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**SUBJECT:** NSF Postdoc Data Project: Literature Review Summary

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## **Introduction**

The literature review was conducted in support of the Postdoc Data Project. It is a useful first step in the assessment of user needs for postdoc data. The documents reviewed furnish information on a number of important questions.

- Current Issues – What are the current postdoc policy and research issues?
- Issue Trends – Have postdoc policy and research issues changed over time?
- Uses of Data – What data have been used to furnish information on postdocs?
- Data Needs – What additional data are needed to address postdoc policy and research questions?

It is important to recognize that the literature review cannot replace a comprehensive user needs assessment. While the documents reviewed furnish information on the breadth of postdoc policy and research issues, only a few of the documents address issues of the prioritization of postdoc information needs.

### *Westat Literature Review*

Westat completed the first round of the literature review. In that round, the reviewers examined 110 sources, prepared an abstract for each, and coded a series of data fields that characterized the document. The database recorded whether a document addressed one or more of fifteen key topics and, within those topics, one of 74 questions of interest.

The literature review data are stored in an Access database. The database allows one to search the documents by title, author, item type, topic, key question, and other important aspects of the document. In addition, if a document referenced a survey, information also was entered about the referenced survey.

The literature review has several limitations. First, there are a number of important postdoc references that are not included. Second, coding each document with respect to the presence of information for any of 15 topics and 74 key questions may have been an insurmountable task. There are a number of topics and key questions that are not coded as being addressed by any document in the database, even though our subsequent review suggests that a number of documents in the database do address those topics. Third, the database did not explicitly assess the type of data referenced by a document nor the type of information that the author(s) suggested would be needed to furnish better information on postdocs.

Our review of the database suggests that it could be a powerful tool to help characterize user needs for postdoc data. However, the database would need a number of changes to meet those goals, including: expansion of the documents covered, improvements to the database functionality, and improvements in the coding of topic and key questions.

### *APPRISE Literature Review Update*

We conducted a literature review in support of the postdoc data project options task. We reviewed 233 documents, including the 110 documents in the Westat database. We explicitly reviewed each document to assess the kinds of data that it used and the kinds of data that it reported as being needed. We transferred the data to an EXCEL spreadsheet that allowed us to enter additional fields, and to search and sort the database in ways that were not programmed into the ACCESS database.

### *Presentation of Literature Review Findings*

Among the 233 documents reviewed, we identified 29 key documents that are particularly important for understanding postdoc policy and research issues, and for identifying what data can be used or would be needed to answer key policy and research questions. These documents include: reports from workshops or commissions that directly or indirectly examined postdoc issues; reports from major research studies that collected and analyzed information on postdocs; and, reports on projects that used existing data to investigate postdoc issues. These sources are summarized in the “key documents” section of this memo.

The literature review also contains valuable information from journal and periodical articles in which an author comments on issues related to postdocs. In the “postdoc commentary” section of this memo, we identify the sources of these documents, furnish an overview of the major postdoc issues raised, and outline the type of information that are available or are needed to address each issue.

### **Key Documents**

The key documents were developed by government agencies and commissions, nonprofit and academic organizations, and researchers. In this section, we present the series of workshops and reports developed by each organization. For each

organization, we find that the series of documents that were reviewed furnish a comprehensive understanding of the organization's policy and research agenda as it relates to postdocs.

### *Government Agencies and Commissions*

A number of government agencies and commissions have extensively considered postdoc issues. The National Science Board (NSB), National Science Foundation (NSF), the Committee on Science, Engineering and Public Policy (COSEPUP), and government commissions have examined information on both postdoc issues and the broader issues of the science and engineering workforce. These documents are listed and summarized below.

NSB and NSF publications in the literature review describe the findings from meetings, workshops, and reports that discuss the role of the federal government and NSF in the support of postdocs.

