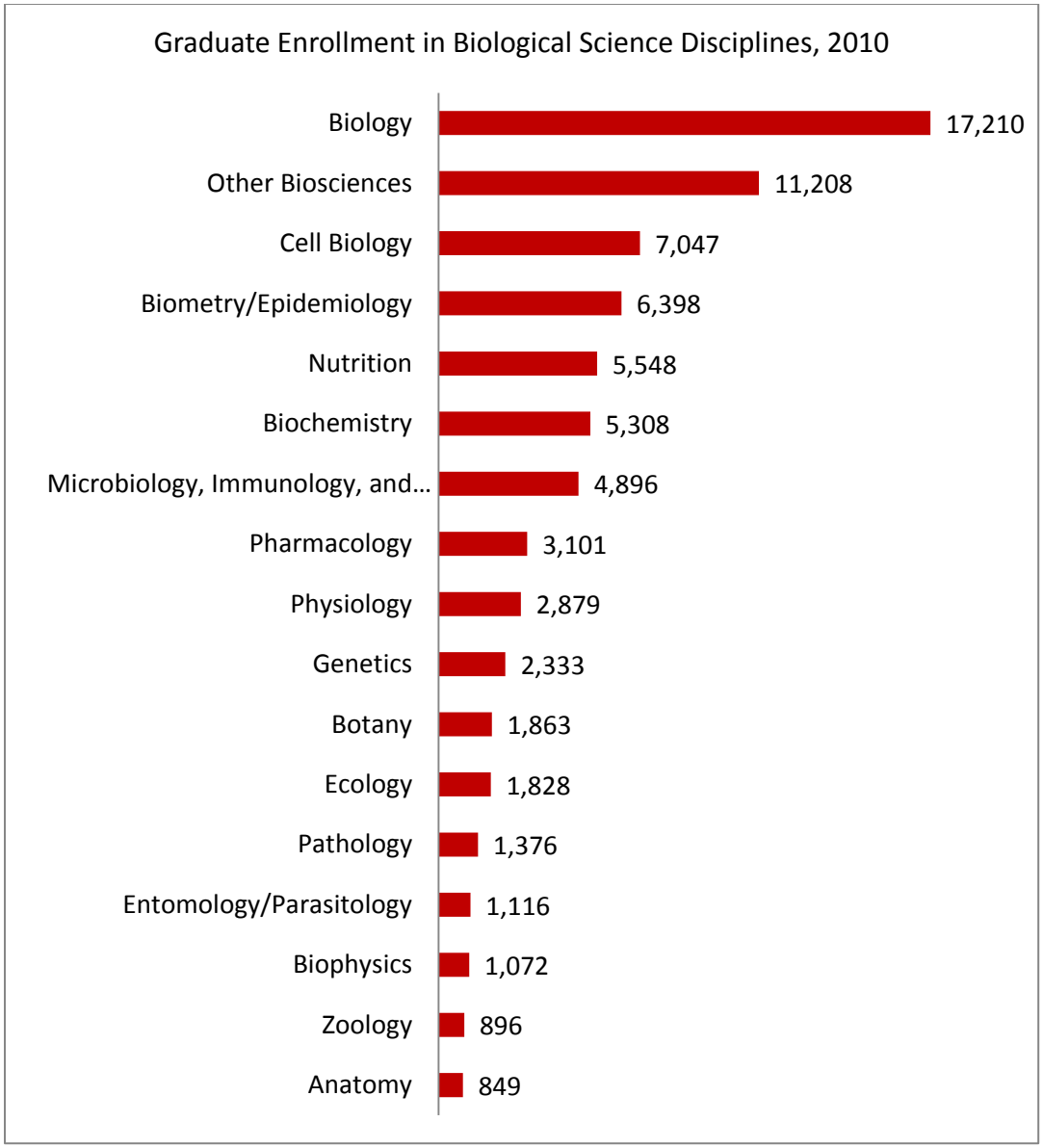


Source: National Science Foundation. Science and Engineering Indicators 2012.

The life sciences discipline can be even further broken down by fields within agricultural sciences, biological sciences and health disciplines. Sub-disciplines such as bioscience, genetics, pharmacology, cell biology, microbiology, biochemistry, biophysics, and others are included under the NCES' definition of biological sciences. Because fields within the biological sciences are more relevant to the scope of this

study, it is important to view enrollment trends across the various areas of study within the biological sciences in more detail.

