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From Doctoral Student to Professor

The Academic Career Path in the United States

Eva Karlsson

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Foreword

The United States is often used as a benchmark in the Swedish research policy debate. The scope and quality of American research, the ability to commercialize research results and the entrepreneurial spirit are some reasons for this.

Against this background the Swedish government commissioned the Institute for Growth Policy Studies (ITPS) to undertake a study on the science system and policies in the United States. The ITPS Office at the Swedish Embassy in Washington D.C. was assigned to conduct the study. The results of the project will serve as an input to the next Bill on Research that will be presented to the Swedish Parliament 2004–2005. The results are presented in this report and three others*.

This study covers the higher education system, and describes the American academic career paths in a broad perspective. It includes a presentation of degrees, funding, doctoral studies, U.S. post-docs, faculty and tenure, and gives examples of measures to promote recruitment to scientific careers.

Stockholm, March 2004

Sture Öberg,
Director-General

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- “American Science – the Envy of the World? An Overview of the Science System and Policies in the United States”, by Kerstin Eliasson.
- “The Structure and Financing of Medical Research in the United States – An Overview”, by Eva Ohlin.
- “Commercialization of Research Results in the United States – An Overview of Federal and Academic Technology Transfer”, by Magnus Karlsson.

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Summary

The higher education system and the major challenges within it are partly different in Sweden and the United States. But, there are facts that can be compared and experiences from the United States that is interesting to illuminate.

Higher Education in the United States

- Almost half of the American adult population has some higher education. In 2001 about 58 percent of all 25- to 29-year-olds had completed some college. The demographic and college attendance patterns of the student population are changing. The students are older than before and are attending college part time.
- Of the 4 182 higher education institutions in the United States the year 2000–2001, 59 percent were private and 41 percent public. Of the approximately 15 million students at higher education institutions, about 80 percent attend public universities and colleges.
- There are three broad types of higher education institutions in the United States. These can be both public and private institutions: two-year colleges, usually called community, junior, or technical colleges; four-year colleges or universities, which usually offer either four years of general undergraduate education or a combination of general and pre-professional education, and comprehensive universities, which offer both undergraduate and graduate education as well as professional degrees.
- Community colleges are important in the higher education system, as they are an accessible and low-cost group of institutions for lifelong learning.
- In 1999–2000, more than 500 000 foreign students were enrolled at the college or university level in the United States. They came from 196 countries and territories around the world. The majority of foreign students came from Japan, China, the Republic of Korea, India, Taiwan, and Canada. About 4 600 Swedish students were studying in the U.S. in the year 2000.

Doctoral Education and Doctoral Degrees

- The 416 universities in the United States that conferred research doctorates awarded 40 744 doctorates during the 2000–2001 academic year. Over the last 40 years, the increase in the number of doctorates granted by U.S. universities averaged approximately 3,3 percent per year.
- Just 48 institutions granted 50 percent of all doctorates in 2001. The University of California-Berkeley granted the largest number of doctorates, 751, or about 2 percent of all doctorates awarded in 2001.

- Maintaining its position since 1988, the life sciences were the largest single broad field with about 8 300 doctorates.
- In 1999, Europe produced far more S&E doctoral degrees (54 000) than the United States (26 000) or Asia (21 000). Looking at broad fields of science, most of the doctorates earned in natural sciences, social sciences, and engineering are earned at European universities.
- Women received 44 percent of all doctorates granted in 2001, including those awarded to foreigners in the United States. This is the highest percentage ever for women, continuing a 30-year upward trend.
- Of the 2001 doctorate recipients with known citizenship status (about 95 percent of the total), 70 percent were U.S. citizens, about 5 percent were non-U.S. citizens with permanent resident visas for the United States (i.e., “green cards”), and about 25 percent were non-U.S. citizens in the U.S. on temporary visas.
- The need to reform doctoral education has been widely noted and discussed in the U.S. during the last decade. The main reason is that doctoral studies have traditionally been focused principally on a future academic career and an academic appointment is no longer the only career opportunity for a person with a doctoral degree. Different organizations and associations have taken measures to reform the doctoral education. Through these changes, the doctoral education can hopefully become more attractive for a larger number of students in the future, particularly in the engineering and the natural sciences. There is also a growing need to recruit U.S. citizens and minority groups to doctoral studies.

Postdoctoral Positions

- In the last 15 years, the number of postdocs has increased to an estimated 52 000 a year. More than half of them are non-US citizens
- In many fields, having had one or several postdoc experiences is a prerequisite for obtaining a faculty position at a university. In many fields, at least one postdoc period is a prerequisite for an appointment also outside the tenure-track system.
- The length of a postdoc period also varies by field. In physics and biological sciences, median time spent in postdoc positions extended well beyond the one to two years found in most other fields. Biologists tend to stay the longest; up to five years is common. For engineers one year is common. Postdoc terms for physical scientists are usually two or three years, but some work for up to six years in postdoc positions.
- Few American PhDs go abroad for a postdoc appointment. However, there are measures taken, for example by the NSF, to improve the international collaboration among researchers.

- A postdoc period can be a valuable first step in an academic career, but the postdoc system has been called into question. The postdoc appointments are not standardized, and the institutional status of postdocs, especially in academia, is often poorly defined. The length of the postdoc period can, in some fields, be more than five years, which means that the PhD is often older than 40 before getting a permanent appointment. But actions have been taken by many associations and organizations within the academia to improve the conditions for the postdoctoral fellows and improve the postdoc system as a whole.

Employment for Persons with a Doctoral Degree

- Today, a research career at a university is just one career option for a person with a doctoral degree. In some fields, especially in engineering, industry is the main employer. Still, many PhDs, especially in the humanities and social sciences, prefer an academic career. During the last decades, however, it has become more difficult to get an appointment at higher education institutions, especially a tenure-track position.
- The proportion of employees with a doctoral degree has increased by 230 percent for private companies, 170 percent for government, and 190 percent for all other segments during the 1973–1999 period.

Faculty in Higher Education Institutions

- The most commonly used faculty titles in the tenure-track system are instructor, assistant professor, associate professor, full professor and professor emeritus.
- There is a growth in academic employment over the past half century that reflects both the need for teachers, driven by increasing enrollments, and an expanding research function, largely supported by federal funds.
- The tenure system is an arrangement under which faculty members are given permanent appointments following a probationary period. It is designed to ensure academic freedom and to provide sufficient economic security to encourage talented men and women to choose academic careers. At least 60 percent of current college and university faculty members have tenure.
- A Ph D is generally a prerequisite for faculty positions at pre-eminent colleges and universities. At some institutions, especially community colleges, a master's degree may be sufficient.
- The most important step in the academic career is the promotion from assistant professor to associate professor, as tenure is often linked to the promotion to associate professor. In the American academic career, it's not unusual to have to choose an institution of lesser status when you want to be promoted.

- The last decades, faculty appointments have decreased and postdoc appointments and other types of non-tenured positions have increased at the higher education institutions. Recent Ph D-holders who enter academic employment today are more likely to receive postdoc appointments (43 percent) than faculty positions (39 percent). Those at research universities are more than twice more likely to be in a postdoc than in a faculty position.
- The number of women faculty in higher education institutions increased six-fold; from 9 to 27 percent, between 1973 and 1999. By the end of the decade, women constituted just less than 25 percent of full-time faculty, up from 6 percent. Compared with men, women faculty remain relatively more heavily concentrated in the life sciences and psychology, with correspondingly lower shares in engineering, physical sciences, and mathematics
- For a long time, the U.S. higher education institutions have relied on foreign scientists. About 28 percent of doctoral scientists and engineers at U.S. universities and colleges in 1999 were foreign born. Computer sciences and engineering had the highest percentages (37 and 35 percent, respectively); followed by mathematics (28 percent); physical, life, and social sciences (from 23 to 19 percent); and psychology (8 percent).
- One of the most important challenges in Sweden is how to deal with the future retirements among faculty at the higher education institutions. This is not a problem in the United States today or in the closest future, mainly because of the great number of foreigners that get their doctoral degree in the United States and then stay to work in academia or in industry.

1 Introduction

One of the most important research policy issues in Sweden is the generation shift within higher education. Many professors, and other teaching and researching staff, will retire during the next decade. Furthermore, the number of higher education institutions, mostly university colleges, has increased during the last decades, as a result of the Government's intention to give a greater number of people the access to higher education. This expansion, together with the generation shift, is causing an increasing demand for teachers and researchers with a doctoral degree in the higher education sector. In addition, there is an increasing demand for employees with a doctoral degree in industry and the private and public sector.

To meet the need for a new generation of faculty and researchers, the Swedish Government, the universities and university colleges, and the research agencies and foundations have taken steps to increase the numbers of PhDs and to improve the support for young researchers. However, further measures are felt to be needed to prevent a future lack of researchers and faculty within higher education.

To meet this challenge, the Swedish Ministry for Education and Science commissioned the Institute for Growth Policy Studies, ITPS, to undertake several studies on the American research system. This study, which has the highest priority, will describe the American academic career path in a broad perspective, focusing primarily on young researchers, doctoral studies, postdoc positions and appointments within the higher education institutions. Similarities and differences between the Swedish and the American career system will be described. The overall purpose is to look into the American system to find how it works out and what we can learn from it.

The study starts with a broad description of higher education in the United States and continues with an illustration of some issues of particular interest from a Swedish point of view. The chapter will end up in a discussion of some important issues.

2 Higher Education in the United States

During the second half of the twentieth century, higher education in the United States expanded considerably. College and university education in the United States is thus much more accessible today than it was prior to the 1950s. Overall enrollment in the nation's institutions of higher education increased from 7 million in 1967 to 15 million in 1992 and then continued essentially unchanged through 1997. Enrollment in higher education is expected to increase in the first decade of the 21st century because of a predicted 13 percent increase in the population of the college-age cohort during this period (NSF 2002).

Almost half of the American adult population has some higher education. About 21 percent have some college education, but no degree. An associate degree has been earned by 16 percent, a bachelor's degree by 16 percent and 9 percent have a graduate or professional degree (The Chronicle of Higher Education 2002). In 1971, 34 percent of 25- to 29-year-olds had completed some college courses. Thirty years later, in 2001, as much as 58 percent of all 25- to 29-year-olds had completed some college. This overall upward trend reflects the increased propensity of high school graduates to enroll in college immediately after high school (NCES 2002).

The demographic and college attendance patterns of the student population are changing. In 1997, more than 50 percent of all undergraduates were age 22 or older, almost 25 percent were age 30 or older, and 40 percent of all students were attending college part time.

The U.S. higher education system is decentralized and diverse. At the national level there is the Department of Education, but its authority and focus are limited. Each of the 50 states has primary responsibility for supervising higher education within their borders. The U.S. Department of Education is only involved in the regulation of education in a limited way. The United States has no equivalent to a centralized national ministry of education, like the Swedish Ministry of Education and Science.

Higher education institutions are either public colleges and universities, established by individual states, or private institutions who receive their charters from a state. State governments possess legal authority to regulate and approve the private institutions continued operations, even if independent nongovernmental bodies carry out the accreditation. The state departments of education, state boards of higher education, and, in some cases, state universities or special state commissions share responsibility for state institutions. Private colleges and universities have their own governing boards but are subject to state laws governing non-profit and for-profit organizations.

THE AMERICAN BASIC EDUCATION – PRIMARY AND SECONDARY SCHOOLS

The American educational system starts with primary and secondary schools. Before children start school, they begin kindergarten at the age of five. The U.S. school system is often talked about as “K-12”, which means from kindergarten to 12 years of primary and secondary school, as most Americans attend twelve years of primary and secondary school. Primary school begins around age six for U.S. children. They attend five or six years of primary school and then they go to secondary school, which consists of either two three-year programs or a three-year and a four-year program. These are called “middle school”, “junior high school” and “senior high school” (often just called “high school”). Americans call these twelve years of primary and secondary school the first through twelfth “grades.” With a secondary school (high school) diploma or certificate, a student can enter college, university, vocational (job training) school, secretarial school, and other professional schools.

2.1 Higher Education Institutions

Higher education refers to college and university academic study beyond the secondary level (high school). Institutions of higher education are called *colleges*, *universities*, or *institutes*. There are three broad types of higher education institutions in the United States. These can be both public and private institutions: two-year colleges, usually called community, junior, or technical colleges; four-year colleges or universities, which usually offer either four years of general undergraduate education or a combination of general and pre-professional education, and comprehensive universities, which offer both undergraduate and graduate education as well as professional degrees. Institutional titles can be confusing, however, because states have different regulations and traditions. For example, many institutions called “universities” do not offer degrees beyond the master’s degree and some offer no degrees beyond the bachelor’s degree. Some “colleges” offer doctorates. A few prestigious comprehensive research universities in the country are known as “institutes”, for example Massachusetts Institute of Technology (ACE 2001).

2.1.1 The Importance of Community Colleges

Community colleges serve a diverse student population and have a broad set of missions: they confer certificates and associate degrees, serve as a bridge for students to attend four-year colleges, offer a range of remedial courses and services, and enroll millions of students in non-credit and workforce training classes. Community colleges are an accessible and low-cost group of institutions for lifelong learning. In 1998, 63 percent of the students in community colleges were enrolled part-time, and more than 60 percent of these part-time students were older than age 25; in general, enrollment in remedial courses includes a significant number of older adults taking refresher courses. The role of community colleges as a bridge to four-year schools is difficult to determine because many students transfer to four-year schools before earning an associate degree. Approximately 25 percent of community college students transfer to four-year institutions, but percentages differ by field and by state. A recent study, presented in *Science & Engineering Indicators 2002*, indicates that minority students attending community colleges are more likely to transfer to four-year institutions to get a higher degree than their

colleagues who begin their academic career at a four-year school. Also, the completion rate for these transfer students is comparable with that of transfer students from other colleges (NSF 2002).

