

Demystifying the Academic Research Enterprise

Becoming a Successful Scholar in a Complex and Competitive
Environment

Facilitator Guide

Kelvin K. Droegemeier

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About This Facilitator Guide

This Facilitator Guide provides information to assist individuals in coordinating formal study of *Demystifying the Academic Research Enterprise*, authored by Dr. Kelvin K. Droegemeier and published by the MIT Press (available at <http://mitpress.mit.edu/9780262547079/link/>). Study of this book can be undertaken as a stand-alone activity (e.g., a university directed reading or independent study course); integrated, in whole or in part, into any existing course; used as an online activity for formal grading or other credentialing; or made part of an educational aid to support institutional requirements (e.g., responsible conduct of research training). Of course, anyone can proceed through the book on their own without facilitation.

About *Demystifying the Academic Research Enterprise*

The book is an educational resource that teaches next-generation researchers—across all disciplines and types of institutions—about the vast array of topics one needs to master in order to be successful, in addition to the formal expertise required in a given discipline or disciplines. This includes but is not limited to the value, necessity and types of research and creative activity; public attitudes toward scholarly work and associated outcomes; priority setting within funding sources; formulating ideas and identifying funding; research methods; collecting data or materials; writing competitive grant proposals; publishing and communicating outcomes; understanding and following ethical rules of conduct; navigating the labyrinth of intellectual property (IP) and compliance regulations; multidisciplinary inquiry; using research outcomes in policy; collaboration and working in teams; diversity, equity, and inclusion; and the future of research.

Intended for undergraduate and graduate students, postdoctoral scholars, and early career faculty, the book was written for individuals at large comprehensive research universities and doctoral institutions (Carnegie R1 and R2 classification; <http://carnegieclassifications.acenet.edu>), doctoral/professional institutions (Carnegie D/PU), masters colleges and universities (Carnegie M1 to M3), Minority Serving Institutions (MSIs), emerging research institutions (ERIs), and institutions that historically have focused principally on instruction but are becoming more active in research (e.g., Primarily Undergraduate

Institutions [PUIs] and community colleges). Particular emphasis is given to individuals at the latter institutions, who have relatively limited exposure to the topics contained herein because their institution often lacks the resources and administrative support frameworks to assist their scholarly endeavors.

The book also is relevant to midcareer and senior faculty, research administrators, funding organization program officers, congressional staff, corporate and nonprofit organization researchers, law and policymakers charged with stewarding America's research enterprise, the media, and the general public. Also, although focused on the academic enterprise, the book is relevant to researchers in industry, government, and nonprofit organizations.

Uniquely, the book is written in a conversational style and blends authoritative information with the author's nearly four decades of experience as a researcher, administrator, and policy expert. It also interleaves topics (e.g., ethical conduct and reproducibility, bias and peer review, and communicating outcomes and public perceptions of the value of research). It is important to note that the book is not a how-to guide or instruction manual for next-generation or current researchers. Rather, it is an educational resource for developing and understanding researcher roles, responsibilities, and opportunities in the context of the reader's own scholarly program and personal circumstances. It also places scholars in a broad national and international context—not as passive recipients of a system already in place, but as key participants in a system in which their active engagement is essential for helping set priorities, determine policies, drive systemic change, and advance knowledge for the success of the enterprise as a whole.

The book has two principal goals: First, to enhance and greatly accelerate understanding, by those pursuing careers of scholarship in all academic disciplines, regarding the aforementioned topics—all of which are both increasingly important as well as complex in today's research and creative activity enterprise. Second, to democratize understanding of these topics across the broad span of America's scholarly enterprise, particularly with regard to organizations, institutions, and individuals traditionally underserved, underrepresented, and underresourced.

How to Most Effectively Facilitate Study of *Demystifying the Academic Research Enterprise*

To reap the greatest benefits from the book, it is important to keep in mind the following.

First, it is assumed that the facilitator has some degree of expertise in the academic research enterprise as a scholar, administrator, instructor, and/or in some other capacity. Facilitators thus are encouraged, as in teaching any course, to use the book as a guide and to “make the facilitated study your own.” Bring in personal insights and examples. Use contemporary materials to illustrate concepts and invite guests to bring their own views.

Second, if possible, utilize an active learning framework in which participants read the book and evaluate other materials in advance, thus allowing ample time during facilitated sessions to discuss and debate topics. Role playing is a particularly appropriate strategy for studying the book, especially with participants playing the part of peer reviewers, policymakers, funding organization program officers, editors, and compliance personnel.

Third, the book is written for *all academic disciplines*, from art history to zoology. To provide the richest learning experience for participants, seek to maximize diversity of the learning cohort in every dimension. When the author first offered a course based upon the book (then only an online resource), an undergraduate dance major and undergraduate biomedical engineering major found astounding linkages in their work and approach to scholarship. Both were profoundly and positively impacted by the experience.

Fourth, turning to the structure of the book itself, it is important to recognize that chapters intentionally are not organized sequentially and thus need not be read in any particular order, though the author recommends beginning with chapter 1. That said, the chapters do in fact reference one another so as to effectively link numerous related concepts, (e.g., the peer review process, bias, research integrity, and research compliance).

Finally, each book chapter begins with a set of learning objectives that frame the material to be presented, and concludes with numerous questions to assess reader comprehension of the material. To provide much deeper understanding of several key topics than space in the book allows, each chapter also concludes with a set of exercises, many of which are designed to be overseen by a mentor or facilitator, and which require several days to a few weeks to complete. Of course, a virtually unlimited array of such exercises can be developed, and consequently facilitators are encouraged to create their own, especially based upon their own experiences.

Suggestions for Discussion and Group Learning, and Guidance for Completing Exercises to Deepen Understanding

Shown below for each chapter are suggestions for facilitating individual or group-oriented discussion about the book, as well as guidance to assist facilitators and readers in working through the Exercises to Deepen Understanding found at the end of each chapter. As noted in the exercises themselves, the amount of time and resources required, and level of guidance needed to complete a given exercise, vary by topic and activity. Although facilitators may choose to use the exercises as is, they are encouraged to modify them based upon their own experiences, or develop additional exercises, to achieve their desired learning outcomes.

Deep in Our Bones

Why and Where We Perform Research and Creative Activity

Suggestions for Discussion and Group Learning

- Describe your own research and creative activity for the participants and have them do the same. Note the extent to which they use discipline-specific language or are aware of the fact they may be speaking to individuals who know nothing about their field of study and thus have no context or understanding of disciplinary jargon.
- Ask participants when they first realized they wanted to perform research and the factors that influenced their thinking/decision.
- To the extent participants feel comfortable, discuss whether they are the first in their family to attend college or university, along with the difficulties encountered in pursuing that ambition and the role research might have played in the decision process.
- Have participants discuss the associated practical benefits of their research and what they hope to accomplish with it.
- See if participants can identify concepts, structures, and approaches that are common across each other's research, especially for notably disparate disciplines.
- Ask participants why they chose their discipline, and share your own story as well.
- Ask participants if they view their research as leading to other professional activities in the future, such as policymaking, administrative leadership, political positions, etc. See if they have a sense of what they might be doing five years from now. Ten years from now.
- Have participants download contemporary news articles or other information from the Internet regarding their research or research in their field. Discuss its importance and how their own work will add to the existing body of knowledge.
- Ask participants if they envision collaborating with other disciplines in their research.
- Have participants describe the status of their research and whether they have presented their results formally (e.g., at a conference, in a publication, at a performance or exhibition).
- Describe how your own research program is being or has been funded, along with the amount of work needed to obtain the funding.
- Describe the structure of your institution's research support services and your personal experience engaging with them. Consider having your institution's senior research officer (SRO) speak to the group about his or her role.
- Ask participants whether they have engaged with their institution's research services organization, and if so, to describe their experience.

- Point participants to resources, on campus and externally, to facilitate their engagement in research and creative activity. If located at an MSI or ERI that has notably limited resources, discuss ways of obtaining the research support services needed (such information is provided in the book as well).
- Ask participants to describe something in chapter 1 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To help the reader become more familiar with the concepts of fundamental/basic/curiosity-inspired research, as well as applied research, by having them develop specific questions about a topic of their choice in both categories.

Guidance: Have readers use the Internet to identify several specific examples of both types of research to gain familiarity with the similarities and differences, and then have them pick one specific research topic from each category. It is important for the reader to develop several specific questions for both examples of research they chose and then compare the questions to highlight differences in fundamental versus applied research. Additionally, in describing the value and relevance of the research, they may find that fundamental research has intrinsic intellectual value but less immediately demonstrable relevance to society than applied research.

Exercise 2

Goal: To help the reader understand the many differences between federal agencies and private foundations as funders of research.

Guidance: A list of federal agencies is located at <https://www.grants.gov/learn-grants/grant-making-agencies.html>, and a list of several private foundations that fund science is located at <https://sciencephilanthropyalliance.org/>. Additional foundations may be found at https://oedb.org/ilibrarian/100_places_to_find_funding_your_research/. The reader can locate other foundations in nonscience/STEM (science, technology, engineering and mathematics) fields via an Internet search. The key to this exercise is for the reader to understand, by comparing and contrasting two organizations (one federal and one private), the specific guidelines, rules, restrictions, special requirements, and procedures used in funding research.

Then use this information to suggest how both types of organizations might improve by incorporating elements from one another or making other changes.