1. *NSB Task Force on Graduate and Postdoctoral Education, 1996* – This report made recommendations on the study of alternative modes of graduate support, with discussion of, but less emphasis on potential changes in postdoc support.
2. *Building Diversity in the Science Workforce: Report from the National Science Foundation Minority Postdoctoral Research Fellows and Mentors Annual Meeting, 1996* – This report presents the findings from a meeting to discuss the effectiveness of the Minority Postdoctoral Research fellowship program.
3. *The Federal Role in Graduate and Postdoctoral Education, 1998* – This report discusses the findings from an NSB Convocation that considered future directions for support of graduate and postdoc education by the Federal Government. The report reaffirms the federal role in graduate and postdoc education and identifies the policies issues that NSF should pursue.
4. *Postdoctoral Appointments: Roles and Opportunities, 2003* – This report presents the findings from a workshop that examined the postdoc appointment process and sought to identify priorities for NSF support of postdocs.
5. *The Science and Engineering Workforce: Realizing America's Potential, 2003* – Within the broader context of the need to encourage students to undertake study in the science and engineering fields, the report recommends better support and compensation for graduate students and postdocs to make science careers competitive with other career choices.

NSF's policy and research interests focus on the maintenance of the highly qualified science and engineering workforce that makes the US a world leader in technological advancement. The NSB reaffirmed NSF's role in supporting career development of the S&E workforce through support of graduate students and postdocs. The NSB also

recommended that NSF should continue to support the research enterprise through grants and should ensure that such support contributes to the development of graduate students and postdocs. To ensure that NSF funding is effectively supporting these goals, the NSB suggests that NSF needs better information on whether postdoc appointments are a necessary step in the development of effective S&E researchers, whether postdoc support is adequate to encourage highly qualified doctorates to pursue postdoc appointments, and whether broader research funding is contributing to the most effective use of postdocs.

Another series of NSF publications included in the literature review demonstrate how NSF data can be used to study important postdoc policy and research issues. The Science and Engineering Indicators Reports and the series of SRS Issue Briefs furnish information and statistics on postdocs.

1. *Science and Engineering Indicators, 2004* – The Indicators report includes a range of data on postdocs, including the population of postdocs, the decision to take a postdoc position, the employment status for postdocs, and the number of foreign postdocs.
2. *What Follows The Postdoctorate Experience? Employment Patterns Of 1993 Postdocs In 1995, Regets, 1998* – This report uses longitudinal SDR data to examine the distribution of career transitions for postdocs. Similar analysis of the status of 1999 postdocs in 2001 was included in the 2004 Indicators Report.
3. *Has The Use Of The Postdoc Changed?, Regets, 1998* – This report uses the 1995 SDR postdoc module to examine changes in postdoc experiences for doctorates receiving degrees in different time periods.
4. *Plans For Postdoctoral Research Appointments Among Recent U.S. Doctorate Recipients, Hill, et.al., 2004* – This report uses the 1982 and 1993 – 2002 SED surveys to examine trends with respect to postdoc appointments.
5. *Emigration Of US-Born S&E Doctorate Recipients, Burelli, 2004* – This report uses the 1998 – 2002 SED surveys to furnish information on international appointments by U.S.-born doctorates, including the intent to take international postdoc appointments.

These reports show that the existing set of SRS surveys can furnish a considerable range of information on postdocs. In particular, the time series of SRS surveys furnish information on postdoc trends. However, to furnish information on some of the major issues presented by the NSB discussions – student perceptions of the adequacy of compensation, the value of the postdoc experience in creating research scientists, and the effect of research funding on the creation of postdoc positions – the surveys would need to be modified or enhanced, or new surveys would need to be developed.

COSEPUP has conducted a series of studies on the development of science and technology resources. Some of the documents focus on postdocs, while others discuss the role of the postdoc in the context of the broader development of scientists in specific disciplines.