In addition to these traditional institutions of higher education, there are industrial learning centers, distance education, and certificate programs. Education in industry is mainly oriented toward engineering, design, and business management. Interest in science and engineering courses and entire programs via distance education is growing. In 1997, postsecondary institutions offered more than 50 000 different on-line courses and 91 percent of those were at college-level (NSF 2002).

2.2 Degrees

There are four higher education degrees in the United States; the associate, the baccalaureate, the master's, and the doctorate. In the American system, education up to a Bachelor's degree is called undergraduate education, and education above that level is called graduate education. The Master's degree and the Doctoral degree are much more integrated than in the Swedish system. In the US, a study at the master level is often seen as a first step toward a doctoral degree.

Two-year colleges (junior or community colleges) and some four-year colleges grant the associate degree in arts (A.A.) or science (A.S.). The associate degree is usually awarded after 60 credit hours have been completed. Some four-year colleges and universities also award it. The associate degree is usually accepted for transfer to a four-year college as an alternative to the first two years of a bachelor's degree.

The traditional *bachelor's degree* that requires four years of full-time study is in arts (B.A.) or sciences (B.S.). Some colleges and universities award bachelor's degrees, which are more focused, such as the bachelor of education, bachelor of nursing, or bachelor of social work. The bachelor of fine arts degree ordinarily indicates that the focus has been in performing arts, such as art, drama or dance.

The *master's degree*, traditionally a master of arts or a master of science, may also be awarded in professional areas such as education (M.Ed.), nursing (M.S.N.), business administration (M.B.A.), fine arts (M.F.A.), or social work (M.S.W.). Every master's degree includes one or two years of full-time study (or the equivalent) at the graduate level. Some master's degrees require a thesis or original piece of work.

The *doctoral degree* is the highest academic degree awarded by universities in the United States. In this category, the Doctor of Philosophy (Ph D) degree usually indicates at least two, but often more, years of courses beyond the bachelor's degree, successful completion of comprehensive written and oral examinations, and a major research project in the form of a dissertation. Other doctorates include the Doctor of Medicine (M.D.), Doctor of Education (Ed.D.), and Doctor of Jurisprudence (J.D.). All require substantive coursework beyond the master's level, comprehensive examinations, and a scholarly paper (if not a dissertation), with the exception of the J.D. and M.D.

2.3 Classification of Higher Education

The classification of higher education that is commonly used in the U.S. is the *Carnegie Classification of Higher Education*. Developed in 1970s, the classification identifies categories of colleges and universities from the functions of their institutions and the characteristics of students and faculty members. The most recent update of the classification, which is described below, was made in the year 2000. The 2000 edition classifies institutions based on their degree-granting activities from 1995–1996 through 1997–1998. The 2000 Carnegie Classification includes all colleges and universities in the United States that are degree-granting and accredited by an agency recognized by the U.S. Secretary of Education.

CARNEGIE CLASSIFICATION OF HIGHER EDUCATION 2000

DOCTORAL/RESEARCH UNIVERSITIES are institutions that typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the doctorate. During the period studied, the *Extensive Doctoral/Research Universities* awarded 50 or more doctoral degrees per year across at least 15 disciplines and the *Intensive Doctoral/Research Universities* awarded at least ten doctoral degrees per year across three or more disciplines, or at least 20 doctoral degrees per year overall.

MASTER'S COLLEGES AND UNIVERSITIES are institutions that typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the master's degree. This group is divided into two, one group (I) that awarded 40 or more master's degrees per year across three or more disciplines and another group (II) that awarded 20 or more master's degrees per year.

BACCALAUREATE COLLEGES are primarily undergraduate colleges with major emphasis on baccalaureate programs. This category includes Colleges of Liberal arts that awarded at least half of their baccalaureate degrees in liberal arts field and Baccalaureate/Associate's Colleges that are undergraduate colleges where the majority of conferrals are below the baccalaureate level (associate's degrees and certificates).

ASSOCIATE'S COLLEGES are institutions that offer associate's degree and certificate programs but, with few exceptions, award no baccalaureate degrees. This group includes community, junior, and technical colleges. This group includes institutions where, during the period studied, bachelor's degrees represented less than 10 percent of all undergraduate awards.

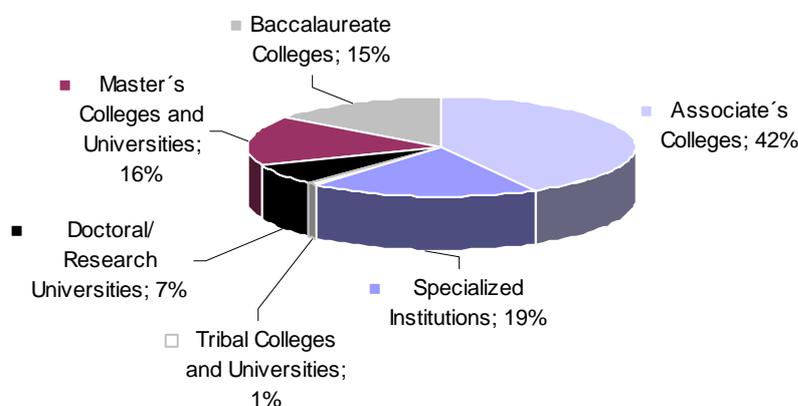
SPECIALIZED INSTITUTIONS which offer degrees ranging from the bachelor's to the doctorate, and typically award a majority of degrees in a single field. Specialized institutions include, among others, theological seminaries, medical schools, schools of engineering and technology, schools of business and management, schools of law and teachers colleges.

TRIBAL UNIVERSITIES AND COLLEGES that, with few exceptions, are tribally controlled and located on reservations. They are all members of the American Indian Higher Education Consortium.

2.4 The Number of Higher Education Institutions

Of the 4 182 higher education institutions in the United States the year 2000–2001, 59 percent were private and 41 percent public (NCES 2001). Of the approximately 15 million students at higher education institutions, about 80 percent attend public universities and colleges (NSF 2002). Since the Carnegie Classification 2000; some hundred new institutions have been established. The percentages in the figure below is from the latest Carnegie Classification, where the number of higher education institutions were 3 941. The figure shows the percentage of the different categories of higher education institutions. The proportions are, however, about the same (Carnegie Foundation 2001).

FIGURE 1
Different categories of higher education institutions



Source: Carnegie Foundation 2001

Of the 263 doctoral/research universities in 2001, 63 percent were public and 37 percent were private. Among the Master's universities, 57 percent were private and 43 percent were public. Among the Baccalaureate Colleges about 85 percent were private. Among the specialized institutions, 89 percent were private. The majority of these institutions are theological seminars, which are governed by different communions (NCES 2001).

2.5 Funding of Higher Education Institutions

Governing authorities and funding sources vary according to institutional type. Private institutions have independent governing boards and rely heavily on tuition fees. They do not receive general subsidies from the federal or state government, although accredited institutions have access to state and federal research, scholarships, and loan funds. Private institutions are either non-profit (some of which are affiliated with religious groups) or for-profit. Most of the private institutions are, however, non-profit. Public institutions are governed by boards of regents or trustees whose authority is delegated by the state or, in some cases, such as community colleges, county or city-government. Traditionally, their largest single source of revenue has been state (or county or city) tax funds. In recent years, however, some state governments have reduced their financial contributions such that they contribute less than one-quarter of the public institution revenue. The figure below shows the proportion of incomes at public and private higher education institutions. As the figure shows, the main differences between public and private institutions are the incomes from tuitions, which are a much bigger part at private institutions and funding from state government, which is the major income at public institutions. Also public universities receive gifts, but not as much as private institutions.

TABLE 1
Current-Fund Income (1995–1996)

	Public Institutions	Private Institutions
Tuition and Fees from Students	18.8 %	43.0 %
Federal Government	11.1 %	13.8 %
State Governments	35.8 %	1.9 %
Local Governments	4.1 %	0.7 %
Private Gifts, Grants and Contracts	4.1 %	9.1 %
Endowment Income	0.6 %	5.2 %
Sales and Other Services	22.2 %	21.0 %
Other Sales	3.3 %	5.3 %

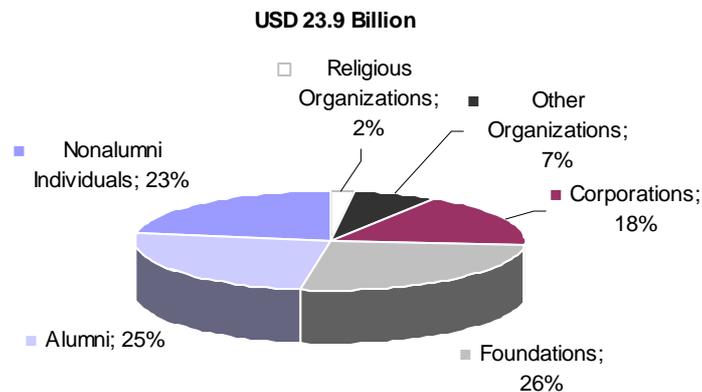
Source: ACE 2001

2.5.1 Gifts and Donations

Gifts and donations are increasingly important to the maintenance of high-quality colleges and universities. In the year 2000–01, private contributions to United States colleges and universities reached about 24 billion dollars, an increase from the year before by \$1 billion, according to the results of Council for Aid to Education’s annual survey (CAE 2003). But charitable gifts to colleges and universities declined in 2002, for the first time in 15 years (CAE 2003). The nation’s top fundraising universities in 2002, in order of dollars received, were:

- University of Southern California – \$585,161,932 (private)
- Harvard – \$477,617,144 (private)
- Stanford – \$454,769,878 (private)
- Cornell – \$363,031,766 (private)
- University of Pennsylvania – \$319,742,070 (private)
- Johns Hopkins – \$318,687,392 (private)
- University of Wisconsin–Madison – \$307,213,842 (public)
- UCLA – \$282,343,369 (public)
- Columbia – \$271,231,231 (private)
- Duke – \$264,580,048 (private)

FIGURE 2
The sources for the voluntary support in 2002



Source: CAE 2003

2.6 Undergraduate Education

Postsecondary education institutions in the United States enrolled more than 14.7 million students in 1999 (NCES 2001). There has been a constant increase in the number of students since the 1950s, when the number of students was about 2.6 million. Today's undergraduate population is different than it was a generation ago. In addition to being 72 percent larger in 1999 than in 1970, proportionately more students are enrolled part-time (39 percent versus 28 percent) and at two-year colleges (44 percent versus 31 percent). Women have replaced men as the majority, representing 56 percent of the total compared to 42 percent in 1970 (NCES 2002). Women outnumber men in undergraduate enrollment for every race and ethnic group. White women constitute 55 percent of white undergraduate students, and black women constitute 62 percent of black undergraduate enrollment (NSF 2002). There are relatively older students on campus as well. In 1999, 39 percent of all postsecondary students were 25 years or older, compared to 28 percent in 1970 (NCES 2002).

Research universities enroll only 19 percent of the students in higher education, but they play the largest role in S&E degree production. They produce most of the engineering degrees and a large proportion of natural and social science degrees both at the graduate and undergraduate levels. In 1998, the nation's research universities (now classified as extensive doctoral/research universities) awarded more than 42 percent of all S&E bachelor's degrees and 52 percent of all S&E master's degrees (NSF 2002).

2.6.1 Students Study Financing

The major costs for college and university students are tuition, fees, and room and board. Tuition helps to help cover the cost of instruction. Depending upon the institution, undergraduate tuition for an academic year may vary from \$1,000 to more than \$20,000. As a rule, tuition rates are higher at private colleges and universities than at public institutions. Public institutions' tuition rates for state residents are usually somewhat lower than for non-residents, because their families have paid taxes to that state to underwrite the cost of education. Tuition and other fees at graduate level and professional schools are typically higher than at the undergraduate level. (American Council on Education 2001) The average tuition and fees in the academic year 1999–2000 at public 4-year institutions were \$3,506, at public two-year institutions \$1,359 and at private for-year institutions \$15,531 (Chronicle of Higher Education 2002).

Qualified students can choose from a wide range of public and private colleges and universities with significantly different costs. The cost of postsecondary education has increased over the past decade, but so have the opportunities for financial aid. Approximately 70 percent of full-time students receive some financial aid. At private, not-for-profit colleges, the average amount of aid is \$9,460 per year. Three out of four full-time undergraduate students pay less than \$10,000 per year for

everything – tuition, room, board, books, and living expenses. One-third pays less than \$5 000 per year (ACE 2001).

2.6.2 The Social and Ethnic Background of Undergraduate Students

Expectations of college attendance have increased dramatically over the past 20 years, also among low-performing students. More than two-thirds of high school graduates attend college, and a rising proportion has taken a college preparatory curriculum in high school. High school graduates from low-income families enter four-year institutions at lower rates than those from high-income families. Although financial barriers exist for many low-income students, their lower enrollment rate also depends on their lower academic qualifications. But, expectations for college attendance have increased dramatically over the past 20 years, also among low-performing students. Overall, immediate college enrollment rates for high school graduates increased from 49 percent to 63 percent between 1972 and 1999. Much of the growth in these rates between 1984 and 1999 was due to increases in the immediate enrollment rates for females at four-year institutions. Some differences in immediate enrollment rates among groups of graduates have not changed. The gap in rates between students from high- and low-income families persisted for each year between 1990 and 1999. Likewise, graduates whose parents had attained a bachelor's degree or higher were more likely to enter college immediately after high school graduation for each year between 1990 and 1999, than those with parents who had less education (NSF 2002).