Exercise 3

Goal: To help the reader identify the trail of activities or steps between a practical outcome of research that benefits society (e.g., a product or service) and the academic research that gave rise to it.

Guidance: The reader will need to trace the evolution of the outcome, going backward in time to the associated research in academia, and describe how society has benefited from it. This work may involve searching federal agency or academic websites for proposals related to the chosen outcome, scouring press releases and corporate communications, and even interviewing the academic researchers and corporate individuals involved. The exercise could be expanded to include several such examples in vastly different disciplines (e.g., natural science, engineering, medicine, art, music/musical theatre, and a social, behavioral, or economic science).

Exercise 4

Goal: To help the reader become more familiar with archive literature and, in particular, publications authored by a single individual in comparison to those authored by five or more individuals as a means for recognizing the prevalence of team-oriented research.

Guidance: Provide the reader with two or three journals in which to conduct the search and ensure they have selected a topic directly relevant to their own field of study or project so as to reap additional benefits from the exercise. Because single-author publications are increasingly rare in many disciplines, you may need to modify the number of authors in this exercise (e.g., two or three compared to ten or more). The reader should evaluate factors such as possible correlations between the number of authors and type/scope of work, types of institutions involved, domestic and international authors, etc. Also, as they search the literature for the two papers to be evaluated, they should describe their impressions about the number of authors, including differences among journals. In this exercise, journal articles could be replaced by music scores and an evaluation of the number of composers, musical productions, etc.

Exercise 5

Goal: To help the reader become more familiar with independent research institutes, as components of America's research enterprise, by comparing their missions and structures with those of federal agencies.

Guidance: Ensure the reader knows how to access lists of both federal agencies and independent research institutes based upon information provided in the exercise, and guide their selection of a few organizations in each category that tend to fund similar topics for ease of comparison. Have them evaluate and compare attributes such as the structure of the organization, its budget, target audience for assistive awards, methods of communication with that audience (e.g., announcements of opportunity or solicitations), range of topics funded, procedures for submitting and evaluating proposals, number of programs, and the manner in which the organization itself performs research, as appropriate. Based upon this comparative and critical evaluation, the reader should suggest ways in which the two types of organizations might learn from one another and thus improve their processes. Additionally, the reader should describe, as appropriate, why changes should *not* be made in light of the nature of the organization.

Exercise 6

Goal: To help the reader understand the wide degree of variation in research support services across America's academic institutions and, in particular, the extent to which many institutions are significantly underresourced and thus unable to adequately support scholarly pursuits.

Guidance: Because this exercise involves selecting institutions across an array of characteristics defined by the Carnegie classification scheme, begin by pointing the reader to the Carnegie website and discussing with them the various schemes and their significance to institutions and researchers. Assist the reader in selecting six to ten institutions across this array of characteristics and have them develop a spreadsheet that compares the attributes mentioned in the exercise, as well as others you may wish to add. Have them note similarities and differences (e.g., most institutions may offer a particular service while only a few others may do so for another service) and relate them to institution type, size, location, etc. To highlight the challenges faced by individuals at underresourced institutions, have the reader put themselves in the position of such an individual and discuss with them various options for obtaining needed resources. Also, discuss ways in which such resources could be provided by state or federal governments.

2

The Money Trail

Funding for Research and Creative Activity

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experiences with funding for research and creative activity prior to reading the book.
- Discuss with the group resources available on-campus to support research and creative activity. If located at an MSI or ERI that has notably limited resources, discuss ways of obtaining the research support services needed (such information is provided in the book as well).
- Ask participants if they have interacted with, as appropriate, their institution's office of undergraduate research, graduate college or program, postdoctoral office or support services, or resources available to support the scholarly work of early-career (pretenure) faculty. Discuss their experiences and recommendations.
- Discuss the various categories of research (fundamental, applied, etc.) and have participants describe which category or categories apply to them.
- Ask participants if they have applied for funding in any form, including student financial aid, along with the nature of the funding organization (private, state, federal). Discuss programs that provide research resources for traditionally underrepresented groups or institutions.
- Download information from the Internet regarding current research and development (R&D) budgets being debated or recently passed by Congress and discuss the various issues at play and disciplines involved. Relate this to the federal R&D budget process schematic shown in the text. Have participants debate, including in teams, various positions regarding federal research priorities and programs.
- Discuss with participants various issues associated with funding entitlement programs versus funding for R&D relevant to their own work. Do they have concerns about the growing national debt, and how would they balance the need for funding social programs compared with R&D?
- Play for the group videos from previous congressional budget hearings and discuss the nature of member questions and the quality of witness answers. Ideally, one hearing should involve federal agency witnesses (e.g., agency heads) while the other should involve subject matter experts, especially from academia.
- Download from the Internet and discuss one or a few funding solicitations from federal agencies. Highlight key points and requirements and have the group discuss their interpretation of the contents. Ask participants if they can "see themselves and their work" in the solicitations.
- Discuss ways in which participants can remain informed of developments regarding funding in their discipline as well as R&D budgets overall (e.g., subscription to listserves, regular reports from sources listed in the book).

- Ask participants to describe something in chapter 2 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To help the reader understand the process by which R&D funding priorities are determined, budgets are created, and funding is provided to federal agencies.

Guidance: The reader should study carefully the sections of the book that speak to the topic of this exercise and, in particular, the figure and associated text that tracks the federal R&D budget from inception (President's Budget) to completion (congressional appropriation and funding bills sent to the president to be signed into law). This exercise focuses on the US House of Representatives Committee on Science, Space and Technology (HSST), which is an authorizing committee for the agencies shown in the exercise. Others could be selected, such as those which oversee appropriations for the National Institutes of Health (NIH) (US House of Representatives Subcommittee on Labor, Health and Human Services, Education and Related Agencies), or the National Endowment for the Arts (NEA) and the National Endowment for the Humanities (NEH) (their committees may be found at <https://www.americansforthearts.org/events/national-arts-action-summit/facts-figures-to-make-your-case/key-congressional-committees-for-arts-policy>). The reader should select one agency for a federal fiscal year and track the budget of that agency throughout the entire process, starting with agency priorities for R&D via a search of the agency website. Other helpful websites include that of the associated congressional committee (e.g., for hearings) as well as <https://congress.gov> to track specific bills. Have the reader comment on the overall process and identify opportunities for improvement.

Exercise 2

Goal: To demonstrate for the reader the manner in which the White House communicates high-level priorities for R&D funding to all relevant agencies, and how these priorities change each year and particularly across administrations.

Guidance: The R&D priorities memos to agencies can be found on the Internet, and the reader should perform a critical comparative analysis of ten to fifteen consecutive versions to show how the priorities change from year to year within a given administration, as well as across

administrations, particularly in light of the political party holding the presidency. Additionally, the reader should identify how R&D priorities within a given federal agency relate back to the White House memo. Note that the priorities memo is issued during summer for the fiscal year budget (and agency budget) that begins a year from the upcoming October (see section 2.2 in the book). Also, have the reader comment on any impacts to White House and agency priorities and activities should a Continuing Budget Resolution be enacted in place of regular appropriation bills.

Exercise 3

Goal: To acquaint the reader with the Federal Register and how it is used by the federal government to seek input on a wide array of topics, including R&D, from the general public.

Guidance: Assist the reader in browsing the Federal Register (<https://www.federalregister.gov/>) and have them identify one or more topics of particular interest or relevance. The reader should summarize the associated Requests for Information (RFIs) and then develop their own response, or set of responses, which you should evaluate and discuss with them. Consider issues such as the completeness of the questions asked and their relation to the topic, the amount of time provided, how the agency will use the information, and whether the agency will communicate its responses in a general manner. For policy already enacted, it would be valuable for the reader to search through RFI archives, identify a final rule or regulation of interest, and then compare the final version issued with the original version placed for comment on the Federal Register.

Exercise 4

Goal: To provide the reader with practical experience developing an outline for a research proposal that could be submitted to a federal agency or private foundation.

Guidance: A list of federal agencies is located at <https://www.grants.gov/learn-grants/grant-making-agencies.html>, and a list of several private foundations that fund science is located at <https://sciencephilanthropyalliance.org/>. Additional foundations may be found at https://oedb.org/ilibrarian/100_places_to_find_funding_your_research/. The reader should browse the website of an agency or foundation most relevant to their research and identify an associated call for proposals, announcement of opportunity, or solicitation that applies to their work. Using guidance provided by the funding source (most have a specific set of instructions

for material to be included, formatting, etc.), have the reader develop a detailed outline for a proposal. In bullet form, the reader should address the questions shown in the exercise and any others you or the reader feels are relevant. Review this outline with the reader and perhaps ask someone from your sponsored programs or research development office to do the same.

Exercise 5

Goal: To provide the reader with deeper understanding regarding tradeoffs that must be made each year in the federal budget among competing priorities of funding mandatory programs, managing deficits and the national debt, and funding federal R&D.

Guidance: This exercise involves identifying and evaluating a broad array of information concerning tradeoffs in funding programs across the federal government. The reader should use the Internet to gather information from authoritative sources regarding views held by various constituencies, including organizations such as academic and professional associations and societies, interest groups, and nongovernment organizations. Additional sources include White House and agency documents, press reports, and congressional statements. Positions taken on some of the issues (e.g., increasing funding for mandatory programs) align with political party affiliation while others, such as R&D, tend to be more bipartisan. The reader should assemble the information and critically evaluate arguments on all sides, noting that no right or wrong answer exists. However, the reader should offer suggestions regarding strategies for resolving differences such that tradeoffs provide maximum benefit to all concerned.

