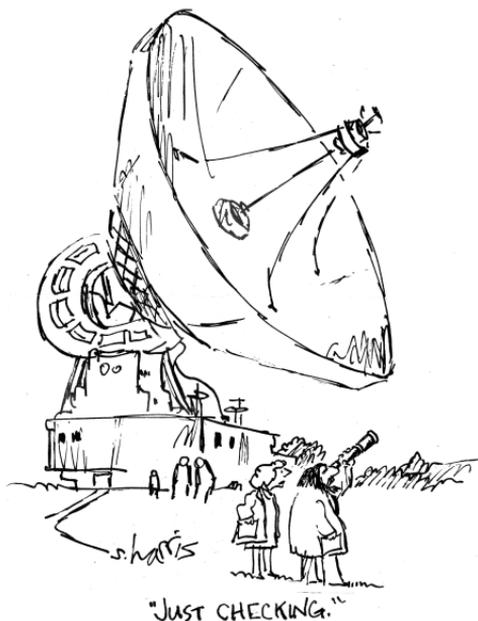


# 1

## RESPONSIBLE CONDUCT OF RESEARCH AND THE GLOBAL CONTEXT

### An Overview



Scientific research is one of the great adventures of our time. Researchers are members of a global community that is producing new knowledge at an unprecedented rate. This new knowledge is transforming society by contributing to the development of new technologies and by changing

how we think about the natural world, ourselves, and our institutions.

The growth and accelerating pace of scientific discovery has made the twenty-first century an exciting time to be a researcher. Large international teams are working on problems that were impossible to solve in the past, such as the annotation of the human genome, the search for dark matter, or the analysis of “big data” derived from social media. New fields of research are opening up at the intersection of traditional disciplines, such as nanobiology and neuroeconomics (Glimcher 2003; Nussinov and Alemán 2006). Researchers are generating knowledge that could fundamentally alter agriculture, energy production, environmental protection, communications, and many other aspects of human life. Our future on this planet will depend to a considerable extent on the products of research.

Like the rest of society, the research enterprise has been undergoing momentous changes. Information technology is revolutionizing how research is done and how researchers interact with each other. Most researchers work not just on individual tasks but as parts of research teams that include people with many different backgrounds and perspectives and may be international in scope. Governments around the world, recognizing the critical role of research in improving the well-being of their citizens, are increasing their support for science and engineering. As a result, millions more scientists and engineers are working today than was the case just two decades ago (NSB 2012).

The changes going on within research have created challenges. Team research can create conflict as well as opportunity. The rapid expansion of the research community may disrupt the transmission of traditions and ethical principles to new researchers. Increased competition for resources may intensify the pressures faced by researchers, including young investigators, to publish more papers and to publish in the most prestigious journals. Technology-enabled tools

such as blogs and social media increase the speed of scientific communication but may also contribute to eroding collegiality or facilitate the spread of unreliable information. Many researchers travel to countries where they may encounter different research practices than they are used to, or they may become involved in interdisciplinary research that is unlike research they have done before. The research landscape has become more diverse, more interconnected, faster paced, and more complex than ever.

Throughout the history of research, young and early career researchers have learned about standards of conduct by working with more experienced researchers. This process of learning by doing will continue to be essential in the training of future generations of researchers. However, new researchers can benefit from having a readily accessible and compact source of guidance—guidance that more-experienced researchers need to review and follow as well. All researchers can benefit from a better understanding of changes in the research landscape and their possible impacts.

In 2008, the International Council for Science (ICSU) published a booklet providing guidance about the responsibilities and freedom of researchers to maximize the benefits of science for society. One year later, the educational guide *On Being a Scientist: A Guide to Responsible Conduct in Research* (NAS-NAE-IOM 2009) was published. In 2012, the InterAcademy Council (IAC) and IAP—The Global Network of Science Academies—published *Responsible Conduct in the Global Research Enterprise: A Policy Report*, which describes the values of research and how those values should guide the conduct of research. This 2012 report acknowledged that different disciplines and countries have varying research traditions and cultures. But it argued that the fundamental values of research transcend disciplinary or national boundaries and form the basis for principles of conduct that govern all research.

The educational guide you are reading now is an adaptation and expansion of the earlier policy report and was written by the same committee. It includes much of the same content and in some cases even the same language; text from the recommendations of the report is printed in bold-face type when it appears in this publication. However, this publication has a different goal than previous documents. It has been written as a practical guide to conduct in a research environment that is being transformed by globalization, interdisciplinary research projects, team science, and information technologies. It addresses both long-standing issues in the responsible conduct of research and emerging issues. It is aimed not only at new researchers but at more-experienced researchers and research administrators, funders, and policymakers, all of whom are caught up in the broad trends that are reshaping the research enterprise.