1. *Educating Mathematical Scientists: Doctoral Study And The Postdoctoral Experience In The United States, 1992* – This document discusses the postdoc model for mathematical scientists and proposes changes in the funding for and characteristics of mathematical postdocs that would better serve to develop mathematical scientists.
2. *Science, technology, and the federal government: national goals for a new era, 1993* – This is a more general discussion of the committee's vision in terms of the federal government role in the promotion of science and technology.
3. *Reshaping the graduate education of scientists and engineers, 1995* – This report identifies a growing mismatch between the number of new research doctorates and the number of research positions, including trends for a greater percentage of research doctorates taking postdocs and spending more time in those postdocs. The committee identifies the need for NSF to furnish accurate, timely, and accessible data on employment trends, careers, and sources of student and postdoc support.
4. *Careers In Science And Engineering: A Student Planning Guide To Grad School And Beyond, 1996* – This document only references postdocs in the context of overall planning by a student for a career in science.
5. *Enhancing The Postdoctoral Experience For Scientists And Engineers, 2000* – This report uses postdoc data to furnish postdocs with information on postdoc trends and with recommendations for making best use of the postdoc experience. As part of this study, COSEPUP conducted a postdoc survey of 49 institutions – 40 responded – and gathered information on institutional postdoc practices.

COSEPUP reports suggest that they consider postdoc experiences to be important for science and engineering research doctorates. Their reports focus on how to ensure that these postdoc positions can be used most effectively. Their reports explicitly identify the need for timely trend data on postdocs, as well as other indicators for the science and engineering workforce. Their reports also suggest that data on the quality and usefulness of different postdoc experiences also would be valuable.

The National Research Council conducted two important studies of postdoc education. They are notable in that they document the change in postdoc experiences from the 1960s to the 1980s.

1. *The Invisible University: Postdoctoral Education in the United States, Curtis, 1969* – This study conducted a census of current postdocs, interviewed former postdocs, and surveyed academic faculty. This study found that faculty and postdocs were generally satisfied with the postdoc experience. However, universities saw postdocs as a potential drain on resources and government officials were concerned about a “brain drain” caused by foreign postdocs taking their research experience back to their home countries after completing the postdoc.
2. *Postdoctoral Appointments and Disappointments: A Report of the Committee on a Study of Postdoctorals in Science and Engineering, 1981* – This study included surveys of Department Chairmen, U.S. PhDs ten years after graduation, U.S. PhDs two years after graduation, and postdocs who were foreign citizens. The study completed analyses of the postdoc trends and experiences for each of the major S&E disciplines. The findings with respect to postdoc trends and the value of experiences differed by field. Recommendations included establishment of federally funded portable fellowships, special fellowships for minority research doctorates, establishment of postdoc committees at universities to monitor and evaluate postdoc policies, and the enhancement of longitudinal data collection activities that focus on career decisions and transitions for individual in the S&E workforce.

The difference between the two documents furnishes insights into broader changes for research doctorates in the S&E workforce. The findings from the 1981 document are consistent with many of the issues identified today. It makes recommendations that are still being identified as issues in today’s discussion of postdoc issues.

Other government commission reports have discussed postdoc policy and research issues. These documents focus on the life sciences.

1. *Committee on Dimensions, Causes, and Implications of Recent Trends in the Careers of Life Scientists, Trends in the Early Careers of Life Scientists, 1998* – The report furnishes detailed statistics on which a number of recommendations are based. The report uses data to document trends for scientists that include fewer academic positions, longer postdocs, and inadequate opportunities for scientists as demonstrated by the large percentage in temporary research positions.
2. *Committee on National Needs for Biomedical and Behavioral Scientists, Addressing The Nation's Changing Needs For Biomedical And Behavioral Scientists, 2000* – This study furnishes a labor market assessment for scientists. Because of the increasing challenges in career transitions for life scientist, the Committee proposes certain changes in postdoc funding. The committee also identifies the need for better tracking of how graduate students and postdocs are used on National Institutes of Health (NIH) research grants.

3. *NIH Statement In Response To The NAS Report: Addressing The Nation's Changing Needs For Biomedical And Behavioral Scientists, 2001* – In this document, NIH identifies the importance of tracking graduate students and postdocs funded by NIH grants in order to better understand the linkage between funding, the need for graduate students and postdocs, and the effectiveness of career transitions.

