Research-Doctorate Programs in the Biomedical Sciences: Selected Findings from the NRC Assessment

Joan F. Lorden, Charlotte V. Kuh, and James A. Voytuk, editors

An Assessment of Research-Doctorate Programs: Panel on the Biomedical Sciences

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An Assessment of Research-Doctorate Programs: Panel on the Biomedical Sciences

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Preface and Acknowledgments

The panel was asked to respond to specific questions posed by NIH staff eager to learn more about what the recently issued *Data-Based Assessment of Research-Doctorate Programs in the United States* could reveal about the talent, training environment, outcomes, diversity, and international participation in the biomedical sciences workforce. The unprecedented amount of data collected from faculty, programs, and students as part of the *Assessment* provides a unique resource for a deeper understanding of these topics and for comparisons across fields. This report details some of the insights to be gained from mining the *Assessment* data. It also illustrates the challenges inherent in attempting to collect data consistently across many sources.

Like most research projects, this one answered some questions but raised many more. Questions on career outcomes for doctoral recipients, the role of postdoctoral scholars in the training environment, and strategies for increasing the participation of underrepresented minorities on research faculties are among those that the panel considered but could not answer. Readers will certainly add more questions to those posed by NIH and by the panel and perhaps be encouraged to undertake further study of this rich data source themselves.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Academies' Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

We wish to thank the following individuals for their review of this report: Irwin Arias, Tufts University; John Bailar, University of Chicago; Marie Davidian, North Carolina State University; David Korn, Harvard University; Thomas Louis, Johns Hopkins University; and Nancy Schwartz, University of Chicago.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Stephen Fienberg, Carnegie Mellon University. Appointed by the National Academies, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Joan F. Lorden
Chair

Contents

Summary

In September, 2010, the National Research Council (NRC) released *A Data-Based Assessment of Research-Doctorate Programs in the United States*[1] (referred to here as the *Assessment*), a report describing an extensive database of data and rankings from more than 5,000 doctoral programs, 982 of which were in the biomedical sciences. As part of its support for this project, the National Institutes of Health (NIH) asked the NRC to examine data on the biomedical sciences programs to see if they could shed light on specific questions about research training and support, many of which were highlighted in *Investing In the Future, National Institute of General Medical Sciences Strategic Plan for Biomedical and Behavioral Research Training*[2].

Given its substantial investment in doctoral research training, NIH was particularly interested in the following questions:

1) In fields such as biochemistry, where programs are housed in both medical schools and in arts and sciences faculties, are there apparent differences in median time to degree and completion rates?

2) What correlations exist between student median time to degree and completion rates and other characteristics of the programs, e.g.,

a) What is the correlation between students' median time to degree and the publication rates of faculty in their program?
b) What is the correlation between GRE scores and student median time to degree and completion rates?
c) Do programs that offer additional student activities, such as writing workshops, career seminars, etc., have longer times to degree, on average?

3) What are the correlations between the diversity of a program's faculty and the diversity of its students, both with regard to underrepresented minorities and women?

4) A large number of programs in the biomedical sciences classified themselves as "Integrated biological science" programs and span the biomedical sciences. Are these programs different in observed characteristics from the programs in which students specialize in a specific area from the outset of doctoral study?

NIH also encouraged the panel to discuss other relevant issues.

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[1] National Research Council, 2011. A Data-Based Assessment of Research-Doctorate Programs in the United States. Washington, DC: The National Academies Press. The report and accompanying data table can be found at *www.nap.edu/rdp*. A corrected data table was published on April 29, 2011.
[2] Investing In the Future, National Institute of General Medical Sciences Strategic Plan for Biomedical and Behavioral Research Training 2011.Bethesda, MD. National Institutes of Health.

The panel identified 11 biomedical science fields to examine in this study (Table S-1). An Excel table with data for each program in these fields is available with this report at *www.nap.edu*.

TABLE S-1 Fields in the Biomedical Sciences in the *Assessment of Research-Doctorate Programs* and Number of Programs Included in Each Field

Field Name	**Number of Programs**
Biochemistry, Biophysics, and Structural Biology	157
Biomedical Engineering and Bioengineering	74
Cell and Developmental Biology	120
Genetics and Genomics	66
Immunology and Infectious Disease	68
Integrated Biological and Biomedical Sciences	113
Microbiology	71
Neuroscience and Neurobiology	93
Nutrition	45
Pharmacology, Toxicology, and Environmental Health	117
Physiology	58

METHODOLOGY

At the outset, it is important for the reader to understand the sources and some of the limitations of the data used to produce the correlations and other descriptions in this report. The committee authoring the *Assessment* identified several sources of errors in the data that could not be eliminated, including classification errors and data collection errors (see Box 2-1). The omission of field-specific measures, such as books, patents, and articles presented at refereed conferences in some science and engineering fields, means that the data do not capture the full scope of a program's research productivity. Once the data were released, institutions and others identified additional problems, which led to the release of a corrected data table in April, 2011. In addition to data from the *Assessment*, data on training grants and training slots were collected from the NIH website.

The panel created pairwise correlations for a dozen characteristics of biomedical science programs (variables)[3] of interest to NIH:

Average Publications per Faculty Member
Average Citations per Publication
Average GRE Scores
Percent of Non-Asian Minority Students

[3] Definitions of these and other relevant variables used in the Assessment are found in Appendix C.

Percent of Faculty with Grants	Percent of Female Students
Percent of Non-Asian Minority Faculty	Average Ph.Ds per Year, 2002-2006
Percent of Female Faculty	Average Cohort Completion Rate
Awards per Faculty Member	Median Time to Degree

The correlations provide insights into the relationships between characteristics that can be explored further. The panel focused its attention on correlation coefficients greater than or equal to 0.3[4] (highlighted in the report) because they are nontrivial and they may display, in the panel's view, important relationships between program characteristics. When important correlations are found, further analyses will be required, adjusting for potential confounding variables, to better understand the causal relationships. Such adjustments are beyond the scope of this brief report.

RESPONSES TO QUESTIONS IN THE STATEMENT OF TASK

1) Comparison of Median Time to Degree and Completion Rates in Programs Housed in both Medical Schools and Arts and Sciences Schools

The panel was unable to shed much light on the differences between programs in the same field housed in medical schools and in arts and sciences schools, because the data that the institutions provided for the *Assessment* were not specific enough to draw these distinctions among individual programs. We did conduct an email inquiry of institutions with medical schools, asking where their biomedical science programs were located administratively, but not enough information was obtained, and too many ambiguities existed, to provide reliable comparisons.

2a) Correlation of Median Time to Degree or Completion Rates with Faculty Research Productivity

The panel found correlations greater than or equal to 0.3 in six fields between the average student time to degree and various measures of faculty research productivity: publications per faculty member, citations per publication, and the percent of faculty with grants. Where appreciable correlations exist, greater faculty research productivity is associated with *longer* times to degree. We found weaker relationships between the average cohort completion rate and faculty research productivity, with the exception of physiology.

[4] Correlations of 0.295 and higher were rounded to 0.3.

TABLE S-2 Fields with Correlations ≥ 0.3 Between Median Time to Degree or Completion Rates and Faculty Research Productivity

Field	Correlation ≥ 0.3
Biomedical Engineering and Bioengineering	Median Time to Degree with Average Cits/Pubs
Genetics and Genomics	Median Time to Degree with Average Cits/Pubs
Immunology and Infectious Disease	Median Time to Degree with Average Cits/Pubs
Microbiology	Median Time to degree with % of Faculty w/ Grants
Nutrition	Median Time to degree with Average Pubs/Faculty
Physiology	Median Time to Degree with Average Cits/Pubs
Physiology	Median Time to degree with % of Faculty w/ Grants
Physiology	Completion Rate with % of Faculty w/ Grants

2b) Correlation of Median Time to Degree or Completion Rates with GRE Scores and Average Number of Ph.D.'s

GRE General Test scores do not have correlations greater than or equal to 0.3 with median time to degree in any fields except microbiology and nutrition, where students with higher GRE scores have *longer* times to degree. The correlations between completion rates and both average GRE scores and average number of Ph.D.'s are uniformly low, and in several fields are negative (Table 3-2). The exception is physiology.

TABLE S-3 Fields with Correlations ≥ 0.3 Between Median Time to Degree or Completion Rates and Average GRE Scores or Average Number of Ph.D.'s

Field	Correlation ≥ 0.3
Biomedical Engineering and Bioengineering	Median Time to Degree with Average Number of Ph.D.'s
Microbiology	Median Time to Degree with Average GRE Scores
Nutrition	Median Time to Degree with Average Number of Ph.D.'s
Nutrition	Median Time to Degree with Average GRE Scores
Physiology	Completion Rate with Average Number of Ph.D.'s

2c) Correlation of Median Time to Degree with Student Activities

The panel did not conduct an analysis of the possible correlations between median time to degree and student activities such as writing workshops and career seminars. Preliminary examination of the overall data on student activities made it clear that these types of activities are offered in most doctoral programs, so correlations with other variables like median time to degree would be small.

3) Correlation of Faculty Diversity with Student Diversity

The correlations on diversity demonstrate a strong relationship between underrepresented minority (URM) faculty and URM students in six of the eleven biomedical science fields:

TABLE S-4 Fields with Correlations ≥ 0.3 Between Percent of Underrepresented Minority (URM) Faculty and Percent of URM Students

Field	Correlation of % URM Faculty with % URM Students
Biochemistry, Biophysics, and Structural Biology	0.489
Integrated Biological and Biomedical Sciences	0.529
Microbiology	0.765
Nutrition	0.531
Pharmacology, Toxicology, and Environmental Health	0.370
Physiology	0.570

Potential factors associated with increased URM student enrollment are explored in Chapter 5.

With regard to gender, the panel found no meaningful correlation between the percent of female faculty in a program and the percent of female students; the correlations are below 0.3 in every biomedical science field. The highest correlation (0.288) is in nutrition, where over 50 percent of the faculty and over 75 percent of the students are female.

4) Comparison of Programs in Integrated Biological and Biomedical Sciences with Other Fields

The panel took a close look at the programs in the field of integrated biological and biomedical sciences. We wanted to use this diverse field to identify the programs in which students typically spend one year sampling research in different laboratories and then choose an area of specialization. However, the responding institutions provided data for individual fields, even when those fields were part of an umbrella program.

Using data from the *Assessment* survey of doctoral programs, the panel examined the ratio of the number of students who enrolled to the number of students who received offers of admission to see if the integrated biological and biomedical science programs were more popular (as indicated by a higher enrolled-to-offered ratio), but did not find any evidence of this.

OTHER TOPICS

In addition to the specific questions outlined in the statement of task, the panel used the data from the *Assessment* to explore in a preliminary way several related topics: the relationship of and completion rates to student funding; potential factors associated with increased URM enrollment; doctoral student experience and related characteristics in neuroscience and neurobiology; and the number and location of postdoctoral fellows.

Median Time to Degree, Funding, and Completion Rates

Median time to degree is relatively constant across programs: medians range between 4.88 and 5.73 years for all biomedical science fields. In almost all programs, more than 90 percent of students are fully funded in the first two years, about one-quarter with an institutional fellowship and the rest through either a traineeship or research assistantship (Table 4-1). By the third year, almost all students are funded through some combination of research assistantships and traineeships. Since funding for the biomedical sciences comes primarily from NIH, the agency can use its influence to encourage program practices in the biomedical sciences in a way that is not available for other fields in science and engineering.

As might be expected, a *shorter* median time to degree correlates with a *higher* completion rate; in at least six fields the correlation coefficient is < -0.3.

TABLE S-5 Correlations Between Median Time to Degree and Average Completion Rate by Field

Field	Median Time to Degree (years)	Average Completion Rate (%)	Correlation
Biochemistry, Biophysics, and Structural Biology	5.63	45.9	-0.375
Biomedical Engineering and Bioengineering	5.06	46.3	-0.134
Cell and Developmental Biology	5.66	50.1	-0.383
Genetics and Genomics	5.73	41.6	-0.451
Immunology and Infectious Disease	5.36	56.2	-0.071
Integrated Biological and Biomedical Sciences	5.62	47.4	-0.362
Microbiology	5.58	47.1	-0.493
Neuroscience and Neurobiology	5.68	46.2	-0.464
Nutrition	4.88	55.8	-0.165
Pharmacology, Toxicology, and Environmental Health	5.21	56.1	-0.260
Physiology	5.13	50.9	-0.179

A Deeper Analysis of Underrepresented Minorities

The Role of Training Grants

Associating NIH training grants with the university to which each program belongs, the panel investigated two questions about the relationship of training grant awards to underrepresented minority (URM) students and to international students.

Do institutions with heavy dependence on training grants recruit more students who are from underrepresented minority groups (URMs) than schools with less dependence?

The panel found that institutions with a large number of training grants do have more minority graduate students, but the programs are larger, and the correlation between the number of training grants and the *percentage* of minority students is 0.00.

Do institutions with heavy dependence on training grants enroll fewer international students?

The same holds true with regard to international students. In fact, the correlation between the number of training grants and the percentage of international students is slightly negative (-0.240). Since international students cannot be supported on NIH training grants, this correlation is not surprising. Thus, having more training grants does not appear to increase the fraction of minority students or international students.

A Statistical Approach to Factors Associated with URM Enrollment

Simple correlations cannot tell the whole story, and the panel also developed a statistical model that relates enrollment by URM's to other program characteristics, in order to better understand how to expand URM enrollment and graduation from PhD programs. The model involved answering the three questions below.

How many URM graduates are expected per year across all programs?

Of the approximately 4,700 new Ph.D.'s per year in the biomedical sciences in 2002-2006, roughly 550 (11.7 percent) were URM graduates (Figure 5-4). Based on these numbers, only 17 percent of the biomedical science programs are expected to graduate more than one URM student per year, and only three percent of programs are expected to graduate two or more.

What factors predict higher URM enrollment in a Ph.D. program?

The panel attempted to predict the expected enrollment rate of URM students as a function of three factors (although other variables such as completion rate or percent of first year students with full financial support could also be used):

- number of URM faculty;
- research productivity as measured by the 5th percentile of the NRC "research productivity" ranking; and
- biomedical science field.

As would be expected, the fraction of URM faculty is a very strong predictor of URM student enrollment; overall, an increase in URM faculty members from 10 to 20 percent is associated with an increase in the fraction of URM enrolled students from 10 to 40 percent (a factor of 3). Faculty research productivity is *not* a strong predictor of URM PhD student enrollment, once the number of Ph.D. students is taken into account.

Having controlled for these factors, to what extent does URM enrollment cluster within universities, and which universities exceed URM enrollment expectations?

Since many universities have a large number of Ph.D. programs in the *Assessment*, the panel also investigated whether there are unmeasured characteristics of each university that attract URM Ph.D. students beyond the predictors considered above, i.e., whether URM students cluster in biomedical science programs at a given university due to a random "university effect" that is common to all the programs within that institution. Table 5-3 lists the 10 universities with the highest values, which indicate the attractiveness of the university's programs to URM students beyond what is predicted by the field, percent of URM faculty, and research productivity.

Profile of Neuroscience and Neurobiology

The panel also looked at data from the *Assessment*'s survey administered to students admitted to candidacy in neuroscience and neurobiology and compared these results to other science and engineering fields included in the student survey (chemical engineering and physics). Although we do not have similar data for the other biomedical fields, we found that 95 percent of the neuroscience and neurobiology students were somewhat or very satisfied with their training program, and (along with chemical engineering) they reported the highest levels of student productivity in research presentations and publications. Neuroscience and neurobiology students were more likely to have their academic progress assessed by program faculty than students in the other surveyed fields, and 86 percent of the programs collected data on students' postgraduation employment. As in the other biomedical science fields, the percent of female faculty in neuroscience and neurobiology (26 percent) did not correlate with the percent of female students (52 percent), but it did correlate with *shorter* times to degree (-0.346).

Postdoctoral Scholars

Not surprisingly, most faculty members in every biomedical science field have spent time as postdoctoral scholars, with older faculty having a smaller percentage of people with postdoctoral experience. About 90 percent of the faculty who received their Ph.D.'s in the 1990s, e.g., have held postdoctorates, except for those in biomedical engineering and nutrition. Postdoctorates are concentrated in the largest programs, and they are also concentrated in the programs that are in the top two quartiles for research productivity (Table 7-4). The largest numbers of postdoctorates are being trained in, and presumably are contributing to, the most productive research environments.

1
Introduction

In September, 2010, the National Research Council (NRC) released *A Data-Based Assessment of Research-Doctorate Programs in the United States*[1], (referred to here as the *Assessment*), a report that described an extensive database containing data and rankings from more than 5,000 doctoral programs, 982 of which were in the biomedical sciences. A list of the biomedical sciences fields covered in the *Assessment* and the number of programs included in each field is shown in Table 1-1. An Excel table with data for each program is available with this report from The National Academies Press, *www.nap.edu*.