College transition rates for white and black high school graduates have increased over the past 30 years, while rates for Hispanic graduates have been stable. Transition rates for white high school graduates increased from 50 percent in the early 1970s to about 60 percent in the mid-1980s and have fluctuated between 60 and 67 percent since then. Since 1984, college transition rates for black graduates have increased faster than those for whites. The enrollment rates for Hispanic graduates have shown no consistent growth since 1972, fluctuating between 45 and 65 percent from 1972 to 1997 (NSF 2002).

2.6.3 Students from Abroad

In 1999–2000, more than 500 000 foreign students were enrolled at the college or university level in the United States. They came from 196 countries and territories around the world. The majority of foreign students came from Japan, China, the Republic of Korea, India, Taiwan, and Canada. About 4 600 Swedish students were studying in the U.S. in the year 2000 (Chronicle of Higher Education 2002).

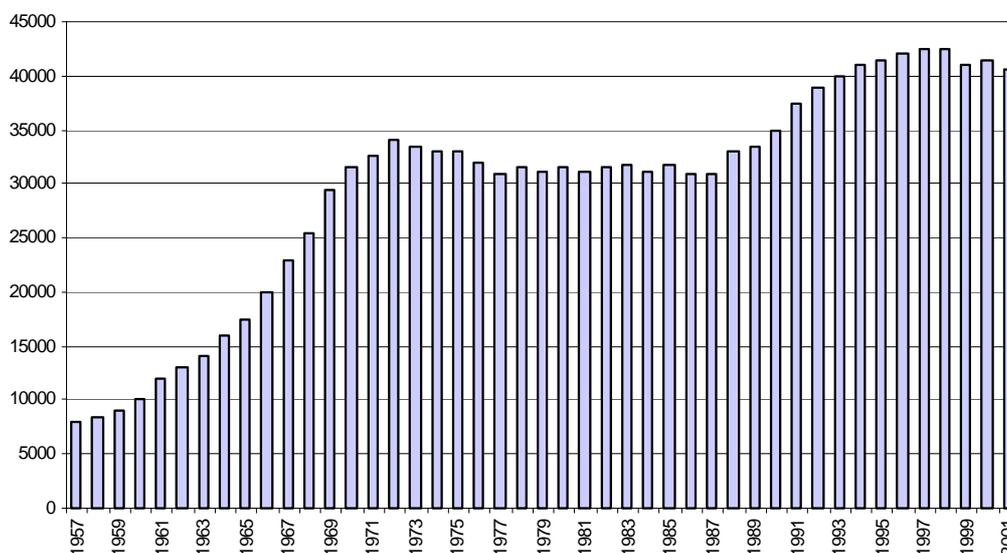
2.7 Doctoral Education and Degrees

The doctoral degree is the highest academic degree awarded by universities in the United States. The Doctor of Philosophy (Ph D) degree usually indicates at least two years of courses beyond the bachelor's degree, successful completion of comprehensive written and oral examinations, and a major research project in the form of a dissertation. Other doctorates include the Doctor of Medicine (M.D.), Doctor of Education (Ed.D.), and Doctor of Jurisprudence (J.D.).

2.7.1 Number of Doctoral Degrees Increasing

The 416 universities in the United States that conferred research doctorates awarded 40 744 doctorates during the 2000–2001 academic year, a decline of 1,4 percent from the 41 340 doctorates awarded in 2000, and a 4,4 percent decline from the all-time high of 42 654 doctoral degrees in 1998. The 2001 total is the lowest since 1993. Despite the lack of growth in 2001, the long-term trend in the number of new research doctorates has been one of considerable expansion. Over the last 40 years, the increase in the number of doctorates granted by U.S. universities averaged approximately 3,3 percent per year (NSF, NIH et al 2002).

FIGURE 3
Doctorates awarded by U.S. universities, 1957–2001



Source: NSF/NIH/USED/NASA, *Survey of Earned Doctorates 2002*

During the 2001 academic year there were, thus, 416 universities in the United States and Puerto Rico that awarded at least one research doctorate. This is the highest number of institutions ever recorded and reflects a trend of steady increases in the number of doctorate-granting institutions from the early 1960s. There were 175 in 1962. Just 48 institutions granted 50 percent of all doctorates in 2001. The

University of California-Berkeley granted the largest number of doctorates, 751, or about 2 percent of all doctorates awarded in 2001, followed by the University of Texas at Austin (732), the University of Illinois at Urbana-Champaign (673) and the University of Wisconsin-Madison (656).

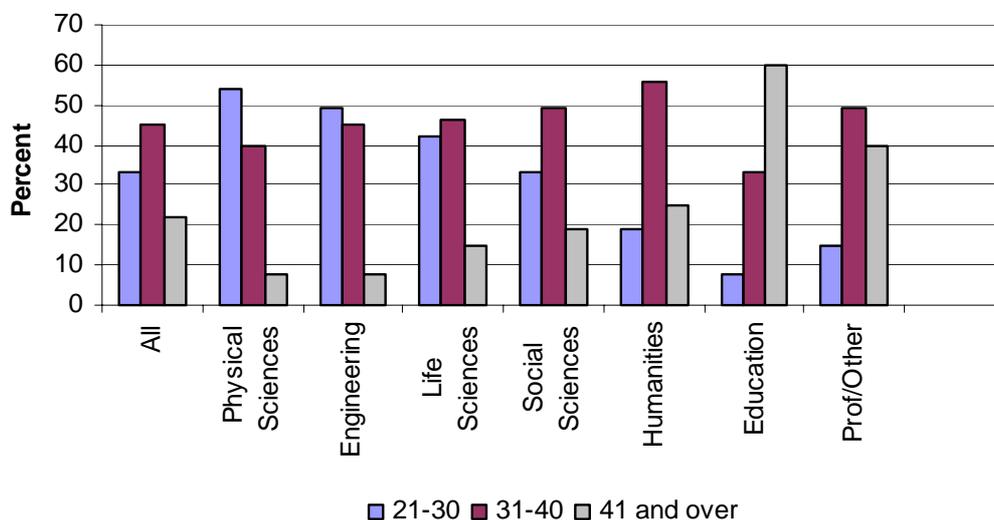
In 2000 and 2001, the top 10 institutions granted approximately 16 percent of all doctorates. The University of California-Berkeley awarded the most doctorates in the physical sciences (168). The Massachusetts Institute of Technology (MIT) granted the most engineering doctorates (226), while the Johns Hopkins University led all universities in the life sciences (189). The University of Texas-Austin topped the list both for social science doctorates (113) and for doctorates in the humanities (150). Nova South-eastern University had the highest total in education (314) as well as in the diverse “professional/other” category (84) (NSF, NIH et al 2002).

Maintaining its position since 1988, the life sciences were the largest single broad field with about 8 300 doctorates. Compared to five years earlier, the total number of doctorates awarded was almost 1 700 more than the total in 2001. Engineering, the physical sciences, and professional/other showed large decreases: 12,8 percent, 10,5 percent, and 9,6 percent lower in 2001 than in 1996. Education (-6,8 percent) was also lower while the total numbers completing doctorates in the life sciences and social sciences were about the same. Humanities registered the only percentage increase from 1996 to 2001, with 9,3 percent more degrees awarded in 2001 than five years earlier (NSF, NIH et al 2002). Physical sciences, life sciences, social sciences, and engineering – the four broad fields that together constitute “science and engineering” (S&E) – represented about 65 percent of all doctorates awarded in 2001. They accounted for approximately the same percentage of all doctorates ten years ago in 1991, but the S&E fields represent a larger percentage of the total in 2001 than 25 years ago (1976), when they comprised about 56 percent of all new doctorate recipients.

In 1999, Europe produced far more S&E doctoral degrees (54 000) than the United States (26 000) or Asia (21 000). Looking at broad fields of science, most of the doctorates earned in natural sciences, social sciences, and engineering are earned at European universities (NSF 2002).

For the 2001 doctorate recipients, the median total time span from baccalaureate to doctorate was 10 years, nearly the same as in 2000. The total time span was shortest in the physical sciences (almost 8 years) and longest in education (19 years). The broad field of education includes large numbers of individuals who have worked full-time before starting their graduate degree programs, and who even continue to work full-time while earning their doctorates. The median age at receipt of the doctorate in 2001 was about 33 years, but age at degree varies with field of study (NSF, NIH et al 2002).

FIGURE 4
Age distribution at doctorate by broad field of study, 2001



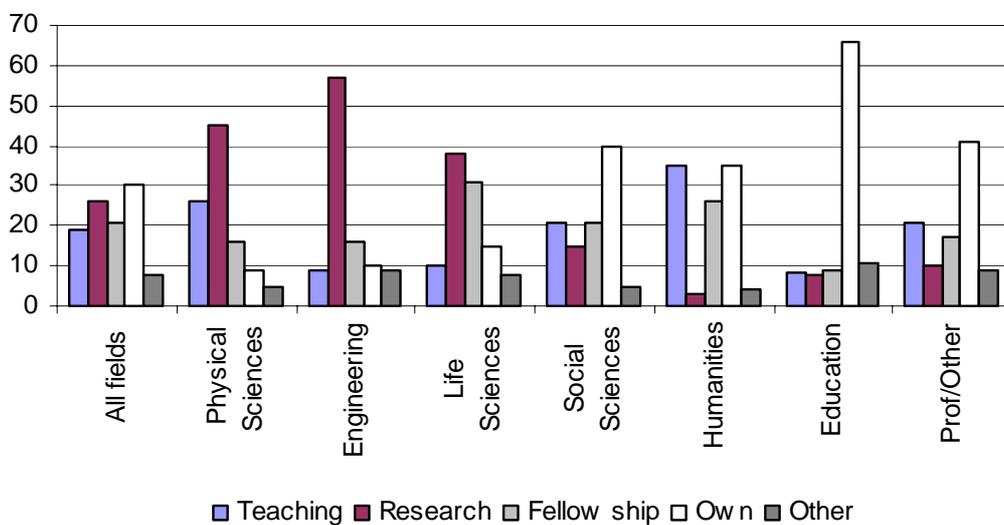
Source: NSF, NIH et al 2002

2.7.2 Funding Doctoral Studies

U.S. higher education has traditionally coupled advanced education with research. This coupling is reflected in the various forms of financial support for doctoral students, particularly those pursuing doctoral degrees. Support mechanisms include fellowships, traineeships, research assistantships (RAs), and teaching assistantships (TAs). Sources of support include Federal agency support, non-Federal support, and self-support. *Fellowships* are competitive awards (often in a national competition) to students to support their graduate studies. *Traineeships* are educational awards given to students selected by the institution. *Research assistantships* are given to students whose assigned duties are primarily research. *Teaching assistantships* are given to students whose assigned duties are primarily teaching. *Other mechanisms* of support include work-study programs, business or employer support, and support from foreign governments (that is not in the form of a previously mentioned mechanism). *Self-support* comes from any loans obtained (including Federal loans) or from personal or family contributions. *Federal support* comes from Federal agencies; examples are the tuition paid by the Department of Defense for members of the Armed Forces. *Non-Federal support* comes from the student's institution of higher education, state and local government, foreign sources, non-profit institutions, or private industry.

Almost two-thirds of the 2001 doctorate recipients received the majority of their support for doctoral study from program- or institution-based sources, such as teaching assistantships, research assistantships/traineeships, and fellowships/grants (64 percent). Less than one-third (29 percent) of all 2001 doctorate recipients reported that their own resources, which include funds from loans, one's spouse, savings, and non-academic employment, were the primary sources to finance their doctoral studies. Foreign government, employer contributions, and "other" sources accounted for the remaining 6 percent of the cases (NSF, NIH et al 2002).

FIGURE 5
Primary sources of financial support for doctorate recipients, 2001



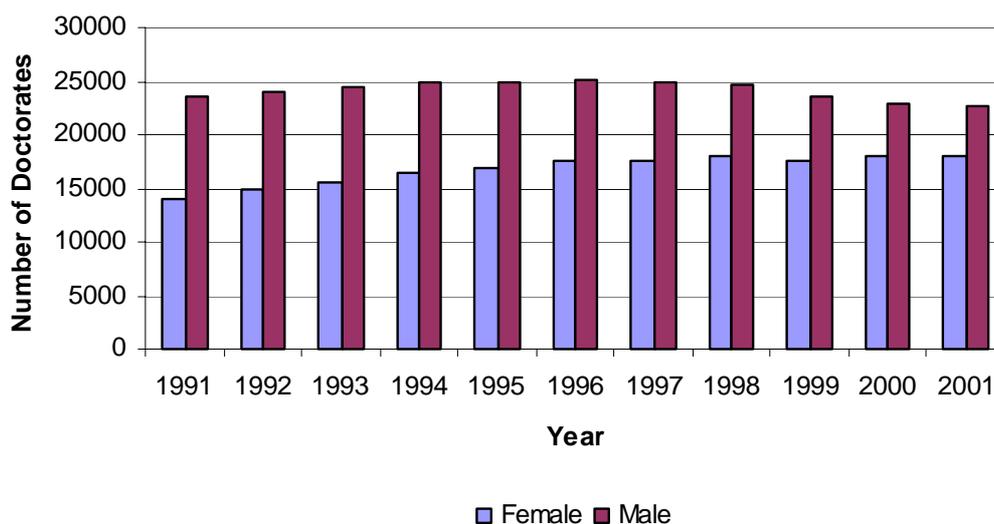
Source: NSF, NIH et al 2002

The National Institutes of Health (NIH) and the National Science Foundation support most of the S&E graduate students, whose primary support comes from the Federal Government, 17 000 and 14 000 students, respectively. The proportion of students supported primarily by NIH increased from less than 22 percent in 1980 to 29 percent in 1999; those supported primarily by NSF increased from less than 18 percent in 1980 to 21 percent in 1999. In contrast, the Department of Defense provided primary support for a declining proportion of students funded primarily by Federal sources, 17 percent in 1988 compared to 12 percent in 1999 (NSF 2002).

