NIH Policy: Enhancing Reproducibility through Rigor and Transparency

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(with edits from 2015-10-03, usability testing feedback, etc.)

(with edits from 2015-10-04, recordings, comments from Angela and Luci)

## Slide 1

Welcome! You have entered the National Institutes of Health's introductory training module for "Enhancing Reproducibility through Rigor and Transparency," a policy designed to clarify NIH's expectations for grant applications and peer review.

## Slide 2

First, here's some information on how to navigate this presentation. The top bar displays the title of the module, as well as how much progress you have made through the presentation, and the total length of time for the audio to play. The top bar also has a tab called "Resources" that lists several websites with more information.

The side bar has a tab called "Menu," which displays a list of the slides in the module. Next to the Menu tab is a tab called "Notes" that displays the title per slide and closed captions for the audio on each slide.

On the bottom of the slide, you can adjust the volume using the speaker icon. You can also skip to the previous or next slide using the buttons on the right.

## Slide 3

This is the first of several training modules for NIH Staff members.

* **Module 1,** this module, provides a general overview of the policy;
* **Module 2**, provides information targeted to NIH Program Officials, although other NIH staff members may also benefit from this training;
* **Module 3** will provide information targeted to NIH Scientific Review Officers. NIH staff will be notified when training Module 3 becomes available in the Spring of 2016, in time for reviewing the first applications submitted after the policy becomes effective for grants submitted on and after January 25th, 2016.
* Additional training modules for other business areas will be announced as they become available.

## Slide 4

The goal of this training is to help NIH staff understand the updated policy on rigor and transparency and its role in supporting the NIH mission to seek fundamental knowledge about the nature and behavior of living systems, and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability.

Upon completion of this training, staff should be able to:

* Describe the issues of scientific rigor and transparency and the driving forces that led to development of the NIH policy;
* Summarize the updates to application instructions and review language; and
* Identify the resources available to support NIH staff in the implementation of this policy.

A critical component of turning discovery into health is the scientific rigor and transparency of biomedical research. The policy on rigor and transparency was developed through a thoughtful collaboration among many stakeholders, prompted by a growing concern about reproducibility that has emerged across various disciplines.

## Slide 5

**Dr. Larry Tabak:** Hello, this is Dr. Larry Tabak, Principal Deputy Director of NIH. I'm happy to have this opportunity to tell you a bit about the updated rigor and transparency policy, and why I believe it's so important to our work.

In January of 2014, the NIH Director Dr. Francis Collins and I published a commentary in the journal *Nature* summarizing the problems that have emerged around reproducibility and we laid out several proposals for action. This training will introduce you to the efforts that have followed, and explain why all of us at NIH should be concerned about tackling the issue head on.

As we noted in the commentary, NIH will not be able to address this issue alone, but our leadership in this area is crucial. By joining forces with scientific publishers, industry, professional organizations, and other members of the research community, we can help improve the quality of biomedical research for the benefit of everyone.

## Slide 6

**Dr. Larry Tabak:** There has been a growing realization in recent years that concerns about reproducibility and the impact on the scientific enterprise deserve sustained and focused attention. Several articles have been published highlighting the difficulties of interpreting and reproducing studies that contain inadequate details about experimental methods, particularly in pre-clinical research. These problems point to an urgent need for restructuring how we think about reproducibility and its impact.

## Slide 7

**Dr. Larry Tabak:** After our *Nature* commentary in January, Dr. Collins co-authored a commentary in May of 2014 with Dr. Janine Clayton, Director of the Office of Research on Women’s Health, about the importance of accounting for sex as a biological variable. In it, they note that despite tremendous success in increasing the inclusion of women in clinical research, there has not been a corresponding improvement to account for sex in animal studies. The consideration of sex is a core element of the updated policy, and Dr. Clayton will be discussing this important aspect in more detail in this training.

## Slide 8

**Dr. Larry Tabak:** Other publications have drawn attention to concerns about cell line authentication -- for example, more than 400 widely used cell lines have been shown to be misidentified. These difficulties present serious obstacles to translating basic and pre-clinical research into effective clinical interventions.

## Slide 9

**Dr. Larry Tabak:** The rigor and transparency policy was informed by the deliberations of many different stakeholder groups who were engaged throughout the process. During the course of policy development, NIH initiated efforts on several fronts to bring together the scientific community through workshops, requests for information, pilot programs and focus groups. These efforts have produced a wealth of resources for policy makers and the research community.