TABLE 1-1 Fields in the Biomedical Sciences in the *Assessment of Research-Doctorate Programs* and Number of Programs Included in Each Field

Field Name	**Number of Programs**
Biochemistry, Biophysics, and Structural Biology	157
Biomedical Engineering and Bioengineering	74
Cell and Developmental Biology	120
Genetics and Genomics	66
Immunology and Infectious Disease	68
Integrated Biological and Biomedical Sciences	113
Microbiology	71
Neuroscience and Neurobiology	93
Nutrition	45
Pharmacology, Toxicology, and Environmental Health	117
Physiology	58

The *Assessment* reported data on characteristics of doctoral programs for the 2005-2006 academic year. When the *Assessment* was released, much attention focused on the rankings, and the use of the study as a data source was largely ignored. Further, those analyses that appeared in the *Assessment* were primarily for broad fields—it was left to users to choose which data they found useful for benchmarking and to conduct those studies on their own.

In this context, the National Institutes of Health (NIH) asked the National Research Council to explore the data for the biomedical sciences to answer specific questions relevant to

[1] National Research Council, 2011. A Data-Based Assessment of Research-Doctorate Programs in the United States. Washington, DC: The National Academies Press. The report and accompanying data table can be found at *www.nap.edu/rdp*. A corrected data table was published on April 29, 2011.

doctoral training in those fields (see Box 1-1 for the full statement of task). NIH is the major federal agency to fund biomedical training of both doctoral students and postdoctoral scholars in the United States. Funding for institutional and individual training grants exceeds $700 million per year. In 2005, 5,707 predoctoral fellows and trainees in biomedical sciences were supported by National Research Services Awards (NSRAs). This constituted approximately 20 percent of the eligible[2] biomedical science students in the *Assessment*.

Box 1-1 Statement of Task

A panel of the Committee on An Assessment of Research Doctorate Programs (BHEW-Q-03-01-A) will examine data from the 2010 assessment with specific reference to the biomedical sciences. The panel will report on findings for each of the biomedical sciences fields with respect to variation in the characteristics of doctoral programs, specifically time to degree, completion rates, program size, diversity, and research productivity. Comparisons will be made among Ph.D. programs in the same field housed in medical schools and in faculties of arts and sciences. Some of the questions to be addressed are:

1) In fields such as biochemistry, where programs are housed in both medical schools and in arts and sciences faculties, are there apparent differences in time to degree and completion rates?

2) What correlations exist between student time to degree and completion rates and other characteristics of the programs, e.g.,

a) What is the correlation between students' time to degree and the publication rates of faculty in their program?

b) What is the correlation between GRE scores and student time to degree and completion rates?

c) Do programs that offer additional student activities, such as writing workshops, career seminars, etc., have longer times to degree, on average?

3) What are the correlations between the diversity of a program's faculty and the diversity of its students, both with regard to underrepresented minorities and women?

4) A large number of programs in the biomedical sciences classified themselves as "Integrated biological science" programs and span the biomedical sciences. Are these programs different in observed characteristics from the programs in which students specialize in a specific area from the outset of doctoral study?

Other issues may be raised by the panel on which the study data can throw light. The panel will issue a consensus study report with findings but with no recommendations.

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[2] International students, about 30% of total enrollment in the biomedical sciences, are not eligible for funding on NRSA grants.

A description of the sources of the data and a brief discussion of their limitations are provided in Chapter 2, along with definitions of the specific variables from the *Assessment* used in this study. A statistical summary of the variables by field can be found in Appendix E. Chapter 3 discusses the panel's approach to the examination of pairwise correlations and analyzes correlations of median time to degree and completion rates with measures of faculty research productivity, GRE scores, and the average number of Ph.D.'s per year. It also describes the correlations between the percent of underrepresented minority (URM) faculty and URM students in a program, and between the percent of women faculty and women students. Correlations for each variable for all 11 fields are provided in Appendix D.

Chapter 4 provides a profile of time to degree, completion rates, and patterns of funding in the biomedical sciences as a whole, as well as the sources of student funding in the biomedical sciences compared with the broad fields of engineering and physical and mathematical sciences. Chapter 5 delves more deeply into the possible connections between the number and percent of students from underrepresented minority groups and other characteristics of doctoral programs, including the number of training grant awards, the size of the program, the number of URM faculty, faculty research productivity, and the percent of URM students in the field as a whole.

Chapters 6 and 7 use the *Assessment* data to explore some topics not explicitly mentioned in the statement of task. In Chapter 6 the panel examines a specific field, neuroscience and neurobiology, in greater depth, drawing on the results of the survey of doctoral students conducted in this and four other sample fields in the *Assessment.* Chapter 7 describes the participation of postdoctoral fellows in each of the 11 biomedical science fields, including the percent of faculty with postdoctoral experience, the number of postdoctorates in each field, and the average number of postdoctoral fellows based on the research quality of the program.

The panel was unable to shed much light on three of the questions in the statement of task. Differences between programs in the same field housed in medical schools and in arts and sciences schools, and differences between programs in integrated biological and biomedical sciences and other fields, are discussed briefly in Chapter 8. In both cases, however, the data that the institutions provided for the *Assessment* were not specific enough to draw these types of distinctions among individual programs.

Also, the panel did not conduct an analysis of the possible correlation between student activities such as writing workshops and career seminars and median time to degree. Preliminary examination of the overall data on student activities made it clear that these types of activities are offered in most doctoral programs, so correlations with other variables like time to degree will be small.

In its deliberations, the panel—which consisted of experts in training policy, graduate education in the biomedical sciences, and statistics—was frequently tempted to delve into the explanations of the findings or expand the findings into recommendations. The committee's analysis and findings, however, were limited by the collected data and the fact that NIH did not ask for causal analysis. Even with these limitations, the findings illustrate the type of insights that can be gained through use of this very rich source of data on doctoral programs in the biomedical sciences, as well as pointing out possible directions for future research.

2

Sources of the Data

The data used in this study were collected as part of the National Research Council's *Data-Based Assessment of Research-Doctorate Programs*, and the data collection procedures and *caveats* are described in detail in that report.[1] The committee authoring the *Assessment i*dentified several sources of errors in the data that could not be eliminated, including classification errors and data collection errors. The omission of field-specific measures, such as books, patents, and articles presented at refereed conferences in some science and engineering fields, means that the data do not capture the full scope of a program's research productivity (see Box 2-1).

The data on research productivity that were collected during the study were analyzed in specific ways in the *Assessment* report, but the full database available to researchers could extend this analysis to explore alternate measures of research productivity by the faculty. For example, less emphasis could be placed on a count of journal articles, which were not judged on the basis of their impact, and greater emphasis could be placed on the citation measure. Alternately, only articles with citations could be counted. These are only a few suggestions for further analysis.

Once the data were released, institutions and others identified additional problems, which led to the release of a corrected data table in April, 2011.[2] It is important for the reader to understand some of the limitations of the data used to produce the correlations and other analysis in this report.

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[1] See Chapter 3 of *the Assessment*, "Study Design."

[2] A summary of the changes made to the data table and a log of individual corrections are available at www.nap.edu/rdp.

BOX 2-1 Sources of Data Errors in the Assessment of Research-Doctorate Programs

1) Classification errors. The taxonomy of fields may not adequately reflect distinctions that the field itself considers to be important. For example, in anthropology physical anthropology is a different scholarly undertaking from cultural anthropology, and each subfield has different patterns of publication. By lumping together these subfields into one overall field, the committee is implying comparability. Were they separate, different weights might be given to publications or citations. Anthropology is not alone in this problem. Other fields are public health, communications, psychology, and integrated biological science. Although this study presents ranges of rankings across these fields, the committee encourages users to choose comparable programs and use the data, but apply their own weights or examine ranges of rankings only within their peer group.

2) Data collection errors. The committee provided detailed definitions of important data elements used in the study, such as doctoral program faculty, but not every program that responded paid careful attention to these definitions. The committee carried out broad statistical tests, examined outliers, and got back to the institutions when it had questions, but that does not mean it caught every mistake. In fields outside the humanities it counted publications by matching faculty names to Thomson Reuter's data and tried to limit mistaken attribution of publications to people with similar names. Despite these efforts, some errors may remain.

3) Omission of field-specific measures of scholarly productivity. The measures of scholarly productivity used were journal articles and, in the humanities, books and articles. Some fields have additional important measures of scholarly productivity. These were included in only one field, the computer sciences. In that field peer-reviewed conference papers are very important. A discussion of data from the computer sciences with its professional society led to further work on counting publications for the entire field. In the humanities the committee omitted curated exhibition volumes for art history. It also omitted books for the science fields and edited volumes and articles in edited volumes for all fields, since these were not indexed by Thomson-Reuters. All of these omissions result in an undercounting of scholarly productivity. The committee regrets them, but it was limited by the available sources. In the future it might be possible to obtain data on these kinds of publication from résumés, but that is expensive and time-consuming.

NOTE: The computer sciences count as publications articles that are presented at refereed conferences, but until recently few of these papers were indexed by Thomson Reuters. To deal with this practice, the committee compiled a list of such conferences that were not indexed and counted these publications from faculty résumés, as it did in the humanities.

SOURCE: *A Data-Based Assessment of Research-Doctorate Programs in the United States*, p. 7.

In addition to data from the *Assessment*, data on training grants and training slots were collected from the NIH website.[3] Using these two sources, the panel has identified correlations among many of the characteristics of doctoral programs in the biomedical sciences mentioned in the statement of task:

Average Publications per Faculty Member
Average Citations per Publication
Percent of Faculty with Grants
Percent of Non-Asian Minority Faculty
Percent of Female Faculty
Awards per Faculty Member
Average GRE Scores
Percent of Non-Asian Minority Students
Percent of Female Students
Average PhDs per Year, 2002-2006
Average Cohort Completion Rate
Median Time to Degree

Appendix D provides the correlations for these 12 variables for each field. With the exception of Awards per Faculty Member, all are discussed in Chapter 3.

In addition to the above list, other variables, such as the percent of first-year students with research assistantships or the percent with external fellowships, were used in analyses in later chapters (e.g., Chapter 4). Appendix C contains definitions of all of the relevant variables from the *Assessment;* data on these variables for each biomedical program are included in the Excel table available with this report. Appendix E contains the statistical summary of each variable by field.

Finally, the panel relied on other results from the *Assessment* surveys of doctoral programs, faculty, and students for more targeted analysis. Data on doctoral student satisfaction, productivity, and changes in career objectives in neuroscience and neurobiology (Chapter 6) came from the survey conducted of doctoral students in that and four other sample fields (chemical engineering, physics, economics, and English)[4]. Data on postdoctorates in Chapter 7 were drawn from primarily unpublished results of the program and faculty surveys. Although not all of these data are discussed in the *Assessment* report, they are available in the online Excel data table that accompanies this report or in the full database available for public use.

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[3]See *http://grants.nih.gov/training/outcomes.htm#fundedgrants*; data are from the version posted in 2009. Using NIH data, we were unable to associate training grant funding with particular programs. We were, however, able to tie them to particular institutions, and this is the approach we take in the analysis in this report.

[4] See "Data from Student Questionnaires" in Chapter 7 of the *Assessment*.

3

PAIRWISE CORRELATIONS

In its statement of task, the panel was asked to examine the correlations among a number of the variables in the *Assessment* (see Box 1-1). Several of the correlations are presented in this chapter, including correlations of student time to degree and completion rates with various characteristics of doctoral programs, and correlations between the diversity of a program's faculty and the diversity of its students. All of the data are drawn from the tables of pairwise correlations found in Appendix D, in which any correlations greater than or equal to 0.3[1] are highlighted.

The correlations provide insights into the relationships between characteristics that can be explored further. The panel focused its attention on correlation coefficients greater than or equal to 0.3 because they are nontrivial and they may display, in the panel's view, important relationships between program characteristics. Pairwise correlations uncover these potential relations of interest. Where associations are detected that, based upon prior knowledge, are judged indicative of relationships worth further study, adjustments for potential confounding variables must be made. Such adjustments are beyond the scope of this brief report.

Table 3-1 provides the correlations of student median time to degree and average cohort completion rate with three measures of faculty research productivity: average publications per faculty member, average citations per faculty member, and the percent of faculty with grants (see Appendix C for definitions). There is little relation between the average cohort completion rate and the productivity measures, with the exception of faculty with grants in physiology. The correlation of median time to degree and grants is also strong for physiology, and the correlations of median time to degree with citations per publication are strong for physiology, biomedical engineering and bioengineering, genetics and genomics, and immunology and infectious disease. Correlations in these four fields do not meet the 0.3 level with respect to publications per faculty, although they range from 0.179 to 0.272. The only field with a strong correlation between median time to degree and publications per faculty is nutrition. Where appreciable correlations exist between median time to degree and measures of faculty research productivity, greater research productivity is associated with *longer* times to degree.

[1] Correlations of 0.295 and higher were rounded to 0.3.

Table 3-1 Correlations of Median Time to Degree and Average Cohort Completion with Publications, Citations, and Grants

	Correlation with Median Time to Degree			Correlation with Average Cohort Completion		
Fields	Average Pubs per Faculty	Average Cits/Pubs	Percent Faculty with Grants	Average Pubs per Fac	Average Cits/Pubs	Percent Faculty with Grants
Biochemistry, Biophysics, and Structural Biology	0.052	0.166	0.077	0.123	0.089	0.094
Biomedical Engineering and Bioengineering	0.185	0.369	0.018	-0.184	0.015	0.148
Cell and Developmental Biology	0.014	0.128	0.081	0.087	0.057	-0.041
Genetics and Genomics	0.181	0.364	0.23	0.229	-0.02	0.149
Immunology and Infectious Disease	0.179	0.327	0.189	-0.067	-0.05	-0.02
Integrated Biological and Biomedical Sciences	-0.12	0.058	0.04	0.056	0.021	0.014
Microbiology	0.232	0.289	0.302	-0.072	-0.087	-0.201
Neuroscience and Neurobiology	0.059	0.21	0.169	0.036	0.046	-0.03
Nutrition	0.475	0.216	0.202	-0.037	0.085	-0.095
Pharmacology, Toxicology, and Environmental Health	-0.01	0.29	0.058	0.136	-0.095	0.117

Table 3-2 correlates median time to degree and average completion rate with GRE General Test scores and the average number of Ph.D.'s in each program. The correlations between cohort completion and both average GRE and average PhDs are uniformly low, and in several fields are negative. The exception is physiology. There is a positive correlation with respect to median time to degree and both average GRE scores and average Ph.D.'s produced, but only in nutrition are both strongly correlated. In biomedical engineering and bioengineering there is a strong correlation between median time to degree and average number of Ph.D.'s, and in microbiology a strong correlation between median time to degree and average GRE scores.

TABLE 3-2 Correlations of Median Time to Degree and Average Cohort Completion with GRE Scores and Number of PhDs

	Correlation with Median Time to Degree		Correlation with Average Cohort Completion	
Fields	GRE Average	Average Ph.D.'s 2002 to 2006	GRE Average	Average Ph.D.'s 2002 to 2006
Biochemistry, Biophysics, and Structural Biology	0.114	0.140	0.094	0.046
Biomedical Engineering and Bioengineering	0.251	0.491	0.080	-0.011
Cell and Developmental Biology	0.093	0.074	-0.022	-0.022
Genetics and Genomics	0.179	0.074	-0.108	0.235
Immunology and Infectious Disease	0.033	0.050	-0.216	0.051
Integrated Biological and Biomedical Sciences	0.111	0.145	-0.181	-0.033
Microbiology	0.319	0.270	-0.075	-0.089
Neuroscience and Neurobiology	0.156	0.150	0.007	0.076
Nutrition	0.487	0.309	-0.055	-0.106
Pharmacology, Toxicology, and Environmental Health	0.179	0.038	-0.058	0.103
Physiology	0.223	0.192	0.261	0.295

The correlations in Table 3-3 demonstrate a strong relationship between underrepresented minority faculty and underrepresented minority students in six of the eleven fields:

Biochemistry, Biophysics, and Structural Biology;
Immunology and Infectious Disease;
Microbiology;
Nutrition;
Pharmacology, Toxicology, and Environmental Health; and
Physiology.

For a fuller discussion of underrepresentation see Chapter 5.

