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# Effective and Meaningful Responsible Conduct of Research Instruction and Institutional Plans

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**ABSTRACT:** The National Science Foundation [NSF] has long been a leader in promoting responsible and ethical research environments and responsible conduct in research, both through their research programs and their implementation of the America Competes Act, which mandated training in the responsible conduct of research for researchers supported by their funds. However, many institutions still do not have plans for required RCR education that incorporate best practices in a meaningful way because they have no clearly articulated goal for an RCR program, are not aware of model practices, and face institutional obstacles and constraints. The project reported here brought together subject matter experts and key partners from the research integrity community to develop and evaluate resources that might address those concerns. Here we present two of the resources developed through these workshop activities: (1) recommended approaches for effective and meaningful RCR instruction, and (2) guidance for Institutional NSF RCR Plans.

## Introduction

**THE NATIONAL SCIENCE FOUNDATION [NSF]** has long been a leader in promoting responsible and ethical research environments and responsible conduct in research (RCR[1]), both through their implementation of the America COMPETES Act[2] and their funding of research through the Ethics Education in Science and Engineering, Cultivating Cultures of Ethical STEM, and Ethical and Responsible Research programs.

In keeping with these efforts, the NSF funded a workshop focused on the development of relevant and timely resources for faculty, staff, and administrators responding to the America Competes requirement for RCR education.[3]

The Research Integrity Scholars and Educators [RISE] Consortium, a signature program of the Association for Practical and Professional Ethics [APPE; https://appe-ethics.org] hosted the workshop and conducted the related research activities. Members of RISE are leading scholars and educators in the field of RCR with specialized knowledge and experience in working collaboratively to develop resources and curricula for researchers and administrators working to promote RCR (Plemmons 2023).

This project brought together subject matter experts and key partners from the research integrity community to develop and evaluate resources for promoting ethical and responsible research. More than 30 administrators, scholars, and educators of RCR contributed to this project as interviewees, members of a drafting group, reviewers, or workshop participants. The resources incorporate points of agreement across major studies of best practices in ethics education, including the 2009 report from the NSF-funded National Academies workshop, *Ethics Education and Scientific and Engineering Research: What's Been Learned? What Should Be Done?* [National Academies, 2009], and the 2017 report from the National Academies of Science, Engineering, and Medicine, *Fostering Integrity in Research* [National Academies, 2017].

This article presents two of the resources developed through these workshop activities: (1) recommended practices for effective and meaningful RCR instruction, and (2) guidance for Institutional NSF RCR Plans.

## Background

In 2007, the America COMPETES Act [US Congress; PUBLIC LAW 110–69] was signed into law by President Bush with the goal of improving the competitiveness of the United States by investing research and development. The Act included several education and mentoring requirements aimed at strengthening the STEM workforce; to this end, section 7009 required institutions seeking funding for research to have a plan "to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduate students, graduate students, and postdoctoral researchers participating in the proposed research project" [PUBLIC LAW 110–69, section 7009] In 2010, the National Science Foundation (NSF) implemented section 7009 of the America COMPETES Act by requiring institutions applying for research awards to certify that they have a plan to provide RCR training.

Unlike other federal agencies with similar requirements (see Heitman 2024 for a broad history of these requirements), the NSF did not provide guidance or specify requirements for content, format, or frequency of the educational activities, or the structure of the plan.[4] NSF representatives conducted outreach, and shared best practices, but the NSF deliberately chose not to state requirements because "the research community . . . is best placed to determine the content of RCR training without a need for NSF-specified standards" (NSF FAQ 2011).

Five years after the NSF implemented the requirement, Phillips et al [2018] conducted an analysis of the training plans of institutions classified as Carnegie "very high research activity." They found that very few institutions had developed plans incorporating best practices shared by NSF regarding content, format, frequency, and structure. Most institutions (82%) had plans that could be satisfied with one-time non-instructor led online programming that did not actively engage trainees and did not differ according to career stage or discipline.