Fields related to bioscience grew substantially between 2000 and 2010. Graduate enrollment in the "Other Biosciences" industry increased from 4,265 in 2000 to 11,208 in 2010, which represents an increase of 163%. No other disciplines within the biological sciences increased nearly as rapidly. However, seven of the other fields in biological sciences did experience notable increases in enrollment since 2000. Programs in nutrition, biology, genetics, biophysics, physiology, cell biology and biometry/epidemiology all increased enrollment numbers by more than 25% between 2000 and 2010. The following chart illustrates the number of graduate students enrolled in each discipline in 2010.



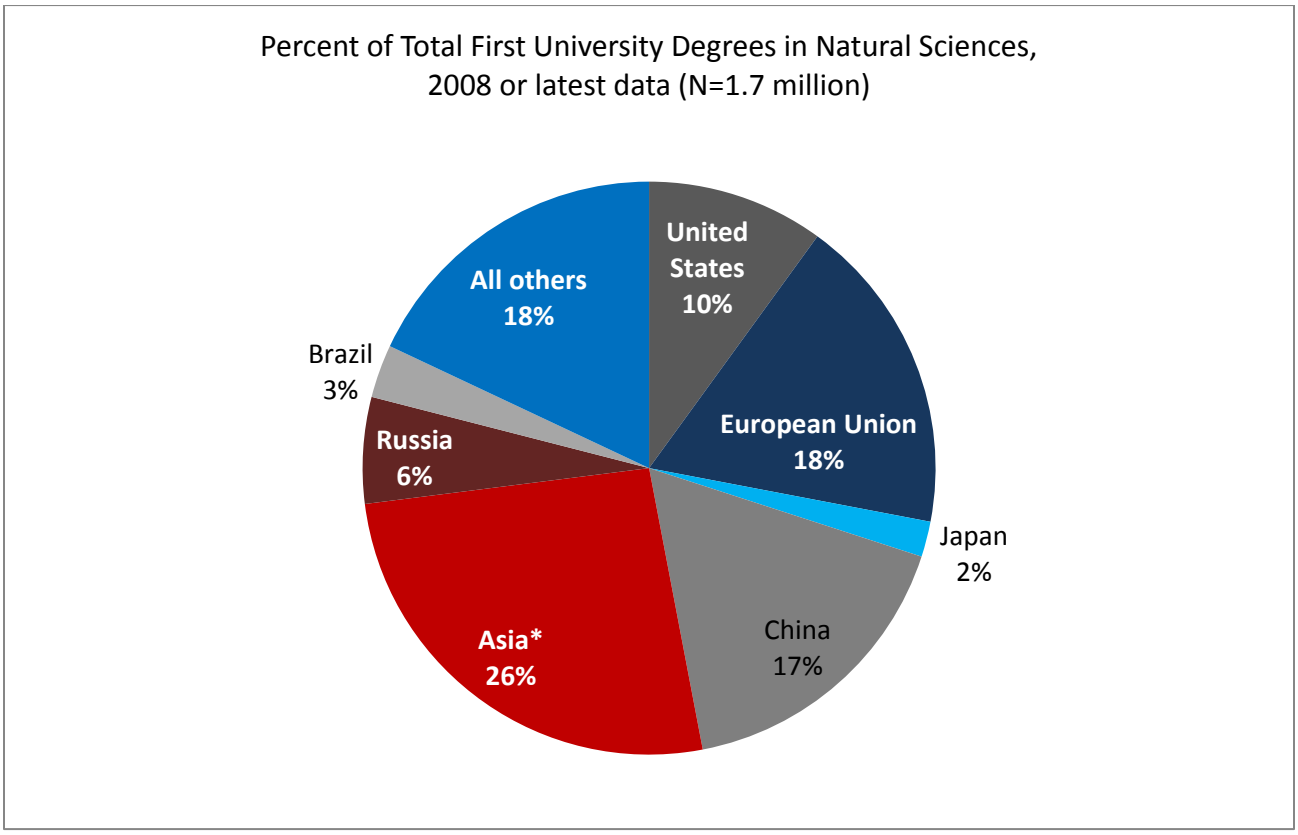
Source: National Science Foundation. Science and Engineering Indicators 2012.