The same relationship does not hold true for gender. The panel found no meaningful correlation between the percent of female faculty in a program and the percent of female students; the correlations are below 0.3 in every biomedical science field. The highest correlation (0.288) is in nutrition. While the average percentage of female students in all fields except biomedical engineering and bioengineering is over or near 50 percent, this is not the case with the average percentage of female faculty (see Appendix E). Only in nutrition is the average percentage of female faculty over 50 percent; the average percentage of female students is over 75 percent. Participation of women in faculty positions in the biomedical sciences is not a new issue. Women have consistently been represented on the faculty of biomedical fields at a rate lower than their proportion in the Ph.D. population.[2] Thus, although programs with a higher percentage of minority faculty do indeed seem to attract minority students at a higher rate, the same is not true for women.

TABLE 3-3 Correlations of Percent Female Students with Percent Female Faculty and Percent of Non-Asian Minority Students with Percent Minority Faculty

	Correlation with Percent Female Students	Correlation with Percent Non-Asian Minority Students
Fields	Percent Female Faculty	Percent Minority Faculty
Biochemistry, Biophysics, and Structural Biology	0.170	0.489
Biomedical Engineering and Bioengineering	0.118	0.076
Cell and Developmental Biology	0.004	0.247
Genetics and Genomics	0.109	0.290
Immunology and Infectious Disease	0.014	0.150
Integrated Biological and Biomedical Sciences	0.227	0.529
Microbiology	0.233	0.765
Neuroscience and Neurobiology	0.204	-0.002
Nutrition	0.288	0.531
Pharmacology, Toxicology, and Environmental Health	0.187	0.370
Physiology	0.086	0.570

The correlations in Appendix D permit examination of many other relationships among the characteristics of doctoral programs, faculty, and students. For example, the relationship between program size (as measured by average number of Ph.D.'s) and research productivity (as measured by faculty publications, citations, and grant awards) may be of particular interest to some university administrators and researchers. Although correlation does not imply causation,

[2] Research Training in the Biomedical, Behavioral, and Clinical Research Sciences, National Academies Press, 2011,p. 39.

it would make sense that, in fields where laboratories are critical to research productivity, programs with larger laboratories would be more productive—even when measured on a per capita basis. This is seen in the relationship between the three measures of research productivity and number of Ph.D.'s, where several fields with higher values for these productivity variables also tend to have a larger number of Ph.D.'s (see Appendix E).

4

Time to Degree, Funding, and Completion Rates

Median time to degree in the biomedical sciences is relatively constant across fields: medians range from 4.88 to 5.73 years for all biomedical science fields with a standard deviation of less than or equal to one year (see Appendix E). There is a "model" for doctoral training. In almost all programs, more than 90 percent of students are fully funded in the first two years, about one-quarter with an institutional fellowship and the rest through either a traineeship or research assistantship. By the third year, almost all students are funded through some combination of research assistantships and traineeships. This funding is available for 6 years of doctoral study, although the source of funding may vary.

Table 4-1 shows the funding patterns in the biomedical sciences compared with the broad fields of engineering and the physical and mathematical sciences. Nearly one-third of students in the biomedical sciences receive funding through external fellowships or traineeships after the first year, as compared with a percentage that is less than one-half as large for engineering and the physical sciences. Since funding for the biomedical sciences comes primarily from the National Institutes of Health, NIH can use its influence to encourage program practices in the biomedical sciences in a way that is not available for other fields in science and engineering, where research assistantships on grants to individual investigators are the dominant avenue for funding doctoral students beyond the first year.

TABLE 4-1 Sources of Funding for Ph.D. Students by Year of Enrollment 2005-2006, by Percent

	YEAR 1			YEAR 2		
	Biomedical Sciences	Physical and Mathematical Sciences	Engineering	Biomedical Sciences	Physical and Mathematical Sciences	Engineering
External fellowships or traineeships alone or with institutional support	25	9	10	33	11	11
Institutional fellowships and assistantships alone or with institutional support	34	25	27	18	17	20
Research assistantships	22	14	33	33	28	46
Teaching Assistantships	12	45	15	12	37	11
Other or less than full support	4	2	4	3	2	4
Unfunded	2	5	10	2	4	7

	YEAR 3			YEAR 4		
	Biomedical Sciences	Physical and Mathematical Sciences	Engineering	Biomedical Sciences	Physical and Mathematical Sciences	Engineering
External fellowships or traineeships alone or with institutional support	35	13	11	35	13	10
Institutional fellowships and assistantships alone or with institutional support	16	14	18	14	14	17
Research assistantships	37	38	49	40	43	51
Teaching Assistantships	8	2	10	7	23	8
Other or less than full support	3	2	4	3	2	4
Unfunded	2	4	7	2	4	8

TABLE 4-1 Sources of Funding for Ph.D. Students by Year of Enrollment 2005-2006, by Percent (cont'd)

	YEAR 5			YEAR 6		
	Biomedical Sciences	Physical and Mathematical Sciences	Engineering	Biomedical Sciences	Physical and Mathematical Sciences	Engineering
External fellowships or traineeships alone or with institutional support	34	12	9	32	11	6
Institutional fellowships and assistantships alone or with institutional support	11	14	16	10	12	12
Research assistantships	43	47	53	46	48	52
Teaching Assistantships	6	20	7	6	18	7
Other or less than full support	4	2	4	4	4	6
Unfunded	2	4	8	2	7	14

	YEAR 6+		
	Biomedical Sciences	Physical and Mathematical Sciences	Engineering
External fellowships or traineeships alone or with institutional support	26	7	4
Institutional fellowships and assistantships alone or with institutional support	11	9	9
Research assistantships	42	43	40
Teaching Assistantships	6	15	7
Other or less than full support	7	6	6
Unfunded	7	18	31

In terms of completion rates, the average percent of doctoral students who complete their degrees in 6 years or less ranges from 42 percent in genetics and genomics to 56 percent in pharmacology, toxicology, and environmental health. There is substantial variation among programs, however. For example, in immunology and infectious disease, one university had a completion rate of 100 percent, while another had a completion rate of 25 percent, although both programs average 3.4 doctorates per year. The extent to which this difference is due to variations in admissions policies, retention efforts, funding, or other factors, is impossible to say. Case studies or other detailed analyses would be needed to sort this out. It is noteworthy, however, that immunology and infectious disease programs at both institutions had the same median time to degree for those students who did complete.

As might be expected, a shorter median time to degree is correlated with a higher completion rate. In at least six fields the coefficient is < -0.3:

TABLE 4-2 Correlations Between Median Time to Degree and Average Completion Rate by Field

Field	Median Time to Degree (years)	Average Completion Rate (%)	Correlation
Biochemistry, Biophysics, and Structural Biology	5.63	45.9	-0.375
Biomedical Engineering and Bioengineering	5.06	46.3	-0.134
Cell and Developmental Biology	5.66	50.1	-0.383
Genetics and Genomics	5.73	41.6	-0.451
Immunology and Infectious Disease	5.36	56.2	-0.071
Integrated Biological and Biomedical Sciences	5.62	47.4	-0.362
Microbiology	5.58	47.1	-0.493
Neuroscience and Neurobiology	5.68	46.2	-0.464
Nutrition	4.88	55.8	-0.165
Pharmacology, Toxicology, and Environmental Health	5.21	56.1	-0.260
Physiology	5.13	50.9	-0.179

5

Representation of Underrepresented Minorities

NIH TRAINING GRANTS[1]

Associating training grants with the universities to which a program belongs, the panel investigated two questions about the relationship of training grant awards to underrepresented minority (URM) students and to international students.

Do institutions with heavy dependence on training grants recruit more students who are from underrepresented minority groups (URMs) than schools with less dependence?

To explore this question, the number and percentage of URM students were plotted against the number of training grants for each institution. Data showing the numbers of URM's as well as the percentage by institution are given in Figures 5-1a and 5-1b. Numbers were used in Figure 5-1a to test the hypothesis that the more training grants an institution has, the more URMs it will recruit. Figure 5-1b, using the percentage of URMs, shows that, even in institutions with a large number of training grants, the representation of URMs is about average, and is similar to institutions with fewer grants.

It is true that the programs with more URM students also are the larger departments and the ones with higher research productivity. Hence, while a higher number of NIH training grants go to programs with a larger number of minority Ph.D. students, it is not necessarily true that the proportion of support going to minorities is greater *because* of the training grants. Program specific data would be important for an analysis that addresses this more challenging question.

[1] A note on the data: Using NIH data, we were unable to associate training grant funding with particular programs. We were, however, able to tie them to particular institutions, and this is the approach we take in the analysis that follows. MARC training grants were not included.

FIGURE 5-1a Comparison of the Number of Training Grant Awards and the Number of Underrepresented Minorities by Institution. The correlation between training grants and number of URM students is 0.748.

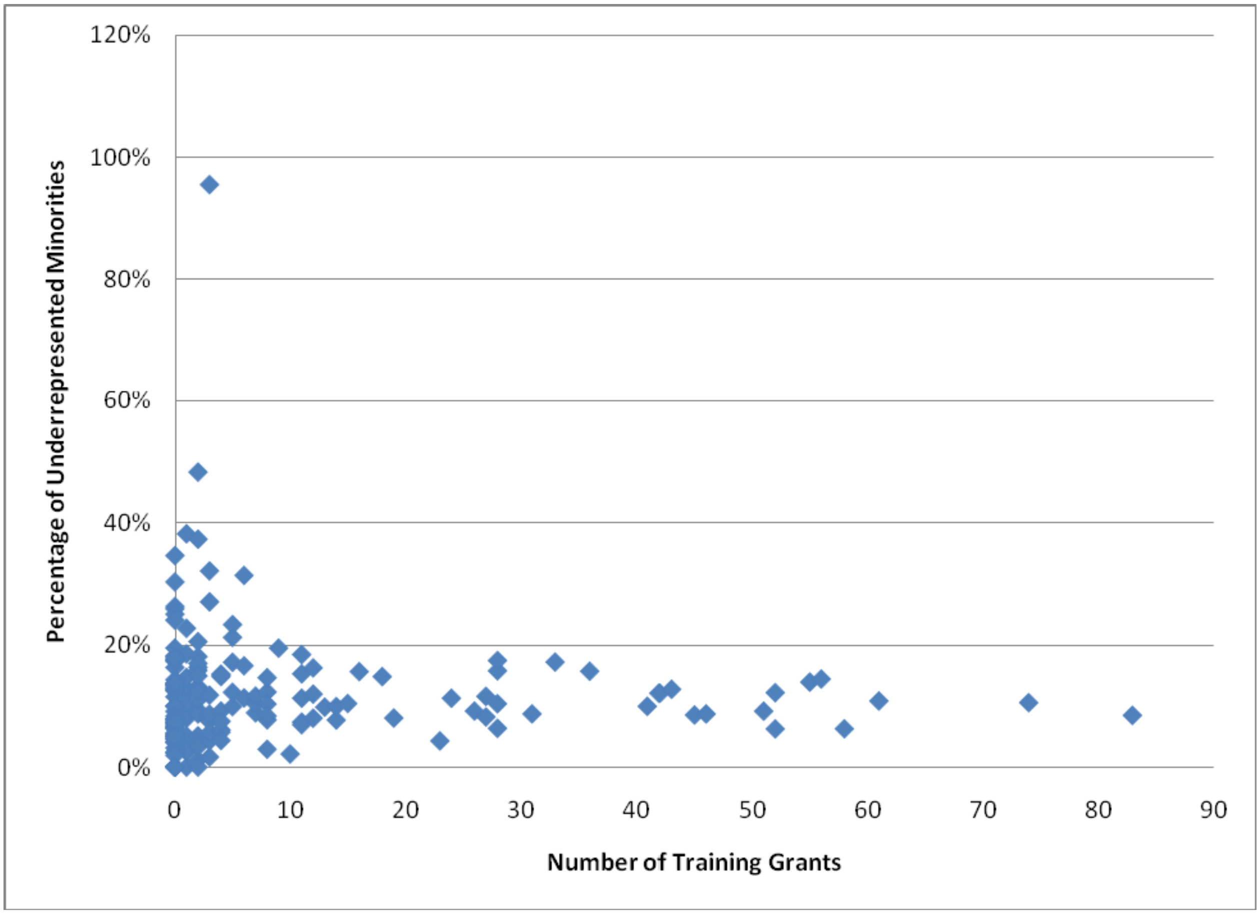

FIGURE 5-1b Comparison of the Number of Training Grant Awards and the Percentage of Underrepresented Minorities by Institution. The correlation between training grants and the percentage of URM students is 0.000.

The above notwithstanding, there are some institutions that stand out as having a high percentage of URM students, regardless of the number of training grants (see Table 5-1).

TABLE 5-1 Institutions with programs having 20 percent or more URM students and the number of their training grant awards

Institution Name	Average Percent of URM Students	Average of Number of Training Grant Awards
Howard University	95%	3
New Mexico State University Main Campus	48%	2
City University of New York Grad. Center	38%	1
University of North Texas Health Science Center	37%	2
Loma Linda University	35%	0
University of Georgia	32%	3
University of New Mexico Main Campus	31%	6
University of Southern Mississippi	30%	0
University of Miami	27%	3
Auburn University	26%	0
Florida International University	26%	0
University of North Carolina at Greensboro	25%	0
University of South Carolina Columbia	24%	0
University of Louisville	23%	5
Oklahoma State University Main Campus	23%	1
University of California-Santa Cruz	21%	5
University of Maryland Baltimore County	21%	2

More analysis is needed to identify the characteristics of these institutions that make them particularly successful in recruiting URM doctoral students.

Do institutions with heavy dependence on training grants enroll fewer international students?

Here we looked at the percentage of international students in a program related to the number of training grants the institution holds. As shown in Figure 5-2, institutions with greater than 15 training grant awards had an average of about 25 percent international students in their biomedical sciences programs, compared to about 35 percent at institutions with smaller numbers of grants. Since international students cannot be supported on NIH training grants, this difference is not surprising.

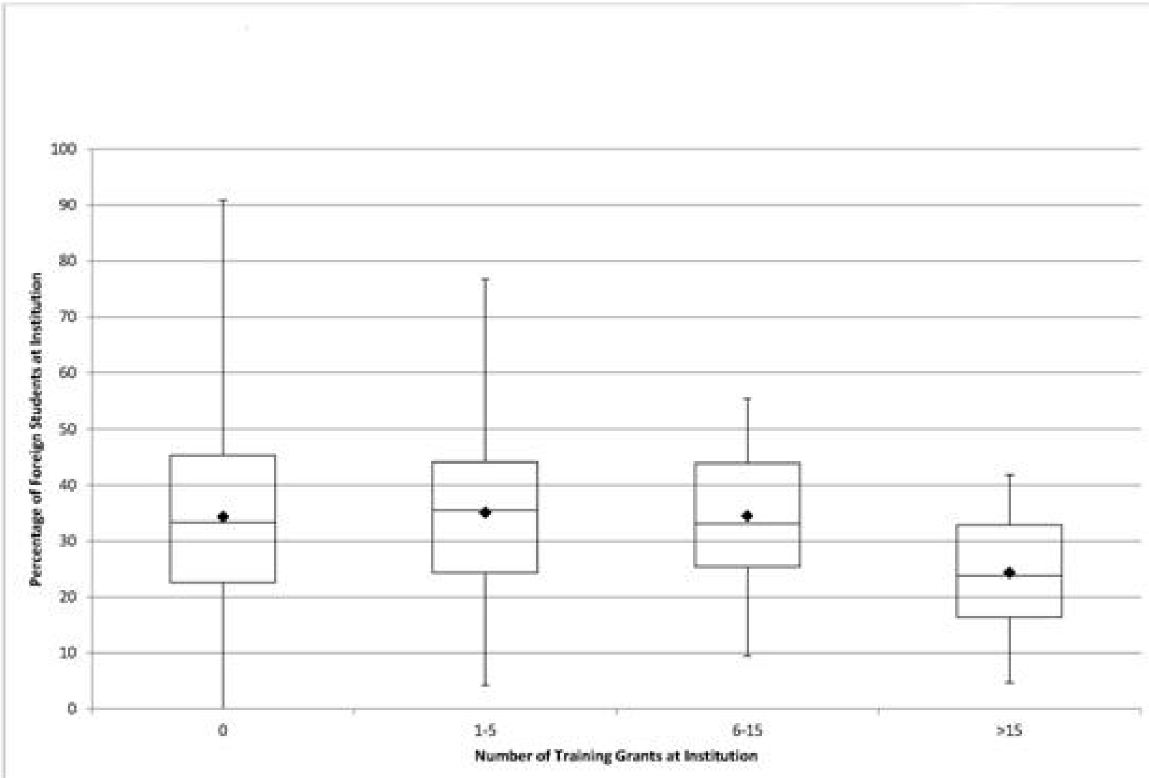

FIGURE 5-2 Percent of International Students at an Institution Grouped by Number of Training Grants (All Institutions) The correlation between training grants and the percentage of international students is -0.240

A STATISTICAL APPROACH

Another approach to issues relating to underrepresented minorities is to develop a model of enrollment by URM's that relates enrollment to other program characteristics, in order to better understand how to expand their enrollment and graduation from Ph.D. programs. Toward that end, the biomedical sciences data of the *Assessment* can identify factors associated with higher URM enrollment among the participating programs. The panel addressed three questions in turn:

- *How many URM graduates are expected per year across all programs?*

- *What factors predict higher URM enrollment in a PhD program?*

- *Having controlled for these factors, to what extent does URM enrollment cluster within universities, and which universities exceed URM enrollment expectations?*

URM Ph.D. Students and Graduates

There are close to 40,900 Ph.D. students in the 982 biomedical sciences programs in the *Assessment*. Of these, approximately 4,700 (11.5 percent) are from underrepresented minority groups (URMs). Figure 5-3 shows the distribution of the percentage of URM Ph.D. students across the programs (0 = no URM students; 100% = all are URMs). The median percent of URMS is 10 percent; the middle half of programs have between 4 and 16 percent of URM Ph.D. enrollments, which corresponds to 1 to 7 URM students.