Around the same time, the NSF Office of the Inspector General [OIG] issued similar findings (2017). They reviewed the training plans and interviewed administrators and trainees at 53 institutions, and found, as did Phillips et al, that many institutions provided all of their RCR training through standard non-instructor led online training. According to interviews with administrators, the primary reason for offering this type of training was convenience, both in terms of access and tracking completion. However, trainees reported that this uniform training, which did not differ by career stage or discipline, "provided mostly common-sense advice and/or advice that was repetitive, not applicable to their research, and/or too basic and generalized." Furthermore, trainees reported that "they did not like the online training format because they did not have the opportunity to ask questions about what they were learning or discuss the content being presented" and they did not, for example, have "an opportunity to discuss case studies" (p6-7). The OIG report concludes that "NSF's awardees could benefit from NSF providing written guidelines or templates for universities to follow . . . and from the sharing of best practices with the broader community" (P13).

It is our experience that many institutions still do not have plans for RCR education that incorporate best practices because they (1) have no clearly articulated goal for an RCR program, (2) are not aware of model practices, and (3) face institutional obstacles and constraints. These challenges to developing and implementing a plan that provides meaningful educational experiences were first identified by the Council for Graduate Schools (CGS) in 2008 and 2012; again in Phillips et al [2018]; and again in the NSF OIG report [2017]. This project aims to guide institutions in identifying the goals for an NSF RCR plan, raise awareness of best practices, and provide guidance and structure for implementation plans.

## Methods

Recognizing the diversity among the people and offices involved in institutional efforts to promote RCR, the project began by identifying partners and conducting interviews. RCR efforts can include university administrators charged with facilitating RCR instruction; RCR instructors (both seasoned and novice); PIs; undergraduate, graduate student, and post-doctoral researchers; non-university instructors and students; other research ethics professionals; STEM funding officers; and government leaders. In order to better understand this diversity of audience and purpose, PI Trisha Phillips and co-PI Dena Plemmons identified

key stakeholders and conducted telephone interviews prior to the workshop.[5] The aim of the interviews was to construct profiles of those involved with institutional efforts to promote RCR and identify needs regarding informational content and categories of resources.

Phillips and Plemmons then convened a working group to draft materials, solicited written reviews from subject matter experts, hosted a workshop in Cincinnati for further discussion, and revised the materials and recommendations accordingly.

## Results

Phillips and Plemmons conducted interviews with representatives from the American Society for Bioethics and Humanities (ASBH), the Association for Research Integrity Officers (ARIO), the Council on Government Relations (COGR), the Council of Graduate Schools (CGS), Public Responsibility in Medicine and Research (PRIM&R), and the Society for Research Administrators International (SRA International). Themes which emerged from these interviews included:

1. Participant members would like a statement of scope for responsible and ethical conduct of research that is coherent, distinctly situated within larger concerns of social, professional, and personal integrity, and recognizes the role of responsible and ethical conduct of research within the broader institutional culture of integrity.
2. Participant members would like the NSF to do more to "elevate RCR" and signal the importance of education in RCR to all parties.
3. Participants would like guidance on meaningful and effective institutional plans.
4. Participant members would like more instructional resources.
5. Participant members would like instructor manuals.
6. Participant members would like metrics for effectiveness.

While some of these requests were beyond the scope of this particular project, we attended to those items which we could address. Here we present two resources developed through the project : (1) recommended practices for effective and meaningful RCR instruction, and (2) guidance for institutional plans, in the form of "key considerations." These resources are also available on the Online Ethics Center (OEC).

## Guidance for Effective and Meaningful RCR Education[6]

Excellence in science depends on individuals, groups, and organizations conducting research in a responsible and ethical manner.

The responsible and ethical conduct of research [RCR] can be defined as proposing, performing, reporting, and evaluating research in a way that merits trust by:

- being honest, objective, and open
- using rigorous and reproducible methods
- adhering to ethical, professional, and regulatory standards, and
- promoting and maintaining safe, inclusive, and equitable working environments

The NSF's implementation of the America COMPETES Act allows universities and research institutions the "flexibility to develop and deliver effective training" (2009) and this flexible approach has not changed with the passage of the CHIPS and Science Act (2022). This resource shares general guidance for RCR education that may be helpful to PIs, instructors, administrators, and institutional leaders who wish to provide meaningful and effective RCR educational activities (Kalichman 2024).

Meaningful education in RCR engages all research personnel in discussions about ethical research practices to raise awareness, convey norms and expectations, develop skills, and provide resources for navigating ethical issues. RCR education contributes to professional development, helps researchers at all career stages (trainees, PIs, and senior personnel) understand the connection between ethical practice and good research, and strengthens institutional cultures of integrity.