These documents suggest the need for data that links funding to the demand for graduate students and postdocs, as well as data that tracks career transitions.

#### *Academic and Nonprofit Research Studies Workshops*

The Commission on Professionals in Science and Technology (CPST) is a nonprofit organization founded by the American Association for the Advancement of Science. The CPST has conducted a series of workshops that have addressed both postdoc issues and broader issues in the scientific workforce.

1. *Employment Outcomes Of Doctorates In Science And Engineering, 1998* – In this workshop, participants discussed the very significant changes in the employment of research doctorates over the last 20 years. New research doctorates are much more likely to work outside the academic sector than were their PhD advisors. The need to educate research doctorates for a broader range of employment presents important challenges to both doctoral programs and postdoc positions.
2. *Employment Of Recent Doctoral Graduates In S&E: Results Of Professional Society Surveys, 1998* – This report furnishes statistics from the joint effort of CPST and the S&E professional societies to collect information on the employment experiences of recent doctoral graduates. It furnishes valuable data for each S&E discipline.
3. *Changing Career Paths In Science And Engineering, 2001* – This workshop discussed changing career paths for scientists in the context of changing hiring and retention policies of employers.
4. *Postdocs: What We Know And What We Would Like To Know, 2002* – This workshop included presentations using a range of data sources, including SRS data, the *PhDs – Ten Years Later* study data, professional society data from the American Chemical Society, the American Mathematical Society, the American Institute of Physics, and the American Sociological Association. In addition, the workshop included statements about information needs from representatives of NSF, NIH, and COSEPUP. The workshop also discussed information sharing and data collection activities by *Science*, Sigma XI, and the National Postdoctoral Association.

5. *What Does The Future Of The Scientific Labor Market Look Like?*, Babco, 2003, Article uses varied secondary sources of data to describe trends in the scientific labor market.

A broad theme that appears throughout the work published by the CPST is that employment in the S&E sector is changing in important ways. In particular, research doctorates are increasingly employed outside the academic sector by government, business, and others. These changes are affecting the way that postdocs are used and the skills that postdocs need. Participants at the various workshops emphasized the need for data on postdocs outside the academic sector, data on foreign-degreed postdocs, and longitudinal data on career transitions and outcomes for research PhDs.

Other researchers and organizations have also addressed the postdoc issues through research studies, meetings, and workshops.

1. *Extending the Educational Ladder – The Changing Quality and Value of Postdoctoral Study*, Zumeta, 1985 – In this study, the Higher Education Research Institute collected information from over 8,000 science and engineering PhDs. The report supports the emerging concerns that postdoc positions are not fulfilling their intended mission, i.e., to furnish new research doctorates with the opportunity to enhance or broaden their graduate training and thereby prepare them for a research career.
2. *PhD's – Ten Years Later*, Nerad and Cerny, In 1996, Nerad and Cerny conducted a study of the research doctorates in six fields from 61 universities. The study included all aspects of career development, including detailed questions on postdoc decisions and experiences.
3. *Committee on Postdoctoral Education – Report and Recommendations*, American Association of Universities, 1998 – This committee conducted informal surveys with university administrations and departments in four disciplines (biochemistry, mathematics, physics, and psychology). A key finding was that most postdocs seek a tenure track position, but only about one-fourth achieve that goal. Given that and other issues, the Committee recommended that universities establish more consistent postdoc policies that ensure that postdoc receive adequate compensation, benefits, and supervision during their postdoc appointment, as well as adequate support in making the career transition from a postdoc to a permanent position.
4. *The Growing Postdoc Population at U.S. Research Universities*, Ma and Stephan, 2004 – This research paper used the GSS, the SED, research funding data, and labor force data to examine the reasons for the growth in the postdoc population.

These studies indicate the importance of these issues to the academic sector and support the ongoing need for data collection and analysis that supports decision-making by funding agencies and academic organizations.