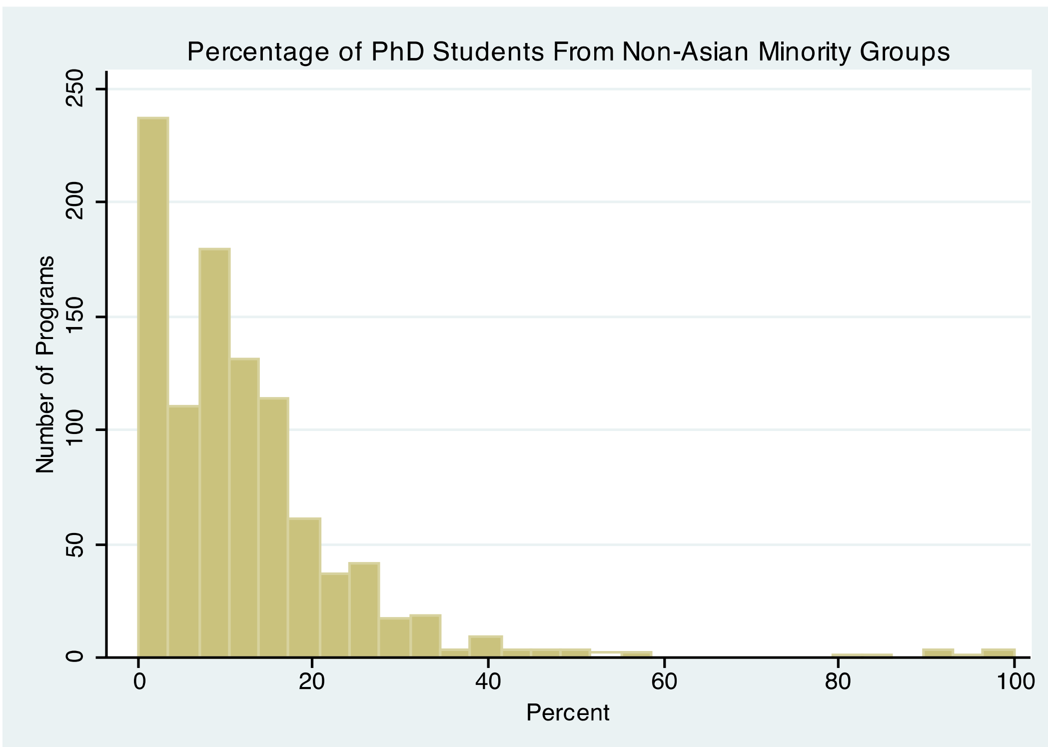

FIGURE 5-3 Histogram Describing the Percentage of URM Ph.D. Students for 981 Bioscience Programs[2]

Figure 5-4 shows the distribution of the expected number of URM graduates per year. This measure for a program is estimated by multiplying the share of enrolled URM students by the average number of graduates over the previous 3 years. Seventeen percent of programs are expected to graduate more than one URM student per year; three percent of programs are

[2] One of the 982 programs did not have data for URMs.

expected to graduate two or more. Of the approximately 4,700 new Ph.D.'s per year over the 982 departments, roughly 550 were URM graduates.

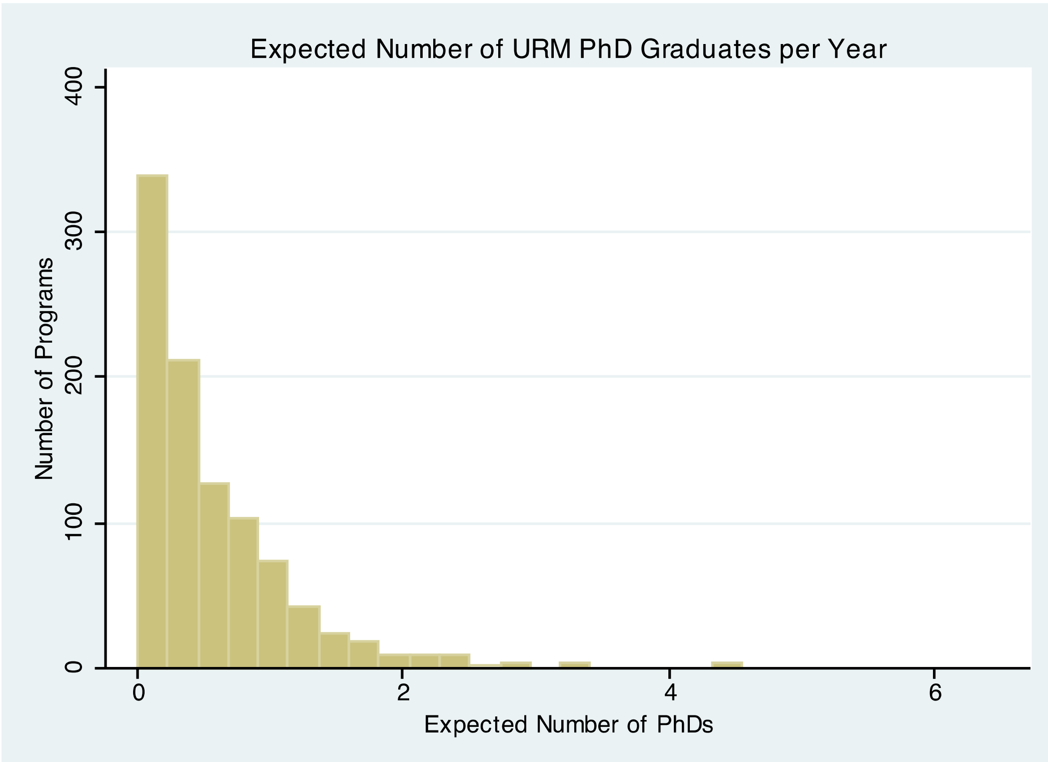

FIGURE 5-4 Histogram Describing the Expected Number of URM PhD Graduates per Year for 982 Bioscience Programs

Factors that Predict URM Enrollments

To identify key factors that predict the number of URM graduate students in a program, the panel used Poisson log-linear regression to predict the expected rate of enrolled URM students (number URM per total enrolled students) as a function of the following factors:

- number of URM faculty;
- research productivity as measured by the 5th percentile of the NRC "research productivity" ranking[3]; and
- biomedical science field.

[3] Other variables (e.g., completion rate or percent of first year students with full financial support) could be used in this analysis.

The model also includes a random effect for each university to account for the correlation among URM enrollments among programs from the same university (see below). The regression coefficients are estimates of log relative rates of URM enrollment per unit change of the predictor, other variables held fixed. For example, the exponential of the coefficient for the URM faculty fraction is the factor that multiplies the expected URM student enrollments if the fraction of URM faculty increases from 0 to 100 percent. A factor of 1.0 = exp(0) means that the percentage of URM faculty has no effect on the fraction of URM PhD students; a factor of 3 means that an increase in URM faculty members from 10 to 20% is associated with an increase in the fraction of URM enrolled students from 10 to 40%. Table 5-2 shows a subset of the results of this log-linear regression.

TABLE 5-2 Predictor, Estimated Relative Rate (RR) and t-Statistic for Null

Predictor	Relative Rate	t-statistic
Biochemistry, Biophysics, and Structural Biology+	1	-------
Biomedical Engineering and Bioengineering	1.17	2.26
Cell and Developmental Biology	1.16	2.44
Genetics and Genomics	1.09	1.09
Immunology and Infectious Diseases	1.32	3.56
Integrated Biological and Biomedical Sciences	0.97	-0.42
Microbiology	1.35	4.15
Neuroscience and Neurobiology	1.25	3.45
Nutrition	1.35	2.91
Pharmacology, Toxicology, and Environmental Health	1.48	6.08
Physiology	1.28	2.71
URM Faculty Fraction	**2.96**	**3.160**
Research Productivity	1.0015	1.73

NOTE: RR=1 from log-linear regression of the number of URM PhD students on the indicators of field; biochemistry, biophysics, and structural biology is the reference program with RR assigned to be 1.0, fraction of URM (0-1), and for the 5^{th} percentile of the research productivity (0-100).

The relative rate estimates for biochemistry, biophysics, and structural biology and for integrated biological and biomedical sciences are the smallest, indicating that among the observed data, they are the least well-subscribed biomedical science departments by URM students, all else being equal. Pharmacology, toxicology, and environmental health, microbiology, immunology and infectious disease, and nutrition have the largest estimates, which range from 35 to 48 percent higher rates of enrollment than in biochemistry, biophysics, and structural biology.

Research productivity of the program faculty is not a strong predictor of URM Ph.D. student enrollment, once the number of PhD students is taken into account. However, as would be expected, the fraction of URM faculty is a very strong predictor. For a 10 percentage point increase, say from 5 to 15 percent of URM faculty, the fraction of URM Ph.D. enrollments is expected to increase by 26.1 percentage points, nearly a 3-to-1 ratio. This is by far the most important predictor among those considered.

Clustering of URM Students

Many universities have a large number of Ph.D. programs (ranging from 1 to 18) in the *Assessment*. Therefore, it is possible to ask whether there are unmeasured characteristics of each university that attract URM Ph.D. students beyond the predictors considered above. Because such factors are common to all programs from a university, their influence can be detected as correlation or "clustering" among the rates of URM enrollments for programs from the same university.

A simple extension of the log-linear model above can be used to estimate the degree of clustering by adding a random "university effect" that is common to all the programs within that institution. We have added a random intercept to the Poisson regression described above. With this model, we have estimated the multiplicative factor that indicates how each university's URM enrollment is increased or decreased across all of its programs using empirical Bayes estimation as implemented in the software package Stata (Rabe-Heckesh, Skronda, and Picles (2002).[4] Table 5-3 lists the estimated relative rates for the 10 universities with the highest values.

[4] Rabe-Heckesh, S., A. Skronda, and A. Picles. 2002. Reliable estimation of generalized mixed models using adaptive quadrature. The Stata Journal, Vol. 2, (1), 1-21.

TABLE 5-3 Listing of the Universities with Highest "University Relative Rates"

Institution	Relative Rate
Howard University	3.98
City University of New York	3.52
New Mexico State University	3.44
University of New Mexico Main	3.29
University of North Texas HSC	3.25
Loma Linda University	2.36
University of Texas HSC	2.36
University of Maryland Baltimore	2.12
University of Georgia	2.10
University of Miami	2.09

NOTE: These rates indicate the attractiveness of the university's programs beyond what is predicted by the field, percent of URM faculty, and research productivity.

The degree of clustering of URM graduate students is substantial, even after controlling for the clustered URM faculty. The standard deviation of the university effect is estimated to be 0.50 (95 percent confidence interval 0.43 to 0.59). A standard deviation of 0.5 for a Gaussian distribution means that roughly 1 of 3 universities would have relative rates below 0.6 or above 1.6, a demonstration of important variation among institutions in their ability to attract URM PhD students, even after controlling for variation among them in their fractions of URM faculty, research productivity, and field.

6

Neuroscience and Neurobiology: Combining Data from the Program and Student Surveys

Of the 11 biomedical science fields included in the *Data-Based Assessment of Research-Doctorate Programs*, the field of neuroscience and neurobiology was selected for inclusion in the student survey as a representative of the broad field of biological sciences.[1] To put the neuroscience and neurobiology student data into context, they have been compared with other science, technology, engineering, and mathematics (STEM) disciplines and used it as a case study of biomedical science disciplines.

STUDENT EXPERIENCE

Compared with chemical engineering, physics, economics and English, the other fields in which students were queried about their training programs, neuroscience and neurobiology appears to be a field with a relatively high level of overall student satisfaction. Ninety-five percent of the students were somewhat or very satisfied with their training program (Table 7-15 in the *Assessment*), a number equaled only by chemical engineering. Students in neuroscience and neurobiology also reported the highest levels of student productivity in both research presentations and publication of research findings, again similar to chemical engineering (Table 7-16 in the *Assessment*). Although students in all five fields surveyed reported that the assessments of academic progress that they received were helpful, neuroscience and neurobiology students reported much higher rates of assessment (Table 7-17 in the *Assessment*). Eighty-six percent of the neuroscience and neurobiology programs reported collecting data about the postgraduation employment of their students, higher than any other biomedical science field.

The student survey also asked students to reflect on their career objectives when they entered graduate school and when they took the survey, which was after admission to candidacy. At program entry, more than 80 percent of neuroscience and neurobiology students recalled an

[1] Most of the data on students in neuroscience and neurobiology comes from the survey of doctoral students. For a discussion of the results of the student survey, see Chapter 7 in the *Assessment*. The complete “Admitted-to-Candidacy Doctoral Student Questionnaire” can be found in Appendix D of the *Assessment*.

intention to pursue a career in research and development, similar to those in physics and chemical engineering. Unlike those fields, however, neuroscience and neurobiology students reported a large change in career objectives, with a 13 percent decrease in interest in research and development (see Table 7-18 in the *Assessment)*. It is unclear if this decline reflects student perception of static employment opportunities for biomedical scientists in academia or, perhaps more positively, the opening of a wider array of career options for application of technical expertise in the biomedical sciences. This is an area that merits continued data collection for a more complete understanding of career outcomes in the biomedical science fields.

COMPLETION RATES AND TIME TO DEGREE

The percentage of neuroscience and neurobiology students completing programs within 6 years exhibited an interquartile range of 36 percent to 57 percent with a median of 53 percent[2]. The cohort completion rate did not correlate with measures of faculty research productivity (i.e., publications, citations, and grants), as shown in Appendix D. This was similar to other biomedical science programs.

We can reliably identify the locus of management of only 60 percent of the neuroscience and neurobiology programs. This is further complicated by the interdisciplinary nature of neuroscience and neurobiology, where "behavioral" neuroscience and neurobiology programs are more likely to be administered in an arts and sciences faculty while "anatomical" or "physiological" neuroscience and neurobiology programs are more likely to be in medical schools. Of the programs that we can locate, 57 percent are in medical schools and 43 percent are in arts and sciences.[3] For these identifiable programs, the completion rate for programs in medical schools was 43 percent, while it was 48 percent for programs in arts and sciences.

The median time to degree for neuroscience and neurobiology programs ranged from 5 to 7.26 years, with 73 of the 93 programs falling between 5 and 6.5 years. This was similar to the other biomedical science fields with the exception of biomedical engineering and bioengineering, where the median time to degree tended to be lower with a range of 3.4 to 6.5 years.

DIVERSITY

Gender

Like most of the biomedical sciences, the neuroscience and neurobiology programs had relatively large numbers of female students. Eighty-three of the 93 programs reported 30-70 percent female students enrolled. The percent of female faculty ranged widely in neuroscience and neurobiology from 0 to 100 percent, although the interquartile range, which spans 86 of the 93 programs, reported from 21 percent to 30 percent female faculty. No meaningful correlation (r = -0.002) was found between the percent of female faculty and the percent of female students enrolled in neuroscience and neurobiology or other biomedical fields. In neuroscience and

[2] Unless otherwise noted, the data in the remainder of this chapter is based on the online Excel data table accompanying this report at www.nap.edu.

[3] These data were collected specifically for this report from the institutions in a separate email survey.

neurobiology, the percent of female faculty did correlate negatively with median time to degree (r = -0.346), indicating shorter times (see Appendix D). The important question these data do not answer is whether programs with a higher proportion of female faculty are associated with a higher completion rate for female students.

Race and Ethnicity

The numbers of non-Asian minority faculty tend to be low in most biomedical science programs, although each field has exceptions. In neuroscience and neurobiology, the top 10 percent of the programs in terms of racial and ethnic diversity reported between 8.6 and 19.2 percent non-Asian minority faculty. This was comparable to other biomedical fields. As with female students, the percentages of non-Asian minority students reported were considerably higher than the faculty percentages, with the range for the top 10 percent of programs between 20 and 33 percent. In neuroscience and neurobiology, there were not large correlations between the numbers of non-Asian minority faculty and students, although the panel did find nontrivial positive correlations between the number of underrepresented minority faculty and underrepresented minority students in six fields: biochemistry, biophysics, and structural biology; immunology and infectious disease; microbiology; nutrition; pharmacology, toxicology, and environmental health; and physiology (see Table 3-3).