3

Perception and Reality

Public Attitudes, Understanding, and Use of Research

Suggestions for Discussion and Group Learning

- Download and discuss the summary from Vannevar Bush's book *Science, the Endless Frontier*. Note how it comports with today's priorities of fundamental research, STEM education, and open access.
- Ask participants to share their feelings about a portion of their tax dollars being used to fund R&D, and their priorities of R&D funding relative to funding for social entitlement programs. Do they feel some disciplines receive too much funding? Not enough? Discuss the varying costs to conduct research across the span of academic disciplines.
- Have the group share their views about the effectiveness and societal impact of various societal institutions shown in the book (e.g., Congress, the press, education, the military, and the scientific community). Compare them with long-standing surveys (e.g., General Social Survey) as well as recent surveys, some of which show dramatic changes during the past few years.
- Invite faculty and other researchers from a broad array of disciplines to describe to the group their research and experiences as scholars, particularly with regard to needing and obtaining funding as well as public attitudes toward their work or, more broadly, the type of work performed in their discipline(s). Have them highlight in particular how they deal with the lack of resources if they are at an MSI or ERI.
- Ask participants to share their primary sources of information regarding their discipline, research, world affairs, politics, etc. Discuss the extent to which they trust these sources and also whether they seek independent verification or simply believe what they read.
- Have participants share situations in which they have communicated about their research to general, nonexpert audiences, along with audience reaction. To what extent did they proactively seek to provide such communication or wait to be asked?
- Discuss participant views regarding use of federal/taxpayer dollars to fund controversial research, such as that involving stem cells, cloning, ancient languages, etc. What shapes these views, and do they feel comfortable discussing them?
- Have participants describe topics they view as particularly sensitive or divisive and the manner in which research might help bring multiple "sides" together toward a compromise solution. How do the views vary among majority and minority stakeholders?
- Discuss the COVID-19 pandemic and the manner in which participants feel decisions regarding masks, vaccines, and other factors were determined by research versus other considerations. Discuss the manner in which various communities were disparately affected and how research might address such issues.
- Discuss public policy topics in which participants feel research is not being sufficiently considered in comparison to other factors such as economics, national security, and politics.

- Ask participants whether they place greater or lesser trust in research produced by government organizations compared to that produced by research universities, for-profit private companies, and independent research institutes. Discuss their reasoning.
- Find out how many participants are interested in policy fellowships or volunteering in a local congressional office. Discuss the value of such activities in the context of research and provide suggestions for how they might engage, formally and informally. Also, suggest policy-related courses they might take at their institution as well as special offerings by professional societies.
- Discuss the extent to which participants believe their research and creative activity might lead to innovations that could be licensed or patented. This topic is addressed in greater detail in chapter 12.
- Ask participants to describe something in chapter 3 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To help the reader introspect regarding the roles played by various factors in shaping their personal views, especially regarding controversial topics, and how those views have changed over time.

Guidance: Work with the reader to identify one or two topics in research and creative activity, relevant to their interests or current work, about which they have specific opinions. The topics also could be more general in character. Dialogue with them about the factors responsible for shaping their views, which could include family members, coaches, faith leaders, teachers, mentors, peers, social media, news outlets, research publications, and traditional media. It is important that you, as the facilitator, make absolutely no judgments regarding their responses, but rather help them think carefully and answer the questions posed in the book. Discuss the importance of considering opposing views as well as factors that might influence the reader's perception of others (e.g., race, accent, dress) and thus their willingness to consider associated viewpoints.

Exercise 2

Goal: To help the reader understand the roles played by research in setting policy at the local, regional and/or national levels, and why sometimes research, even though relevant and present in the process, is not always reflected in policy.

Guidance: Assist the reader in identifying a policy issue of interest, ideally related to their research, and in gathering information regarding the roles played by research in creating it. If the policy takes the form of a law, work backwards from it by identifying the members of Congress who sponsored the legislation and then explore factors that gave rise to it. Quite often, the preface of legislation describes the motivation behind it. If the policy is not a law but rather part of federal agency procedures, contact relevant agency personnel to understand the origin of the policy and determine whether it was informed by public input from the Federal Register. Most federal agencies have nongovernmental advisory committees that make recommendations regarding policy, and the National Science and Technology Council, within the Executive Office of the President (EOP), likewise creates analyses and recommends policy. One of the most important EOP organizations in creating policy is the Office of Management and Budget (OMB) and its Office of Information and Regulatory Affairs (OIRA). Additionally, numerous agency policies take the form of presidential executive orders. In all cases, the reader will need to connect the dots and use available information to determine the history of the policy, and identify how and whether research played a role in its formulation. If not, why not, and if so, what influence did the research have?

Exercise 3

Goal: To help the reader understand the disparate nature of funding across academic disciplines, and how to develop persuasive arguments for increasing support to those that traditionally have been underfunded.

Guidance: Assist the reader in identifying additional information about funding for various disciplines based upon references provided in the book, and have them explore other sources (e.g., articles in *The Chronicle of Higher Education*, statements by academic professional societies and associations, congressional hearings, federal agency and nongovernmental organization reports) to better understand the positions taken by stakeholders and the rationale for them. Additionally, have the reader meet with faculty from a wide array of disciplines at their institution to better understand the funding required for their own research and creative activity. Using the above information, have the reader develop arguments for increasing funding as described in the statement of the exercise. Help them appreciate multiple points of view and take the position of advocating for funding in disciplines notably distinct from their own.

Exercise 4

Goal: To help the reader understand how the federal government receives input from public and private organizations to inform the development of policies governing research.

Guidance: Help the reader select three notably different organizations, based on information provided in the book or from other sources, and have them evaluate the manner in which the organizations provide input to the executive or legislative branches of government regarding research policy. Have the reader answer the questions in the exercise, and discuss with them your own experiences providing input on research policy. Additionally, help the reader identify others in your institution who have been involved with research policy (e.g., by testifying at a hearing, serving on committees, or meeting with members of Congress or organizations within the White House) to obtain their views, and identify ways in which the reader can become involved with policy at this and future stages of their career.

Exercise 5

Goal: To help the reader understand the purpose and history of academic tenure and the important role it plays in research and creative activity.

Guidance: Discuss with the reader your personal experience with tenure and views of its importance, and also point them to your institution's tenure and promotion policy. Help the reader identify sources of information regarding the history and evolution of tenure and the views toward it held by different stakeholders. Focus especially on efforts to eliminate or modify tenure and the pros and cons of doing so. It would be helpful to introduce the reader to several faculty at your institution, especially those in disciplines different from that of the reader, to discuss their views regarding tenure.

4

Essential Concepts

Performing Research and Creative Activity

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with research methods prior to reading the book.
- Ask participants whether they have taken a formal course in research methods, and if so, whether and how they are applying them in their research. If they have not taken such a course, do they feel it would be or would have been valuable?
- Discuss the methodology used in your own research and relate it to the frameworks described in the book.
- Discuss with the group how their research maps to the frameworks described in the book.
- Have a few participants describe their hypotheses and methods being used to test them. If statistics are involved, have them discuss the methods used and how they are ensuring statistical rigor.
- Discuss with the group the meaning of the words “theory” and “law,” having participants give examples of each from their own discipline.
- Ask participants if any of them utilizes citizen science approaches in their research. If so, describe them and if not, discuss whether such approaches might be useful and the ways in which they could be applied.
- Ask participants if they were aware, prior to reading the book, of issues regarding reproducibility, reliability, and replicability of research results, and whether these attributes apply to their work. If so, how would they go about ensuring such characteristics?
- Discuss possible consequences of participants’ research if they cannot be reproduced or replicated. Has this issue been raised with their supervisor?
- Ask participants to identify research outcomes or other developments in their field that were due largely or wholly to serendipity. See if they have experienced this in their own research.
- Ask participants to describe something in chapter 4 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader with practical experience applying the scientific method to a research problem of interest. Note that the reader need not be in a STEM field, and that the scientific method, modified appropriately, can be used in all fields.

Guidance: Review the scientific method with the reader to ensure their understanding of it and, in particular, to underscore that it is not a single method but rather a flexible framework. Help the reader identify an appropriate topic and assist them as they apply the various components of the scientific method to it. Once complete, review the resulting framework with them and discuss alternative pathways to various stages should problems arise.

Exercise 2

Goal: By placing the reader in the position of citizen scientist, this exercise will acquaint them with the roles played by such volunteers and their importance to the research enterprise.

Guidance: Assist the reader in selecting a citizen science project from the links provided in the exercise and ensure they are answering the questions provided in the book. Add other questions as you see fit, relate your own experiences with citizen science, and help the reader identify projects within your institution, or region, that involve citizen science and might provide an opportunity for reader engagement.

Exercise 3

Goal: To help the reader better understand the concepts of reproducibility, replicability, and reliability by looking at specific research problems that do and do not possess these characteristics.