This guide provides an overview of which research behaviors are responsible and to be embraced and which are irresponsible and to be avoided. It uses specific examples from a variety of areas to provide guidance relevant to researchers in all fields. The organization of the guide parallels the research process. The even-numbered chapters follow the process of research, from planning and preparing to undertake research (chapter 2) to carrying out research (chapter 4), to preventing and addressing irresponsible research practices (chapter 6), to reporting research results (chapter 8), to communicating with policymakers and the public (chapter 10). The odd-numbered chapters discuss broader issues associated with performing research: the researcher's responsibilities to try to prevent the misuse of research and related technology (chapter 3), the researcher's responsibilities to society in planning and carrying out research (chapter 5), aligning incentives with responsible research (chapter 7), and the benefits and challenges of international collaboration (chapter 9). The references and additional resources do not represent an exhaustive bibliographic source, but they

provide the reader with further material about the topics covered in each chapter.

Two types of boxes accompany the text. Focus boxes illustrate the issues discussed in each chapter. Discussion scenarios describe hypothetical situations and related questions to foster debate.

A key premise of this project is that prevention is better than cure—that more and better efforts to educate and train researchers about the importance of adhering to high standards and good practices will speed the advance of knowledge and increase the positive impacts of research. Many publications are available that describe responsible conduct in science. What sets this guide apart is its emphasis on internationally harmonized standards in a rapidly changing global research environment. Some of these standards are still in flux and are not yet universally observed. But every researcher has a responsibility to contribute to the development and dissemination of these standards, just as every researcher has an obligation to maintain the integrity of research. Societies around the world have placed their trust in scientific research to generate knowledge for its own sake and to understand and solve major problems. To maintain this trust, everyone involved with the research enterprise must help ensure that research is conducted responsibly.

## **Terminology and Definitions in This Guide**

### Research

This report treats research as encompassing many forms of disciplined human thought, including the natural sciences, the social and behavioral sciences, and the humanities. Research thus includes the generation of new knowledge in fields traditionally recognized as the sciences, whether theoretical, experimental, or computational, and in other areas grounded in the rational analysis of empirical evidence.

## Irresponsible Conduct, Practices, or Behavior in Research

In this report, all unethical and harmful behaviors by researchers that relate to the conduct of research are referred to as irresponsible research practices, behavior, or conduct. The report refers to ethical and desirable research-related behaviors as responsible research practices or responsible research conduct.

## Misconduct and Fraud

Different countries define research misconduct and research fraud to include serious categories of irresponsible research practices such as fabrication or falsification of data or plagiarism. Some countries include as misconduct or fraud such behaviors as obstructing an investigation into research misconduct or retaliating against a whistle-blower.

## Bias

For the purposes of this report, a bias is a tendency or inclination on the part of a researcher or research group that introduces systematic error into the research process and damages the validity of the resulting work. Biases can affect research design, data collection and interpretation, or the reporting of results. While biases may be difficult or impossible to eliminate completely, steps can be taken to identify and minimize the most serious potential sources of bias.

## Conflict of Interest

A researcher is considered to have a conflict of interest when financial, personal, or other considerations have the potential to compromise judgment or objectivity. Research sponsors and research institutions often require researchers to disclose possible conflicts of interest and may institute

additional oversight procedures or restrict involvement of the conflicted researcher in the work.

### Principal Investigator (PI)

This term refers to the senior researcher in a laboratory or research group. PIs are often the primary supervisors of graduate students and postdoctoral fellows and are responsible for tasks such as submitting proposals and complying with research-related regulations.

### **Possible Ways of Using this Guide**

This guide can be used in many different ways. It can be read by individuals, discussed in groups, or taught in seminars or classes. It can form the basis for an online seminar or discussion involving larger or more-distributed groups. A research group or institution could use it to supplement existing codes of conduct. Or it could be used to develop a code of conduct for a specific research field or institution. It is short enough to cover in a single workshop or can be combined with other materials in a broader treatment of responsible research.

The committee has sought to keep the guide concise. A growing wealth of excellent materials on research integrity and scientific responsibility is available, and the “References and Additional Resources” sections at the end of each chapter provide the necessary information about accessing such materials.

The discussion scenarios in this guide have been designed to foster examination of difficult questions. They do not have simple answers or easy solutions. One way to use these discussion scenarios would be to assign individuals or groups to present and defend contrasting viewpoints. Discussants could identify affected parties—whether individuals, institutions, research fields, or society—and the

interests each party has in the situation. They then could explore possible actions and the consequences of each action. Discussants also could be encouraged to act out the roles of parties with conflicting interests to explore more deeply the tradeoffs and uncertainties associated with possible actions.