NIH has supported workshops covering a range of issues affecting reproducibility. Details and links to workshop summaries, videocasts, and Training Modules to Enhance Data Reproducibility can be found in the resource guide that accompanies this training.

## Slide 10

**Dr. Larry Tabak:** One of the most productive collaborations we initiated was a workshop where journal editors came together to discuss ways to encourage authors to provide the information necessary for reviewers to adequately evaluate their work -- and for colleagues to reproduce it. They developed a set of common principles guiding how research results should be reported in scientific publications. These principles were developed by editors from over 30 journals, and have now been endorsed by over 135 journals and societies. The principles span a broad range of issues including: increased attention to reporting experimental parameters like standards, replicates, and sample size; statements on data and materials sharing; consideration of refutations; and best practices for reporting on reagents, cell lines, and animal strains.

## Slide 11

**Dr. Larry Tabak:** NIH also supported several pilot programs to field-test different approaches to collecting and reviewing grants for rigor. I'm very happy to report that the pilots were very informative, and I feel assured that the changes we are implementing have the potential to improve the quality and impact of the already excellent science that NIH supports.

## Slide 12

**Dr. Larry Tabak:** NIH's updated Instructions for Applicants and peer review criteria are the focus of this training. One of our guiding principles has been to ensure that NIH is investing in the best science while minimizing unnecessary burden. The focus of the updated policy is on helping applicants to improve their research descriptions by clarifying our expectations about scientific rigor and transparency. The policy requires NIH-supported research to address the elements of rigor and transparency -- appropriate to the scientific question -- through revised grant application instructions and review criteria.

These policy changes complement the publication guidelines being adopted by journals with the goal that these two important aspects -- grant support and publication -- can work together to address the issues that have been raised.

## Slide 13

NIH's updated Instructions for Applicants and peer review language clarify four key areas:

* Scientific Premise -- the research that is used to form the basis for the proposed research question;
* Scientific Rigor -- the strict application of the scientific method to ensure robust and unbiased experimental design, methodology, analysis, interpretation, and reporting of results;
* Consideration of Relevant Biological variables, such as sex, in study designs and analyses; and
* Authentication of Key Biological and/or Chemical Resources used to conduct research.

This training module will explain the purpose and rationale for each of the four elements. The subsequent training modules will revisit each of them in detail.

The basic principles of rigor and transparency and the four areas of focus apply to the full spectrum of research, from basic to clinical. Grant applicants should consider how each of the four areas applies to their proposed research and address them appropriately in their applications. Likewise, the updated review language directs reviewers to consider whether each of the four areas have been appropriately addressed in the grant application.

It is important to note that every field of science has unique needs. There is no expectation that the policy can be implemented in a one-size-fits-all manner. Rather, these elements should be considered and implemented in a way that is most appropriate for the science at hand.

These are not new expectations. The updated instructions formalize NIH's longstanding expectations for grant applicants and peer review. Many grant applications already address some or all of the elements of rigor and transparency. In other cases, the elements may not be explicitly reported in the applications or publications, but are addressed in the conduct of the research. NIH believes that all science will benefit from increased attention to rigor and transparency in research grant applications and reviews.

Now we will briefly describe the need for each of these four elements.

## Slide 14

**Scientific Premise**

**Dr. Shai Silberberg:** Hello, I'm Shai Silberberg, a Program Director at the National Institute of Neurological Disorders and Stroke. I've been involved with several pilot programs focused on enhancing reproducibility of NIH-funded research by emphasizing the importance of scientific premise in grant applications and peer review. Broadly speaking, scientific premise is a measure of the strength of the body of evidence supporting the proposed research questions.

## Slide 15

**Dr. Shai Silberberg:** To better understand this concept, let's start with an example from our experience here at NINDS that demonstrates the link between scientific premise, rigor, and reproducibility.

Based on a discovery that a small fraction of patients with Lou Gehrig’s disease, ALS, have a gain of function mutation in the superoxide dismutase gene, an animal model was created, the Super Oxide Dismutase 1 mouse or SOD1. This SOD1 mouse model was extensively used to seek potential treatments for ALS and in 2002, it was reported by a number of groups that the drug minocycline significantly extends the survival of SOD1 mice. Consequently, within a year, NINDS funded a clinical trial to look at the effects of minocycline in ALS patients. Sadly, it was found that minocycline had no benefit.