2.7.3 Doctoral Degrees Earned by Women

Women received 17 900 doctorates, or 44 percent of all doctorates granted in 2001, including those awarded to foreigners in the United States. This is the highest percentage ever for women, continuing a 30-year upward trend. Of all doctorates awarded to U.S. citizens 50 percent went to women, about as many as in 2000 and continuing a long-term trend of U.S. women approaching parity with their male counterparts. There are, however, some differences between the fields. Women earned about 47 percent of the doctorates granted in life sciences, 54 percent in the social sciences, 51 percent in the humanities, 65 percent in education, and 43 percent in business or other professional fields. In some fields, however, women received a minor part of the doctorates. In the physical sciences and engineering, about 25 percent and 17 percent of the doctorates went to women (NSF, NIH et al 2002).

FIGURE 6
Doctorate recipients by sex, 1991–2001



Source: NSF, NIH et al 2002

2.7.4 Doctoral Degrees Earned by Minority Groups

In 2001, about 4 300 members of U.S. racial/minority groups were awarded doctorates, representing 16 percent of the U.S. citizens earning research doctorates that year. Blacks earned the most doctorates (1 600) of the four main U.S. minority populations in 2001, followed by Asians (1 400), Hispanics (1 100), and American Indians (149). The 2001 number of minority doctorate recipients is about 28 percent higher than the total five years earlier (1996) and 72 percent higher than 10 years earlier (1991). Doctorates awarded to U.S. minority groups generally increased much more in the 1990s than in the (NSF, NIH et al 2002).

2.7.5 Doctoral Degrees Earned by Foreigners

Each year from 1986 to 1996, the number of foreign students earning S&E doctoral degrees from universities in the United States increased. The number of such degrees earned by foreign students increased much faster – about 8 percent annually – than the number earned by U.S. citizens, which was about 2 percent annually. Foreign students earn a larger proportion of degrees at the doctoral level than any other degree level. More than one third of all S&E doctoral degrees awarded were received by foreigners (NSF 2002).

Of the 2001 doctorate recipients with known citizenship status (about 95 percent of the total), 70 percent were U.S. citizens, about 5 percent were non-U.S. citizens with permanent resident visas for the United States (i.e., “green cards”), and about 25 percent were non-U.S. citizens in the U.S. on temporary visas. Among those doctorate recipients holding temporary visas, only 29 percent were women. In 2001, about 2 700 doctorate recipients were citizens of China, comprising about 7 percent of the total 40 744 degrees awarded (NSF, NIH et al 2002). During the period 1986–99, foreign students earned 120 000 doctoral degrees in S&E fields. China was the top country of origin of these foreign students; almost 24 000 Chinese earned S&E doctoral degrees at universities in the United States during this period (NSF 2002).

Historically, approximately 50 percent of foreign doctoral recipients planned to stay in the United States after graduation, and a smaller proportion had firm offers to do so. In 1999, more than 72 percent of foreign students who earned S&E doctoral degrees at universities in the United States reported that they planned to stay in the United States after graduation, and 50 percent had accepted firm offers to do so. These percentages in the late 1990s thus represent significant increases (NSF 2002). The areas having the highest concentrations of non-U.S. citizens who plan to stay in the United States are chemistry (89 percent), biology (83 percent), computer sciences (82 percent), and physics (81 percent) (NSF 1999). This is, however, just an indicator of the recent doctorates plans for their future. Whether they actually stay or not is not known.

2.7.6 Doctorates by Parental Education Background

In the Survey of Earned Doctorates, new doctorate recipients reported their fathers’ and mothers’ levels of educational attainment. The answers were grouped into three categories: high school diploma or less; some college, including the baccalaureate; and advanced degree, including the master’s, doctorate, or a professional degree.

The 2001 data showed that about 30 percent of recipients’ fathers and 39 percent of their mothers’ had only earned a high school diploma or less. About one-third of doctorate recipients had a father who had attended college (but may not have earned a baccalaureate degree); about 40 percent of the mothers had some college background. Finally, the father had an advanced degree for about 35 percent of the doctorate recipients, compared with about 22 percent of the mothers. Although

similar on the whole, parental education background of male and female 2001 doctorate recipients differed with respect to mothers' education. Female doctorate recipients were more likely than their male counterparts to have a mother who attended college or who earned an advanced degree. Doctorate recipients in the humanities displayed the highest percentages of both fathers (44 percent) and mothers (29 percent) with advanced degrees. The lowest percentages of advanced degrees by fathers or mothers were within the education doctorate recipients, 22 percent and 13 percent, respectively.

There is considerable variation in parental educational attainment by race/ethnicity, citizenship status, and broad field of study. Among U.S. citizens, Asian doctorate recipients were more likely than members of the other racial/ethnic categories to come from families in which the one or both parents had advanced degrees. Black, Hispanic, and American Indian recipients' parents were the least likely to have advanced beyond high school (NSF, NIH et al 2002).

2.8 Employment for Persons with a Doctoral Degree

Universities and colleges employ less than half of doctoral scientists and engineers. Academic employment of S&E doctorate holders reached a record high of about 240 000 persons in 1999, approximately twice their number in 1973. Long-term growth of these positions was markedly slower than that in business, government, and other segments of the economy. The academic doubling compares with increases of 230 percent for private companies, 170 percent for government, and 190 percent for all other segments. As a result, the academic employment share dropped from 55 to 45 percent during the 1973–1999 period. Within academia, growth was slowest for the major research universities (NSF 2002).

In 1999, for S&E Ph D-holders four to six years since receipt of degree, 22 percent were in tenure-track or tenured positions at four-year institutions of higher education. Across fields, tenure-program academic employment for those four to six years since receipt of Ph D ranged from about 7 percent in chemical engineering to 51 percent in political science. For Ph D-holders one to three years since receipt of degree, only 14 percent were in tenure programs. This rate reflects the increasing use of postdoctoral appointments by recent Ph D-holders in many fields.

Although academia is just one possible sector of employment for S&E Ph D-holders, the availability of tenure-track positions is an important aspect for those who seek academic careers. The fall in rate of tenure-track employment for Ph Ds four to six years after their degree from about 27 percent in 1993 to 22 percent in 1999 reflects both job opportunities in academia and alternative opportunities for employment. One of the largest declines in tenure-program employment occurred in computer sciences; from 52 percent in 1993 to 32 percent in 1999 and computer science departments report difficulties recruiting faculty. The attractiveness of other employment may also explain drops in tenure-program rates for several engineering disciplines. However, it is less likely to explain the smaller but steady drops in tenure-program employment rates in fields showing other measures of distress, such as physics and mathematics. Between 1993 and 1999, small increases

in tenure-program rates for Ph D holders four to six years after their degree were found in chemistry, geosciences, psychology, and sociology and anthropology (NSF 2002).

The unemployment rate for recent S&E Ph D recipients has been very low. In April 1999, the unemployment rate for this group was 1,2 percent, compared to 4,4 percent for all civilian workers (NSF 2002). Now, however, the unemployment rate is increasing.

2.9 Postdoctoral Positions

A post doctorate appointment – or postdoc – is defined in Science and Technology Indicators, as a temporary position awarded in academia, industry, or government for the primary purpose of receiving additional research training (NSF 2002).

2.9.1 The Number of Postdocs Increasing

The origins of the postdoc phenomenon reach back over a century, to 1870, when high-level apprenticeships at the research institutions were created. The hiring of postdocs grew only modestly during the first half of the twentieth century, but then started to grow faster, because of the increase in federal spending stimulated by the Cold War. In the end of the 1970s, the government support to graduate fellowships was reduced, due to the recession. At the same time, the number of postdocs increased as the PhD labor market weakened. The length of the postdoc periods also increased, as there were few other academic appointments available. The conditions improved somewhat in the 1980s, but in the 1990s the situation deteriorated again. In the last 15 years, the number of postdocs has increased to an estimated 52 000 a year. More than half of them are non-US citizens (NAS/NAE/IM 2000).

Postdocs perform an essential function in American research. A survey of research articles in two issues of *Science* found that 43 percent of first authors were postdocs. In 1998, more than 15 U.S. universities had more than 500 postdocs each; many of them foreigners. More than half of all postdocs in science and engineering in 1998 were temporary U.S. residents (NAS/NAE/IM 2000). American citizens, in contrast to their European counterparts prefer to stay in the U.S. on a postdoc appointment, rather than to go abroad.

In many fields, having had one or several postdoc experiences is a prerequisite for obtaining a faculty position at a university. About 32 percent of 1998 graduates in S&E had a postdoc position in 1999. However, there is a great difference between the academic fields. In the biological sciences, which account for about two-thirds of all postdocs, the postdoc rate one year after receipt of degree was 61 percent in 1999. At the same time, physics, the other traditionally large postdoc field, experienced a decline in the incidence of postdocs one year after receipt of degree from 57 percent in 1995 to 47 percent in 1999. In other fields the postdoc rate one year after receipt of degree continued a slow decline from 21 percent in 1995 and 20 percent in 1997 to 19 percent in 1999 (NSF 2002).

2.9.2 Length of the Postdoc Period

The length of a postdoc period also varies by field. In physics and biological sciences, median time spent in postdoc positions extended well beyond the one to two years found in most other fields. Biologists tend to stay the longest; up to five years is common. For engineers one year is common. Postdoc terms for physical scientists are usually two or three years, but some work for up to six years in postdoc positions (NAS/NAE/IM 2000). The postdoc period can consist of one appointment or many and may include different institutions. In some fields, more than one postdoc period may be useful to gain multidisciplinary knowledge. In other fields more than one postdoc appointment is rather an indication of the lack of available permanent positions.

2.9.3 Sources of Funding for Postdocs

Postdocs are paid through many different funding sources and their status often depends on the nature of the source. Most postdocs are supported through the grant of a principal investigator (PI) and are usually called *postdoctoral associates* or *research associates*. A smaller number bring their own funding and are often called postdoctoral fellows. Of the 4 500 postdocs funded by the NSF in 1999, only 200 postdocs were funded through fellowships and the others through PIs (NAS/NAE/IM 2000). A postdoc who has a fellowship generally has more prestige and is more independent than a postdoc funded through grants from an adviser (PI). On the other hand, fellows may not qualify for important institutional benefits. Most individual fellowships are funded by federal agencies, notably the NIH and NSF. Other postdoc fellows are supported by foreign governments, private foundations and private firms (NAS/NAE/IM 2000).

2.9.4 Postdocs in Different Sectors

The majority of postdocs work in universities as research associates on PI grants. Most of them work with both research and teaching but the focus is almost always on research. Industry also provides postdoc appointments. The salaries and benefits are often better than in academia, but the possibility of teaching is rare and restrictions on the use and publication of results may in some cases hinder the postdoc from moving back into academia. Government facilities also offer postdoc positions, particularly the large national labs, and these facilities often provide more interdisciplinary work and collaboration with other researchers than universities (NAS/NAE/IM 2000).

2.9.5 Postdoc Fellowships Abroad

As was mentioned before, few American PhDs go abroad for a postdoc appointment. However, there are measures taken to improve the international collaboration among researchers. The National Science Foundation (NSF) has a special program, International Research Fellowship Program (IRFP), with the purpose of providing early career scientists and engineers with opportunities to gain international professional experience. NSF provides support to conduct research at science and engineering establishments in all foreign countries. Applicants are eligible in any area of science and engineering supported by NSF and may conduct their research anywhere in the world. The majority gain that experience through participation in international research projects. Many others become involved internationally through the NSF's fellowships programs. About 40 young postdoctoral researchers received grants from the IRFP in FY2001 to carry out advanced research in their fields at overseas universities and research institutes. These grants support residence abroad of three to 24 months. The 24-month period may include one year (or some portion of the total duration) at the foreign site and one year (or duration equal to the foreign tenure) used as a "re-entry" year in the United States. There are also fellowships available for postdoc periods abroad in particular fields, for example in biological sciences, particle physics and mathematical sciences. NATO offers postdoc fellowships, NATO Advanced Study Institutes Travel Awards, both for U.S. Ph D recipients to go abroad and for foreigners from a nation that is member of NATO to come to the United States. (www.nsf.gov/sbe/int/pubs/02overview/scientists.htm).

2.9.6 Reasons for Taking a Postdoc Position

Postdocs in 1999 were asked to give their reasons for taking their current postdoctorate appointment. For all fields of degree, 32 percent gave "other employment not available" as their primary reason. Most respondents gave reasons consistent with the defined training and apprenticeship functions of postdoctorate appointments. About 20 percent said that a postdoc position was generally a prerequisite in order to pursue a career in their fields and about 18 percent said they were seeking additional training in their fields. About 11 percent said they took a postdoc appointment because they were seeking additional training outside their fields (NSF 2002). From these figures, a postdoc appointment is often seen as a "second best" when other appointments are unavailable.