Guidance: Encourage the reader to read key portions of the National Academies of Science, Engineering and Medicine report, found in the references, on the topic of reproducibility. Then, assist them in identifying and evaluating problems that do and do not possess the characteristics mentioned in the exercise. Discuss with them the importance of the three attributes mentioned from the vantage point of researchers, the research enterprise, and also law and policy makers. Have them determine how outcomes from the problems they selected might be misinterpreted as research misconduct if the results are not reproducible.

Exercise 4

Goal: To help the reader better understand and appreciate the role played by serendipity in research, and the manner in which research results obtained from such activities benefit society directly and indirectly.

Guidance: Assist the reader in identifying research outcomes that arose by virtue of serendipity (several are provided in the book), and discuss with them whether outcomes from your own research came about unexpectedly. Some of the more familiar examples occurred decades ago; for example, from the early days of the space program (Teflon), while others are more contemporary. Help the reader identify how the outcomes emerged and why they were unexpected.

Exercise 5

Goal: To help the reader better understand and appreciate the variety of research methods employed across academic disciplines.

Guidance: Your active involvement in this exercise is important by first helping the reader identify appropriate academic programs to study within their institution. Second, assist the reader in developing a set of questions, as noted in the book, regarding research methods used. Third, and most importantly, it will be especially helpful if you contact the department chairs or directors of the programs selected and describe the exercise and your role in it. Although the reader can and should make the formal overture to gain experience communicating with program leaders, an initial contact by you may be important for legitimizing the reader's request given the heavy workloads of those to be interviewed. Discuss interview outcomes with the reader and consider sharing the reader's perspectives (e.g., in a report) with those interviewed.

Exercise 6

Goal: To help the reader better understand and appreciate the value of Indigenous research methods, as well as consider ways in which such methods might be applied to the reader's own research.

Guidance: In addition to reading the papers noted in the exercise, point the reader to individuals in your institution who either apply Indigenous research methods or study Indigenous communities. Doing so will provide additional and possibly personal perspectives. Discuss the reader's answers to the questions posed in the exercise, and add other questions as you see fit.

5

Becoming a Detective

Finding What You Need and Using It Effectively

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with data collection and analysis methods prior to reading the book.
- Ask participants how they became aware of previous work in their field related to their own research. What resources did they use? Physical books and journals, online publications, etc.? How difficult was the material to access? Were they unable to access desired materials owing to the lack of institutional subscriptions, funding, etc.?
- Determine what participants learned by performing a literature review apart from the material itself (e.g., names of researchers repeatedly appearing, sources with multiple authors, frequently encountering work from specific institutions).
- Ask participants to describe something that surprised them in reviewing the literature or ways in which their thinking about their own research changed as they became more familiar with previous research.
- Discuss situations in which participants found previous work to be questionable, or the results or explanations in contrast to what the participant felt should be or was the case.
- Have participants describe how they are collecting and analyzing data in their research, including problems they have encountered and ways they overcame or are overcoming them—particularly if they are at an MSI or ERI.
- Discuss the importance of data quality control and quality assurance, and ask participants whether/how they are using such procedures in their own work.
- If participants are using data sets generated by others, have them describe the steps they took to ensure the data are of appropriate quality. Did they simply trust the source or work to verify it?
- Discuss the importance of backing up or creating multiple copies of their work, and methods participants are using to do so. Ask participants if and how they do it.
- For participants who are using complex computer codes or statistical analysis packages, discuss ways in which they are learning about the software and determining that it is performing as expected.
- To what extent did participants have to find alternatives to software or other supporting analysis tools because of insufficient institutional resources?
- For participants using statistics, have them explain the importance of appropriate use and give examples of how statistics can be misused to produce desirable results.
- Ask participants to describe something in chapter 5 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader with hands-on experience performing a literature review or environmental scan of work conducted previously on a topic of interest, and from it developing a set of questions that remain unanswered and could serve as the foundation of a research proposal.

Guidance: Assist the reader in identifying a topic of interest or relevance to their own research, along with a few authoritative references to get them started on their literature review or environmental scan. Make sure they use the bibliographies of those initial few references to build out their evaluation, as well as review or summary articles as appropriate. Describe for them how a gap analysis is used to identify questions that remain unanswered or work that remains to be completed. If possible, have them present their results to peers for critique and discussion. Make clear to the reader that such information is an essential component of research grant proposals and formal publications as it provides a context for the work to be proposed or explained, respectively.

Exercise 2

Goal: To expose the reader to the powerful roles being played in the research process by artificial intelligence and machine learning (AI/ML), especially in the evaluation of literature.

Guidance: As noted in the book, this exercise is similar to exercise 1 of this chapter, though instead of a manual search through the literature or other sources, it involves investigating the use of AI/ML to complete the task (though as noted in the book, the reader is not asked to actually utilize AI/ML). If your institution has a computer science or information science department or program, help the reader engage them in this exercise to provide additional insight into how AI/ML are used in literature evaluations. Further, assist the reader in identifying AI/ML services that support archive literature synthesis and hypothesis generation.

Exercise 3

Goal: To provide the reader with practical experience applying quality control concepts to a real data set.

Guidance: Although the example provided involves weather, the concepts are general and can be applied to many disciplines. If you have other examples of quality control and assurance more

directly relevant to the reader's particular field of study, feel free to use them. Otherwise, help the reader think about the issues mentioned in the exercise, review the data with them, and discuss how to go about identifying problematic values in the data, including via an automated algorithm.

Exercise 4

Goal: To help the reader understand how to collect data (see definition) for a problem of interest and apply appropriate procedures to ensure quality, usability, and availability to others.

Guidance: Assist the reader in identifying an appropriate research problem, perhaps from a previous exercise or their own research, and discuss how they could go about collecting data for it. Note that the definition of data is very broad (see exercise statement) and thus applies to all disciplines. Share with the reader your own experiences and procedures for collecting data, preparing them for use in research, and making them available (e.g., via a data management plan, which is now required in research grant proposals by many federal agencies and private foundations).

Exercise 5

Goal: To help the reader fully understand and describe the tools and methods used in their own research to synthesize data and develop understanding from them. If the reader already has done this and a written narrative was produced, this exercise may help them improve it. If they have not undertaken such work yet or are in the early stages, the exercise should help them assemble a plan and create a resulting narrative around it.

Guidance: If the reader already is engaged in research, work with them to address the questions posed in the exercise. If they are not, have them select a problem of interest or relevance to their discipline and proceed from it. Otherwise, follow the exercise by having the reader interview others in your institution who have experience collecting data and synthesize the information gathered to compare approaches used.

6

Diving into the Pool

Research Proposals, Evaluation Processes, and Project Management

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experiences with research proposals and merit review prior to reading the book.
- Ask participants to discuss any type of formal proposal or application they have submitted in the past, and their reaction to the response received.
- Describe why grant proposals submitted to fund research and creative activity have so many components, and reflect on your own experience both developing and reviewing proposals.
- Walk participants through the various components of a grant proposal and bring in personal examples as appropriate.
- Discuss the pros and cons of cost sharing from the point of view of a researcher, a funding organization program officer, and a university SRO. Ask the group whether they view cost sharing as unfairly disadvantaging institutions that have limited resources.
- Walk participants through a grant proposal budget (one from your own work or one created solely for discussion), and make sure they understand the nature of various costs and the difference between direct costs and facilities and administrative costs (F&A). Show them how quickly a budget can grow as necessary items are added.
- Provide participants with a one-page project summary from any of your previous proposals (or obtain one from your colleagues or the Internet) and have participants evaluate it, subject to specified criteria, and discuss their evaluation. This could be done in teams.
- Ask participants if any of their work involves human subjects or animals, and discuss the pros and cons of such work (although ethical issues are addressed in chapters 9 and 10, the discussion here could include them as well).
- Download statistics from the National Science Foundation (NSF), National Institutes of Health (NIH), or other federal agencies and discuss the disparate nature of funding across the research enterprise, with particular emphasis on R1 institutions as compared to Minority Serving Institutions (MSIs) and Established Program to Stimulate Competitive Research (EPSCoR) jurisdictions. Have participants identify possible solutions that Congress should consider.
- Ask participants to place themselves in the role of a federal research agency program officer who has to balance a huge number of factors in determining which proposal to fund. Consider issues such as the research topic, amount of funding received by and track record of the investigators, geographic balance, institutional characteristics, amount of research funded on the given topic, etc. Have participants identify other factors that are or should be considered.

- Ask participants to describe something in chapter 6 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader with a detailed understanding of grant proposal content and submission procedures, and how they differ, among a few federal funding agencies.

Guidance: This exercise is similar to that of exercise 1 in chapter 1, though the present exercise focuses on the grant proposal itself (content, format, etc) and associated submission procedures. The reader should select at least two agencies from the list of four provided, which are most relevant to their interests or current research and compare and contrast the attributes listed in the exercise. Others should be added as well. The reader should pay particular attention to differences in proposal structure/content as well as procedures across organizations, and the extent to which such differences could be confusing to researchers submitting proposals or add unnecessary administrative burden. The reader should suggest ways in which requirements might best be harmonized and burdens reduced, noting of course that necessary differences among funding organizations must be considered in making arguments for change.

Exercise 2

Goal: To provide the reader with a detailed understanding of grant proposal content and submission procedures, and how they differ, among a few nonprofit foundations.

Guidance: Follow the guidance provided for exercise 1 of chapter 2, and if the reader has completed exercise 1, have them describe the ways in which they found federal agencies to differ from private foundations. A list of several private foundations that fund science is located at <https://sciencephilanthropyalliance.org/>, and additional foundations may be found at https://oedb.org/ilibrarian/100_places_to_find_funding_your_research/.