International Education Trends

Each year, the National Science Foundation publishes the *Science and Engineering Indicators* to record high-quality quantitative data on the U.S. and international science and engineering enterprise.[4] The publication collects objective information on the scope, size and vitality of various disciplines within science and engineering programs around the world.[5] McKinley has used the *Science and Engineering Indicators 2012* report as a primary resource to measure trends among international higher education programs related to the broader field of the natural sciences, as well as educational trends in physical and biological sciences. It is important to note that these worldwide statistics only include countries where relatively recent data are available, which primarily countries in Asia, Europe and the Americas.[6]

FIRST UNIVERSITY DEGREES

More than 14 million students worldwide earned first university degrees (i.e., equivalent to bachelor's degree in the U.S.) in 2008, with 1.7 million of these in the natural sciences.[7] While the natural sciences includes a variety of fields, including physical, biological, environmental, agricultural, and computer sciences, and mathematics, data on first university degrees by sub-fields and disciplines is limited at the international level. The following chart depicts the percentage of first degrees within the natural sciences produced in 2008 by country or region. The United States, China, the European Union and Asia* emerged as leaders in terms of the number of first degrees produced in the natural sciences.

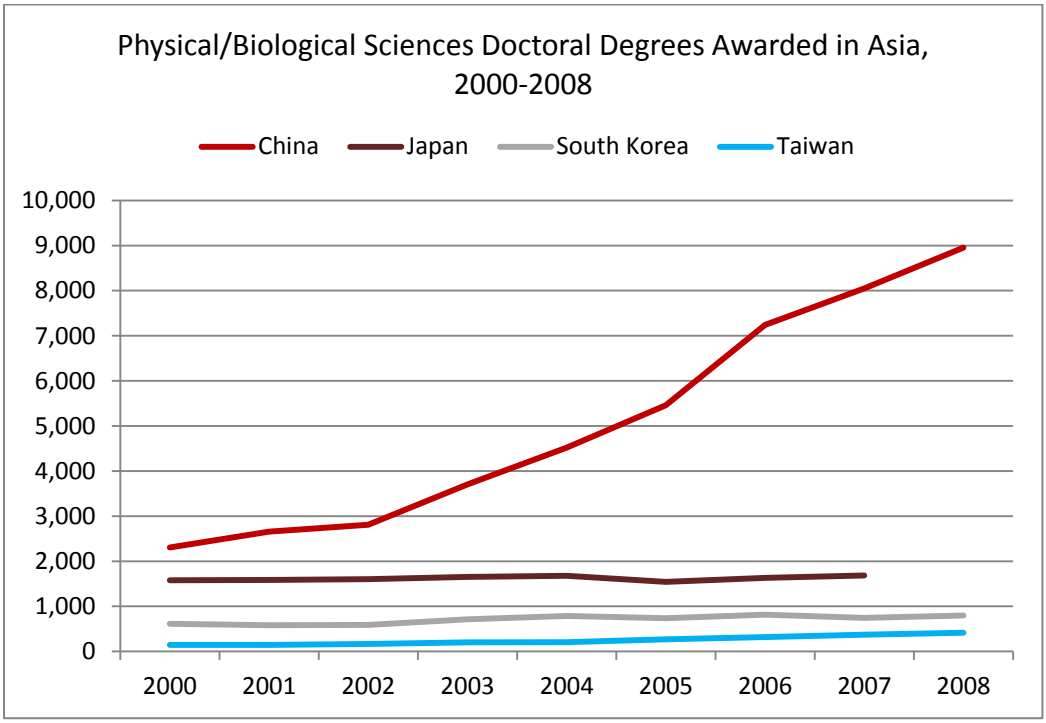


**Includes India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand.*
Source: National Science Foundation. Science and Engineering Indicators 2012.