### *Summary of Data and Information Needs Identified by Key Documents*

SRS statistics demonstrate that postdocs are a small part of the overall S&E workforce. From that perspective, research on postdocs may not be the highest priority area for S&E research. However, the statistics also demonstrate that, in some disciplines, the majority of research doctorates take at least one postdoc during their career and spend an average of over three years in postdoc positions. In those disciplines, policymakers are concerned that the quality of postdoc experiences can have a significant impact on a research doctorate's career. Statistics also show that scientists in postdoc positions earn far less than those with comparable experience in private industry. Policymakers are concerned that the financial sacrifice required to complete a doctoral program and a postdoc may discourage the best students from pursuing a research science career.

Researchers and policymakers agree that a postdoc position can play an important role in the development of a high quality S&E workforce. At the same time, inadequate attention to the quality postdoc experiences can detract from continued growth of the S&E workforce and the S&E sector of the economy. Researchers, government commissions, academic organizations, and nonprofit interest groups have issued reports in the last decade that recommend comprehensive research on postdoc issues, including:

- Employment Statistics – Information on the population of postdocs in all sectors and disciplines, including the number of appointments, sources of funding, the types of organizations that employ postdocs, duration of postdoc appointments, country of origin, compensation, and benefits.
- Postdoc Quality and Experience Indicators – Information directly from postdocs regarding the amount of training and guidance received, as well as the number of opportunities to conduct independent research and author publications.
- Institutional Data – Information from organizations that employ postdocs regarding structures and procedures in place for supporting postdocs during their time with the organization and in career transition.
- Principal Researchers – Information from principal investigators on research grants regarding their decision to employ postdocs, the process of recruiting postdocs, the role of postdocs in the research process, and the support that they offer postdocs in both postdoc research and career transitions.
- Career Transitions – Longitudinal information for both U.S.-degreed and foreign-degreed PhDs regarding career aspirations and the progression from doctoral programs, through postdoc positions, to final employment outcomes.

- Student Perceptions – Information from college graduates in science and engineering fields regarding their perceptions of career paths in science and engineering, and to examine how their decision on whether to pursue an advanced degree in science and engineering was affected by those perceptions.

While some of these data are already available from the existing longitudinal SRS surveys, most of these data have been collected only in smaller-scale or cross-sectional research studies. Policymakers and researchers identified the need for timely data to assess not only the existing status of postdocs by discipline, but also postdoc trends that are currently not furnished by the existing periodic large-scale research efforts.

### Recent Postdoc Commentary

Postdoc issues have generated a large amount of interest and discussion during the last decade. This is demonstrated by the 204 other documents identified and examined in the literature review. These documents generally did not involve the extensive research that typified the major research studies discussed above, or the extensive consensus building that took place in the development of commission reports. However, they furnish guidance on critical research issues from researchers and policymakers that are directly involved with the postdoc community today.

Table 1 shows some of the major sources for the articles and reports represented in the other 204 documents.

**Table 1**  
**Sources of Additional Documents Reviewed<sup>1</sup>**

<b>Source of Document Reviewed</b>	<b>Number</b>
Science Next Wave	96
Science	33
Nature	24
Chemical and Engineering News	8
The Scientist	6
Chronicle of Higher Education	4
Issues in Science and Technology	3
FASEB	3
Other Contributors	27
<b>Total</b>	<b>204</b>

<sup>1</sup> In addition to the 29 key documents, 204 documents from other sources were reviewed. The review includes documents published through December 2005. An effort was made to review a representative sample of documents from the major sources. Since the budget available for this task was limited, the review is representative, but does not include every document that discusses postdoc issues.

Examples of other contributors to the discussion are the American Association of University Professors, the American Chemical Society, the Fred Hutchinson Cancer Research Center, and EMBO reports.

Most of the sources reviewed addressed one or more of the following major research issues.