Exercise 3

Goal: To provide the reader with a deeper understanding of how federal agencies utilize cost sharing in their funding programs to both stretch federal dollars as well as ensure buy-in from institutions (such as universities) receiving funding.

Guidance: Discuss with the reader the material presented in the book regarding cost sharing to

ensure their full understanding of the topic, including pros and cons as well as unintended consequences. Specific references include Bienenstock (2000), Feller (2000a), Hardy (2000), Kamerer and Wasserman (2000), Paoletti (2000), Seligman (2000), Thibault (2000), and National Science Board (2009). Help them identify federal agencies relevant to their interests or current research, and within them broad agency cost-sharing rules as well as rules specific to a given solicitation or funding opportunity announcement. The reader should compare and contrast the cost-sharing information and describe ways in which cost sharing can both stimulate as well as inhibit institutional engagement in research. Additionally, the reader should provide recommendations that will promote equity in cost sharing principles and practices across federal agencies, recognizing, of course, that each agency has its own unique mission and rationale for how it utilizes cost sharing.

Exercise 4

Goal: To provide the reader with practical experience developing a project budget and associated justification for the proposal outline they created in exercise 4 of chapter 2. If they have not completed that exercise, they should be encouraged to do so before attempting the current one.

Guidance: To help the reader become more familiar with the details of a proposal budget and associated justification for submission to a federal agency, this exercise provides a link to the project description, project budget, and budget justification for a real NSF early career proposal. However, as the facilitator, you should feel free to use one or more of your own proposals to teach the reader about the finer points of budgets and their justification. Review each category of the demonstration budget and relate each back to material explained in the book. Help the reader develop their own budget by determining appropriate costs for each item and the need for them. If available, engage your Office of Sponsored Programs (OSP) to provide salary, fringe benefit, F&A cost rates, and other relevant information. Have the reader answer the questions provided in the exercise, and add others as you see fit. Discuss the budget and associated justification they created, and demonstrate how quickly the budget can grow by simply adding a graduate student, additional faculty salary time, postdoctoral scholar, etc. Relate this budget behavior to the size of federal R&D budgets described in chapter 2 of the book.

Exercise 5

Goal: To provide the reader with a deeper understanding of F&A costs in research and the degree to which they are misunderstood by various constituencies.

Guidance: The references in the book contain numerous works regarding the history, rationale for, application, and lack of understanding associated with F&A costs (e.g., Droegemeier 2018; Association of American Universities 2017b; Council on Governmental Relations 2019). Have the reader examine these and other sources (e.g., congressional hearings, reports, press releases) in detail to better understand how F&A came into existence, the role it plays in research, the disparate views held of it by researchers, research administrators, Congress, federal agencies, and private foundations, and efforts during the past ten to twenty years to change it. Provide to the reader your own views about F&A and encourage conversations between the reader and others in your institution, including the SRO. If you are mentoring a group of readers, have them debate the F&A issue.

Exercise 6

Goal: To provide the reader with practical experience submitting a proposal through their institution to a federal agency.

Guidance: This exercise requires continuous involvement of a faculty or staff facilitator at the reader's academic institution. First, assist the reader in obtaining institutional training, or point them to institutional or external resources, regarding the various steps in developing and submitting a grant proposal to a federal agency. Discuss this process to ensure their understanding, and then explain to your OSP that the reader will be submitting to them a mock proposal for learning purposes only, and that the proposal is not to leave the institution. Second, work with the reader to identify a federal agency relevant to their interests or research and select a particular solicitation or announcement of opportunity having the same characteristics. Third, work with the reader to lay out the proposal sections, though each can be blank unless you wish to expand the exercise by having them complete a mock project description, etc. If the reader previously developed a project budget and associated justification (see exercise 4 of this chapter), they can use it for the present exercise. When all sections are available, work with the reader and the OSP to complete all steps associated with institutional proposal routing and approval, up to the final step of submission to the federal agency. Discuss the experience with

the reader and have them comment on how the process might be improved. Relate your own experiences and note the importance of meeting deadlines and following agency as well as institutional instructions.

Exercise 7

Goal: To provide the reader with practical experience developing, or participating in the development of, a complete research grant proposal for submission to an external funding organization.

Guidance: As in exercise 6 of this chapter, the current exercise requires continuous involvement of a faculty or staff facilitator at the reader's academic institution. Although many options exist for facilitating this exercise, perhaps the best strategy is to have the reader participate in the development of an actual proposal (yours or that of someone in your research group, department or college) for submission to an external funding organization. This process can extend for several weeks to several months, and thus sufficient time should be allocated to this exercise. Consider having the reader contribute to each part of the proposal, and as in exercise 6 of this chapter, ensure they engage in the various steps involved in institutional proposal routing and approval, as well as final submission to the funding organization. If possible, engage the reader in evaluating and responding to the reviews (chapter 7 in the book). Discuss with the reader the process and how it might differ at other institutions, especially those which are underresourced.

The Give and Take of Criticism

Subjecting Research to Scrutiny via Peer/Merit Review

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with peer review prior to reading the book.
- Discuss ways in which participants have been scrutinized throughout their lives in a manner not connected with their research (e.g., in school work, athletics, jobs, social media posts). What lessons have they learned and how did they apply this scrutiny to improve themselves?
- Step through the process of peer review for a journal article and grant proposal associated with your own research to ensure participants understand how it occurs. If you feel comfortable doing so, share and discuss the reviews with the group as well as your responses. What did you learn and how did you apply reviewer feedback to improve the submissions?
- Have individuals from non-STEM disciplines speak to the group about how peer review is applied to their scholarly activities (e.g., juried performances, recitals, etc.). Discuss common threads with peer review applied to STEM fields as well as differences.
- Provide participants with a one-page project summary from any of your previous proposals (or obtain one from your colleagues or the Internet) and have participants evaluate it, subject to specified criteria, and discuss their evaluation. This could be done in teams.
- Have participants debate (say in teams) various alternatives to traditional peer review. How would they go about bringing new approaches into the scholarly enterprise? Would they start with publishers? Federal funding agencies? The White House via an executive order?
- Download examples from the Federal Register in which public commentary is sought on proposed federal government rules (e.g., an RFI or a Notice of Proposed Rulemaking [NPRM]) and discuss how this process differs from classical scholarly peer review.
- Ask participants whether any aspects of their research have been reviewed, by peers or an advisor, including in classes (e.g., senior thesis or capstone course). Have them describe their initial reactions to negative criticism as well as their formal responses. What did they learn and how have they used that learning to improve their work?
- Ask participants to describe something in chapter 7 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To help the reader gain a deeper understanding of peer review by developing their own alternative to the traditional process.

Guidance: Discuss with the reader your own experience with peer review in proposals, publications, or other documents appropriate to your discipline. Include your review of others' work and their review of yours. Ensure the reader understands the pros and cons of traditional peer review and the various alternatives to it as a means for creating their proposed method. Discuss how their method might be presented to agencies and publishers as an alternative to those currently in use.

Exercise 2

Goal: To help the reader reflect on their response(s) to formal evaluation of their work or performance in various contexts, both professional and personal.

Guidance: Assist the reader in identifying situations in which they or their work were formally evaluated and discuss their answers to the questions provided in the exercise. You may wish to begin by discussing your reactions to reviews of your own work or performance, the many contexts in which they occur, and how they are used. Note to the reader how your reactions may have changed over time, especially as you gained a deeper appreciation for the value of review. Also, comment on situations, if any, in which reviews of your work or performance were incorrect and required rebuttal.

Exercise 3

Goal: To help the reader develop a strong working knowledge of the merit review process, and related strengths and weaknesses, as applied to grant proposals by NSF.

Guidance: Review and discuss with the reader the policy used by NSF for merit review of grant proposals, including your own experiences with it, as appropriate. Additionally, help the reader identify other researchers at your institution, who are or have been funded by NSF, to gain their perspectives for use in answering the questions provided in the exercise. Add other questions as appropriate, and consider sharing the reader's assessment with those interviewed.

Exercise 4

Goal: To help the reader appreciate the differences in review criteria applied to R&D grant proposals both within and across federal agencies and nonprofit foundations.

Guidance: Assist the reader in identifying agencies and nonprofit foundations appropriate to

their interests or current research and offer insights into review criteria based upon your own personal experience. The reader should evaluate differences in review criteria both within and across the two types of organizations listed.

Exercise 5

Goal: To provide the reader with insight into how the US Congress views peer/merit review, as well as actions being considered to modify it.

Guidance: Help the reader locate documents, videos of hearings, and other information in which Congress has debated, discussed, or commented on peer/merit review. Discuss with the reader the issues raised, the multiple points of view presented, and your own views regarding how changes might impact academic research and creative activity. Be sure consideration is given to national security, the protection of researcher ideas from theft by others, researcher administrative workload, privacy, competitiveness of companies seeking to commercialize researcher results, etc. Given the broad interest around this topic, assist the reader in identifying other researchers with whom to discuss these and other issues, perhaps in a group setting.