*Who should engage in RCR educational activities?* The America COMPETES act, as amended by the CHIPS and Science Act, requires that NSF-funded undergraduate students, graduate students, postdoctoral researchers, PIs, and senior personnel engage in RCR education. While the federal mandate simply requires PIs to complete RCR education, for PIs who supervise trainees, it is important for the PI to participate in the trainee's RCR education because it signals that this education is integral to the activities of the research group and trainees' professional development, and it strengthens the ability of the PI to serve as an effective RCR mentor. Additionally, PIs, administrators, and institutional leaders should consider including all members of a program cohort and/or all members of a research team in RCR education (regardless of funding) (Phillips 2024). Moving the training beyond a mere compliance activity based on the funding source's requirements will help all researchers understand and appreciate that RCR education is a fundamental component of learning how to do responsible research. Furthermore, including team members and program cohorts not only makes the experience of the NSF-funded researcher more meaningful, but also contributes to the professional development of other students who are not supported by NSF funds, strengthens the institutional culture, and promotes a climate of research integrity.

*What should be learned?* The practices, concerns, skills, and competencies addressed in any specific RCR activity should be appropriately tailored to the discipline, educational level, and specific needs and circumstances of the audience, and should be relevant to their current research and future professional goals. Additionally, PI involvement in the trainee's RCR education is critical because PIs are well situated to identify the content[7] related needs of their trainees as they evolve and mature in their professional development, increase their level of research involvement, and develop mastery of research skills. Furthermore, PI involvement in trainee's RCR education activates the informal curriculum which is an important complement to the formal curriculum of RCR training.

Regardless of discipline or field, researchers share common obligations and responsibilities that RCR educational programs and daily research practice should prepare them to meet. These encompass:

1. Obligations to the research per se. This includes, for example, good data management practices, mitigation of bias, responsibilities towards the subject(s) of research, awareness of and compliance with relevant regulations, and prevention of research misconduct.
2. Obligations to other researchers and professional colleagues. This includes, for example, responsible mentoring, appropriate authorship practices, responsible peer review, and maintaining a safe, inclusive, and equitable working environment.
3. Obligations to society. This includes, among other concerns, social responsibility, effective scientific communication, responsible stewardship of resources, and maintenance of public trust.

*How should RCR education be delivered?* There are many ways in which RCR education can be effectively delivered. Regardless of the modality, it is important to ensure that approaches to learning are *active, engaged, and learner-centered,* and to apply best practices for adult learning. This can be accomplished in typical "face-to-face" settings as well as in synchronous, interactive, instructor-led training in online or virtual environments.

Non-instructor led, stand-alone online programs can be useful in providing baseline information, but they need to be supplemented with active and engaged learning opportunities. It is important to note that non-instructor led, stand-alone online programs used as the sole RCR educational activity do not "provide an adequate introduction or enough practical experience to prepare [students] for ethical problems that arise in academic and professional life" (Hollander and Arenberg, 2009).

RCR activities will be more appropriate to the educational needs of trainees when the curriculum is designed and delivered by personnel (including PIs) with experience in teaching and research and who have a genuine interest in facilitating conversations about research integrity. If PIs and other research faculty are not themselves providing such instruction, they should at least participate

in RCR instruction in ways that allow them to engage in conversations with and serve as effective role models for their students and trainees.

Finally, in addition to formal training, PIs, senior personnel, and trainees should regularly engage in conversation and reflection about the ethical dimensions of their work in the settings where they conduct their research, and in the context of specific research projects. All members of the team should collaboratively work toward a shared understanding of the values and norms that guide their research.

## Key Considerations for Institutional NSF RCR Plans

The NSF requires that institutions applying for research awards have a plan "to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduate students, graduate students, postdoctoral researchers, faculty, and other senior/key personnel who will be supported by NSF to conduct research" (PAPPG, NSF 24-1, IXB2).

An institution's NSF RCR plan details the institution's RCR educational requirements for NSF funded trainees, faculty, and senior personnel. However, leaders and administrators should keep in mind that best practices recommend a broader institutional RCR education program that provides and may require RCR education for all students and faculty engaged in research, no matter the funding source.

The NSF recognizes that different circumstances may necessitate different approaches; as such, the NSF does not state or specify requirements for an institutional plan. The NSF does, however, note two things specifically: the training "should be effective and must be appropriately tailored to the specific needs and circumstances at each institution" and "must include mentorship and mentor training" (PAPPG, NSF 24-1, IXB2).