- **Postdoc Market Conditions** – Many of the documents reviewed discussed issues related to the growth in the number of postdoc positions and the availability of qualified postdocs to fill those positions. Some researchers believe that the growth in the number of postdoc positions is a function of the growth in the research funds. This growth accounts for the large number of foreign-degreed PhDs that must be recruited to fill US postdoc positions. Other researchers believe that the mismatch between the number of new research doctorates and the number of tenure track academic positions, as well as the availability of qualified foreign-degreed PhDs, makes it possible to conduct research using new doctorates in low salary temporary positions.
- **Postdoc Financial Circumstances** – There is a general concern that postdocs are not adequately compensated for the value that they bring to the research enterprise. Some analysts believe that inadequate compensation represents an important barrier to qualified candidates pursuing postdocs and the valuable research and training associated with a postdoc position. The documents discuss the challenges presented by postdoc compensation and the potential impacts on career development for scientists.
- **Postdoc Experiences** – Many researchers believe that postdoc positions are an important step in the development of an effective S&E researcher. However, some analysts suggest that postdoc positions do not always meet those goals. The documents discuss the elements that are needed for a postdoc to succeed in their current role and develop into an effective independent researcher.

Within these three broad areas, we identified 15 key issues that were discussed by the documents. While most of the key issues were limited to one of the three broad areas of inquiry, a few were relevant to all three areas. Table 2 illustrates how frequently each of the fifteen most identified global topics was recorded among the 233 documents reviewed. Since many articles referenced a number of issues, the totals add to more than 100%.

**Table 2**  
**Postdoc Issues and Experiences:**  
**Fifteen Most Identified Global Topics**

<b>Postdoc Issues</b>	<b>Percent of Coverage</b>
<b>Market Conditions</b>	
Supply and Demand [number of postdocs and postdoc positions]	19%
Difference by Sector [industrial, government, and academic]	12%
Employment [broader S&E workforce issues]	11%
Funding [sources and impact]	7%
Foreign [effect on postdoc market]	4%
<b>All References to Market Conditions</b>	<b>38%</b>
<b>Postdoc Financial Circumstances</b>	
Salary	26%
Benefits	18%
<b>All References to Financial Circumstances</b>	<b>31%</b>
<b>Postdoc Experiences</b>	
Conditions [organization and nature of postdoc work]	19%
Association [collective action, support or advocacy group]	17%
Career Development [aspirations, career transition, and migration]	16%
Training	14%
Duration	10%
Mentoring [advisor or principal investigator relationship]	10%
Definition [characteristics of a postdoc position]	7%
Integration [with overall university community]	7%
Foreign [issues in foreign postdoc experiences]	6%
<b>All References to Postdoc Experiences</b>	<b>64%</b>

There tended to be a significant amount of overlap in the documents reviewed. In this section, we identify the issues discussed in each area, as well as some of the most common findings and recommendations made on the topics.

### Market Conditions

A key set of research issues relate to the supply of and demand for postdocs. Researchers want to get a better understanding of how many postdoc positions exist, how they are funded, and what population segments are filling those positions.

### *Supply and Demand*

A significant debate within the literature is whether there are too many or too few postdocs. Some researchers suggest that, since the number of research doctorates in the PhD pipeline (i.e., graduate students obtaining PhDs and postdocs) is greater than the number of tenure-track academic positions, academic principal investigators can exploit the availability of new research doctorates by creating low paid postdoc research positions. The argument for “too few” is derived from anecdotal complaints of faculty members who are unable to fill postdoc positions and statistical evidence of the rise in foreign-born PhDs obtaining postdoc positions in the United States. Although this debate focuses on academic postdoc positions, the SDR shows that over 50 percent of research doctorates work in industry. [Note: As a point of reference, over 50% of research doctorates are employed in industry. Since those positions are available, the lack of suitable alternatives may not be the most important factor in the decision by new research doctorates to take postdoc positions.]

### *Employment Sector*

PhDs and postdocs have several employment sector choices within science and engineering (e.g., academic, industrial, or government) as well as outside science and engineering (e.g., business and non-MD health positions). Several articles address the differences between the employment sectors and the mechanisms that lead postdocs and PhDs to choose one sector over another.