## Slide 16

**Dr. Shai Silberberg:** One year after the completion of the clinical trial the ALS Therapy Development Institute published a very important paper that shed light on possible causes for the failure of the minocycline clinical trial. Over a period of five years, the ALS Therapy Development Institute tested the effects of more than 70 drugs on the SOD1 mouse model of ALS using rigorous experimental techniques. They appropriately randomized the animals to the various experimental groups; they blinded the investigators to treatment and appropriately powered the experiments to minimize the possibility that they would get a false positive effect due to a small sample size. Under these conditions, they found no survival benefit for any of the tested drugs, including minocycline. They concluded that the previously observed positive effects may have been due to chance.

This audacious conclusion was based on a very interesting analysis. Because they conducted so many experiments, they had large numbers of SOD1 mice that served as controls. The life span of these 2241 control SOD1 mice were entered into a database and then animals were randomly drawn from the database, placed into two separate groups, and compared for mean life expectancy. This was repeated thousands of times in order to determine the probability of seeing at least a 5% difference in life span between the two groups of mice drawn at random, which by definition would be by chance, since all the animals in the database were control animals. It was found, for example, that for a sample size of 10 animals per group, when all possible precautions were taken to match and balance the groups for sex and litter, and to exclude low transgene copy numbers there was a 10% chance of obtaining a statistically significant effect by chance alone. According to their analysis at least 12 SOD1 mice of each sex should be used per group to minimize the likelihood of a false effect.

The studies that suggested a potential therapeutic benefit for minocycline treatment used just 7-10 animals per group and lacked sufficient detail to evaluate the quality of the data that informed the finding. They lacked information on whether the experiments were blinded or randomized and provided no rationale for the selected sample size.

## Slide 17

**Dr. Shai Silberberg:** In hindsight, it is clear that if the scientific premise for the proposed clinical trial had been more closely scrutinized during review, NINDS might have chosen to reproduce the preclinical studies in a rigorous fashion with large groups of animals rather than proceed to a clinical research study involving ALS patients.

Based on these and other findings, NINDS study sections now pay greater attention to strengths and weaknesses of the body of evidence supporting the application.

## Slide 18

**Dr. Shai Silberberg:** NIH's updated policy on rigor and transparency highlights to applicants the need to consider the scientific premise of their proposed research.

Applicants are expected to describe the general strengths and weaknesses of the prior research that they cite as crucial to supporting their application. This consideration of strengths and weaknesses could include attention to the rigor of previous experimental designs, methodology, analysis, and interpretation, including relevant biological variables and authentication of key resources.

## Slide 19

**Dr. Shai Silberberg:** It is important to note that the updated application instructions for scientific premise should not impede innovation. It is useful to keep in mind the distinction between highly innovative research and exploratory research. Innovative research holds the potential to extend the scientific field into new areas or create something novel. Innovative research is inherently risky, but appropriate attention to scientific premise can help investigators to identify the risks and develop a rigorous research strategy to address them that will bolster the success of the proposed work. Exploratory research activities may require less discussion of preliminary data or previously published literature; however, the rationale behind a proposed idea should still be clearly explained.

Appropriate attention to scientific premise will also support the progression of science at an appropriate pace. If the basic science that supports a research proposal is weak, this weakness should be addressed with further basic research before extending the research program in new directions or into the preclinical or clinical domain.

## Slide 20

The current instructions to applicants submitting research grants have been updated to include Scientific Premise in the Significance section of the Research Strategy. The updated instructions read:

"Describe the scientific premise for the proposed project, including consideration of the strengths and weaknesses of published research or preliminary data crucial to the support of your application."

## Slide 21

The corresponding review language for Significance has been updated to include a consideration for scientific premise. The updated instructions read:

"Is there a strong scientific premise for the project?"

## Slide 22

**Rigorous Experimental Design**

**Dr. Judy Hewitt:** Hello, I'm Judy Hewitt, Chief of the Research Resources Section at the National Institute of Allergy and Infectious Diseases. I've been on detail to the NIH Office of Extramural Research, leading the team developing and implementing the NIH policies on rigor and transparency, and I am pleased to be introducing the second important aspect of the policy.