8

We See the World Differently

Bias and Differing Views

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with bias prior to reading the book.
- Discuss the words “bias” and “discrimination” and have participants reflect on how they interpret and apply these words in everyday life as well as in their own research. Compare this with the formal definitions given in the book.
- Have participants describe situations in which they have been the victim of bias, in the context of their research or other academic activities. If at an MSI or ERI, discuss the extent to which such affiliation might contribute to bias.
- Have participants describe situations in which they have been the victim of bias in ways other than research and academic activities. What similarities and differences exist compared to research and academic pursuits, and are solutions to bias the same for all such situations?
- Ask participants whether they have received formal training in bias as well as strategies for mitigating it. If so, have them describe the experience and the manner in which they are applying lessons learned.
- Discuss the various types of bias presented in the book and have participants give examples of how such biases might occur or be particularly prevalent in their discipline.
- Have participants describe ways in which bias might appear throughout the process of their own research, including types of bias. Discuss ways in which participants can work to ensure such bias does not occur or has minimal impact.
- Have participants describe ways in which bias might appear in the evaluation of their research (e.g., by their mentor or committee members, external peers), including types of bias. Discuss ways in which participants can work to ensure such bias does not occur or has minimal impact.
- Have participants identify examples in which research from their discipline (including their own work) has been misinterpreted or misused by policymakers or the general public.
- Discuss ways in which participants work to avoid or minimize their own biases in research and daily life.
- Ask participants to describe something in chapter 8 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader with insight regarding their biases using the Project Implicit evaluation framework.

Guidance: Although this exercise largely is self-paced and can be completed independent of a facilitator, it would be helpful to discuss with the reader your own experiences with bias and bias training. Consider taking the same online test as the reader to assess your unconscious bias. Compare notes with the reader and encourage others in your research group or institution to take the online test as well. If your institution offers training in bias awareness and mitigation, encourage the reader to complete it even if they are not required to do so. If no such training is available, identify other resources for the reader to use.

Exercise 2

Goal: To help the reader understand a variety of bias types and their similarities, differences, and impacts.

Guidance: Help the reader select biases that are most relevant to or most likely to occur in their discipline or scholarly activity, as well as a few others which are not. As necessary, assist them in comparing and contrasting the biases and address the questions in the exercise. Identify other researchers at your institution, in disciplines notably different from those of the reader, to whom the reader can speak about biases. A group discussion, involving individuals from multiple disciplines, could be most helpful for examining this topic.

Exercise 3

Goal: To help the reader reflect on biases that exist in society beyond research, their views toward individuals who exhibit such biases, and actions they can take to help mitigate bias.

Guidance: This exercise will be most effective if the facilitator and reader (or multiple readers) engage in open, thoughtful, respectful dialogue regarding biases they perceive to exist in society. Although not related to research, participants can gain additional insight into research-related bias by considering biases beyond the academic research enterprise. To the extent possible, understanding should be underpinned by authoritative data and analyses. Issues such as the potential for bias in new AI-driven decision systems also should be discussed, and if available,

individuals from your institution's computer or information science program should be invited to join the discussion. Additionally, scholars in academia study social bias (e.g., psychologists, sociologists, statisticians, political scientists), and they also should be engaged to provide a rich learning experience.

Exercise 4

Goal: To provide the reader with deeper insight into the possible occurrence of bias in peer review of research grant proposals.

Guidance: Discuss with the reader whether bias might have occurred in proposals you submitted to any external funding organization, and how you and the funding organization responded to it. Help the reader assess the studies mentioned in the exercise and also investigate other authoritative work that has evaluated possible bias in proposal peer review. Also, discuss the related issues of bias and broadening the participation of traditionally underrepresented, underserved, and underresourced populations and institutions, as well as efforts now underway to enhance their engagement in academic research and creative activity.

Exercise 5

Goal: To provide the reader with formal bias training.

Guidance: Help the reader identify institutional or external resources available to them for training in all types of bias, particularly that related to research, and have them take the training if possible. Discuss with them your own training and related experiences, and whether such training is required as part of your employment. Have them answer the questions provided in the exercise and add others as you see fit.

Honesty Is the Best Policy

Ethical Conduct and Research Integrity

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with ethical conduct in research prior to reading the book.
- Ask participants whether they have received formal training in the responsible and ethical conduct of research (RECR). Discuss their experiences and the value they found in such training.
- Ask participants whether they are aware of research misconduct that occurred in their own discipline, say at another institution as reported in the press, and discuss the outcomes and implications.
- Discuss how participants apply ethical principles in their own research and ways in which misconduct could occur (e.g., via fabrication of data, falsification of experimental results, etc.).
- Discuss whether participants have observed research misconduct directly and any actions they took or failed to take.
- Ask participants if they know how to report research misconduct and whether they fear doing so. Discuss policies at your institution for such reporting and ensure participants know how to utilize them. If your institution has a research or other ethics official, invite them to address the group.
- Ask participants to describe something in chapter 9 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To help the reader better understand RECR in specific contexts.

Guidance: Discuss with the reader the importance of RECR and your experience maintaining a program of ethical scholarship. Include situations where you had to report problematic behavior or address issues before they became serious problems. Ensure the reader understands that ethical conduct is relevant to all phases of research, and that breeches of ethical rules sometimes involve judgment calls for which paths to be taken are not entirely clear. If your institution offers RECR training and the reader has not yet participated, encourage them to do so, even if not required for them.

Exercise 2

Goal: To provide the reader with a broad view of institutional codes of conduct and how they differ across organizations and sectors.

Guidance: Help the reader locate appropriate institutions in multiple sectors and their associated codes of conduct/values. Have the reader note organizations that do not have them, and proceed to have them answer the questions posed in the exercise. Discuss your own institutional values or codes (for faculty, students, staff), how they have changed over time, and how they are communicated and enforced.

Exercise 3

Goal: To help the reader better understand the nature of and consequences associated with research misconduct by examining actual cases.

Guidance: Help the reader locate information about research misconduct cases as noted in the exercise, and keep in mind that semiannual reports to Congress by federal agency inspectors general also describe such cases, though without naming institutions and individuals. Discuss the reader's findings and follow the instructions of the exercise.

Exercise 4

Goal: To help the reader better understand the differences between unethical behavior that violates policy and illegal behavior that violates the law.

Guidance: Help the reader identify a topic and discuss with them the importance of adhering to policies, such as those for proposals submitted to any funding source and associated grants awarded, even though violation of the policy may not be a formal violation of the law. Note also that some states are passing laws whereby a violation of federal research agency policy indeed is a violation of the law and can result in serious consequences for the offender.

Exercise 5

Goal: To provide the reader with practical experience developing a plan for RECR applied to a large group of researchers operating as a team.

Guidance: Discuss with the reader your own experiences in ensuring RECR for yourself and those under your supervision, and help them devise the plan required by the exercise. If your

experience in this area is limited, identify researchers at your institution who have led or are leading relatively large groups, and have the reader meet with them to discuss their own plans.

Better Safe than Sorry

Research Compliance

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with research compliance prior to reading the book.
- If participants have undergone formal training in research compliance (e.g., for responsible conduct of research, human subjects or animal research, export controls, working with hazardous substances), have them share their experiences about both the training they received and how they are applying it in their research.
- Discuss research compliance training at your institution. If appropriate training does not exist, discuss how participants can obtain it.
- Describe how research compliance factors into your own research, as appropriate, and the amount of time you spend on compliance-related activities relative to research itself.
- Have participants describe the overall quality of the research environment in which they perform their work. That is, safety, security, diversity, inclusiveness, collegiality, etc. How might it be improved?
- Have participants reflect upon the research guidelines, rules, and principles most important to or most emphasized in their field of study.
- Discuss the topic of conflicts of interest and have participants identify potential conflicts that might impact their work were they to pursue external funding from a federal agency, nonprofit organization, or for-profit private company.
- Discuss the topic of research security and assemble teams to debate the competing challenges of securing research assets while promoting an open, international research enterprise. Evaluate the merits and drawbacks of potential solutions being explored by Congress, including concerns about racial profiling.
- Discuss the penalties associated with violating research compliance rules and regulations and identify resources, such as plagiarism-checking software, that help ensure compliance is achieved.
- Point the group toward institutional and external resources for learning more about research compliance, including formal training modules and webinars. Encourage them to take advantage of such resources.
- Ask participants to describe something in chapter 10 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader with deeper insight into responsible conduct of research via examination of actual cases.

Guidance: Assist the reader in identifying cases in which research misconduct occurred and review their summary and answers to the questions posed. Share your own experiences with research misconduct that occurred in your discipline and the manner in which it could have been prevented. Direct the reader to resources at your institution for receiving training in RECR and encourage them to take advantage of them even if they are not required to do so.

Exercise 2

Goal: To provide the reader with practical experience developing an Institutional Review Board (IRB) protocol framework for research involving human subjects.

Guidance: The issue of research involving human subjects is a complex one, and consequently, this exercise requires careful oversight by a facilitator having experience with an IRB. If your institution subscribes to CITI (Collaborative Institutional Training Initiative) services (see book for details), encourage the student to first complete the training sequence required for IRB-approved research. If not, direct the reader to online government resources (e.g., <https://www.bioethics.nih.gov/courses/irb.shtml>) to obtain deeper insight into IRBs and possible training. Assist the reader in developing the IRB protocol framework described in the exercise and encourage your institutional IRB officials to assist the reader as well.

Exercise 3

Goal: To ensure the reader is aware of compliance training required for their program of research, and to help them understand the amount of time required for meeting compliance requirements in research.