RESEARCH PRODUCTIVITY

Correlations of Ph.D. production (average Ph.D.'s, 2002-2006) with measures of faculty research productivity in neuroscience and neurobiology are high. In fact, neuroscience and neurobiology and integrative biological and biomedical sciences are the only 2 of the 11 biomedical fields in which Ph.D. production is strongly correlated with all three measures of faculty research productivity (see Appendix D). In neuroscience and neurobiology all of the programs producing the largest number of PhDs have NIH predoctoral training support.

Additional data on postdoctoral trainees in neuroscience and neurobiology and all other fields of biomedical science research would be very useful. Particularly as employment in the first full-time academic position beyond the postdoctoral period may be increasingly competitive, it could be important information to guide the training and development of these early-stage investigators.

7

Postdoctoral Scholars: An Extension of the Data

Although the program survey and the faculty survey for the *Assessment* collected data on postdoctoral scholars, these data have yet to be analyzed. This section reports on some initial findings.[1] First, and not surprisingly, most faculty members in every biomedical science field have spent time as postdoctoral scholars. This is shown in Table 7-1.

Postdoctoral experience is slightly less prevalent in biomedical engineering and bioengineering and in nutrition, which are not viewed traditionally as core fields in the biological sciences. Table 7-2 shows, however, that postdoctoral experience is age dependent. Older faculty have a smaller percentage of people with postdoctoral experience than more recent cohorts. For the 1990s cohorts, all fields, except for biomedical engineering and bioengineering and nutrition, are over or near 90 percent. The data for the most recent period, 2000 to 2006, is not a good indicator of postdoctoral training, since many of those in this cohort who will eventually take faculty positions have not yet completed their postdoctoral training.

The next tables provide information from the program survey about postdoctorates in 2005-2006. From Table 7-3, it is apparent that postdoctorates are concentrated in the largest programs. Further, as can be seen in Table 7-4, they are concentrated in the programs that are in the top two quartiles for research activity.

The largest numbers of postdoctorates are being trained in, and presumably are contributing to, the most productive research environments. It would be interesting to understand more about the effect of postdoctorates on the training environment for graduate students.

[1] Copies of the Program Questionnaire and Faculty Questionnaire can be found in Appendix D of the *Assessment.*

TABLE 7-1 Percent of Faculty with Postdoctoral Study by Field

Field	Faculty with no Post Doc	Faculty with Post Doc	No response to Post Doc Questions	Total Survey Respondents	Percent of total faculty surveyed	Percent of respondents to Post Doc Question
Biochemistry, Biophysics, and Structural Biology	167	3073	319	3559	86.30%	94.80%
Biomedical Engineering and Bioengineering	439	1064	140	1643	64.80%	70.80%
Cell and Developmental Biology	194	3241	399	3834	84.50%	94.40%
Genetics and Genomics	145	1496	158	1799	83.20%	91.20%
Immunology and Infectious Disease	217	1274	284	1775	71.80%	85.40%
Integrated Biological and Biomedical Sciences	367	3206	429	4002	80.10%	89.70%
Microbiology	110	1310	168	1588	82.50%	92.30%
Neuroscience and Neurobiology	233	2474	317	3024	81.80%	91.40%
Nutrition	238	440	71	749	58.70%	64.90%
Pharmacology, Toxicology and Environmental Health	245	1603	192	2040	78.60%	86.70%
Physiology	84	959	106	1149	83.50%	91.90%
Total	2439	20140	2583	25162	80.04%	89.20%

NOTE: The data file with the faculty responses to the faculty questionnaire for whether they had a postdoctorate contains 2,583 blank cells; therefore, the percentage with a postdoctorate was computed for all responders to the survey and for those with data.

TABLE 7-2 Percent of Faculty with Postdoctorates by Field and Decade of Doctorate Receipt

Field	PhD in 1940s and 1950s (%)	PhD in 1960s (%)	PhD in 1970s (%)	PhD in 1980s (%)	PhD in 1990s (%)	PhD in 2000 to 2006 (%)
Biochemistry, Biophysics, and Structural Biology	75.0	88.2	93.9	95.2	97.1	93.4
Biomedical Engineering and Bioengineering	42.9	47.0	60.3	60.8	79.1	76.6
Cell and Developmental Biology	40.0	91.2	89.0	95.9	95.5	95.1
Genetics and Genomics	25.0	87.7	90.7	92.7	93.0	79.7
Immunology and Infectious Disease	57.1	91.5	86.6	85.8	87.6	73.4
Integrated Biological and Biomedical Sciences	66.7	83.4	83.8	92.1	92.9	89.4
Microbiology	80.0	89.3	88.8	92.4	95.8	91.6
Neuroscience and Neurobiology	83.3	80.5	86.8	93.1	94.9	89.2
Nutrition	50.0	75.0	66.4	59.4	71.3	65.0
Pharmacology, Toxicology and Environmental Health	60.0	74.7	85.1	87.1	91.7	76.1
Physiology	60.0	81.8	90.7	93.8	94.6	83.8
Total	60.2	83.4	86.0	89.6	92.0	84.4

NOTE: Percentages are based on survey responses with data for both a postdoctoral appointment and year of PhD.

TABLE 7-3 Average Number of Postdoctoral Fellows in Programs by Field and Size of Programs Based on Student Enrollment

	Program Size Quartiles, with Largest Programs in Size Quartile 1				
Fields	Size Quartile 1	Size Quartile 2	Size Quartile 3	Size Quartile 4	Total
Biochemistry, Biophysics, and Structural Biology	36.3	19.1	18.1	9.0	20.3
Biomedical Engineering and Bioengineering	25.9	8.5	4.1	3.1	10.5
Cell and Developmental Biology	52.3	28.5	18.4	10.7	27.2
Genetics and Genomics	55.0	18.3	23.5	9.3	24.5
Immunology and Infectious Disease	39.2	17.4	18.4	13.7	22.3
Integrated Biological and Biomedical Sciences	97.4	24.2	12.8	4.4	34.8
Microbiology	33.8	22.7	12.5	5.5	18.7
Neuroscience and Neurobiology	51.1	24.4	19.5	7.0	24.8
Nutrition	18.0	6.1	3.0	2.4	6.8
Pharmacology, Toxicology, and Environmental Health	25.6	18.2	11.6	7.1	15.5
Physiology	20.9	10.7	14.3	5.1	13.0

NOTE: Two programs were trimmed from the top and bottom of integrated biological and biomedical sciences based on the number of postdoctorates in those programs, to avoid distorting the percentages.

TABLE 7-4 Average Number of Postdoctoral Fellows in Programs by Field and Research Quality of Programs

	Program Research Quality Quartiles with Better-Ranked Programs in "Research Quality Quartile 1"				
Fields	Research Quality Quartile 1	Research Quality Quartile 2	Research Quality Quartile 3	Research Quality Quartile 4	Total
Biochemistry, Biophysics, and Structural Biology	37.2	21.2	14.6	8.2	20.4
Biomedical Engineering and Bioengineering	23.5	9.6	5.1	4.3	10.5
Cell and Developmental Biology	44.1	34.5	22.0	8.3	27.2
Genetics and Genomics	33.4	33.8	26.1	5.9	24.5
Immunology and Infectious Disease	30.1	33.7	18.8	9.3	22.3
Integrated Biological and Biomedical Sciences	105.5	28.9	8.1	3.2	34.5
Microbiology	27.1	25.1	16.4	7.0	18.7
Neuroscience and Neurobiology	53.9	27.0	19.0	6.4	24.8
Nutrition	11.1	13.9	2.4	1.7	6.8
Pharmacology, Toxicology and Environmental Health	27.6	9.8	11.0	14.0	15.5
Physiology	20.2	18.6	9.9	4.2	13.0
Total	41.4	23.7	14.4	7.1	21.2

NOTE: Quality quartiles are determined by taking the 0.05 Research Quality ranking.

8

Administrative Questions about Biomedical Science Programs and Concluding Thoughts

Initially, the panel thought that it could contrast programs on the basis of two variables dealing with administration:

> *Was the program managed in a medical school or in a graduate school of arts and sciences?*
> *Was the program part of a biomedical science "umbrella" program?*

It turned out that neither question was straightforward for all programs.

MEDICAL SCHOOL OR GRADUATE SCHOOL

In an attempt to categorize programs correctly, the panel conducted an email inquiry of institutions with medical schools, asking them where their biomedical sciences programs were located administratively. A number of programs were shared between arts and sciences and the medical school. We had thought that medical schools might impose a more "professional school" model on their Ph.D. programs, that is, the expectation would be of completion in a fixed period of time, and the assumption would be that most enrollees would complete.

What we found was that some programs were administered jointly. The only unambiguous contrast we could make was between programs in the same field in the same institution. Even then, these programs were not strictly comparable—for example, in the field of pharmacology, toxicology, and environmental health, a single institution may have separate programs in each field. Given these uncertainties, it was difficult to make comparisons that the panel thought were reliable.

As an illustration of data that might be used to identify differences between programs in medical school and arts and sciences, Table 8-1 compares completion rates and median time to degree for five fields in which the panel was able to identify common programs at three or more institutions.

TABLE 8-1 Comparison of Completion Rates and Median Time to Degree for Programs in both Arts and Sciences and Medical Schools (by Percentages for Completion and Years for Time to Degree)

Field	Number of Institutions with Common Programs	A&S Program Average of Completion Rate	Medical School Program Average of Completion Rate	Med School minus A&S	A&S Program MedianTime to Degree	Medical School Program MedianTime to Degree	Med School minus A&S
Biochemistry, Biophysics, and Structural Biology	8	46.83%	42.11%	-4.71%	5.59	5.97	0.38
Cell and Developmental Biology	5	29.62%	56.72%	27.06%	6.6	5.9	-0.72
Immunology and Infectious Disease	3	60.50%	56.87%	-3.60%	6.1	5.27	-0.83
Neuroscience and Neurobiology	4	46.28%	41.55%	-4.73%	5.87	5.72	-0.15
Pharmacology, Toxicology and Environmental Health	8	50.15%	52.91%	2.75%	5.42	5.68	0.26

PROGRAMS IN INTEGRATED BIOLOGICAL AND BIOMEDICAL SCIENCES

The panel took a close look at the programs in the field of integrated biological and biomedical sciences. We wanted to use this diverse field to identify the programs in which students typically spend one year sampling research in different laboratories and then choose an area of specialization. However, the responding institutions provided data for individual fields, even when those fields were part of an umbrella program.

Using data from the *Assessment* survey of doctoral programs,[1] the panel examined the ratio of the number of students who enrolled to the number of students who received offers of admission to see if the integrated biological and biomedical science programs were more popular (as indicated by a higher enrolled-to-offered ratio), but did not find any evidence of this. Such an effect may have been obscured by the ambiguities in the classification of programs.

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[1] See Program Questionnaire, Question #C3, (Appendix D of the *Assessment)*.

APPENDIX A

BIOGRAPHIES OF PANEL MEMBERS

JOAN F. LORDEN (Committee Chair), Ph. D., joined the University of North Carolina at Charlotte as provost and vice chancellor for academic affairs in August 2003. She received the Bachelor of Arts in Psychology and the Doctor of Philosophy in Psychology from Yale University. Prior to coming to UNC Charlotte, she served as Associate Provost for Research and Dean of the Graduate School at the University of Alabama at Birmingham (UAB), where she was Professor of Psychology. She has published extensively in the area of brain-behavior relationships and specialized in the study of animal models of human neurological disease. In 1991, she was awarded the Ireland Prize for Scholarly Distinction. She has served on peer review panels and scientific advisory boards at NIH, NSF, and private agencies. At UAB she organized the doctoral program in behavioral neuroscience and directed the university-wide interdisciplinary Graduate Training Program in Neuroscience. In addition to her work in research and graduate education at UAB, Dr. Lorden founded an Office of Postdoctoral Education, programs for professional development of graduate students, an undergraduate honors program, and several programs designed to improve the recruitment of women and minorities into doctoral programs in science and engineering. Dr. Lorden was elected Chair of the Board of Directors of the Council of Graduate Schools (2003) and during 2002-2003, she was the Dean in Residence in the Division of Graduate Education at the National Science Foundation. She has chaired the Board of Directors of Oak Ridge Associated Universities, was a Trustee of the Southeastern Universities Research Association, and chaired the executive committee of the NASULGC Council on Research Policy and Graduate Education. She was a member of the National Research Council's Committee on the Methodology for the Study of the Research-Doctorate. She is a member of the Society for Neuroscience, the American Psychological Association, and the American Psychological Society.

ROGER CHALKLEY, Ph.D., is Senior Associate Dean of Biomedical Research Education and Training at the Vanderbilt School of Medicine. Dr. Chalkley is responsible for the overview of the activities of the office of Biomedical Research Education and Training, including oversight of the IGP, the MD/PhD Program, PostDoctoral Affairs, Graduate Student Affairs as well as Minority Activities and supporting Training Grant applications. Dr. Chalkley was educated at Pembroke College, Oxford in Chemistry and did his Post Doctoral research in gene regulation and chromatin structure in the laboratory of James Bonner at Caltech. After almost 20 years in the Biochemistry Department at the University of Iowa School of Medicine, he moved to Vanderbilt in 1986. He has published almost 200 papers in chromatin research. Dr. Chalkley has had an active interest in graduate education for many years and was involved in the establishment of the IGP where he served as Director for the last 8 years.

VIRGINIA S. HINSHAW, Ph.D., is the Chancellor of the University of Hawai‘i at Mānoa and Professor of Virology in the John A. Burns School of Medicine at UH Mānoa. Dr. Hinshaw earned her B.S. in laboratory technology and her M.S. and Ph.D. in microbiology from Auburn University. For over 25 years, her research focused on influenza viruses in humans, lower mammals, and birds, investigating such aspects as: important hosts in nature; transmission among species; genetic changes related to disease severity; the molecular basis of cell killing; and new approaches to vaccines. She conducted research at various hospitals and universities, including the Medical College of Virginia, UC Berkeley, St. Jude Children's Research Hospital, Harvard Medical School and University of Wisconsin-Madison. She has been recognized for her innovative and energetic teaching style and her continual advocacy for research and education, particularly related to increased participation by women and minorities. She has served on numerous national and international committees associated with the American Society of Virology, Committee on Institutional Cooperation, World Health Organization, Association of American Universities (AAU) and Association of Public and Land-grant Universities (APLU, formerly NASULGC). She served as vice chair of the NRC Data-Based Assessment of Research Doctoral Programs Committee and she currently serves as Co-Chair for the Energy Advisory Committee for APLU and as a member of the American Council on Education (ACE) Commission for Effective Leadership. Prior to joining UH Mānoa, Dr. Hinshaw served as the provost and executive vice chancellor at the University of California Davis and as dean of the graduate school and vice chancellor for research at the University of Wisconsin–Madison.

JOAN M. LAKOSKI, Ph.D., is the associate vice chancellor for academic career development and the founding and executive director of the office of academic career development at the University of Pittsburgh Health Sciences, associate dean for postdoctoral education and professor of pharmacology at the University of Pittsburgh, School of Medicine. Dr. Lakoski received her doctoral degree from the University of Iowa, completed postdoctoral training in the Department of Psychiatry at the Yale University School of Medicine and has held faculty positions at the University of Texas Medical Branch in Galveston and the Pennsylvania State University College of Medicine, including Interim Chair of the Department of Pharmacology at Penn State. She maintains an active research program investigating the neuropharmacology of aging and impacts of mentoring, and is a member of the graduate faculty at the University of Pittsburgh and participates as a reviewer for NIH CSR study section panels. She has been the recipient of an NIH Research Career Development Award, an Independent Investigator Award from the National Alliance of Research on Schizophrenia, an Administrative Fellowship at the Pennsylvania State University and a Committee on Institutional Cooperation Academic Leadership Program Fellow. Currently, she serves as Chair of the Ethics Advisory Committee of the Endocrine Society, as a member of the AAMC Group on Faculty Affairs Program Planning and Transition Committee, as a member of the Board Development Committee for the National Postdoctoral Association, as a member of the Postdoctorate Committee for the AAMC Graduate Research and Education Training Group, as Chair of the Committing on Teaching for the International Union of Pharmacology, as a AAMC Women's Liaison Officer for the University of Pittsburgh School of Medicine and serves as Co-Director of the KL2 Clinical Research Scholars Program and Director of Mentoring and Faculty Development for the Clinical Translational Service Award at the University of Pittsburgh Schools of the Health Sciences. Her administrative responsibilities encompass oversight and development of comprehensive career development services, including mentoring programs for professional students, postdoctoral fellows, residents, clinical fellows and faculty across the health schools at the University of Pittsburgh. She remains committed to creating and shaping the future of the biomedical research community.