Scientific rigor is the strict application of the scientific method to ensure robust and unbiased experimental design, methodology, analysis, interpretation and reporting of results. A crucial aspect of scientific rigor is the full transparency in reporting experimental details so others can reproduce and extend the findings, and this includes both grant applications and the resulting publications. The journal reporting guidelines Drs. Tabak and Silberberg mentioned seek the same goals as NIH's updated grant application instructions, by emphasizing transparency and rigor at complementary stages of research: that is, planning and reporting. While the journal reporting guidelines specifically apply to preclinical research, NIH's updated grant policy applies to all research grants, not just preclinical grant applications. NIH applicants are expected to describe the proposed experimental design and methods, and how they will achieve robust and unbiased results. Robust and unbiased results are those obtained by methods specifically designed to avoid bias and can be reproduced under well-controlled conditions using reported experimental details.

## Slide 23

**Dr. Judy Hewitt:** Why is this important now? There is much literature about the lack of crucial details in publications, and grant applications are no different. A 2009 review of 271 publications using animals revealed that only 59% identified the hypothesis being tested, only 12% stated that they randomized subjects, only 14% were noted as blinded. Some publications reported the sex of animals used but fewer reported ages or weights and even fewer reported individual animal data. There are derogatory terms for inappropriate statistics, from "p-hacking" to "HARKing" (hypothesis after results known) that can be used to describe biased publications.

## Slide 24

**Dr. Judy Hewitt:** A systematic review and meta-analysis of 29 animal studies testing a candidate drug for stroke, FK506, assessed the publications for details about randomization, blinding, sample size calculations and other determinants of quality, with a possible total score of 10 for the highest quality study. The effect of the drug varied among studies, so the authors compared the quality score for each study to the effect size for the drug. They concluded that there is a significant relationship, with lower quality studies reporting higher drug effects.

## Slide 25

**Dr. Judy Hewitt:** A more recent publication looking at NHLBI supported large clinical trial data published before and after clinicaltrials.gov pre-registration was required demonstrated a shift from predominantly positive results to overwhelming support for the null hypothesis.

Without these critical details, reviewers cannot uncover potential flaws or biases. While scientific premise is about the foundational data, scientific rigor is about the planned research. NIH takes seriously our role as a leader in biomedical research funding and catalyzing the shift to appropriate attention to scientific rigor.

## Slide 26

**Dr. Judy Hewitt:** The features of experimental design that are most important to achieve scientific rigor will vary from field to field, grant to grant. Some examples of rigor that may be needed in applications include use of standards (for example, reference reagents or data standards); sample size estimation; randomization; blinding; appropriate replicates; controlling for inter-operator variability; the statistical methods planned for analyzing the data; inclusion and exclusion criteria; subject retention and attrition; and how missing data will be handled, to name just some. Investigators should adhere to the scientific method this policy stresses, over the complex array of factors contributing to today's reproducibility issue.

## Slide 27

**Dr. Judy Hewitt:** NIH has always strived to fund the best science, and we are clarifying our expectations and formalizing the review process to ensure that the best science is also rigorous and unbiased. Some NIH-funded research is already being performed and reported in a rigorous, unbiased manner, some may be but is not reported in a fully transparent manner that supports replication, and some research will be improved by greater attention to scientific rigor and controlling potential sources of bias.

NIH hopes that the updated policy on rigor and transparency will encourage investigators not only to apply rigor to their experiments and share the details in their reports, but also empower them to engage more openly in dialogue as a scientific community about what it means to conduct research rigorously.

## Slide 28

**Dr. Judy Hewitt:** Do investigators have to supply excruciating detail on their methods? No, they are expected to offer a succinct description that will assure the reviewers that they understand the elements of rigor needed. The pilots that have been conducted demonstrated that applicants can address rigor within the existing page limits, so we are confident that this is feasible.

## Slide 29

The instructions to applicants submitting research grants have been updated to include Rigorous Experimental Design in the Approach section of the Research Strategy. The updated instructions read:

"Describe the experimental design and methods proposed and how they will achieve robust and unbiased results."

## Slide 30

The corresponding review language for Approach has been updated to include a consideration for rigorous experimental design. The updated instructions read:

"Have the investigators presented strategies to ensure a robust and unbiased approach, as appropriate for the work proposed?"