As mentioned before, the postdoc periods can, in some fields, last for up to five years, or even more. Statistics from NSF show that of those persons in postdoctorate positions in 1997, about 34 percent remained in a postdoctorate position two years later. That is a small reduction from the 38 percent of 1995 postdocs who were still postdocs in 1997. Only 15 percent went from a postdoctorate position to a tenure-track position at a four-year educational institution, which is a decline from about 17 percent in 1997. About 16 percent found other employment at an educational institution, 25 percent were at a for-profit firm, 6 percent were employed at a non-profit institution or by government and, finally, about 1 percent was unemployed (NSF 2002).

2.10 Faculty in Higher Education Institutions

Growth in academic employment over the past half century reflects both the need for teachers, driven by increasing enrollments, and an expanding research function, largely supported by federal funds. There are currently more than 1 million faculty members in the institutions of higher education in the United States. They have three main responsibilities: teaching, research and service. Service is, for example, governance and committee work.

Employment growth over the past decade was slower at research universities¹ than at other universities and colleges, after enjoying strong earlier increases. From 1993 to 1999, doctoral S&E employment at research universities expanded by about 4 percent. In contrast, employment at other higher education institutions grew uninterrupted for at least three decades, increasing by 11 percent during the 1990s. (NSF 2002)

A large proportion, approximately two-fifths of all faculty work part time. Some institutions rely on part-time faculty to a greater degree than others; almost two-thirds (65 percent) of faculty at public two-year institutions holds part-time appointments, whereas approximately one-fifth of faculty at four-year public higher education institutions work part time (NSF 2002).

2.10.1 Faculty Positions and the Career Path

The most commonly used faculty titles in the tenure-track system are *instructor*, *assistant professor*, *associate professor*, *full professor*, and *professor emeritus* (ACE 2001). Lecturer, adjunct professors and other adjunct faculty, and professor emeritus are not considered “ranks” because they are not subject to the ordinary requirements for advancement or promotion. These positions are, however, important for the higher education institutions, especially for teaching.

¹ *Research Universities are here defined according to the 1994 Carnegie Classification, where Research I and II universities are defined as institutions with a full range of baccalaureate programs, commitment to graduate education through the doctorate, annual award of at least 50 doctoral degrees, and receipt of federal support of at least \$15.5 million. The classification has since been modified, for the latest classification; see the table, p14.*

Instructor

“Instructor” is usually the starting rank for either a full-time, “tenure-track” faculty member without a Ph D or a person without a Ph D on a contract or term appointment. Time spent as an instructor is usually considered part of the probationary period required for tenure consideration. At most institutions, six years is the maximum amount of probation time allowed for promotion to a tenured rank. Instructors usually receive renewable one-year contracts. In most cases, instructors are promoted to assistant professor upon completion of a Ph D. At many colleges and universities, an instructor’s contract is not renewed if he or she is not promoted after the probationary period.

Assistant professor

A candidate with an earned doctoral degree but no teaching experience in higher education may be appointed to the faculty at the level of *assistant professor*. In some fields and in some institutions, a postdoc period is required before an appointment as assistant professor. According to the guidelines of the American Association of University Professors (a national organization that deals with academic issues and whose recommendations are followed by most institutions), an assistant professor should usually be given a three-year contract as a probationary period and the contract may then be renewed annually, usually for up to six years. At most four-year colleges and research universities, an individual may serve as assistant professor for no more than six to eight years. If the individual is denied tenure, he or she must seek employment elsewhere.

Associate Professor

After serving for a specified period, usually five to seven years, as assistant professor, the faculty member who has all the qualifications (an earned doctorate, favorable annual teaching evaluations, and evidence of contributions to the discipline) may be recommended for promotion to the rank of associate professor. Consideration for tenure usually comes at the same time. After serving another five to six years as associate professor, the faculty member may be recommended for promotion to the rank of full professor. However, there is no limit to the number of years an individual may serve as associate professor; an individual may retire as an associate professor.

(Full) Professor

Professor is the highest academic rank awarded to an individual. The professorship is not based solely on serving the required number of years in the preliminary ranks. Rather, it is bestowed by the college or university on a person whose teaching, scholarship, and service have had a significant impact on the development of the institution and the discipline. To become a full professor, a faculty member must improve his or her skills, particularly in research.

Professor Emeritus

“Professor Emeritus” is an honorary title conferred upon an individual for long and distinguished service to the institution. It is usually awarded at the end of a faculty member’s full-time service or at retirement.

Lecturer

A lecturer most commonly is a short-term or part-time faculty member who is appointed principally for teaching. Lecturer is not a rank in the tenure-track system. Another title used for this position is “adjunct”. The adjuncts/lecturers are often professionals, who are well established in a particular field, for example in the arts, law or the media, and who do teaching as a hobby. These persons are, however, very valuable for the institutions, not the least because they strengthen the link between university education and working life. In this way, professionals are able to combine teaching with their ordinary employment. To appoint professionals as part-time faculty is in many cases the only way to make professionals interested in teaching, especially in the arts field. The title “visiting professor” is similar to “lecturer” and usually applies to a scholar with some experience and status who joins the faculty of a college or university for a limited time.

Adjunct Professor

This title designates a part-time faculty member. Occasionally it is given to a visiting professor, especially from a foreign university, who is serving on the faculty for a semester or a year.

2.10.2 The Tenure System and Qualifications Needed for an Academic Career

The tenure system is designed to ensure academic freedom and to provide sufficient economic security to encourage talented men and women to choose academic careers. It is an arrangement under which faculty members are given permanent appointments following a probationary period. At least 60 percent of current college and university faculty members have tenure.

A Ph D is generally a prerequisite for faculty positions at pre-eminent colleges and universities. At some institutions, especially community colleges, a master’s degree may be sufficient. Faculty members are assessed according to their performance, credentials, and years of service to the college or university. Generally, individuals are reviewed annually by the appointing department for salary adjustments and, after about to five to seven years, for tenure. The annual review takes into account the year’s record of teaching and research and the actual criteria depend on the institution’s mission.

Faculty appointments, renewal – and non-renewal – of contracts, and advancement in rank are usually based on the recommendation of tenured department members. Those decisions are often reviewed by a faculty committee of a college or division (such as social science, humanities, medicine), then reviewed by a university-wide

committee, and finally forwarded to the appropriate executive officer, usually the Provost. It is a relatively lengthy process where many persons are involved. The student evaluation system of the quality of the instruction also has some influence on the promotion process, as well as the evaluation that is done in the departments and by the administration.

The most important step in the academic career is the promotion from assistant professor to associate professor, as tenure is often linked to the promotion to associate professor. In the American academic career, it's not unusual to have to choose an institution of lesser status when you want to be promoted. For example, a person can begin an academic career after the doctoral degree as a lecturer at Harvard University, but then have to start a job as an assistant professor at a less prestigious university.

2.10.3 Trends in Higher Education Faculty Appointments

The last decades, faculty appointments have decreased and postdoc appointments and other types of non-tenured positions have increased. Overall academic employment of doctoral scientists and engineers was quite robust, growing from 118 000 in 1973 to 240 000 in 1999. However, traditional faculty positions grew less rapidly, especially during the 1990s, when the number of senior faculty – full and associate professors – rose only moderately, and the number of junior faculty – assistant professors and instructors – remained static. The share of full-time senior faculty fell from 65 percent of total employment in the mid-1980s to only 57 percent in 1999, with particularly steep drops during the 1990s. The share of junior faculty also declined, bringing the overall faculty share to 75 percent of total employment, a steep loss from 88 percent in the early 1970s. The decline in the 1990s was linear, from 82 to 75 percent in fewer than 10 years. These employment trends in the past decade occurred at the same time as academic R&D spending rose by half. A great many of the faculty who had been hired during the expansionist 1960s retired and academic hiring of young Ph D-holders showed only a modest rebound (NSF 2002).

2.10.4 Declining Faculty Appointments and Tenure Track Positions

An academic researcher pool outside the tenure track system has grown over the years as the tenured faculty share of the academic workforce has declined. Instead, postdocs and others carry out more research activity in non-faculty positions. This change toward an increased research effort by non-faculty staff was particularly distinct in the 1990s. In addition, the use of short time and contract personnel has increased. One reason for this is the decrease in state funding, which has made it necessary for the universities to cut their costs.

Non-faculty ranks, which in Science and Technology Indicators is defined as full- and part-time adjunct faculty, lecturers, research and teaching associates, administrators, and postdocs, increased from about 37 000 in 1989 to 60 000 in 1999. This 62 percent increase stood in sharp contrast to the 6 percent rise in the number of full-time tenured faculty. The full-time non-faculty appointments grew by 72 percent and postdocs appointments grew by 61 percent between 1989 and 1999, while part-time employment rose by 32 percent (NSF 2002).

According to current statistics (The Condition of Education 2003) about 66 percent of all higher education institutions had tenure systems in place in the fall 1998 and 88 percent of all full-time faculty worked at these institutions. The majority of these institutions have in some way changed the tenure system for full-time faculty and instructing staff during the previous five years. The main changes were early or phased retirement to full time tenured faculty (48 percent), more stringent standards for granting tenure (11 percent) and downsized tenured faculty (8 percent). About 16 percent of the institutions reported that they had replaced some tenured positions with fixed-term contracts. But there are differences between institutions. Research institutions were more likely than doctoral institutions to have taken measures related to the tenure-track system. Public research institutions were more likely than other research or doctoral institutions to have downsized tenured faculty during the last five years (NCES 2003).

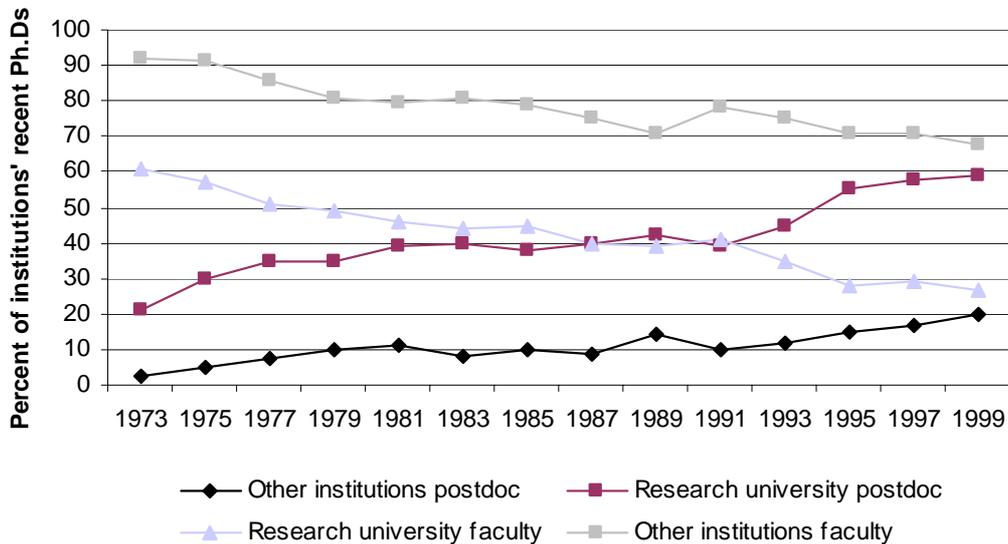
2.10.5 Young Faculty and Postdocs in Higher Education Institutions

University hiring of young faculty is increasing, but full-time faculty appointments are less available than ever (NSF 2002).

A sharper indication of current trends can be observed by looking at the academic employment patterns of those with recently awarded Ph Ds (here defined as persons who earned their doctorates at U.S. universities within three years of the survey year). Recent Ph D-holders who enter academic employment today are more likely to receive postdoc appointments (43 percent) than faculty positions (39 percent). Those at research universities are more than twice more likely to be in a postdoc than in a faculty position. Overall, since 1973, the percentage of recent Ph D-holders hired into full-time faculty positions has been cut nearly in half, from 74 percent to 37 percent. The decline at research universities has been sharper, from 60 percent to 24 percent. On the other hand, the overall proportion of Ph D-holders who reported being in postdoc positions has increased from 13 percent to 43 percent for all research institutions and from 21 percent to 58 percent at research universities. Those at public research institutions are somewhat more likely than those at private institutions to hold full-time faculty positions and somewhat less likely to have postdoctorate rank (NSF 2002).

FIGURE 7

Recent S&E Ph.Ds hired into faculty and postdoc positions at research universities and other academic institutions, 1973–1999



Source: NSF 2002

For those in academia four to seven years after earning their doctorates, the picture looks quite similar: only two-thirds had attained a faculty position at that point compared with nearly 90 percent in the early 1970s, and the trend continues to point downward. Only about half were in tenure track positions, with 10 percent already tenured, well below the experience of previous decades. Moreover, the overall proportion of those in a tenure-track position, whether tenured or not, has declined during the past two decades.

Taken together, these data suggest a continuing shift, toward forms of employment outside traditional tenure track positions. This shift toward non-tenure track employment touched most major fields. In fact, gains in the total number of full-time faculty positions were restricted to the life and computer sciences, while the other fields were holding steady or registering only marginal increases. For every field except environmental (i.e., earth, atmospheric, and ocean) sciences, the proportion of total doctoral employment held by full-time faculty decreased (NSF 2002).