CAROL B. LYNCH, Ph.D., is a senior scholar at the Council of Graduate Schools, where she directs the professional master's initiatives. She is also dean emerita at the University of Colorado at Boulder where she was dean of the graduate school and vice chancellor for research from 1992 to 2004. She was professor of ecological and evolutionary biology, and is a fellow of the Institute for Behavioral Genetics. She received her B.A. from Mount Holyoke College, her M.A. from the University of Michigan, and her Ph.D. from the University of Iowa. She held a National Science Foundation Postdoctoral Fellowship in the Institute for Behavioral Genetics at the University of Colorado. Much of her professional career was spent at Wesleyan University in Middletown, Connecticut, where she served as a professor of biology and dean of the sciences. She has received a Research Career Development Award from the National Institutes of Health, is a fellow of the AAAS, and was president of the Behavior Genetics Association. Prior to coming to the University of Colorado, Dr. Lynch was the program director in population biology and physiological ecology at the NSF. She was president of the Western Association of Graduate Schools and has served on the board of directors of the Council of Graduate Schools and on the executive committee of the Council on Research Policy and Graduate Education at NASULGC (now APLU). She is currently a member of the Graduate Record Examination Board and was the chair of the TOEFL Board (Educational Testing Service, ETS). Dr. Lynch has authored numerous publications in evolutionary and behavioral genetics.

ROBERT NEREM (NAE, IOM), Ph. D., joined Georgia Tech in 1987 as the Parker H. Petit Distinguished Chair for Engineering in Medicine. He is now an Emeritus Professor and he serves as the Director of the Georgia Tech/Emory Center (GTEC) for Regenerative Medicine, a center established by an NSF Engineering Research Center award in 1998. He also is a part-time Distinguished Visiting Professor at Chonbuk National University in Korea. Until recently he served as the Director of the Parker H. Petit Institute for Bioengineering and Bioscience. He received his Ph.D. in 1964 from Ohio State University and joined the faculty there in the Department of Aeronautical and Astronautical Engineering, being promoted to Professor in 1972 and serving from 1975-1979 as Associate Dean for Research in the Graduate School. From 1979 to 1986 he was Professor and Chairman of the Department of Mechanical Engineering at the University of Houston. Professor Nerem is the author of more than 200 publications. He is a past President of the International Union for Physical and Engineering Sciences in Medicine (1991-1994) and also a past President of the International Federation for Medical and Biological Engineering (1988-91). In addition, he is a past Chairman of the U.S. National Committee on Biomechanics (1988-91), and he is a Fellow and was the founding President (1992-1994) of the American Institute of Medical and Biological Engineering (AIMBE). He is past President of the Tissue Engineering Society International (2002-2004), the forerunner of the Tissue Engineering and Regenerative Medicine International Society (TERMIS), and he was a part-time Senior Advisor for Bioengineering in the National Institute for Biomedical Imaging and Bioengineering at the National Institutes of Health (2003-2006). He is Fellow, American Association for the Advancement of Science; Fellow, Council of Arteriosclerosis, American Heart Association; Fellow, American Physical Society; and Fellow, American Society of Mechanical Engineers (ASME). He was Technical Editor of the ASME Journal of Biomechanical Engineering (1988-

1997). In 1989 he received the H.R. Lissner Award from ASME and in 2002 the Pierre Galletti Award from AIMBE. In 1988 Professor Nerem was elected to the National Academy of Engineering (NAE), and he served on the NAE Council for six years (1998 - 2004). In 1992 he was elected to the Institute of Medicine of the National Academy of Sciences and in 1998 a Fellow of the American Academy of Arts and Sciences. In 1994 he was elected a Foreign Member of the Polish Academy of Sciences and in 1998 he was made an Honorary Fellow of the Institution of Mechanical Engineers in the United Kingdom. In 2004 he was elected an honorary foreign member of the Japan Society for Medical and Biological Engineering, and in 2006 a Foreign Member of the Swedish Royal Academy of Engineering Sciences. In 2008 Professor Nerem was selected by NAE for the Founders Award. Professor Nerem holds honorary doctorates from the University of Paris, Imperial College London, and Illinois Institute of Technology. Research interests include biomechanics, cardiovascular devices, cellular engineering, vascular biology, and tissue engineering and regenerative medicine.

JOEL OPPENHEIM, Ph.D., joined the faculty of NYU School of Medicine in 1973 as an assistant professor in the department of microbiology, and was later appointed Associate Professor in 1978. He ran an NIH funded research lab for 20 years while training PhD students, medical residence and Post docs. Dr. Oppenheim also served as the Co-PI and Associate Program Director of the Department's NIH funded Infectious Diseases Training Grant. In 1994, he was appointed the Associate Dean for Graduate Studies and Director of NYU's Sackler Institute of Graduate Biomedical Sciences (the largest full-time granting PhD division of NYU's Graduate School of Arts and Science which offers graduate programs in the basic medical sciences leading to the Ph.D. and M.D./Ph.D. degrees), and was promoted in 2002 to Senior Associate Dean for Biomedical Sciences at NYU School of Medicine, a position that oversees all student research (Ph.D., M.D./Ph.D., and all summer programs) and postdoctoral training. Dr. Oppenheim presently serves on the NYU School of Medicine's M.D. and M.D./Ph.D. Admissions Committees and chair the Ph.D. Admissions Committee. While Dean, some of Dr. Oppenheim's major accomplishments include: the creation of one of the first "umbrella" structured graduate programs which offers students interdepartmental and interdisciplinary training; the initiation of an aggressive national recruitment program which has resulted in a 250 percent increase in total applicants, a 600 percent increase in U.S. applicants, a 2000 percent increase in the number of underrepresented minority applicants, and a 1800 percent increase in the number of underrepresented minority matriculates (who now make up 17 percent of graduate student population). Other accomplishments include: the initiation of teaching scientific ethics and grant writing courses at NYU School of Medicine for all graduate students, postdoctoral and clinical fellows; the creation of NYU's Postdoctoral Program, which was established to improve the quality of life and educational experience for postdoctoral fellows; and, the organization of "What Can You Be With a PhD" fairs, the largest continually running graduate and postdoctoral career fair in the country. Dr. Oppenheim was one of the initial founding members of the Leadership Alliance (1992), the AAMC GREAT Group (1994) and NYAS Science Alliance (2002). Dr. Oppenheim have served on many national advisory committees involved with graduate education, including NIH, NSF, ASM, Leadership Alliance, grant study sections (NIGMS, NSF, Sloan Foundation), as a reviewer of numerous National Research Council and National Academy of Sciences reports and as NYU's representative to the AAMC GREAT Committee. He has been an invited speaker on graduate education issues at: Leadership Alliance Summer Research Symposia; SACNAS National Meetings; NIGMS National Minority Research

Symposia (ABRCMS); the California TRIO/McNair Directors Conference; the NIH UGSP Scholars, Post baccalaureate, and NIH Academy programs; at multiple NSF meetings; and at Brown University, Cornell University, Harvard Medical School, Sloan Kettering and University of Pennsylvania.

VALERIE PETIT WILSON, Ph.D., is the associate provost and director of institutional diversity for Brown University, where she provides oversight and coordination of policies related to pluralism and equity, and initiates programs and leadership for practices that promote diversity, inclusion and fair treatment of all members of the University community. Prior to this appointment, she was the Associate Dean of the Brown University Graduate School, for Recruiting and Professional Development (2005-2009) and coordinator for the University's long-standing partnership with Tougaloo College (2004-2010). In a concurrent role, she was the Executive Director of the Leadership Alliance (2003-2010) where she led, managed and implemented the activities and programs of a 32-member, multi-university consortium dedicated to increasing the number of students of color receiving the PhD and ultimately increasing diversity in the faculty of the nation's institutions of higher learning. Throughout her tenure at Brown, she has been a Clinical Professor of Community Health, in the public health program of the Division of Biology and Medicine. Prior to her tenure at Brown University, Dr Wilson was the Deputy Director of the Center for Bioenvironmental Research at Tulane University (1998-2003) and Clinical Professor of Environmental Health at the Tulane School of Public Health and Tropical Medicine. From 1993-1997, she was the Director, Division of Health Sciences Policy, at the Institute of Medicine, National Academy of Sciences. This Board was responsible for ensuring that adequate attention is paid to the science base underlying health and health care. In earlier years, she held leadership roles in policy and program analysis in National AIDS Program Office and Office of the Assistant Secretary for Health of the US Public Health Service, and in program management and administration at the National Institutes of Health. Wilson is the recipient of awards from the Secretary of Health and Human Services, the U.S. Surgeon General, the Institute of Medicine, and mentoring awards from Tulane University, Brown University and a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring for work during her tenure as Executive Director of the Leadership Alliance. Dr. Wilson received her B.S. degree in Chemistry/Pre-Med from Xavier University of Louisiana and her Ph.D. in Molecular Biology from The Johns Hopkins University.

SCOTT L. ZEGER (IOM), Ph. D., has been Professor of Biostatistics at the Johns Hopkins Bloomberg School of Public Health since 1991 and the University's Vice Provost for Research since 2007. He served as interim provost in 2009 and chair of biostatistics from 1996 to 2007. Dr. Zeger conducts statistical research on regression analysis for correlated responses as occur in surveys, time series, longitudinal or genetics studies. He has made substantive contributions to our understanding of the effects on health of smoking and air pollution, progression of HIV, cognitive loss after cardiac surgery, normative aging and other topics. As Vice Provost for Research, Dr. Zeger represents the university in all matters related to the research and scholarship of its faculty and students. Among his major responsibilities, he chairs the Research Oversight Committee, comprising the research deans, research administration directors and key university personnel, to strategically plan the university's research infrastructure. He chairs the Institutional Compliance Oversight Committee (ICOC) that reports at each Board of Trustees meeting and assures that the university complies with all government rules and regulations. He directs the University Research Programs Administration that oversees policies, procedures and information systems relevant to research grants. Professor Zeger has been elected as a Member of the Institute of Medicine, Fellow of the American Association for the Advancement of Science and of the American Statistical Association. He has served as expert witness to the U.S. Department of Justice and several states in their civil suits against the tobacco industry and as a member of the Board of Scientific Advisors for the Merck Research Laboratory. Professor Zeger is author or co-author of 3 books and more than 170 scientific articles and book chapters. Science Watch identified Dr. Zeger as one the top 25 most cited mathematical scientists of in the 1990s. He served for 12 years as founding co-editor of the Oxford University Press journal Biostatistics and a member of the Springer-Verlag editorial board for statistics. He was awarded the 2008 Wilks Award from the American Statistical Association for contributions to statistical science, 2007 Bradford Hill Medal from the Royal Statistical Society for outstanding contributions to medical statistics, and the 2007 Marvin Zelen Award from Harvard University for leadership in the field of biostatistics. In 2006, 2002 and 1988, the Johns Hopkins Bloomberg School Student Assembly awarded Dr. Zeger with the Golden Apple for excellence in teaching.

APPENDIX B

COMMITTEE AND BOARD ROSTERS

Committee on an Assessment of Research-Doctorate Programs

Jeremiah P. Ostriker, *Chair,* Charles A. Young Professor of Astronomy and Provost Emeritus, Princeton University
Virginia S. Hinshaw, *Vice Chair,* Chancellor, University of Hawai'i at Mānoa
Elton D. Aberle, Dean Emeritus of the College of Agricultural and Life Sciences, University of Wisconsin–Madison
Norman Bradburn, Tiffany and Margaret Blake Distinguished Service Professor Emeritus, University of Chicago
John I. Brauman, J. G. Jackson–C. J. Wood Professor of Chemistry, Emeritus, Stanford University
Jonathan R. Cole, John Mitchell Mason Professor of the University, Columbia University (resigned June 2010)
Paul W. Holland, Frederic M. Lord Chair in Measurement and Statistics (retired), Educational Testing Service
Eric W. Kaler, Provost and Senior Vice President for Academic Affairs, Stony Brook University
Earl Lewis, Provost and Executive Vice President for Academic Affairs and Asa Griggs Candler Professor of History and African American Studies, Emory University
Joan F. Lorden, Provost and Vice Chancellor for Academic Affairs, University of North Carolina at Charlotte
Carol B. Lynch, Dean Emerita of the Graduate School, University of Colorado at Boulder, Senior Scholar in Residence and Director of the Professional Master's Programs, Council of Graduate Schools
Robert M. Nerem, Institute Professor and Parker H. Petit Professor Emeritus, Institute for Bioengineering and Bioscience, Georgia Institute of Technology
Suzanne Ortega, Provost and Executive Vice President for Academic Affairs, University of New Mexico
Robert J. Spinrad, Vice President (retired), Technology Strategy, Xerox Corporation (resigned January 2008; deceased September 2009)
Catharine R. Stimpson, Dean, Graduate School of Arts and Science, and University Professor, New York University
Richard P. Wheeler, Vice Provost, University of Illinois at Urbana-Champaign

Staff
Charlotte Kuh, Study Director and Deputy Executive Director, Policy and Global Affairs
Peter H. Henderson, Director, Board on Higher Education and Workforce
James A. Voytuk, Senior Program Officer
Michelle Crosby-Nagy, Research Associate

Kara Murphy, Research Associate
Rae E. Allen, Administrative Coordinator
Sabrina E. Hall, Program Associate

Data Panel for the Assessment of Research-Doctorate Programs

Norman M. Bradburn, *Chair,* Tiffany and Margaret Black Distinguished Service Professor and Provost *Emeritus*, University of Chicago
Richard Attiyeh, Vice Chancellor for Research, Dean of Graduate Studies, and Professor of Economics *Emeritus,* University of California, San Diego
Scott Bass, Provost, The American University
Julie Carpenter-Hubin, Director of Institutional Research and Planning, The Ohio State University
Janet L. Greger, Vice Provost for Strategic Planning, University of Connecticut *(retired)*
Dianne Horgan, Associate Dean of the Graduate School, University of Arizona
Marsha Kelman, Associate Vice President, Policy and Analysis, Office of the President, University of California
Karen Klomparens, Dean of the Graduate School, Michigan State University
Bernard F. Lentz, Vice Provost for Institutional Research, Drexel University
Harvey Waterman, Associate Dean for Academic Affairs, Graduate School-New Brunswick, Rutgers, The State University of New Jersey
Ami Zusman, Coordinator, Graduate Education Planning & Analysis, Office of the President, University of California *(retired)*

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Jean-Lou A. Chameau, President and Professor of Civil Engineering, Environmental Science and Engineering, & Mechanical Engineering, California Institute of Technology
Rita R. Colwell, Distinguished University Professor, University of Maryland College Park and the John Hopkins University Bloomberg School of Professional Health
Peter Ewell, Vice President, National Center for Higher Education Management Systems
Sylvia Hurtado, Professor and Director, Higher Education Research Institute, University of California, Los Angeles
William N. Kelley, Professor of Medicine, Biochemistry and Biophysics, University of Pennsylvania School of Medicine
Earl Lewis, Provost and Executive Vice President for Academic Affairs and Asa Griggs Candler Professor of History and African American Studies, Emory University
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Michelle Crosby-Nagy, Research Associate
Sabrina E. Hall, Program Associate

APPENDIX C
Definitions of Relevant Variables from the *Data-Based Assessment of Research-Doctorate Programs*

Data: Research Activity	**T: Average Number of Publications (2000-2006) per Allocated Faculty, 2006**	Data from the Thomson Reuters (formerly Institute for Scientific Information) list of publications were used to construct this variable. It is the average over seven years, 2000-2006, of the number of articles for each allocated faculty member divided by the total number of faculty allocated to the program. Data were obtained by matching faculty lists supplied by the programs to Thomson Reuters and cover publications extending back to 1981. For multi-authored articles, a publication is awarded for each author on the paper who is also on a faculty list.
	U: Average Citations per Publication	The annual average of the number of allocated citations in the years 2000-2006 to papers published during the period 1981-2006 by program faculty divided by the allocated publications that could contribute to the citations. For example, the number of allocated citations for a faculty member in 2003 is found by taking the 2003 citations to that faculty member's publications between 1981 and 2003. These counts are summed over the total faculty in the program and divided by the sum of the allocated publications to the program in 2003.
	V: Percent of Faculty with Grants, 2006	The faculty questionnaire asks whether a faculty member's work is currently supported by an extramural grant or contract. The total of faculty who answered affirmatively was divided by the total respondents in the program and the percentage was calculated.
Data: Student Support & Outcomes	**X: Percent of First Year Students with Full Financial Support, Fall 2005**	For each program, question E8 reported the type of support that full-time graduate students received during the fall term each year of enrollment. For this variable the data for the first year were added for all types of support and divided by the total number of students.
	Y: Avg. Completion Percentage: 6 Years or Less	Questions C16 and C17 reported for males and females separately the number of graduate students who entered in different cohorts from 1996-1997 to 2005-2006 and the number in each cohort who completed in 3 years or less, in their 4th, 5th, 6th, 7th, 8th, 9th years, and in 10 or more years. To compute the completion percentage, the number of doctoral students for a given entering cohort who completed their doctorate in 3 years or less and in their 4th, 5th, 6th years were totaled and the total was divided by the entering students in that cohort. This computation was made for each cohort that entered from 1996-1997 to 2000-2001. Cohorts beyond these years were not considered, since the students could complete in a year that was after the final year 2005-2006 for which data were collected. To compute the average completion percentage, an average was taken over 5 cohorts.
	Z: Median Time to Degree (Full- and Part-time Graduates), 2006	Question C2 reported the median time to degree for full-time and part-time students. That reported number was used for this variable. The median was calculated from graduates who received doctoral degrees in the period 2003-2004 through 2005-2006. A negative coefficient means that shorter times are valued.