### *Employment*

Several articles describe the employment situation for scientists including the number of positions, rate of growth, average salaries, and other statistics stratified by field or subdiscipline. Several articles provide useful trend information on the historical and likely future employment and economic landscape for postdocs and recent PhDs.

### *Funding*

The literature related to funding consists mainly of commentary and position statements from funding agencies (e.g., NIH) regarding their efforts as it relates to postdocs. There were also several “advice-column” articles that instructed postdocs on how variation in funding source can impact postdoc experiences. For example, the postdoc who brings her own funding increases her opportunity to work with a principal investigator of her choice without straining the principal investigator’s budget.

### *Supply of Foreign national Candidates*

The research studies identified in the key documents demonstrated that foreign national postdocs have filled a large share of postdoc positions since the 1960s. Some articles suggested that the large number of foreign postdoc candidates results in an oversupply of candidates and thereby lowers compensation for all postdocs. However, other articles

suggest that without the foreign postdoc supply, it would be challenging to get enough new research doctorates to undertake all of the research that is needed.

### Postdoc Financial Circumstances

Researchers want data on the salaries, benefits, and resources available to postdocs. They are interested in variation in the financial circumstances within the postdoc community, as well as comparisons of the financial circumstances of postdocs to those of other recent PhD recipients.

#### *Salary*

The primary issue related to salary concerns is that there is no minimum wage for postdoc salaries and that these salaries might be insufficient relative to a postdoc's education and the type of work that postdocs perform. Some have argued that institutions use NIH stipends as postdoc salary guidelines. Certain research institutions fund postdocs beyond these salary levels to attract the best candidates. Anecdotal data suggests that other institutions that are unable to match the NIH funding levels have found difficulty attracting postdocs. Consequently, stipends vary widely within as well as between institutions, fields, and subdisciplines.

#### *Benefits*

Several articles highlight the dissimilarity among postdoc appointment benefits, including health and dental care plans, parental leave policies, childcare benefits, retirement plans, disability benefits, vacation and sick leave time, and parking privileges. Even in the same lab, postdocs with different funding sources are likely to have different benefit packages.

### Postdoc Experiences

Researchers want data on the quality of postdoc experiences, including the value of the training received, the support offered by the postdoc's advisor, and the outcomes for individual postdocs. As noted in the key documents, many organizations have recommended that research universities establish guidelines to standardize the training for postdocs and the expectations of postdocs. The articles that discuss this issue suggest that comparatively few institutions have implemented such guidelines.

#### *Conditions*

Many articles describe the conditions (e.g., responsibilities, daily hours worked, etc.) under which postdocs perform their work. Some of the concerns raised by postdocs in these articles relate to inadequate recognition and reward for their contribution. Postdocs also voice complaints that they are mistreated by principal investigators who lack interpersonal and management skills. The largest concern regarding the

organization and the nature of postdoc work is that institutions tend not to have a formal and fair grievance procedure for postdocs.

### *Associations*

Near the end of the millennium, postdocs at larger research institutions began to share experiences and resources to support one another and advocate for improvements to postdoc working conditions. Postdoc associations led by and for postdocs began to form across the country. The first postdoc network meeting occurred in 2001 and the National Postdoctoral Association was formed in 2003. Many articles describe the formation and efforts (e.g., internal surveys) of these postdoc associations. In addition to postdoc associations, some institutions established postdoc administrative offices.

### *Career Development*

Many articles describe career development paths and concerns of postdocs. These articles address postdoc career aspirations, career trajectories including those that involve multiple postdoc positions, and efforts undertaken by institutions and advisors to assist postdocs in the transition to permanent employment. Some articles suggest that advisors are best suited to train postdocs for academic jobs. The institution must furnish take responsibility for helping to broaden that training to prepare postdocs for employment in other sectors. Some postdoc administrative offices have been effective in linking postdocs to nonacademic mentors and employment opportunities.