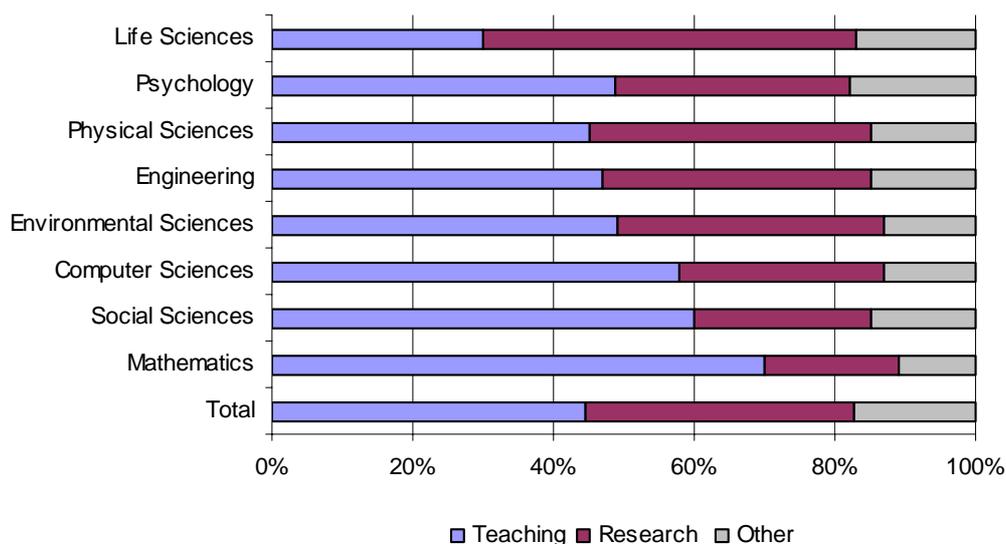
Graduate students – at master's and doctoral level – play a key role in U.S. academic S&E research, and research assistantships were the primary means of support for about one-quarter of them. The number of research assistants has risen faster than overall graduate enrollment. A shift has occurred from the physical into the life sciences, reflecting changes in the field distribution of academic research funds (NSF 2002).

2.10.6 Teaching versus Research among Faculty

For the majority of the faculty teaching is the primary work activity in most fields. The number of faculty whose primary task is research has, however, increased since the 1970s.

The growth of doctoral-level academic researchers has been large, from 27 800 in 1973 to 91 400 in 1999. During this period, the number of those with teaching as their primary activity increased less rapidly, from 73 300 to 108 600. The different fields have different patterns of relative emphasis on research, but the overall trend is largely the same. The life sciences, however, has a higher proportion of people who identify research as their primary activity, growing from 26 000 to 60 800, compared to a much lower proportion of those reporting teaching as their primary activity from 25 300 to 43 600. The other fields generally included fewer researchers than teachers in the 1970s, but this trend has been reversed for the physical, earth, atmospheric, and ocean sciences and engineering (NSF 2002).

FIGURE 8
Primary work activity of academic doctoral S&E workforce, 1999



Source: NSF 2002

To the number of doctoral researchers for whom research is a primary or secondary work activity must thus be added an estimate of the number of graduate students who are active in research. The more than 300 000 full-time S&E graduate students contribute significantly to the conduct of academic research. Graduate research assistantships (RAs) were the primary means of support for slightly more than one-quarter of these students. In both enrollment and distribution of RAs, a shift away from the physical sciences into life sciences has occurred. Nevertheless, engineering, natural sciences, mathematics and computer sciences have relatively higher proportions of research assistants compared to their enrollment. It is worth noting that in computer science and engineering the number of graduate research assistants exceeded the number of doctoral researchers (NSF 2002).

2.10.7 Women Faculty

The academic employment of women with S&E doctorates has risen sharply over the past quarter century, reflecting the steady increase in the proportion of women among holders of newly awarded S&E doctorates. The number of women faculty in higher education institutions increased six-fold between 1973 (when this type of employment information was first collected) and 1999, from 10 700 to an estimated 64 400, or from 9 to 27 percent. By the end of the decade, women constituted just less than 25 percent of full-time faculty, up from 6 percent. Compared with men, women faculty remain relatively more heavily concentrated in the life sciences and psychology, with correspondingly lower shares in engineering, physical sciences, and mathematics (NSF 2002).

Women's growing share of academic employment is due to several facts. Women constitute a rising proportion among new doctorates, they have a somewhat greater tendency for choosing an academic career, and they have been hired into these positions at a somewhat higher rate than men. This development is reflected in declining numbers of women as one move up in faculty rank: in 1999, women constituted 12 percent of full professors, 25 percent of associate professors, and 37 percent of the junior faculty, the latter roughly in line with their recent share of earned Ph Ds.

In contrast, the number of men increases as one move from junior to senior faculty ranks. This pattern indicates the relatively recent arrival of significant numbers of women doctorate-holders in full-time academic faculty positions. It suggests that the number of women among the faculty will continue to increase, assuming that women stay in academic positions at a rate equal to or greater than men (NSF 2002).

2.10.8 Foreign Born Faculty

For a long time, the U.S. higher education institutions have relied on foreign scientists. About 28 percent of doctoral scientists and engineers at U.S. universities and colleges in 1999 were foreign born. Computer sciences and engineering had the highest percentages (37 and 35 percent, respectively); followed by mathematics (28 percent); physical, life, and social sciences (from 23 to 19 percent); and psychology (8 percent). Many of these scientists and engineers had obtained their doctorates from U.S. institutions. These estimates are conservative and do not reflect the strong rise in immigration during the 1990s (NSF 2002).

2.10.9 Future Retirements among Faculty

In the US future retirements among faculty may become a greater challenge for the higher education institutions than previously. In the 1960s, the number of institutions, students, and faculty expanded rapidly in the United States, bringing many young Ph D-holders into academic faculty positions. This growth boom slowed sharply in the 1970s, and faculty hiring has since continued at a more modest pace. The result is that increasing numbers of faculty (and others in non-faculty positions) are today reaching or nearing retirement age.

A law defining age discrimination, the *Age Discrimination in Employment Act*, became fully applicable to universities and colleges in 1994. It prohibits the forced retirement of faculty at any age, which means that faculty themselves decide when to retire. But this act raised concerns about the potential ramifications of an aging professorate for scholarly productivity and the universities' organizational vitality, institutional flexibility, and financial health. These concerns were the focus of a National Research Council (NRC) (1991) study, presented in *The Science and Technology Indicators 2002*. The study concluded that "overall, only a small number of the nation's tenured faculty will continue working in their current positions past age 70", but added: "At some research universities a high proportion of faculty would choose to remain employed past age 70 if allowed to do so". Sufficient data have now accumulated to allow examination of these concerns. Statistics show that the proportion of 60- to 64-year-olds was rising well before the act became mandatory, and then leveled off. A similar progression can be seen for those 65 or older, which made up 3 percent of the research universities' full-time faculty and 2 percent of other institutions' full-time faculty in 1999. The employment share of those older than age 70 rose during the last quarter century; it stood at 0.5 percent in 1999 (NSF 2002).

2.11 George Mason University – An American University with Similarities to a Swedish University

2.11.1 Facts about George Mason University

George Mason University (GMU) was established as a university branch of the University of Virginia in 1957. In the following years GMU expanded and in 1972 the university became an independent public university. George Mason University is located in Northern Virginia in the Washington D.C. area and has three campuses; the major campus in Fairfax and the other two in Arlington and Manassas (Prince William). The total number of students the fall 2002 was about 27 000; of those were about 14 000 full-time students. Most of the students, 88 percent, are from the State of Virginia and 12 percent from other states, particularly the neighboring District of Columbia and State of Maryland. GMU offer 138 programs, of which 59 are undergraduate, 78 graduate (Master's 62 and Doctoral 16) and one professional program (law). The goal for the university is to expand to about 30 000 students in 2007. In 2001 the total number of faculty was 2 250, of which 965 were full time, 693 part time and 592 graduate assistants. The number

of faculty has increased by almost 6 percent between 1997 and 2001. The number of faculty who has a tenure-track position varies between the fields. For example, in arts and science, about half of the about 400 faculty members have a tenure-track appointment. In some fields, however, the situation is quite the opposite; in computational science, only 12 out of 65 persons have tenure, and as many as 47 is hired on contract. The university would like to increase the number of tenured faculty to be at least 40 percent of the total number of faculty (GMU 2003).

2.11.2 Recruiting Students and Faculty

In an interview with George Mason University Provost Dr Peter N Stearns and Vice Provost Dr Christopher Hill, they both underline the advantages of the geographic location in the D.C. area. It is important in recruiting students, but even more important when it comes to faculty personnel. With many potential employers in the area, it's possible for spouses to get a qualified appointment. Characteristics of the university that may attract students are the focus on political and policy issues, the multicultural climate and the international orientation of the university with possibilities for the students to go overseas. George Mason University has, for example, an exchange program with Växjö University in Sweden.

The ambition of the university in recruiting faculty is to find persons who want to stay for a long period and establish a platform at GMU. Consequently, the university makes an effort to give new faculty good opportunities in research as well as and teaching. George Mason University has no plans to give up tenure-track appointments, which, according to the interviewees, is a necessity to get well-qualified faculty. But, the number of non-tenured faculty is quite large. Non-tenured lecturers are important for the university, especially in teaching. There are two different kinds of lecturers. One is part-time faculty (sometimes with a PhD), hired for a short period mainly for teaching and often on a rather low salary. The other type is a professional, who are well established in a special field, e.g. arts and law, and who teach rather as a side appointment. Both types are important for the university in different ways. A postdoc period is not a prerequisite to be appointed as an assistant professor at GMU. Many PhDs have a postdoc experience and it makes them more qualified for the position.

The faculty positions have changed since GMU has developed from an undergraduate college to a research university. The distinguished research fields are public policy, management and psychology. The university also has two Nobel Laureates in economics, the most recent in year 2002. GMU now focus more on research and recruit research scientist, who are appointed for a limited time, funded mostly by research grants. These scientists are focused only on research and do not have to teach. However, this is true mostly in engineering and psychology.

According to the Provost and Vice Provost there are, in most cases, no difficulties to recruit faculty. But in engineering it is often harder because there is a lack of PhDs and the university has to compete not only with other universities but also with well-paying private companies. When GMU recruit new faculty, they follow the rules by advertising, but they also use their personal contacts, especially in recruiting professors. It is also common that scholars contact GMU and ask for possible appointments. To be competitive George Mason University aims at developing its particular strengths. The Provost and Vice Provost describe the advantages of being a growing, dynamic and new university with an entrepreneurial spirit.

2.11.3 Concluding Remarks

George Mason University is comparable to many Swedish universities in the aspect of the number of students, the development from being a university branch to an independent university and the intensified focus on research. GMU does not try to compete with the old, prestigious universities but tries to develop its own strong points to be competitive. For example, the university makes use of its geographical location in the D.C. area by cooperating with other universities; all with the purpose of strengthening its competitiveness. The two Nobel Laureates in Economics have been important for the university, especially as GMU has the ambition to be in a leading position in the area of public policy and economics, together with psychology and engineering. After the announcement of one of the 2002's Nobel Laureates in Economics, Professor Vernon Smith at GMU, the number of students who applied for courses in economics raised considerably.

3 Policy Issues

In this chapter, issues of interest and in concern in American higher education will be illuminated. There are large differences between Sweden and the United States in the organization and culture of higher education, but many of the issues discussed in the United States may also be of great interest to Sweden.

3.1 Doctoral Education

The need to reform doctoral education has been widely noted and discussed in the U.S. during the last decade. The main reason is that doctoral studies have traditionally been focused principally on a future academic career. An academic appointment is no longer the only career opportunity for a person with a doctoral degree. The demand for individuals with a doctoral degree is increasing from the high technology based industry as well as from government and administration (NAS/NAE/IM 1995). Furthermore, the number of tenure-track positions in higher education institutions is decreasing. The doctoral education must live up to the expectations of the future employers, whoever they may be, and doctoral students. Another reason to reform Ph D training is the decreasing interest in doctoral education among American students. The only reason why the total number of doctoral students has not decreased considerably is the large number of foreign students that earn their PhD in the United States. In 2001, 25 percent of the doctorate recipients were non-U.S. citizens with temporary visas (NSF, NIH et al 2002).

3.1.1 COSEPUP's Initiative to Reform Doctoral Education

In 1995, the Committee on Science, Engineering, and Public Policy (COSEPUP) gave recommendations on how to reform doctoral education in the United States. COSEPUP is a joint committee of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. Most of its members are current or former members of the Councils of the three institutions. COSEPUP has a very high status in the U.S. and their recommendations are highly valued and often adopted.

COSEPUP recommended a broadening of the education of doctoral students to prepare the students not only for an academic research career but also former non-academic employment. COSEPUP also recommended that doctoral students acquire training in the broad fundamentals of their field, familiarity with several subfields, the ability to communicate complex ideas to non-specialists, and the ability to work well in teams. The committee called attention to the need of better information to the students and their adviser about future careers (NAS/NAE/IM 1995). Later on, professional societies and leading educators encouraged the expansion of COSEPUP recommendations beyond the physical sciences and engineering to include all doctoral education.

3.1.2 IGERT – A Project by NSF to Broaden the Doctoral Education

NSF responded to COSEPUP's recommendations by establishing the Integrative Graduate Education and Research Traineeship (IGERT) programs. The program gave universities the possibility to offer fellowships to graduate students to engage in research in emerging multidisciplinary areas of S&E. From 1997 to 2000, NSF granted university faculties a total of 57 awards within the framework of the IGERT program.