This resource presents key elements to consider when developing an institutional RCR plan to meet the NSF requirement; similar considerations might be helpful when designing RCR plans for NIH training grants or individual fellowships. While many institutions use the same plan for NSF and USDA NIFA RCR requirements, administrators should be aware that the NSF and USDA NIFA have different criteria regarding required content.

For additional information, see the 24-1 PAPPG Chapter II.D1d(iv) and Chapter IX.B.

### WHY

1. Beyond meeting this NSF requirement, what does your institution intend to achieve through this plan? What are the institutional goals in terms of promoting ethical and responsible research and preparing the next generation of researchers? What are the instructional goals in terms of trainee, faculty, and senior personnel awareness,

understanding, abilities, skills, or behaviors? Will the institutional NSF RCR plan be part of a broader institutional RCR education program?

WHAT

1. Will the requirements be uniform for all NSF-funded trainees, faculty, and personnel? Or will they be differentiated based on career stage or learner demographic? For example, will undergraduate students have different training than post-docs? Will domestic trainees have different training than international trainees? Will the requirements for PIs and senior personnel differ from the requirements for trainees? Similarly, will certain specialized topics or project-specific content be required for specific groups?
2. Will the requirements be uniform across the institution, or will they vary by college or unit?
3. Will there be minimum requirements that a uniform plan or options in a differentiated plan must meet? For example, will the plan require synchronous instructor led engagement? Will there be a required minimum amount of educational engagement (e.g., 8 hours)?
4. Will the plan accommodate PIs, programs, and/or units that want to offer RCR educational activities for their NSF-funded trainees, faculty, and personnel? If so, will the institution specify any criteria for such activities? (For example, criteria regarding format, duration, or content?) What is the process by which those educational activities are reviewed and approved?

WHEN

1. By when will NSF-funded trainees, faculty, and personnel be required to complete the RCR education? (For example, within 90 days of joining the project, or when trainee support begins.)
2. How often are NSF-funded trainees, faculty, and personnel required to complete RCR education? (For example, once per project, or once per career stage, or once every 4 years?) For planned multiple exposures at different time points or career stages, will the programming or expectations be different?
3. Under what circumstances can RCR education that was completed prior to joining an NSF project satisfy the institution's requirement?

HOW

1. How will instruction be offered? Will there be a range of formats (e.g., synchronous online sessions, face-to-face sessions, or some hybrid approach)?

2. Will there be only one way to satisfy the requirement, or will the institution provide learners with a choice among options (e.g., synchronous online sessions, asynchronous non-instructor led on-line modules, face-to-face sessions, or some hybrid approach)?
3. Will PIs and senior personnel who are supported by NSF funds be required to participate in the RCR educational activities for their trainees? If so, how will they engage? (For example, complete the same training, incorporate content into lab meetings, or facilitate discussions). How will they be supported?
4. Will faculty, advisors, or mentors who are not supported by NSF funds be encouraged or required to be involved in RCR training?
5. How will the RCR educational activities address mentor training and mentorship?
6. How will completion of the RCR education requirement be documented and tracked for internal purposes? (For example, will the institution's electronic research administration system manage this data, or will a specific individual collect and store the data?) How will it be documented for trainees, faculty, and personnel? (For example, will trainees get a certificate? Or will it be noted on their transcript?)

<u>WHO</u>

1. Who will be required to take the training? That is, how will institutions determine who is "supported by the NSF to conduct research"? If there are members of the research team who are not funded by NSF, will they be encouraged to participate as well?
2. Who will deliver the education? Will faculty, advisors, or mentors be encouraged or required to be involved in RCR teaching?
3. Who (and in which institutional offices) is responsible for drafting, revising, approving, and disseminating the RCR plan? Will more than one office be involved, and if so, how will they coordinate efforts?
4. Who (and in which institutional offices) will manage the educational activities associated with the plan? Will this be a central administrative unit, for example the Office of Research or the Graduate School? Or will the activities be administered through a coordinated effort involving multiple units?
5. Who at the institution will provide a [regularly updated] list of activities that satisfy the requirement? And if so, where can that information be found?
6. Who at the institutional level has responsibility for monitoring and verifying completion of RCR education? Will PIs be responsible for

tracking their trainees and personnel and reporting to the institutional office?