DOCTORAL DEGREES

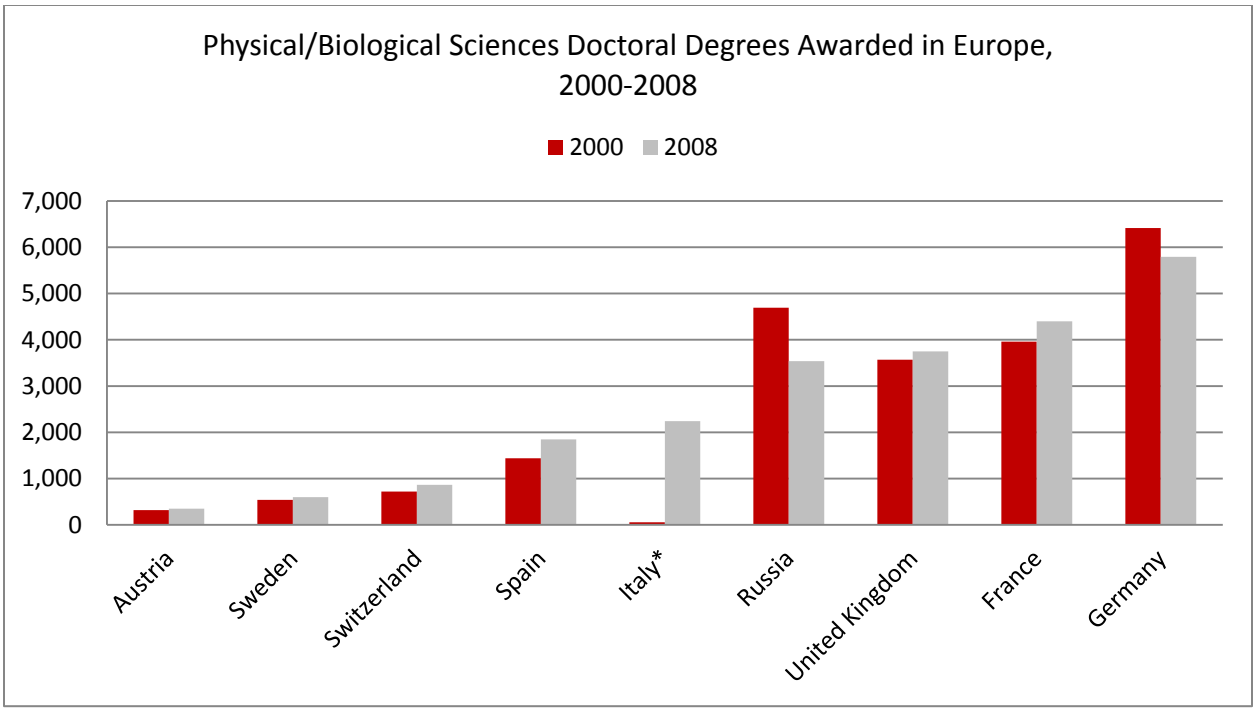
While data on first degrees is only available at the macro level, trends in doctoral degrees can be assessed on a more detailed level in terms of the field of study. The following section analyzes the number of doctoral degrees produced within the field of physical/biological sciences within Asia and Europe.

In Asia, China was the largest producer of doctoral degrees in the physical/biological sciences. The number of doctorates awarded in the physical/biological sciences rose from about 2,306 in 2000 to about 8,953 in 2008. This type of growth points to an increased capacity for advanced education in the biological sciences. The number of physical/ biological science doctorates awarded in Japan, South Korea and Taiwan also rose from 2000 to 2008, but at a lower rate.[8]



Source: National Science Foundation. Science and Engineering Indicators 2012.

A comparison of doctoral degrees produced within European countries reveals that the number of physical/biological sciences doctoral degrees awarded in Italy has risen sharply in recent years, rising from 55 in 2000 to about 2,243 in 2007. Russia also increased considerably between 2002 and 2007, but decreased sharply in 2008. The number of doctoral degrees awarded among other European countries remained relatively consistent between 2000 and 2008.[9]



**Degree data for 2008 not available, figure represents the number of degrees awarded in 2007.*
Source: National Science Foundation. Science and Engineering Indicators 2012.

Endnotes

[1] Massachusetts Institute of Technology. (2011). *The Third Revolution: The Convergence of the Life Sciences, Physical Sciences, and Engineering.* Retrieved from http://www.cimit.org/images/about/MIT-White-Paper-on-Convergence.pdf.

[2] NCES

[3] NCES.

[4] National Science Foundation. (2012). Science and Engineering Indicators 2012. Retrieved from http://www.nsf.gov/statistics/seind12/?CFID=11320659&CFTOKEN=41016538&jsessionid=f030347bfd001f2aaaf72b92c3827612d919.

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] Ibid.

[9] Ibid.