One current effort by the NSF is a project on how to “re-envision the Ph D” to meet the needs of society in the 21st century and how to make reforms without prolonging the time to a degree. This re-envisioning project provides a forum for national dialogue on doctoral reforms among key stakeholders: research- and teaching-intensive institutions, doctoral students, agencies that fund and hire doctoral recipients, disciplinary societies, and education associations. A workshop composed of many such stakeholders agreed on six themes for doctoral reforms: shorten time to degree acquisition, increase underrepresented minorities among doctoral recipients, improve the use of technology for research and instructional purposes, prepare students for a wider variety of professional opportunities, incorporate understanding of the global economy and international scientific enterprise, and provide doctoral students with an interdisciplinary education (NSF 2002).

3.1.3 Concluding Remarks on Doctoral Education

The initiatives mentioned are examples of some efforts to improve the doctoral education and make it more attuned to today's need for well-educated persons in academia and in industry. Through these changes, the doctoral education can hopefully become more attractive for a larger number of students in the future, particularly in the engineering and the natural sciences. There is a growing need to recruit U.S. citizens and minority groups to doctoral studies. As has been pointed out before, the increase in the number of doctorate recipients is entirely a result of the large number of foreigners pursuing doctoral studies in the United States. The majority of the non-U.S. doctorate recipients seem to stay in the U.S. after earning their degree. But some countries have recently restricted the length of stay in the U.S. for their citizens, when the government in the native country is financing the doctoral education or postdoc position through fellowships or grants.

3.2 Postdoc Positions

The increase in postdoc appointments during the last decades has called the postdoc system, its purpose and organization, into question. The postdoc appointments are not standardized, and the institutional status of postdocs, especially in academia, is often poorly defined. For many postdocs the postdoctoral period is a positive experience and a first step in their research career. For too many postdocs, however, the situation is unsatisfying. Their terms of employment conditions are often uncertain, as they are neither students nor faculty. The individual institution sets their benefits. In some fields, the length of the postdoc period can be more than

five years, which means that the PhD is often older than 40 before getting a permanent appointment. This is particularly difficult for postdocs with families.

The increase in postdoc positions has in itself contributed to making it more difficult for PhD recipients to get a permanent job. Recent PhD recipients may accept temporary and usually lower paying post doctorate positions because permanent jobs in their fields are not available (NSF 2002).

Different initiatives have been taken by leading educational and scientific organizations and associations to propose improvements for postdocs.

3.2.1 Recommendations by the Association of American Universities

One of these initiatives was taken by the Association of American Universities (AAU), which is an organization of about 60 of the leading research universities in the U.S. and two in Canada. AAU formed the Committee on Postdoctoral Education in 1994 with the task to examine postdoctoral education and develop recommendations for its future organization. The committee presented its report and recommendations in March 1998 (AAU 1998).

The committee conducted three informal surveys at selected major research universities to get insights into campus policies and practices governing postdoctoral education and to have the views of postdocs. The surveys showed that most institutions made little or no attempt to control the number, the quality or the length of postdoctoral appointees. Most of the institutions reported that they classified postdoctoral appointees as employees with employment benefits. Postdocs themselves, however, listed benefits as one of their top areas of needed improvement. Few institutions had policies established specifically for postdoctoral appointees: most institutions reported that conflict-of-interest policies for faculty and staff applied to postdocs, but few institutions had policies governing outside business interests, consulting, or teaching activities by postdocs.

The surveys showed that in about two-thirds of surveyed departments, all assistant professors hired in the last five years had postdoctoral experience. In two fields – biochemistry and physics – more than 80 percent of the departments surveyed said they would not even consider hiring someone without postdoctoral experience. Nearly half of the PhDs who graduated from the surveyed departments in the last two years had gone to postdoctoral appointments; in biochemistry, as many as 80 percent. Upon completion of their appointments, about 60 percent of recent postdocs in surveyed departments had continued to work in research universities. About 25 percent had another postdoc position, 25 percent had gone into tenure-track faculty positions and, finally, about 10 percent into non-tenure-track faculty positions. A considerable majority of departmental officials and postdocs themselves viewed a postdoctoral appointment as a necessary step in an academic career. An overwhelming majority of postdocs said that obtaining a tenure-track faculty position at a research university was their expected career path.

Although the committee's surveys were small and informal and were focused only on leading research universities, several findings are nevertheless interesting. Most fundamentally, the lack of institutional oversight of postdoctoral appointments together with the development of postdoctoral education in a number of disciplines into an implicit requirement for a tenure-track faculty appointment creates an unacceptable degree of variability and instability in the academic institutions.

The committee gave some recommendations to improve the postdoc appointments. The committee recommended, among other things, that each university should develop policies and practices for systematically incorporating postdoctoral education into its overall academic program. A postdoc appointment should remain a temporary appointment with the primary purpose of providing additional research or scholarly training in an academic or research career. The university should establish explicit guidelines for recruitment and appointment of postdocs and initial postdoctoral appointments should be no longer than two to three years in duration. They should be renewed only on the basis of career advancement and achievement by the postdoctoral appointee. As a general rule, the total time spent in postdoctoral appointments by a given individual should not exceed six years.

3.2.2 Measures Proposed by COSEPUP to Improve the Postdoc System

In the late 1990's, the Committee on Science, Engineering, and Public Policy (COSEPUP) decided to scrutinize the postdoc experience in the light of the discussions about shortcomings in the postdoc system. The committee gathered information in meetings with almost 40 different groups of postdocs and advisers at 11 universities, seven national laboratories and five private research institutions or industrial firms. They also met with the leading research funding organizations the NSF and the NIH, and conducted an electronic survey of research institutions. The committee's findings, together with their recommendations, were compiled in a guide: *Enhancing the Postdoctoral Experience for Scientists and Engineers*, which was published in 2000 (NAS/NAE/IM 2000). The committee's scrutiny of the postdoc experience showed that there is a great need for improvements in the planning and structuring of the postdoc appointments. The working conditions for the postdocs also had to be improved.

COSEPUP maintained that a postdoc appointment should have the purpose of gaining scientific, technical and professional skills that advance the professional career. Postdocs should also receive institutional recognition, status and compensation for their work. Policies and standards for postdocs must be worked out and a time limit should be set for a postdoc appointment (of approximately five years). Mechanisms for regular and frequent communication between postdocs and their advisers, institutions, funding organizations etc. had to be developed. The adviser should provide career guidance for postdocs and steps to improve the transitions of postdocs to regular career positions must be taken. COSEPUP stressed the need for all postdocs, regardless of funding source, to have access to health insurance and other institutional services (NAS/NAE/IM 2000).

3.2.3 Concluding Remarks on Postdoc Positions

The postdoc system was established more than hundred years ago to give recent PhDs the opportunity to gain more experience in research in preparation for a research career at higher education institutions. The number of postdocs has since increased considerably and postdoc positions have in many fields become more or less the only position available in academia for a person with a recent doctoral degree. Many of the problems within the present postdoc system have been illuminated in this chapter, together with some recommendations for improvement.

It is considered important, both in Sweden and in the United States, to give recent PhDs, who often are young researchers, good opportunities to begin an academic career. The occurrence of positions available after receiving a doctoral degree is of great value, not only for the career of the PhDs but also as a factor in enhancing the recruitment of students to doctoral studies. If there are not any positions available for recent PhDs, students may initially choose other educational paths where the labor market is better.

In Sweden, postdoc positions at Swedish higher education institutions are relatively uncommon. But, to go abroad for a postdoc period is much more frequent in Sweden than in the US. Postdoc periods abroad is supported by several of the Swedish research agencies by postdoc fellowships for new Ph Ds. International focus and collaboration is desirable also in the U.S. but still, most Ph Ds stay in the United States for their postdoc period (see chapter 2.9.5) (NAS/NAE/IM 2000).

3.3 The Academic Career in Higher Education Institutions

Today, a research career at a university is just one career option for a person with a doctoral degree. In some fields, especially in engineering, industry is the main employer. Still, many PhDs, especially in the humanities and social sciences, prefer an academic career. During the last decades, however, it has become more difficult to get an appointment at higher education institutions, especially a tenure-track position. The opportunities vary between academic fields and institutions. In many fields at least one postdoc period is a prerequisite for an appointment as lecturer or assistant professor.

3.3.1 Tenure-track Appointments Decline

During the past decade, economic problems have led some institutions to reconsider the value of tenure. Tenure also has been attacked as leading to mediocrity in teaching and research. Some academic leaders, accrediting agencies, and citizens worry that teachers and scholars from joining the academia; this possibility became even more probable when mandatory retirement for faculty was made illegal in 1994. Doctoral students are unlikely to prepare for careers in higher education if few faculty positions are available. Some institutions have set limits to the number or percentage of tenured or senior faculty positions and grant tenure only when attrition results in a vacancy. A few have experimented with alternatives to tenure. Some use a two-track hiring plan according to which a faculty member may be appointed to a tenure-track or a non-tenure track position. Some have replaced tenure

with a multiyear contract or offer a choice between the two. A few offer faculty members a choice between tenure and an attractive opportunity, such as teaching overseas every four years (ACE 2001).

3.3.2 Study of Non-Tenure-Track Faculty Members by AAU

The Association of American universities (AAU) has examined the growth of non-tenure-track positions and the role that faculty play at a sample of their member universities. The study found that during the last 20 years, the percentage of total non-tenure-track faculty had increased on average from 24 percent to 31 percent. This increase happened primarily through the addition of new faculty positions rather than by replacement of existing ones. The average number of tenure-track faculty across the sampled institutions had remained almost constant over the measurement period. The average number of non-tenure-track faculty increased by 41 percent (AAU 2001).

The role of non-tenure-track instructional faculty in research universities varies very much, from someone hired to teach one course for one semester to fill an unexpected vacancy, to a fulltime faculty member with a multiyear teaching appointment. Some non-tenure-track faculty members have their primary employment elsewhere and have limited engagement with the university. For other non-tenure-track faculty members, university teaching may be their sole, full-time employment. Moreover, the roles of non-tenure-track faculty within a given institution will vary across departments and schools (AAU 2001).

Individual institutional case histories accompanying the submitted data indicate that the reasons for the increase in non-tenure-track faculty varied widely across institutions. For example, at one institution, growth in non-tenure-track instructional faculty reflected an increased use of teaching associates and visiting scholars; at another institution, non-tenure-track growth was due principally to an increase in senior lecturers and professor emeriti following the implementation of an early retirement program. At several institutions, the increase was due primarily to increased use of non-tenure-track faculty with special skills but without traditional academic certification in programs outside the arts and sciences core disciplines. At some other institutions, a substantial part of the increase was due to a reclassification of advanced graduate students involved in undergraduate teaching as non-tenure-track faculty (AAU 2001).

The titles of assistant, associate, and full professor are reserved almost exclusively for tenure-track faculty, while the titles of lecturer, instructor, and visiting and adjunct professor are used primarily for non-tenure-track instructional faculty. A slight majority of full-time non-tenure-track faculty holds the title of instructor or visiting professor, while larger majorities of part-time non-tenure-track faculty hold the title of lecturer, adjunct professor, or some other title.

Although many non-tenure-track faculty may serve in these positions by choice, some non-tenure-track faculty would no doubt prefer tenure-track status, and some part-time faculty would prefer full time status. The survey data indicate that institutional policies governing non-tenure-track instructional faculty vary considerably by institution, by status, and by discipline (AAU 2001).

The AAU Tenure Committee recommended those universities, which had not recently done so, to examine their policies governing both full-time and part-time non-tenure-track faculty to determine whether their policies meet the needs of the institution and in ways that are responsive to the interests of non-tenure-track faculty (AAU 2001).

4 Discussion

The higher education system and the major challenges within it are partly different in Sweden and the United States. But, there are facts that can be compared and experiences from the United States that is interesting to illuminate from a Swedish point of view.

4.1 Higher Education Institutions and Enrollment

In the United States, about 60 percent of the higher education institutions are private and 40 percent are public. The most prestigious universities in the U.S. are mostly private non-for profit institutions. In Sweden, all higher education is free of charge for the students, which is one of the cornerstones of Swedish education policy. In the United States, tuition and fees can be remarkably high, especially at private higher education institutions. High fees may be an impediment for young people to go on to higher education. In US, there is a current discussion about the increasing fees and what effect that will have on young peoples possibilities to get a university degree.

There is a constant competition between the higher education institutions in the US to attract the most qualified faculty and students and, not least, to get research grants. However, all institutions aren't competing with all the others. The higher education institutions compete with others at the same level or with the same position and try to establish a profile and reputation that will improve its position.

In Sweden, all higher education institutions have demands for establishing a strong research environment. A link between research and education is also a necessity for getting high remarks in national evaluations. Many higher education institutions in the United States are focused both on education and research, but not all higher education institutions have the ambition of being a strong research environment, but focus primarily on education. This is especially true among two-year colleges and some four-year colleges. Community colleges are important American higher education institutions, especially in the aspect of life long learning. Many students in community colleges are enrolled part-time and are older than age 25. Community colleges are often a bridge to four-year schools and advanced degrees. For faculty appointed at these institutions focused primarily on education, a PhD is not always a prerequisite.

In both countries, there has been a great increase in the number of students since the 1950s. The students in the U.S. are now older and many study part time or on distance. In 1997, more than 50 percent of all undergraduates were age 22 or older, almost 25 percent were age 30 or older, and 40 percent of all students were attending college part time. Almost half of the American adult population has some higher education and today more than two-thirds of high school graduates attend college.