Guidance: Assist the reader in determining which compliance training is required for their research and which is required more generally (e.g., training in sexual harassment, diversity). Relate your own experiences in compliance training and how you ensure compliance rules and regulations are followed by you and those in your charge. Also, describe to the reader the amount of time you spend on compliance-related activities in comparison to research.

Exercise 4

Goal: To help the reader understand that, although compliance is a critical aspect of research, some rules and regulations should be modified or eliminated.

Guidance: Ensure the reader appreciates the importance of research compliance rules and regulations, but also that reforms are needed in order that regulations meet their intended purpose and do not pose undue administrative workload on researchers. Discuss with the researcher your own views of compliance and the activities upon which you spend the greatest amount of time. Help them identify a particular rule or regulation that could be reformed to become more effective while also reducing administrative overhead, and evaluate their response to the exercise.

Exercise 5

Goal: To help the reader understand and appreciate the institutional resources and structures needed to meet research compliance needs.

Guidance: Broker an introduction between the reader(s) and your institution's SRO so they can conduct an interview to gather the information needed for this exercise. Ask the SRO to reflect on national trends in compliance and the sources of funding available for increased research compliance at your institution.

Show Time

Making Your Work Known to Multiple Audiences

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with publishing, open access frameworks, and strategies for presenting research outcomes to both expert and nonexpert audiences prior to reading the book.
- Discuss open access publications and ask participants about their experiences with it. Have them describe situations in which a desired publication was inaccessible, or difficult to access, because it was behind a subscription paywall.
- Share with the group examples of various open access options online (green, gold, etc.).
- As a real-time exercise, have participants attempt to find formal material online (e.g., journal articles, books) that is relevant to their research, and ask them to track the number of times resources were available for free versus inaccessible owing to the absence of a subscription.
- Discuss open access data and describe your own experiences, as appropriate, with having to create and support a data management plan in your work. Describe resources provided at your institution for doing so.
- Discuss the pros and cons of open access to publications from the point of view of a researcher, an academic library, a large international for-profit publisher, a nonprofit publisher associated with a professional society, a federal funding agency, and a nonprofit foundation that funds research. Also, discuss how open access will differentially benefit MSIs and ERIs.
- Have participants describe their experiences communicating research outcomes to expert audiences. Do the same for general audiences. What did they find most difficult and most rewarding?
- Have participants describe general-audience venues in which they could present their work (e.g., Kiwanis and Rotary Clubs, Chamber of Commerce, Business Roundtable). What steps would they take to engage with such organizations?
- Have participants describe their research to the group in three minutes or less using no graphics or discipline-specific jargon. Have them critique one another and discuss strategies for improvement. This may take multiple iterations, and it might be useful to have them examine online resources for the “three-minute thesis” or videos on the website of the Alan Alda Center for Communicating Science.
- Set up team debates on particularly controversial or politically sensitive topics and use information from the book to guide the approaches used. In one instance, you may wish to have them be exceptionally collegial while in another, you may wish to let them “take off the gloves.” Have them evaluate the effectiveness of both.

- Have participants role play in one-on-one conversations about particularly controversial or politically sensitive topics. Use information from the book to guide the approaches used. To what extent are participants able to put themselves in the shoes of the individuals they are engaging?
- Ask participants whether they have been drawn into an argument about a particularly controversial or politically sensitive topic, and have them describe the experience. To what extent did they learn from the experience or apply some of the recommendations from the book?
- Identify upcoming local or institution-sponsored conferences and events at which participants might present their research (e.g., undergraduate research day).
- Provide examples of on-campus or community resources for participants to develop or hone their public speaking and writing skills.
- Ask participants to describe something in chapter 11 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To give the reader practical experience explaining their scholarly work to a nonexpert in a highly time-constrained situation.

Guidance: Numerous resources exist on the Internet to assist individuals in developing the type of presentation required by this exercise (e.g., search for “three-minute thesis”). Work with the reader to create the script, noting that the audience in this case is a nonexpert. Jargon should not be used, and analogies to common items and experiences can be especially helpful. You may even wish to specify the disciplinary expertise of the member of Congress and help the reader utilize it to explain their research. Assume the presentation is being made while walking with the member of Congress from one meeting to another (i.e., oral only, with no graphics). See exercise 3 of this chapter for developing a video example.

Exercise 2

Goal: To help the reader understand the array of views held regarding open access publishing by stakeholder groups in the research enterprise.

Guidance: This exercise pertains only to open access publishing, not data, and numerous reports and press releases have been written regarding the differing views toward it held by constituent groups mentioned in the exercise. Assist the reader in identifying sources and compiling

information, bearing in mind that open access is a global issue. Also, have the reader interview stakeholders in your own institution (see list provided in the exercise) as well as external ones (e.g., professional nonprofit society publishers, for-profit publishers, researchers in the private sector).

Exercise 3

Goal: To give the reader practical experience formally presenting their scholarly work, in video format, to a nonexpert in a highly time-constrained situation.

Guidance: This exercise is similar to that of exercise 1 in this chapter but involves creating a video and possibly using graphics. In addition to the resources mentioned in the exercise, consider having the reader speak with students and faculty in your institution's business or entrepreneurship program who are involved in "pitch competitions." In them, individuals pitch their idea for a business to a panel of potential funders in a time-constrained manner (though usually not as brief as three minutes).

Exercise 4

Goal: To help the reader identify venues for presenting their scholarly work to nonexpert audiences.

Guidance: Help the reader identify venues in your community or elsewhere for presenting their scholarly results to nonexpert audiences and evaluate their answers to the questions posed in the exercise. Share your own experiences presenting to such audiences, and help the reader locate speaker bureaus and other organizations that seek such presentations.

Exercise 5

Goal: To help the reader better understand the pros and cons of preprint servers for posting scholarly articles prior to their review or formal acceptance.

Guidance: Guide the reader in locating articles that speak to the issue of preprint servers and provide your own perspectives about their associated advantages and disadvantages. Although the COVID-19 pandemic provides many examples, you may wish to help the reader focus on challenges that have arisen in their discipline when information in articles not yet formally accepted has been used by the press or others.

12

Yours, Mine, and Ours

Ownership of Research Outcomes

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with IP and associated protection mechanisms, in the context of research outcomes, prior to reading the book.
- Ask participants whether outcomes from their research might one day need IP protection. If so, what outcomes and which type or types of protection?
- Ask participants whether they already have sought or received IP protection, and discuss their experiences.
- Have participants identify IP that has been patented, trademarked, is a trade secret, or has some other type of protection. These items need not be related to research.
- Describe any IP protection you have submitted or received for your own research. Discuss your experiences and share lessons learned.
- Describe to participants the IP or technology commercialization resources available at your institution.
- If your institution does not have an IP or technology commercialization services organization, discuss how participants can obtain such support elsewhere.
- Describe to participants resources available to engage in entrepreneurship; e.g., through formal education programs, and special activities such as the NSF I-Corps program.
- Have participants draft a sample license agreement for an outcome that might result from their own research. Discuss them as a group.
- Identify a faculty member who started a private company from IP resulting from academic research and have them speak to the group about their experiences.
- If your academic institution has partnerships with private companies, have an individual from one or more of the partner companies, as well faculty involved with the partnership, speak to the group.
- Have the group identify economic development incentives in your community or state that encourage and support the commercialization of IP developed at colleges and universities.
- Ask participants to describe something in chapter 12 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader with practical experience identifying and pursuing possible IP protections for the outcomes of their research and creative activity.

Guidance: Ensure the reader has a firm grasp of the material in chapter 12, and, in particular, of the mechanisms of and differences among tools for protecting IP. Assist them in thinking about possible outcomes from their own research that might need protecting, and share your own experiences as appropriate. Also, discuss resources within your institution to assist in IP activities and have the reader meet with IP staff to learn more about specific procedures, costs, and timelines. If your institution does not have such an office, coordinate with the SRO or provost to identify appropriate resources for completing this exercise.

Exercise 2

Goal: To provide the reader with a deeper understanding of procedures associated with filing domestic and international patents.

Guidance: This exercise will have greater impact if the reader has access to an invention or IP disclosure on which to file an imaginary patent, including an existing or expected outcome of their own work. If you have experience filing for a patent through your institution, or know others who have, relate the experiences to the reader prior to them visiting the United States Patent and Trademark Office (USPTO) website and beginning this exercise. You also may wish to help identify an existing commercial product, ideally in the reader's area of research, for use in the exercise.

Exercise 3

Goal: To provide the reader with a deeper understanding of the Bayh-Dole Act, its role in IP commercialization, and how it compares with counterpart Canadian policies or laws.

Guidance: If necessary, assist the reader in locating the Bayh-Dole Act and its most recent modifications, as well as efforts within Congress to modify it. Likewise, assist the reader in locating reports, several of which have been produced by the Canadian government, regarding policies, procedures, and successes in IP commercialization, especially in comparison to the US and the Bayh-Dole Act.

Exercise 4

Goal: To provide the reader with a deeper understanding of the policies and procedures used in academia to protect and commercialize IP across multiple disciplines.

Guidance: Assist the reader in identifying and contacting the IP office at your institution and ensure they understand the importance of the reader's work, as an educational endeavor. If your institution does not have such an office, coordinate with the SRO or provost to identify appropriate resources for completing this exercise.