## Slide 31

**Consideration of Relevant Biological Variables, Such as Sex**

**Dr. Janine Clayton:** Hello, I'm Dr. Janine Clayton, Director of the NIH Office of Research on Women's Health. I'm excited to talk with you about NIH's updated policy on consideration of relevant biological variables. The policy was written broadly to apply to any biological variable an investigator decides is relevant, but for now, however, let's focus on consideration of sex in the broader context of enhancing rigor and transparency.

In May of 2014, Dr. Collins and I published a commentary in Nature in which we discussed the need to account for sex as a biological variable in preclinical research. In this article, we provided the rationale for why we believe this is important as we aim to support studies that turn discovery into health.

## Slide 32

**Dr. Janine Clayton:** As part of the updated policy on rigor and transparency, NIH expects that biological variables such as sex will be factored into research designs, analyses, and reporting in vertebrate animal and human studies. Strong justification from the scientific literature, preliminary data, or other relevant considerations must be provided for applications proposing to study only one sex. This policy aims to address a default that exists in biomedical research and medical education. The standard for teaching medicine is to consider the 70-kg white male, and adjust treatment formulas for females. In the laboratory, basic and preclinical biomedical research has often focused on one sex. However, we now know that sex can profoundly influence the outcome of studies.

## Slide 33

**Dr. Janine Clayton:** With the updated policy, we ask that researchers examine sex as a biological variable in every part of the research continuum. From basic research and preclinical studies conducted with animal models, to early phase clinical work reporting important safety information, to Phase III and IV clinical trials reporting on effectiveness and potential side effects – sex as a biological variable should be considered.

## Slide 34

**Dr. Janine Clayton:** As part of the Research Strategy section, NIH applicants are now instructed to explain how relevant biological variables, such as sex, are factored into research designs and analyses of studies in vertebrate animals and humans. These expectations hold for basic and preclinical as well as clinical research. If a study proposes to use only one sex, a strong justification from the scientific literature or preliminary data should be provided to support this decision.

When reviewing these proposals, Reviewers are expected to assess the proposed plans for addressing relevant biological variables and account for this in their scoring of the Approach criterion.

## Slide 35

**Dr. Janine Clayton:** The importance of accounting for of sex as a biological variable is illustrated in the following real-life case. A study published in 2005 found that male and female mice responded differently to treatment with a selective PARP-1 inhibitor. Male mice treated with this inhibitor exhibited less tissue damage than control mice, whereas female mice treated with this inhibitor had more tissue damage, only evident when reviewing data disaggregated by sex.

This study provides an example of the balanced approach that must be taken to consider sex as a biological variable in the context of several other factors that could influence results, such as size, age, and genetic strain.

## Slide 36

**Dr. Janine Clayton:** ORWH has put together many different resources to help researchers understand the updated policy and how to respond effectively to it. These resources can be found at the ORWH website, or in the resource guide that accompanies this training.

In closing, I'd like to introduce the four C's of studying sex in order to strengthen science. The first is that researchers **c**onsider sex when designing studies and factor it into research design or provide a strong justification to study only one sex. Researchers should then **c**ollect sex-based data and **c**haracterize that data through analyses. Finally, researchers are asked to **c**ommunicate sex-based data in progress reports and publications.

We hope that by asking the research community to address sex as a biological variable at the outset, we will continue to strengthen experimental design and benefit from more rigorous science.

## Slide 37

The instructions to applicants submitting research grants have been updated to include Relevant Biological Variables, such as sex, in the Approach section of the Research Strategy. The updated instructions read:

"Explain how relevant biological variables, such as sex, are factored into research designs and analyses for studies in vertebrate animals and humans. For example, strong justification from the scientific literature, preliminary data, or other relevant considerations, must be provided for applications proposing to study only one sex. Please refer to [NOT-OD-15-102](http://grants.nih.gov/grants/guide/notice-files/NOT-OD-15-102.html) for further consideration of NIH expectations about sex as a biological variable."

## Slide 38

The corresponding review language for Approach has been updated to include a consideration for sex as a biological variable. The updated instructions read:

"Have the investigators presented adequate plans to address relevant biological variables, such as sex, for studies in vertebrate animals or human subjects?"