4.2 Doctoral Education and Number of Doctoral Degrees Awarded

The number of doctoral degrees awarded in the U.S. is increasing, but the increase is due to the great number of foreigners that come to the U.S. to study. Doctoral studies in the United States have traditionally been focused principally on a future academic career. Today, however, an academic appointment is no longer the only career opportunity for a person with a doctoral degree. The demand for persons with a doctoral degree is increasing from the high technology based industry as well as from government and administration. To correspond to this development measures has been taken to improve the doctoral education, as it must consequently live up to the expectations from the future employers and the doctoral students. By these changes, the doctoral education can hopefully become more attractive for a larger number of students in the future. There is a need for an increase in the number of doctoral students in the United States, particularly in the engineering and natural sciences. There is also a growing need to recruit U.S. citizens and minority groups to doctoral studies.

4.3 Postdoc Positions

In the last 15 years, the number of postdocs has increased considerably in the U.S. In many fields, having had one or several postdoc experiences is a prerequisite for obtaining a faculty position at a university. A postdoc period can be a valuable first step in an academic career, but the postdoc system has been called into question and actions have been taken to improve the conditions for the postdoctoral fellows and the postdoc system as a whole. In many fields, at least one postdoc period is a prerequisite for an appointment also outside the tenure-track system. By this many Ph Ds will be about 40 years old when they get their first permanent position, even though they finished their degree on time and began their higher education immediately after high school.

Postdoc appointments are not as common in Sweden as in the U.S. Swedish postdocs often go abroad on their postdoc period, which is very uncommon in the US. In Sweden, there is a lack of appointments for recent Ph Ds at higher education institutions. The American postdoc system often brings up as a good example of positions for recent Ph Ds. A postdoc period can be a first step in an academic career as a researcher, but there are disadvantages with the postdoc system in the United States that there is important to be aware of.

4.4 The First Steps in an Academic Career

The last decades, faculty appointments have decreased and postdoc appointments and other types of non-tenured positions have increased in the United States. One reason for this is the decrease in state funding, which has made it necessary for the universities to cut their costs. Recent Ph D-holders who enter academic employment today are more likely to receive postdoc appointments than faculty positions. However, most universities need to offer tenure-track positions to attract outstanding faculty.

The probably most important step in the academic career is the promotion from assistant professor to associate professor, as tenure is often linked to the promotion to associate professor. In the American academic career, it's not unusual to have to choose an institution of lesser status when you want to be promoted.

4.5 Future Retirements at Higher Education Institutions

As described before, one of the most important challenges in Sweden is how to deal with the future retirements among faculty at the higher education institutions. This isn't a problem in the United States today or in the closest future, mainly because of the great number of foreigners that get their doctoral degree in the United States and then stay to work in academia or in industry. The number of foreign-born faculty has risen also in Sweden. The share is much higher among teachers and researchers at higher education institutions than among other occupational groups in the Swedish society. In 1999, about 16 percent of the professors and senior lecturers were born abroad. Of the postdoctoral fellows in 2000/01, about 29 percent were born abroad (HSV 2003). The influx of foreign-born faculty is not, however, enough to attain the future need for faculty.

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Sammanfattning

Högre utbildning i USA skiljer sig på många sätt från högre utbildning i Sverige. Det finns dock sakförhållanden och frågeställningar inom högre utbildning i USA som är intressanta att belysa och diskutera utifrån ett svenskt perspektiv.

Högre utbildning i USA

- Nästan hälften av den vuxna befolkningen i USA har någon form av högre utbildning. Cirka 58 procent av samtliga 25–29-åringar hade 2001 någon form av högre utbildning. Den demografiska strukturen bland eleverna håller på att förändras. Eleverna är äldre än tidigare och studerar på halvtid.
- Av 4 182 lärosäten i USA år 2000–2001 var 59 procent privata och 41 procent offentliga (delstatliga). Vid dessa lärosäten studerade 15 miljoner personer, varav cirka 80 procent studerade vid delstatliga universitet och högskolor.
- Lärosäten för högre utbildning i USA kan generellt delas in i tre kategorier: *tvååriga högskolor* ("colleges"), vanligen kallade "community", "junior" eller "technical"; *fyraåriga högskolor eller universitet*, vilka erbjuder antingen fyra års allmän grundutbildning eller en kombination av allmän grundutbildning och yrkesinriktad utbildning samt "*comprehensive*" universitet som erbjuder både grundutbildning och forskarutbildning samt yrkesutbildningar, exempelvis jurist- och läkarutbildningar.
- Så kallade "community colleges" är viktiga utbildningsinstitutioner för det livslånga lärandet eftersom de är många till antalet, erbjuder utbildningar som passar en bred målgrupp och har relativt låga avgifter.
- År 1999/2000 studerade mer än 500 000 utländska studenter på högskole- eller universitetsnivå i USA. De utländska studenterna kom från 196 länder runt om i världen. Merparten kom från Japan, Kina, Sydkorea, Indien, Taiwan och Kanada. Cirka 4 600 av studenterna i USA år 2000 kom från Sverige.

Forskarutbildning och doktorsexamen

- Vid de 416 universitet i USA som erbjuder forskarutbildning disputerade totalt 40 744 personer under läsåret 2000–2001. De senaste fyrtio åren har antalet personer som doktorerat vid amerikanska universitet ökat med ca 3,3 procent per år.
- Enbart 48 institutioner stod för hälften av alla doktorsexamina som utfärdades år 2001. År 2001 hade University of California-Berkeley det högsta antalet disputerade; 751, vilket motsvarar 2 procent av det totala antalet doktorsexamina år 2001.
- Det område inom vilket flest disputerar är sedan 1988 livsvetenskaperna ("life sciences") med cirka 8 300 disputerande varje år.
- Under 1999 var antalet personer (54 000) som doktorerade inom naturvetenskap, samhällsvetenskap och teknik i Europa betydligt fler än i USA (26 000) eller Asien (21 000). En majoritet av doktorsexamina inom naturvetenskap, samhällsvetenskap och teknik utfärdas vid europeiska universitet.
- Av dem som doktorerade i USA år 2001 var 44 procent kvinnor, inklusive utländska doktorander. Andelen kvinnor som doktorerar har ökat kontinuerligt de senaste trettio åren och andelen kvinnor som disputerade år 2001 var den högsta hittills.
- Av de personer som doktorerade i USA 2001, vars nationalitet är känd (cirka 95 procent), var 70 procent amerikanska medborgare, cirka 5 procent hade permanent uppehållstillstånd i USA (s.k. grönt kort) och cirka 25 procent var utlänningar som vistades i USA på tillfälligt visum.
- Behovet av att utveckla forskarutbildningen har diskuterats i USA sedan i början av 1990-talet. Forskarutbildningen har av tradition främst varit fokuserad på en framtida akademisk karriär, men det är inte längre den enda karriärvägen för personer med doktorsexamen. Även näringslivet och offentlig förvaltning efterfrågar personer med en doktorsexamen, inte minst inom vissa tekniska områden. Olika organisationer och nätverk har vidtagit åtgärder för att förbättra forskarutbildningen. Genom att förändra och förnya forskarutbildningen kan man förhoppningsvis intressera ett större antal studenter för forskarutbildning, särskilt inom teknik och naturvetenskap där behovet är stort. Det finns även ett stort behov av att öka rekrytera av amerikanska medborgare och minoritetsgrupper till forskarutbildningarna.

Postdoc-tjänster

- De senaste femton åren har antalet personer som har en postdoctjänst ökat avsevärt och är nu cirka 52 000 personer per år. Mer än hälften av dessa personer är inte amerikanska medborgare.
- Inom många vetenskapsområden är en eller flera postdocperioder en förutsättning för att komma ifråga för en fast tjänst vid ett lärosäte. Inom många vetenskapsområden är minst en postdocperiod ett krav för en anställning även utanför det s.k. tenure-track systemet.
- Hur lång en postdoc-period är varierar mellan olika ämnen. Inom fysik och biologi är mediantiden för postdoc-tjänster oftast längre än 1–2 år som ofta är vanligt inom andra ämnen. Inom biologi är det inte ovanligt med postdocperioder på upp till fem år, medan en postdocperiod inom teknik ofta sträcker sig över ungefär ett år. Postdocperioderna inom naturvetenskap är vanligen två till tre år, men vissa arbetar upp till sex år på postdoc-tjänster.
- Intresset bland amerikanska medborgare att genomföra en postdoc-tjänstgöring utomlands är mycket lågt. National Science Foundation (NSF) har vidtagit flera åtgärder för att förbättra det internationella samarbetet genom att stimulera till postdoctjänstgöring vid lärosäten utanför USA.
- En postdoc-period kan vara ett betydelsefullt första steg i en akademisk karriär, men det stora antalet postdocs ifrågasatts också. Tjänsten som postdoc är inte standardiserad och statusen för postdocs, särskilt vid universiteten, är ofta bristfälligt definierad. Postdoc-perioden kan inom vissa områden sträcka sig över mer än fem år, vilket innebär att personen ifråga ofta är över 40 år innan han/hon får en fast anställning. Åtgärder har dock vidtagits av flera organisationer och nätverk inom universitetsvärlden för att förbättra villkoren för innehavare av postdoctjänster och för att förbättra postdocsystemet generellt.

Anställningsmöjligheter för personer med doktorexamen

- Numera är en forskarkarriär vid ett universitet endast en av flera karriärvägar för personer med doktorexamen. Inom vissa ämnesområden, framför allt det tekniska området, är näringslivet den arbetsgivare som rekryterar störst andel av de disputerade. För många disputerade, särskilt inom humaniora och samhällsvetenskaplig, är dock en akademisk karriär fortfarande målet. Det har dock blivit avsevärt svårare än tidigare att få en fast anställning vid ett lärosäte direkt efter avlagd doktorexamen.
- Antalet anställda med en doktorexamen har under perioden 1973 till 1999 ökat med 230 procent inom privata företag, 170 procent inom statlig tjänst och 190 procent inom övriga sektorer.

Tjänster inom högre utbildning

- Antalet tjänster inom den akademiska världen har ökat de senaste femtio åren, vilket avspeglar både behovet av lärare, beroende på fler elever, och en expanderande forskning, som i hög grad finansieras av federala medel.
- Tenure-track kallas det amerikanska befordringssystem som ger undervisande och forskande personal vid USA:s lärosäten en fast, icke tidsbegränsad anställning. Systemet etablerades i syfte att säkerställa den vetenskapliga friheten och erbjuda tillräckligt ekonomisk trygghet för att locka begåvade personer att välja en akademisk karriär. Minst 60 procent av den undervisande och forskande delen av personalen vid högskolor och universitet har för närvarande tjänst inom tenure-tracksystemet.
- De vanligaste tjänsterna inom för lärare och forskare vid lärosäten i USA är "instructor", "assistant professor", "associate professor", "full professor" och "professor emeritus". Instructor motsvarar ungefär den svenska befattningen adjunkt, assistant professor motsvarar ungefär lektor, associate professor motsvarar ungefär docent, full professor motsvarar professor och titeln professor emeritus används även i Sverige.
- En doktorsexamen är ett krav för en tjänst vid framstående högskolor och universitet. Vid vissa lärosäten, särskilt vid "community colleges" som är inriktade på grundutbildning, kan det en magisterexamen vara tillräcklig för en tjänst som lärare.
- Det viktigaste steget i den akademiska karriären är befordringen från "assistant professor" till "associate professor" eftersom fast anställning inom tenure-track-systemet ofta är kopplad till den senare. Det är inte ovanligt att byta till ett lärosäte med lägre status för att ta ett kliv uppåt i karriären.
- De senaste decennierna har tjänsterna som lärare och forskare vid lärosäten minskat i antal, särskilt inom tenure-track-systemet, medan postdoc-tjänster och andra anställningar har ökat. För personer som disputerat är det numera vanligare att efter doktorsexamen få en postdoc-tjänst (43 procent) än en tjänst som lärare eller forskare (39 procent). Vid forskningsuniversiteten är det dubbelt så vanligt med postdocstjänster som ordinarie lärar- och forskartjänster.
- Antalet kvinnliga lärare och forskare vid lärosäten i USA ökade från 9 till 27 procent mellan åren 1973 och 1999. I slutet av 1990-talet hade kvinnor ungefär 25 procent av heltidstjänsterna vid landets lärosäten, jämfört med 6 procent 1973. Kvinnorna är förhållandevis koncentrerade till livsvetenskaperna och psykologi, med motsvarande lägre andel inom teknik, naturvetenskap och matematik.

- De högre utbildningsinstitutionerna i USA har under lång tid haft en stor andel utländska lärare och forskare. År 1999 var 28 procent av de disputerade lärarna och forskarna inom naturvetenskap, samhällsvetenskap och teknik vid landets lärosäten födda utomlands. IT- och teknikområdet har högst procentandel (37 respektive 35 procent), följt av matematik (28 procent), fysik, livsvetenskaperna och samhällsvetenskap (från 23 till 19 procent) samt psykologi (8 procent).
- En av de största utmaningarna för Sveriges lärosäten är att hantera de stora pensionsavgångarna som väntas bland lärare och forskare. Behovet av fler disputerade kommer därmed att öka. Detta är inget problem i USA för närvarande eller inom den närmaste framtiden, främst beroende på det stora antalet utländska personer som tar sin doktorsexamen i USA och sedan stannar kvar för att arbeta i den akademiska sfären eller inom näringslivet.

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