Data: Diversity	**AC: Non-Asian Minority Faculty as a Percent of Total Core and New Domestic Faculty, 2006**	For each program the data reported for question B7, the race/ethnicity of core and new faculty in the program, was used to compute the ratio of non-Hispanic Blacks, Hispanic, and American Indians or Alaska Natives to that of all faculty with known race/ethnicity. "Core" faculty are those whose primary appointment is in the doctoral program. "New" faculty are those with tenure track appointments who were appointed in 2003-2006. Unknowns were excluded from the ratio, as were faculty who were neither American citizens nor permanent residents.
	AD: Female Faculty as a Percent of Total Core and New Faculty, 2006	For each program the data reported for question B5, the gender of core and new faculty in the program, were used to compute the ratio of core or new female faculty to the total of core and new faculty. Allocations were not used in the construction of this variable.
	AE: Non-Asian Minority Students as a Percent of Total Domestic Students, Fall 2005	Question C9c reported the race/ethnicity of graduate students in the program. This was used to compute the ratio of non-Hispanic Blacks, Hispanics, and American Indians or Alaska Natives to that of the total of students with known race/ethnicity. Respondents with Race/Ethnicity Unknown where excluded from the ratio, as were international students.
	AF: Female Students as a Percent of Total Students, Fall 2005	Question C9 reported the gender of graduate students in the program. This was used to compute the percentage by taking the number of female graduate students divided by the total number of graduate students.
	AG: International Students as a Percent of Total Students, Fall 2005	Question C9b reported the citizenship of graduate students in the program. These data were used to compute the percentage of international graduate students by taking the number with temporary visas and dividing it by the number of graduate students with known citizenship status.
Data: Other Overall Ranking Measures	**AH: Average Number PhDs Graduated, 2002-2006**	Question C1 reported the number of doctoral degrees awarded each academic year from 2001-2002 to 2005-2006. The average of these numbers was used for this variable. If no data were provided for a particular year, the average was taken over the years for which there were data.
	AJ: Average GRE Scores, 2004-2006	For each program, question D4 reported the average GRE verbal and quantitative scores for the 2003-2004, 2004-2005, and 2005-2006 academic years and the number of individuals who reported their scores. A weighted average was used to compute the average GRE, which was calculated by multiplying the number of individuals reporting scores by the reported average GRE score for each year, adding these three quantities and dividing by the sum of the individuals reporting scores.

	AK: Percent of First-Year Students with External Fellowships, 2005	For each program question E8 reported the type of support full-time graduate students received during fall term each year of enrollment. For this variable the data for the first year were added for support by externally funded fellowships and combinations of external fellowships and other internal support and then divided by the total number of students.
	AL: Is Student Work Space Provided? (1=Yes; -1=No)	Data from the program questionnaire were used for this variable. Question D12 reported the percentage of graduate students who have work space for their exclusive use. If reported percentage was 100 percent, then a value of 1 was given to this variable. Otherwise the value was -1.
	AM: Is Health Insurance Provided? (1=Yes; -1=No)	Data from the institutional questionnaire were used for this variable. Question A1 reported whether or not the institution provided health care insurance for its graduate students. If the response to this question was yes, then a value of 1 was given to this variable. If it was no, then the value was -1.
	AN: Number of Student Activities (Max=18)	Question D8 listed 18 different kinds of support activities for doctoral students or doctoral education. This variable is a count of the number of student support activities provided by the program or the institution.
Data Not Used in Ranking	**AO: Total Faculty, 2006**	Questions B1 and B2, total responses.
	AP: Number of Allocated Faculty, 2006	Calculated as the number of program faculty corrected for association with multiple programs. For more detail on how these data were calculated, refer to footnote 46 in *A Data-Based Assessment of Research-Doctorate Programs in the United States* (2010), Chapter 3, “Study Design.”
	AS: Number of Core and New Faculty, 2006	Total number of core and new faculty.
	AT: Number of Students Enrolled, Fall 2005	Question C9 reported the total number of students enrolled in the fall of 2005.
	AU: Average Annual First Year Enrollment, 2002-2006	Question C3 reflects the number of first-time enrolled for 2001-2002, 2002-2003, 2003-2004, 2004-2005, and 2005-2006. An average was taken over 5 years.
	AV: Percent of Students with Research Assistantships, Fall 2005	Question E8 reported the number of students who received support as a research assistant in the fall of 2005. A percentage was calculated over the total number of students.

	AW: Percent of Students with Teaching Assistantships, Fall 2005	Question E8 reported the number of students who received support as a teaching assistant in the fall of 2005. A percentage was calculated over the total number of students.
	AX: Percent of First Year Students with Institutional Fellowships Alone	Question E8 reported the number of first year students who received support from an institutional fellowship in the fall of 2005. A percentage was calculated over the total number of first year students.
	AY: Percent of First Year Students with a Combination of Fellowships and Traineeships	Question E8 reported the number of first year students who received support from a fellowship or from a traineeship. These quantities were added together and the percentage that this was of total first year students was calculated.
	AZ: Percent of First Year Students with Both Internal Fellowships and Internal Assistantships	Question E8 reported the number of first year students who received support from an internal fellowship or from a traineeship. These quantities were added together and the percentage that this was of total first year students was calculated.
	BA: Percent of First Year Students with Multiple Internal Assistantships	Question E8 reported the number of first year students who received support from more than one internal fellowship. The percentage that this was of total first year students was calculated.
Student Activities	**BB through BT**	Question D8 reports whether the institution and/or program provides support for doctoral students or doctoral education. Key: 1= provided for by institution; 2= program support only; 3= both institutional and program support; 4= neither institutional nor program support

Note: This table is taken from the Guide in the Excel table for the Assessment of Research-Doctorate Programs, www.nap.edu/rdp. The letters listed correspond to column labels for that table.

APPENDIX D

Correlations in the Biomedical Sciences

(Correlations greater than or equal to |0.3| are highlighted)

Biochemistry, Biophysics and Structural Biology Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.449	1										
Percent Fac With Grants	0.494	0.365	1									
Percent Non-Asian Minority Core or New	-0.259	-0.190	-0.343	1								
Percent Female Core or New	-0.141	-0.115	0.032	0.065	1							
Awards per fac	0.593	0.582	0.199	-0.146	-0.047	1						
GRE Average	0.434	0.317	0.218	-0.086	-0.126	0.417	1					
Percent Non-Asian Minority Students	-0.162	-0.115	-0.357	0.489	-0.020	-0.138	-0.126	1				
Percent Female Students	-0.290	-0.154	-0.114	0.130	0.170	-0.245	-0.260	0.208	1			
Average PhDs 2002 to 2006	0.312	0.218	0.149	-0.046	-0.076	0.283	0.216	-0.061	-0.034	1		
Average cohort complete	0.123	0.089	0.094	-0.096	-0.099	0.041	0.094	-0.183	-0.089	0.046	1	
Time to Degree Full and Part Time	0.052	0.166	0.077	0.090	-0.009	0.082	0.114	0.070	-0.084	0.140	-0.375	1

Biomedical Engineering and Bioengineering Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.573	1										
Percent Fac With Grants	0.429	0.229	1									
Percent Non-Asian Minority Core or New	-0.226	-0.119	-0.266	1								
Percent Female Core or New	-0.095	0.028	0.065	0.075	1							
Awards per fac	0.658	0.276	0.199	-0.071	-0.093	1						
GRE Average	0.358	0.307	0.056	-0.006	-0.336	0.212	1					
Percent Non-Asian Minority Students	-0.006	-0.003	0.088	0.076	-0.045	0.001	-0.113	1				
Percent Female Students	0.047	0.191	-0.131	0.066	0.118	-0.053	0.031	-0.151	1			
Average PhDs 2002 to 2006	0.403	0.302	0.222	-0.138	-0.041	0.090	0.324	-0.085	0.018	1		
Average cohort complete	-0.184	0.015	0.148	0.019	-0.080	-0.269	0.080	-0.031	0.073	-0.011	1	
Time to Degree Full and Part Time	0.185	0.369	0.018	-0.210	0.073	0.013	0.251	-0.139	0.123	0.491	-0.134	1

Cell and Developmental Biology Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.394	1										
Percent Fac With Grants	0.435	0.324	1									
Percent Non-Asian Minority Core or New	-0.005	-0.068	-0.038	1								
Percent Female Core or New	-0.143	0.019	0.075	0.213	1							
Awards per fac	0.467	0.417	0.199	-0.101	-0.054	1						
GRE Average	0.344	0.426	0.202	0.010	0.005	0.294	1					
Percent Non-Asian Minority Students	0.129	0.043	0.002	0.247	-0.012	-0.004	0.056	1				
Percent Female Students	0.048	-0.019	0.029	0.014	0.004	-0.043	-0.037	-0.040	1			
Average PhDs 2002 to 2006	0.371	0.390	0.184	-0.007	-0.098	0.266	0.301	0.006	-0.010	1		
Average cohort complete	0.087	0.057	-0.041	0.055	-0.089	-0.142	-0.022	0.120	0.173	-0.022	1	
Time to Degree Full and Part Time	0.014	0.128	0.081	-0.047	0.135	0.197	0.093	-0.130	-0.055	0.074	-0.383	1

Genetics and Genomics Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.484	1										
Percent Fac With Grants	0.362	0.372	1									
Percent Non-Asian Minority Core or New	-0.068	-0.279	-0.180	1								
Percent Female Core or New	0.050	-0.055	-0.004	-0.089	1							
Awards per fac	0.540	0.630	0.150	-0.200	0.074	1						
GRE Average	0.490	0.395	0.248	0.030	-0.140	0.356	1					
Percent Non-Asian Minority Students	-0.060	-0.120	0.170	0.290	-0.116	0.039	-0.014	1				
Percent Female Students	0.014	-0.097	-0.110	-0.073	0.109	-0.078	-0.187	-0.039	1			
Average PhDs 2002 to 2006	0.341	0.379	0.225	-0.022	0.036	0.333	0.292	0.034	-0.022	1		
Average cohort complete	0.229	-0.020	0.149	-0.121	0.034	-0.067	-0.108	0.079	0.141	0.235	1	
Time to Degree Full and Part Time	0.181	0.364	0.230	-0.181	0.000	0.251	0.179	-0.194	-0.036	0.074	-0.451	1

Immunology and Infectious Disease Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.495	1										
Percent Fac With Grants	0.289	0.477	1									
Percent Non-Asian Minority Core or New	-0.183	-0.226	-0.047	1								
Percent Female Core or New	-0.173	-0.317	-0.076	0.232	1							
Awards per fac	0.481	0.474	0.157	-0.066	-0.161	1						
GRE Average	0.366	0.252	0.135	0.092	-0.064	0.223	1					
Percent Non-Asian Minority Students	-0.049	-0.238	-0.116	0.150	0.131	-0.012	-0.133	1				
Percent Female Students	-0.142	-0.084	-0.073	0.054	0.014	0.101	-0.153	0.073	1			
Average PhDs 2002 to 2006	0.249	0.154	0.259	-0.148	-0.092	0.177	0.102	-0.034	-0.085	1		
Average cohort complete	-0.067	-0.050	-0.020	-0.167	0.093	-0.029	-0.216	-0.115	-0.088	0.051	1	
Time to Degree Full and Part Time	0.179	0.327	0.189	-0.416	0.057	0.210	0.033	-0.207	0.033	0.050	-0.071	1

Integrated Biological and Biomedical Sciences Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.473	1										
Percent Fac With Grants	0.579	0.335	1									
Percent Non-Asian Minority Core or New	-0.131	-0.074	-0.081	1								
Percent Female Core or New	-0.130	-0.064	-0.104	-0.006	1							
Awards per fac	0.520	0.485	0.334	-0.123	-0.104	1						
GRE Average	0.481	0.474	0.248	-0.015	-0.104	0.412	1					
Percent Non-Asian Minority Students	0.086	-0.041	0.048	0.529	-0.035	-0.020	-0.088	1				
Percent Female Students	-0.016	-0.025	-0.051	0.035	0.227	-0.040	-0.186	0.017	1			
Average PhDs 2002 to 2006	0.457	0.356	0.415	0.027	-0.099	0.457	0.334	0.088	-0.005	1		
Average cohort complete	0.056	0.021	0.014	-0.229	0.021	-0.045	-0.181	-0.075	-0.050	-0.033	1	
Time to Degree Full and Part Time	-0.120	0.058	0.040	-0.139	0.116	0.166	0.111	-0.180	0.027	0.145	-0.362	1

Microbiology Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.412	1										
Percent Fac With Grants	0.537	0.306	1									
Percent Non-Asian Minority Core or New	-0.174	-0.012	-0.329	1								
Percent Female Core or New	-0.169	-0.088	-0.084	0.166	1							
Awards per fac	0.544	0.370	0.331	-0.109	-0.042	1						
GRE Average	0.585	0.530	0.534	-0.393	-0.138	0.396	1					
Percent Non-Asian Minority Students	-0.032	0.108	-0.166	0.765	0.259	-0.010	-0.235	1				
Percent Female Students	-0.156	0.003	-0.164	0.006	0.233	0.045	-0.070	0.095	1			
Average PhDs 2002 to 2006	0.127	0.184	0.404	-0.180	0.242	0.068	0.271	0.032	-0.062	1		
Average cohort complete	-0.072	-0.087	-0.201	-0.158	0.016	-0.202	-0.075	-0.194	-0.135	-0.089	1	
Time to Degree Full and Part Time	0.232	0.289	0.302	-0.094	0.079	0.264	0.319	0.040	0.137	0.270	-0.493	1

Neuroscience and Neurobiology Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.508	1										
Percent Fac With Grants	0.434	0.536	1									
Percent Non-Asian Minority Core or New	0.210	0.055	0.074	1								
Percent Female Core or New	-0.134	-0.207	0.060	-0.040	1							
Awards per fac	0.484	0.510	0.225	0.048	-0.285	1						
GRE Average	0.369	0.533	0.228	0.057	-0.385	0.507	1					
Percent Non-Asian Minority Students	0.147	0.249	0.225	-0.002	0.068	0.114	0.118	1				
Percent Female Students	-0.111	-0.271	-0.065	0.162	0.204	-0.186	-0.334	-0.123	1			
Average PhDs 2002 to 2006	0.501	0.51	0.358	-0.017	-0.157	0.286	0.448	0.108	-0.171	1		
Average cohort complete	0.036	0.046	-0.030	-0.175	0.110	0.018	0.007	-0.035	-0.020	0.076	1	
Time to Degree Full and Part Time	0.059	0.210	0.169	0.119	-0.346	0.175	0.156	0.006	-0.076	0.150	-0.464	1

Nutrition Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.406	1										
Percent Fac With Grants	0.451	0.337	1									
Percent Non-Asian Minority Core or New	-0.357	-0.182	0.010	1								
Percent Female Core or New	-0.400	-0.142	-0.093	0.123	1							
Awards per fac	0.478	0.002	0.043	-0.204	-0.32	1						
GRE Average	0.501	0.222	0.012	-0.038	-0.309	0.347	1					
Percent Non-Asian Minority Students	-0.314	-0.104	0.135	0.531	0.220	-0.173	-0.222	1				
Percent Female Students	-0.042	0.214	0.023	-0.060	0.288	-0.070	0.058	0.145	1			
Average PhDs 2002 to 2006	0.579	0.208	0.330	-0.128	-0.232	0.228	0.247	-0.101	-0.077	1		
Average cohort complete	-0.037	0.085	-0.095	-0.088	-0.067	0.021	-0.055	-0.319	-0.132	-0.106	1	
Time to Degree Full and Part Time	0.475	0.216	0.202	-0.136	0.007	0.279	0.487	-0.110	0.104	0.309	-0.165	1