### *Training*

The common expectation is that the postdoc position serves as continued training designed to provide experiences that would improve the prospect of obtaining (and reduces the learning curve associated with) an independent research position or career. Several articles highlight the dissimilarity of training mechanisms, opportunities, and objectives. A common concern expressed in several articles is that many postdoc positions, which are designed to help postdocs obtain tenure-track academic positions, do not furnish teaching experience. To the extent that postdocs need training that is relevant to other economic sectors, postdoc offices may be able to establish linkages with local government and industry groups.

### *Duration*

A common question posed in the literature is what caused the significant increase in the duration of time that PhDs tend to hold postdoc positions. Across the documents reviewed, there is disagreement regarding the number of years of postdoc experience that is necessary to develop the required skills. Some scientists argue that the amount of postdoc experience needs to be increased because research has grown more complex, while others believe a few years was adequate in the 70s and 80s and should be adequate now.

### *Mentoring*

The most significant relationship in the life of a postdoc is between the postdoc and their principal investigator. Most articles on this subject stress that a supportive relationship between postdocs and their principal investigators is necessary for the career success of postdocs. Some articles list best practices for postdoc mentors, including the need for setting specific expectations and goals at the outset of the postdoc. COSEPUP researchers requested that the NIH and the NSF make mentoring skills a part of the grant proposal review; however, representatives from these institutions indicated that they couldn't enforce this request.

### *Definition*

The lack of a standard and consistent definition of a postdoc (even within an academic department in a single institution) creates difficulties in providing an accurate count of postdocs. Moreover, researchers have found that the differences in definition correlate with differences in employment statuses, benefits, access to resources, and salaries. Many agree that there should be a standardized classification for postdocs, but there is disagreement on whether that classification should be "non-employee", staff employee, or faculty.

### *Integration*

The literature frequently reports that postdocs are often not integrated into the larger community, particularly at universities where faculty, staff, students, and administrators make up the core four bodies and postdocs don't fit neatly into any of those groups. Several articles illustrate developments at institutions to implement policies governing the postdoc experience including the creation of institutional postdoc offices.

### *Foreign national Postdoc Experiences*

The literature reports that foreign national postdocs have much the same issues as U.S. postdocs with the added complexities of visa issues and tax status. In addition, foreign national postdocs are ineligible for NIH or NSF training fellowships. Moreover, some articles reported that foreign national postdocs tend to have lower salaries and fewer benefits than their U.S. citizen counterparts even within the same institution.

## **Conclusions from Literature Review**

In the review of the key documents, we found that the policymakers and researchers that studied the postdoc issue were consistent in their recommendations with respect to the need for research and policy analysis of postdocs.

- **Federal Role:** Policymakers and researchers reported that the federal government has an interest in supporting the development of a high quality S&E workforce.
- **Importance:** Policymakers and researchers reported that postdoc positions are important step in career development for many research doctorates
- **Effectiveness:** Policymakers and researchers were concerned about the quality and consistency of postdoc experiences, and suggested ways for postdoc positions to be more effective in training research doctorates.
- **Funding:** Policymakers and researchers expressed concern that the structure of federal funding for research may have unintentional consequences with respect to the quality of postdoc experiences.
- **Comprehensive Research:** Policymakers and researchers recommended that the federal government support the development of comprehensive information about postdocs.

The examination of commentary from the series of current journals, articles, and reports supports the findings from the review of key documents. Academic organizations, individual research universities, and postdocs are discussing the importance of improving the quality of postdoc positions and postdoc experiences. Moreover, these groups are taking actions to ensure that these improvements are made, including: establishing institutional postdoc offices, organizing postdoc associations, conducting primary research, and developing information on best practices for postdoc experiences.

A number of the research studies in the literature have been successful in furnishing the kind of comprehensive information that supports postdoc policy analysis. However, those studies tended to be one-time efforts that furnish the information only for a single point in time. The challenge for SRS is to develop a sustainable research plan that can furnish this comprehensive information on a consistent schedule for ongoing postdoc policy formation and review.