## Slide 39

**Authentication of Key Biological and/or Chemical Resources**

**Dr. Jon Lorsch:** Hello, this is Jon Lorsch, Director of the National Institute of General Medical Sciences, and I will be talking with you about the fourth and final core element: resource authentication.

We all know that the quality of the resources used in research is critical to the reproducibility and interpretation of results. Researchers must be sure that the resources they are working with are genuine and have the expected properties. Because this is so important, the policy on rigor and transparency clarifies our expectation that applicants regularly authenticate key biological and/or chemical resources to ensure their identity and validity for use in the proposed studies.

This expectation prompts an obvious question: what's considered a key biological or chemical resource? In general, these are:

* resources that may differ from laboratory to laboratory, or over time;
* resources with qualities or qualifications that could influence results; and
* resources that are integral to the proposed research.

The policy applies whether or not the resources are generated with NIH funds. Some examples include cell lines, specialty chemicals, antibodies, and other biologics.

## Slide 40

**Dr. Jon Lorsch:** In recent years, several high profile publications have drawn attention to serious concerns about the identity of some commonly used cell lines; for example, a 2011 study authenticating 122 neck and cancer cell lines found that 37 of them were misidentified and/or contaminated. A recent analysis of publications from across the biomedical literature found that 54% of the resources described -- including model organisms, cell lines, antibodies, or knockdown reagents -- were not uniquely identifiable. That is, an independent researcher would not be able to unambiguously identify the resource using the publication and publicly available information.

## Slide 41

**Dr. Jon Lorsch:** The new policy on rigor and transparency asks applicants to briefly describe how they plan to authenticate key resources in their proposed work. One of the biggest challenges will be the lack of consensus guidelines for many crucial resources. Of course, these guidelines are best developed by the user community, and NIH encourages the research community to take on this challenge. In the absence of clear guidelines, however, researchers should transparently report on what they have done to authenticate key resources, so a consensus may emerge about best practices.

Given the importance of these resources to our fundamental understanding of biology and the development of clinical interventions, revelations about misidentification and/or contamination warrant serious attention. The scientific community is rising to these challenges, but a lot of work is left to do. We hope that the new policy serves as a catalyst for these efforts, and look forward to continued collaboration with the research community on these issues.

## Slide 42

The current instructions to applicants submitting research grants have been updated to include Resource Authentication as an Other Research Plan attachment. The updated instructions read:

"Briefly describe methods to ensure the identity and validity of key biological and/or chemical resources used in the proposed studies.

Key biological and/or chemical resources may or may not be generated with NIH funds and:

1. may differ from laboratory to laboratory or over time;
2. may have qualities and/or qualifications that could influence the research data; and
3. are integral to the proposed research.

These include, but are not limited to, cell lines, specialty chemicals, antibodies, and other biologics.

Standard laboratory reagents that are not expected to vary do not need to be included in the plan. Examples are buffers and other common biologicals or chemicals.

Reviewers will assess the information provided in this Section. Any reviewer questions associated with key biological and/or chemical resource authentication will need to be addressed prior to award.

Information in this section must focus only on authentication and/or validation of key resources to be used in the study; all other methods and preliminary data must be included within the page limits of the research strategy. Applications identified as non-compliant with this limitation will be withdrawn from the review process (see NOT-OD-15-095)."

## Slide 43

The corresponding review language for Resource Authentication has been updated to include an Additional Review Consideration that will assessed as Acceptable or Unacceptable and is not to affect the Overall Impact Score. The updated instructions read:

"For projects involving key biological and/or chemical resources, reviewers will comment on the brief plans proposed for identifying and ensuring the validity of those resources."

## Slide 44

This table summarizes the key focus areas behind rigor and transparency, and how they should be addressed in research grant application instructions and peer review.

## Slide 45

The timeline for the NIH policy changes start in Fall of 2015, with updated instructions made available for applicants. Grant applications that are submitted for the January 25, 2016 due date must address the rigor and transparency policy in accordance with the updated instructions. In Spring of 2016, training for scientific review officers and peer reviewer guidelines will be available.

The next step is a quiz on the content of this module. Upon completion of this assessment, you should receive a certificate of completion, which you can print and save for your own records.

Thank you for viewing Training Module 1 for the NIH Policy on Rigor and Transparency. Please view the Resources tab in the top right of this module for more information, and feel free to use Module 2 to learn about material geared towards NIH Program Officials.

## Slide 46

Quiz