Pharmacology, Toxicology and Environmental Health Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.298	1										
Percent Fac With Grants	0.200	0.332	1									
Percent Non-Asian Minority Core or New	-0.117	-0.070	-0.123	1								
Percent Female Core or New	-0.063	-0.037	0.136	0.001	1							
Awards per fac	0.205	0.427	0.058	-0.008	-0.002	1						
GRE Average	0.190	0.280	-0.017	0.057	0.084	0.240	1					
Percent Non-Asian Minority Students	-0.065	-0.076	-0.183	0.370	0.028	0.027	-0.070	1				
Percent Female Students	0.133	0.082	0.235	0.129	0.187	0.041	-0.127	0.221	1			
Average PhDs 2002 to 2006	0.159	0.089	-0.048	-0.077	-0.053	0.074	0.219	0.029	0.040	1		
Average cohort complete	0.136	-0.095	0.117	-0.366	-0.074	-0.115	-0.058	-0.051	-0.057	0.103	1	
Time to Degree Full and Part Time	-0.010	0.290	0.058	0.154	0.099	0.174	0.179	-0.102	0.138	0.038	-0.260	1

Physiology Correlations

	Average Pubs per Fac	Average Cits/Pubs	Percent Fac With Grants	Percent Non-Asian Minority Core or New	Percent Female Core or New	Awards per fac	GRE Average	Percent Non-Asian Minority Students	Percent Female Students	Average PhDs 2002 to 2006	Average cohort complete	Time to Degree Full and Part Time
Average Pubs per Fac	1											
Average Cits/Pubs	0.328	1										
Percent Fac With Grants	0.518	0.323	1									
Percent Non-Asian Minority Core or New	-0.086	-0.233	-0.130	1								
Percent Female Core or New	-0.016	0.161	0.081	-0.129	1							
Awards per fac	0.262	0.383	0.195	-0.047	0.078	1						
GRE Average	0.204	0.210	0.171	-0.453	0.134	0.297	1					
Percent Non-Asian Minority Students	0.000	-0.266	0.042	0.570	0.046	-0.044	-0.384	1				
Percent Female Students	-0.062	-0.036	0.016	0.057	0.086	-0.049	0.129	-0.125	1			
Average PhDs 2002 to 2006	0.256	-0.052	0.379	-0.252	0.023	0.049	0.166	-0.056	-0.071	1		
Average cohort complete	0.275	-0.105	0.409	-0.131	-0.039	-0.140	0.261	-0.028	0.009	0.295	1	
Time to Degree Full and Part Time	0.272	0.457	0.322	-0.035	0.172	0.423	0.223	-0.009	0.041	0.192	-0.179	1

APPENDIX E

Biomedical Sciences Field Averages for Each Variable

Field	Number of Programs	Average of Average Number of Publications (2000-2006) per Allocated Faculty, 2006	Average Citations per Publication	Percent of Faculty with Grants, 2006	Awards per Allocated Faculty Member, 2006	Percent of First Year Students with Full Financial Support, Fall 2005
Biochemistry, Biophysics, and Structural Biology	157	1.83	3.79	84.6%	3.30	95.8%
Standard deviation		0.80	1.53	15.2%	5.23	15.4%
Biomedical Engineering and Bioengineering	74	1.56	2.62	84.4%	0.68	85.8%
Standard deviation		0.87	1.07	17.0%	1.62	24.1%
Cell and Developmental Biology	120	1.67	4.36	86.3%	1.40	97.8%
Standard deviation		0.74	1.95	13.6%	2.33	10.1%
Genetics and Genomics	66	1.73	4.62	86.4%	1.46	93.5%
Standard deviation		0.71	2.02	14.8%	2.16	20.0%
Immunology and Infectious Disease	68	1.92	4.12	89.3%	0.78	96.7%
Standard deviation		0.81	1.51	12.8%	1.57	11.8%
Integrated Biological and Biomedical Sciences	113	1.32	3.45	76.5%	0.89	97.2%
Standard deviation		0.73	1.91	17.8%	1.87	9.0%
Microbiology	71	1.43	3.49	82.9%	1.03	97.6%
Standard deviation		0.64	1.49	15.2%	1.44	8.7%
Neuroscience and Neurobiology	93	1.66	3.87	86.0%	1.13	95.6%
Standard deviation		0.60	1.58	14.7%	1.84	15.6%
Nutrition	45	1.32	2.36	75.0%	0.51	88.6%
Standard deviation		0.68	1.04	18.8%	0.67	25.9%
Pharmacology, Toxicology and Environmental Health	117	1.90	2.95	84.7%	0.53	93.9%
Standard deviation		0.74	1.37	15.3%	0.97	18.8%
Physiology	58	1.57	2.94	82.1%	0.54	93.3%
Standard deviation		0.58	1.03	17.0%	0.87	18.7%

Field	Avg. Completion Percentage: 6 Years or less	Median Time to Degree (Full- and Part-Time Graduates), 2006	Percent with Academic Plans	Collects Data About Post-Graduation Employment (1=Yes; -1 No)
Biochemistry, Biophysics, and Structural Biology	45.9%	5.63	69.4%	0.39
Standard deviation	15.8%	0.70	14.1%	0.92
Biomedical Engineering and Bioengineering	46.3%	5.06	57.4%	0.62
Standard deviation	21.2%	0.69	18.7%	0.79
Cell and Developmental Biology	50.1%	5.66	71.8%	0.65
Standard deviation	19.5%	0.72	14.5%	0.76
Genetics and Genomics	41.6%	5.73	67.1%	0.67
Standard deviation	18.6%	0.82	20.6%	0.75
Immunology and Infectious Disease	56.2%	5.36	69.5%	0.65
Standard deviation	17.5%	0.84	15.4%	0.77
Integrated Biological and Biomedical Sciences	47.4%	5.62	74.8%	0.45
Standard deviation	20.4%	0.80	11.1%	0.90
Microbiology	47.1%	5.58	66.8%	0.46
Standard deviation	18.7%	0.80	19.6%	0.89
Neuroscience and Neurobiology	46.2%	5.68	80.6%	0.74
Standard deviation	17.0%	0.66	12.1%	0.67
Nutrition	55.8%	4.88	58.5%	0.56
Standard deviation	19.9%	1.00	18.7%	0.84
Pharmacology, Toxicology and Environmental Health	56.1%	5.21	55.0%	0.66
Standard deviation	18.0%	0.81	19.8%	0.76
Physiology	50.9%	5.13	76.6%	0.38
Standard deviation	23.0%	0.94	15.5%	0.93

Field	Non-Asian Minority Faculty as a Percent of Total Core and New Domestic Faculty, 2006	Female Faculty as a Percent of Total Core and New Faculty, 2006	Non-Asian Minority Students as a Percent of Total Domestic Students, Fall 2005	Female Students as a Percent of Total Students, Fall 2005	International Students as a Percent of Total Students, Fall 2005
Biochemistry, Biophysics, and Structural Biology	3.5%	23.3%	10.5%	46.3%	37.4%
Standard deviation	6.6%	11.2%	11.7%	13.4%	21.2%
Biomedical Engineering and Bioengineering	3.6%	15.2%	11.3%	35.4%	41.1%
Standard deviation	4.5%	10.0%	10.3%	10.6%	19.5%
Cell and Developmental Biology	2.8%	26.7%	10.9%	53.3%	32.1%
Standard deviation	3.4%	8.8%	9.8%	11.2%	20.1%
Genetics and Genomics	3.7%	26.8%	11.6%	55.7%	29.3%
Standard deviation	6.4%	9.0%	14.2%	11.8%	17.5%
Immunology and Infectious Disease	4.0%	25.1%	13.7%	56.3%	25.7%
Standard deviation	5.5%	12.3%	10.9%	10.7%	16.2%
Integrated Biological and Biomedical Sciences	4.0%	26.3%	9.8%	51.9%	29.2%
Standard deviation	5.5%	12.3%	12.1%	10.9%	16.7%
Microbiology	4.6%	25.0%	12.5%	58.1%	25.0%
Standard deviation	10.6%	10.4%	13.6%	10.2%	16.4%
Neuroscience and Neurobiology	2.8%	25.8%	11.1%	51.5%	23.8%
Standard deviation	3.7%	11.6%	7.9%	11.9%	16.5%
Nutrition	7.1%	50.2%	15.2%	77.0%	37.4%
Standard deviation	9.7%	18.2%	19.9%	13.3%	16.7%
Pharmacology, Toxicology and Environmental Health	3.7%	21.8%	13.7%	52.9%	37.6%
Standard deviation	7.7%	9.3%	13.6%	11.6%	22.7%
Physiology	4.8%	21.1%	13.7%	53.6%	32.7%
Standard deviation	8.4%	9.5%	17.6%	15.1%	18.3%

Field	Average Number of Ph.D.s Graduated, 2002-2006	Percent of Interdisciplinary Faculty, 2006	Average GRE Scores, 2004-2006	Percent of First Year Students with External Fellowships, 2005	Is Student Work Space Provided? (1=Yes; -1 No)
Biochemistry, Biophysics, and Structural Biology	4.99	27.9%	714	15.1%	0.68
Standard deviation	3.18	24.1%	44	28.4%	0.73
Biomedical Engineering and Bioengineering	4.77	37.2%	755	14.8%	0.49
Standard deviation	4.02	25.4%	31	22.5%	0.88
Cell and Developmental Biology	5.28	25.5%	702	16.7%	0.68
Standard deviation	5.17	21.5%	39	27.5%	0.73
Genetics and Genomics	4.55	28.4%	709	18.6%	0.76
Standard deviation	2.77	25.8%	49	30.1%	0.66
Immunology and Infectious Disease	4.33	23.5%	697	26.7%	0.44
Standard deviation	2.36	21.6%	37	35.3%	0.90
Integrated Biological and Biomedical Sciences	6.53	21.4%	682	15.1%	0.59
Standard deviation	5.63	21.9%	50	26.7%	0.81
Microbiology	4.61	28.2%	677	13.8%	0.66
Standard deviation	2.88	22.8%	46	25.8%	0.75
Neuroscience and Neurobiology	4.73	23.2%	705	25.9%	0.57
Standard deviation	2.86	22.8%	45	32.9%	0.83
Nutrition	3.28	28.9%	652	10.4%	0.60
Standard deviation	2.24	23.8%	71	24.6%	0.81
Pharmacology, Toxicology and Environmental Health	4.48	27.3%	699	13.4%	0.69
Standard deviation	2.79	23.2%	41	24.8%	0.72
Physiology	3.19	25.4%	682	16.0%	0.76
Standard deviation	1.51	21.4%	56	32.0%	0.66

Field	Is Health Insurance Provided? (1=Yes; -1 No)	Number of Student Activities (Max=18)	Total Faculty, 2006	Number of Allocated Faculty, 2006	Assistant Professors as a Percent of Total Faculty, 2006	Tenured Faculty as a Percent of Total Faculty, 2006
Biochemistry, Biophysics, and Structural Biology	0.71	16	39.03	19.00	18.3%	69.2%
Standard deviation	0.71	2	23.48	11.00	11.5%	16.5%
Biomedical Engineering and Bioengineering	0.73	16	43.61	22.37	20.4%	64.5%
Standard deviation	0.69	2	31.03	14.20	10.9%	14.2%
Cell and Developmental Biology	0.87	17	52.28	26.96	19.7%	67.7%
Standard deviation	0.50	2	40.59	23.42	8.9%	14.7%
Genetics and Genomics	0.85	16	47.12	19.30	19.1%	65.6%
Standard deviation	0.53	3	30.59	10.58	9.5%	13.9%
Immunology and Infectious Disease	0.85	17	39.40	24.06	20.1%	58.0%
Standard deviation	0.53	2	18.90	11.43	9.8%	19.2%
Integrated Biological and Biomedical Sciences	0.61	16	54.35	35.41	16.6%	64.9%
Standard deviation	0.80	2	47.49	28.53	9.3%	18.2%
Microbiology	0.75	16	37.70	19.90	18.6%	67.1%
Standard deviation	0.67	2	24.48	11.77	11.2%	17.2%
Neuroscience and Neurobiology	0.85	17	48.96	27.32	17.7%	66.9%
Standard deviation	0.53	2	25.98	15.59	8.9%	17.4%
Nutrition	0.73	17	28.93	16.73	14.7%	66.0%
Standard deviation	0.69	1	18.73	10.97	9.7%	20.0%
Pharmacology, Toxicology and Environmental Health	0.79	16	32.32	18.86	16.3%	66.4%
Standard deviation	0.61	2	19.84	11.39	8.6%	14.0%
Physiology	0.76	16	33.57	19.13	13.4%	68.6%
Standard deviation	0.66	3	19.10	9.11	7.7%	15.3%

Field	Number of Core and New Faculty, 2006	Number of Students Enrolled, Fall 2005	Average Annual First Year Enrollment, 2002-2006	Percent of Students with Research Assistantships, Fall 2005	Percent of Students with Teaching Assistantships, Fall 2005
Biochemistry, Biophysics, and Structural Biology	26.30	41.27	9.13	39.3%	10.1%
Standard deviation	16.66	27.29	8.58	31.3%	18.8%
Biomedical Engineering and Bioengineering	25.28	59.88	11.79	46.0%	7.6%
Standard deviation	20.05	53.69	8.61	24.8%	13.0%
Cell and Developmental Biology	38.39	46.43	12.61	40.0%	8.2%
Standard deviation	34.62	42.48	16.11	30.2%	15.4%
Genetics and Genomics	32.05	41.32	9.59	42.3%	7.7%
Standard deviation	22.77	29.40	11.72	30.6%	16.3%
Immunology and Infectious Disease	28.59	33.16	10.25	32.1%	2.0%
Standard deviation	14.63	17.54	15.39	31.1%	7.8%
Integrated Biological and Biomedical Sciences	40.07	59.30	12.33	28.0%	28.3%
Standard deviation	35.53	52.11	12.01	25.1%	29.8%
Microbiology	25.65	37.85	9.70	42.6%	14.1%
Standard deviation	19.56	24.09	12.15	31.4%	22.9%
Neuroscience and Neurobiology	37.70	43.24	9.54	30.7%	6.2%
Standard deviation	23.85	26.00	10.16	27.5%	15.2%
Nutrition	19.20	22.02	5.03	41.8%	9.3%
Standard deviation	14.09	20.36	3.73	31.7%	16.9%
Pharmacology, Toxicology and Environmental Health	22.16	31.87	7.31	41.8%	9.7%
Standard deviation	13.81	19.58	6.45	30.2%	18.3%
Physiology	23.09	22.43	6.12	35.0%	6.7%
Standard deviation	12.20	11.40	11.13	31.0%	19.0%

Field	Percent of First Year Students with Institutional Fellowships Alone	Percent of First Year Students with a Combination of Fellowships and Traineeships	Percent of First Year Students with Both Internal Fellowships and Internal Assistantships	Percent of First Year Students with Multiple Internal Assistantships
Biochemistry, Biophysics, and Structural Biology	28.8%	12.7%	6.4%	2.9%
Standard deviation	40.1%	27.7%	19.2%	14.3%
Biomedical Engineering and Bioengineering	21.1%	11.2%	5.6%	1.6%
Standard deviation	29.2%	22.2%	14.0%	5.4%
Cell and Developmental Biology	28.1%	15.3%	9.5%	2.3%
Standard deviation	37.1%	27.6%	24.8%	10.2%
Genetics and Genomics	37.0%	17.0%	3.9%	3.6%
Standard deviation	39.7%	30.2%	17.5%	15.5%
Immunology and Infectious Disease	30.8%	20.8%	4.7%	0.0%
Standard deviation	39.8%	34.4%	17.3%	0.0%
Integrated Biological and Biomedical Sciences	17.8%	11.9%	7.5%	4.2%
Standard deviation	29.9%	25.0%	18.6%	15.4%
Microbiology	22.4%	11.1%	4.2%	5.1%
Standard deviation	33.0%	26.1%	12.8%	19.0%
Neuroscience and Neurobiology	37.7%	22.9%	5.5%	1.2%
Standard deviation	36.6%	32.8%	16.1%	7.1%
Nutrition	14.6%	4.9%	5.3%	5.4%
Standard deviation	22.9%	14.8%	16.7%	17.9%
Pharmacology, Toxicology and Environmental Health	22.3%	10.3%	10.2%	0.5%
Standard deviation	34.1%	24.3%	26.2%	3.8%
Physiology	26.6%	12.5%	8.9%	3.7%
Standard deviation	40.3%	29.2%	24.2%	16.0%