Exercise 5

Goal: To provide the reader with a deeper understanding of the nature, process for addressing, and outcomes of disputes regarding protections for IP.

Guidance: Assist the reader in identifying a case and gathering the needed information. If your institution has a college of law or related program, help the student engage faculty or other experts in IP law in addressing the questions provided.

I Need You and You Need Me

Collaboration, Multidisciplinary Inquiry, and Academic-Corporate Partnerships

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with multidisciplinary or team collaboration prior to reading the book.
- Discuss the various types of multidisciplinary collaboration and have participants describe whether their own work falls into any of the categories presented.
- Although student participants are unlikely to be collaborating with others on their research, the prospects for doing so in the future are high. Have them discuss ways in which they see their work improving or being expanded by virtue of working with others in their own discipline or outside it.
- For nonstudent participants, discuss their experiences in collaboration and the extent to which they were or were not made to feel part of the group. Discuss the notions of diversity, inclusion, acceptability, and belonging and ways in which participants can ensure such features are part of a healthy collaboration.
- Have participants describe intellectually challenging and societally relevant research problems in their fields that require or are being pursued in a multidisciplinary framework. Discuss how progress would be limited in the absence of such collaboration.
- Have participants share their experiences regarding courses taken at the boundary of traditional disciplines or within other disciplines.
- Ask participants whether they are pursuing, or have obtained, formal credentials in fields other than their own (e.g., minors, areas of concentration, certificates, badges). Explore their rationale for doing so and how they plan to apply these credentials in their work.
- Have participants discuss how they view themselves professionally (e.g., as a geologist, linguist, artist, electrical engineer), and how they will convey to others the skills they have within other disciplines.
- Ask participants to share their experiences working in teams, both in their personal as well as professional lives. What did they find valuable or difficult, and what role did they play in the team? What would they change about the team if they had an opportunity to redo the experience?
- Reflect on the diversity of participants in the facilitated discussion in every way the word “diversity” can be interpreted. Is it as diverse as it might be? What steps could be taken to improve diversity? How has diversity impacted the nature of the discussions and the learning that has taken place?

- Discuss the importance of trust in professional relationships and have participants describe situations in which their trust of others, or others' trust in them, was damaged. What happened going forward?
- Have participants identify characteristics of successful teams, in addition to those described in the book, based on their own experience in working with others.
- Pick a research topic of interest to the group and collectively develop a team as well as a strategy for managing it based upon guidance provided in the book.
- Invite outside speakers to discuss their experiences working in teams and in academic-corporate partnerships.
- Ask participants to describe something in chapter 13 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader with practical experience identifying a research problem requiring more than one discipline and forming a multidisciplinary team to tackle it.

Guidance: Help the reader identify the problem and disciplines involved and assist in answering the questions as necessary. Relate your own experiences developing, leading, or participating in multidisciplinary team research and offer insights that might be helpful.

Exercise 2

Goal: To provide the reader with deeper insight into how universities and most federal R&D agencies are organized, and to help them identify changes that might be useful for promoting research involving multiple disciplines.

Guidance: Have the reader explore several federal funding agency and academic websites to better understand their organizational structures in the context of funding and performing research, respectively. Share your personal experiences submitting grant proposals involving more than one discipline and the manner in which the federal agency handled them. If you have limited experience in this regard, help the reader identify individuals in your institution having such experience and set up interviews. Does your institution utilize centers, institutes, and other administrative constructs—outside of traditional academic departments and programs—to support multidisciplinary research? If so, help the reader understand the pros and cons of such

structures, including split appointments across programs, the assignment of credit for grants and publications, etc.

Exercise 3

Goal: To help the reader understand how to position themselves for multidisciplinary scholarship.

Guidance: Share your own experiences with the reader and help them identify individuals in your institution who are working on multidisciplinary problems to understand how they positioned themselves to do so. Have the reader speak with one or more academic advisors to understand how they assist students seeking to gain expertise in multiple disciplines as they proceed through their undergraduate or graduate programs.

Exercise 4

Goal: To help the reader reflect on their own research in the context of research frameworks involving multiple disciplines.

Guidance: Help the reader understand how their research maps into frameworks involving more than one discipline and how it might be expanded and enhanced by including scholars from other disciplines. The issues addressed in this exercise are particularly important for upper-division graduate students, postdoctoral scholars, and early-career faculty as they think about the trajectory of their career over the next five to ten years.

Exercise 5

Goal: To provide the reader practical experience creating a diverse team of scholars to address a research problem.

Guidance: Ensure the reader understands diversity in the broadest sense and considers multiple attributes of diversity in assembling the team. Share your own experiences with diversity, and point the reader to training available at your institution or externally on diversity enhancement in research. Although most institutions now have offices of diversity, equity, and inclusion, they mostly emphasize diversity in the student body, hiring, and institutional culture rather than enhancing diversity in or through research. You may wish to discuss this issue with that office at your institution.

Exercise 6

Goal: To provide the reader practical experience exploring research partnership opportunities with a real for-profit private company.

Guidance: Assist the reader in identifying an array of for-profit private companies, locally or beyond, that might serve as suitable research partners. Help them answer the questions posed in the exercise, and relate your own experiences working with private companies. If you have little or none, point the student to researchers on your campus who do and help set up interviews with them. In addition, if your institution has a corporate partnership office or office of corporate relations, have the reader engage with them in answering the questions posed.

A Glass Half Empty or Half Full

Challenges and Opportunities for the US Academic Research Enterprise

Suggestions for Discussion and Group Learning

- Ask participants about their awareness of and experience with the broader elements of America's research and education enterprise, and their future directions, prior to reading the book.
- Discuss the challenges of equitable representation across all gender, racial, and ethnic groups in research and why diversity is important in this regard.
- Encourage participants to voice their thoughts and concerns about the future of America's academic research enterprise, and explore the roles they can play, now and in the future, to help ensure America remains an internationally engaged global leader in research, creative activity, and education.
- Have participants develop ideas regarding how the US can engage more effectively internationally to produce quality research, educated students, and innovative products.
- Ask participants to describe something in chapter 14 they found particularly interesting or enlightening.

Guidance for Completing Exercises to Deepen Understanding

Exercise 1

Goal: To provide the reader practical experience developing a framework for K–12 students in research and creative activity to ensure America has an adequate and diverse foundation of STEM talent for the future.

Guidance: The development of STEM talent, and addressing the numerous challenges associated with it, are extremely complex issues. Consequently, the first step in facilitating this exercise is to assist the reader in identifying resources to help them understand the nature of these challenges, as well as proposed solutions. Possibilities include reports from the National Science Board (NSB), the National Academies of Science, Engineering and Medicine, professional societies such as the Association of Public and Land-grant Universities (APLU) and the Association of American Universities (AAU), and also Congress. Discuss with the reader the many challenges involved, particularly with regard to broadening the participation of groups and

institutions that traditionally are underresourced, underserved, and underrepresented. Help the reader frame the program and discuss their responses to the questions posed.

Exercise 2

Goal: To help the reader better understand the necessity and value of a skilled technical workforce (STW) in America's research enterprise.

Guidance: Read the NSB report and discuss it with the reader. Point to specific examples, in your field or others, in which an STW is critical to the performance of research and creative activity. Note the relevance of this issue to non-STEM disciplines (e.g., dance and musical theatre, where lighting and sound technicians may not have formal university degrees but rather certificates from technical institutes). Encourage the reader to meet with other researchers at your institution to learn of the dependence on the STW of research and creative activity in their disciplines.

Exercise 3

Goal: To help the reader better understand the importance of American global leadership in research, and actions which can be taken to ensure it maintains this position while also collaborating effectively with international partners.

Guidance: Although the exercise speaks to the importance of international science, engineering and technology, the issues are equally applicable to non-STEM disciplines. Assist the reader in taking a broad view of the research enterprise internationally and help them identify and evaluate additional measures (e.g., scores on standardized tests) that speak to America's current position. Help the reader answer the questions posed, and add others as might be beneficial. Point the reader to researchers in your institution who collaborate with international partners to obtain their views as well.

Exercise 4

Goal: To help the reader better understand the dual value of a degree in higher education and the shift that has occurred during the past few decades toward degrees becoming a private over a public good.

Guidance: Assist the reader in locating additional resources on the changing landscape of higher education during the past few decades in the context of value, cost, and return on investment. If you have been in academia for a relatively short period of time, you may wish to point the reader to those in your institution who have tenures of twenty years or more in order to gain their insight. Help the reader frame a set of arguments for bolstering the notion of higher education as a public good and address the questions posed in the exercise.

Exercise 5

Goal: To help the reader better understand the value of foreign nationals in America's research enterprise and the policies needed to ensure their continued engagement. (Note that research security, discussed in section 10.3 of the book, is an important consideration.)

Guidance: This particular topic is notably challenging and complex as it involves issues related to immigration more broadly as well as economic and military competition between global powers. Ultimately, the issue is one of policy, and thus the best approach is to assist the reader in studying policies (e.g., US State Department visa laws and regulations) related to foreign nationals pursuing academic degrees and conducting research (as students or in other capacities) in the US. Have the reader examine recent congressional reports and hearings on the topic of immigration in the context of research and international competitiveness, and encourage them to discuss the experiences of foreign nationals in your institution. Additionally, an examination of the policies of other nations will be constructive.