7. Who at the institutional level will regularly assess the plan's impact on institutional goals? If individual departments and programs are permitted to provide their own programming, will the institution encourage individual instructors/programs/units to assess the effectiveness of their RCR educational activities?
8. Who is the primary contact person/office for researchers, trainees, and the public who have questions about the RCR plan?

## Conclusion

While we understand that NSF recognizes diversity in educational needs, and allows institutions flexibility in designing the structure and content of RCR educational activities and their NSF RCR plan, anecdotal evidence and our profile interviews show that many of the individuals tasked with providing RCR educational activities and/or creating institutional plans are not aware of the various approaches to meaningful RCR education, the various forms an NSF RCR plan can take, the considerations to be made in designing an effective RCR education program, the points that should be addressed by the plan document, or how to do more than simply require completion of asynchronous, non-instructor led/engaged online modules.

Both the guidance for effective and meaningful RCR education and the "key considerations" for NSF RCR plans provide a series of questions for instructors of RCR and architects of NSF RCR plans to consider as they draft and implement their activities and institutional plans. Neither resource presents any specific requirements for format, content, or duration, but the questions do introduce options for the design of meaningful instruction or the structure of an institutional plan (for example, will undergraduate students have different training than post-docs?). The questions also point to elements that a good RCR activity or plan should cover. For example, the NSF now requires PIs to complete training but does not specify how they must complete training, so a good plan should state whether PIs will be required or encouraged to participate in the RCR training provided for their trainees..

Creating more robust RCR programs and establishing frameworks for how to achieve this will provide opportunities for improving institutional approaches to meeting the RCR requirements for NSF, or ideally, an institutional plan that would meet the RCR requirements for all three federal agencies. By identifying needs and addressing common challenges that institutions face, this project produced guidance for effective and meaningful RCR education and "key considerations" for NSF RCR institutional plans which can be widely distributed and adopted, as appropriate, at other institutions.

We are hopeful that these resources will be useful tools for researchers, educators, and administrators who work to promote research integrity. This will

impact institutional compliance, disciplinary and institutional cultures, research practices, and informal and formal education in RCR.

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## Notes

1. While the NSF uses the acronym RECR, we recommend RCR rather than RECR for two reasons. First, in our experience, the RECR acronym causes a great deal of confusion among scholars, instructors, and administrators working in research integrity. In a space that is arguably too cluttered with acronyms, most people do not immediately equate RECR to RCR. Second, the acronym RECR does not appear in *America COMPETES, CHIPS and Science Act, NSF's Implementation of America COMPETES* and the *PAPPG* (2011, 2013-2019). *America COMPETES* and *CHIPS and Science* use "Responsible Conduct of Research" as section titles, and though *America COMPETES* uses the phrase, "responsible and ethical conduct of research" it does not use the acronym RECR. The *NSF's Implementation of Section 7009 of the America COMPETES* (Federal Register Volume 74, Number 160) uses the phrases "responsible and ethical conduct of research (RCR)" and "education in RCR". Given that the RECR acronym has only recently appeared (2020), we recommend returning to the previous practice of using the longer term "responsible and ethical conduct of research" with the shorter acronym RCR. Our materials use the RCR acronym.

2. Formally titled "America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science."

3. The NSF funded a second workshop to examine the elements of an institutional plan, identify the key challenges to the implementation of programming, and explore strategies for meeting those challenges. Through pre-conference activities, panel presentations, and breakout sessions, this workshop encouraged participants

to enhance RCR education on their campuses. The *Developing and Implementing Institutional RECR Plans* Community of Practice (CoP) on the Online Ethics Center (OEC) was a product of this workshop, and serves as a forum for continuing discussion and support to identify problems and obstacles, and learn from others how to overcome those challenges.

4. In 2022, the CHIPS and Science Act expanded this language to require RCR training for principal investigators and senior personnel, and to require the RCR training to address "mentor training and mentorship."

5. The Office of Human Research Protections at West Virginia University determined this research to be exempt from IRB review (protocol 2006036029, June 17, 2020).

6. The content in this section as well as in the Key Considerations section was developed collaboratively by PI [anonymized], Co-PI [anonymized] and working group members [anonymized].

7. There is an APPE RISE working group crafting guidance for commonly taught content.

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