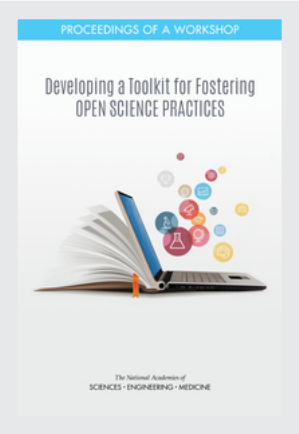

Developing a Toolkit for Fostering Open Science Practices: Proceedings of a Workshop (2021)

DETAILS

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Appendix C

Toolkit Elements

This appendix includes examples of draft elements of a toolkit that have been developed by members of working groups of the National Academies of Sciences, Engineering, and Medicine's Roundtable on Aligning Incentives for Open Science. The following materials were developed to stimulate discussions at the November 5, 2020, workshop on Developing a Toolkit for Fostering Open Science Practices:

I. **Open Science Imperative**. This essay communicates the benefits of open science using approachable language.
II. **Open Science Signaling Language Template and Rubric**. These resources provide specific language that can be adapted and adopted to signal an organization's interest in open science activities at specific points of high leverage (e.g., grant applications, job postings).
III. **Good Practices Primers**. These concise guides offer policy makers a high-level overview of open sharing.
IV. **Open Science by the Numbers Infographic**. This infographic communicates the benefits of open science in a graphic form.
V. **Open Science Success Stories Database**. This database compiles research articles, perspectives, case studies, news stories, and other materials that demonstrate the myriad ways in which open science benefits researchers and society alike.

VI. **Reimagining Outputs Worksheet**. This table enumerates the range of research products stakeholders may choose to consider as they develop open science policies.

The toolkit is primarily intended to assist university leadership, academic department chairs, research funders, learned societies, and government agencies about how such a toolkit might be used, what additional materials are needed, and how such a toolkit should be disseminated for broad adoption. As a result of the workshop, a few sections in the Open Science Imperative and Good Practices Primers have been revised by the working group authors.

II. OPEN SCIENCE SIGNALING LANGUAGE TEMPLATE AND RUBRIC[3]

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This resource provides specific language that can be adapted and adopted to signal an organization's interest in open science activities at specific points of high leverage (e.g., grant applications, job postings). Even absent adoption of formal open science policies, this language can indicate an organization's values and "nudge" researcher behavior toward open practices.

NOTE: The language below can be customized to reflect the specific research considerations of each participating organization.

FUNDERS AND AGENCIES

Grant Application

1. Foundation XYZ values the open sharing of research outputs. If applicable, describe (1) instances where you have engaged in "open" activities (such as making articles open access and sharing data/code according to FAIR principles [Findability, Accessibility, Interoperability, and Reuse of digital assets]); (2) examples of how your open research outputs have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs if possible); and (3) plans to engage in open activities in the future.

[3] The views expressed are those of the authors and do not necessarily reflect the official policies or positions of their employing organizations.

2. For each of the categories below, provide *representative examples* demonstrating how you have made research outputs resulting from other projects openly accessible. If possible, provide the DOI and license terms under which the materials are available.

    - Open access articles
    - Open access books, book chapters, and/or monographs
    - Copies of your papers, chapters, monographs, or other published materials in institutional or disciplinary repositories
    - Preprints
    - Datasets
    - Software/Code
    - Materials/Reagents
    - Preregistration plans
    - Other outputs (please describe)

Additionally, it is important to include negative and null results, which could be covered in a variety of information formats.

Grant Progress Report

1. Foundation XYZ values the open sharing of research outputs. If applicable, describe, in the context of this funded project, (1) instances where you have engaged in "open" activities (such as making articles open access and sharing data/code according to FAIR principles); (2) examples of how your open research outputs have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs if possible); and (3) plans to engage in open activities as the project progresses and concludes.

2. For each of the categories below, provide *representative examples* demonstrating how you have made research outputs resulting from this project openly accessible. If possible, provide the DOI and license terms under which the materials are available.

    - Open access articles
    - Open access books, book chapters, and/or monographs

- Copies of your papers, chapters, monographs, or other published materials in institutional or disciplinary repositories
- Preprints
- Datasets
- Software/Code
- Materials/Reagents
- Preregistration plans
- Other outputs (please describe)

Additionally, it is important to include negative and null results, which could be covered in a variety of information formats.

Grant Final Report

1. Foundation XYZ values the open sharing of research outputs. If applicable, describe, in the context of this funded project, (1) instances where you have engaged in "open" activities (such as making articles open access and sharing data/code according to FAIR principles); (2) examples of how your open research outputs have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs if possible); and (3) plans to engage in open activities for any future outputs pertaining to this project.

2. For each of the categories below, provide *representative examples* demonstrating how you have made research outputs resulting from this project openly accessible. If possible, provide the DOI and license terms under which the materials are available.

    - Open access articles
    - Open access books, book chapters, and/or monographs
    - Copies of your papers, chapters, monographs, or other published materials in institutional or disciplinary repositories
    - Preprints
    - Datasets
    - Software/Code
    - Materials/Reagents

- Preregistration plans
- Other outputs (please describe)

Additionally, it is important to include negative and null results, which could be covered in a variety of information formats.

UNIVERSITIES

Faculty Annual Report

1. For each of the categories below, provide *representative examples* demonstrating how (where appropriate) you have made outputs resulting from your research openly accessible. If possible, provide the DOI and license terms under which the materials are available.

    - Open access articles
    - Open access books, book chapters, and/or monographs
    - Copies of your papers, chapters, monographs, or other published materials in institutional or disciplinary repositories
    - Preprints
    - Datasets
    - Software/Code
    - Materials/Reagents
    - Preregistration plans
    - Other outputs (please describe)

Additionally, it is important to include negative and null results, which could be covered in a variety of information formats.

2. If known, describe how others have made use of these open research outputs, and include relevant DOIs if possible. This can include use in other disciplines and outside of academia.

3. Describe the impact that your openly available research outputs from this evaluation period have had from the research, public policy, pedagogic, and/or societal perspectives.

University Job Posting/Application

1. University XYZ values transparent, replicable, and reproducible research and open science principles (the open sharing of research outputs, including, but not limited to, open access and open data). How have you engaged in "open" activities during your career and how do you plan to do so in the future?

   Or

2. University XYZ values transparent, replicable research and open science principles (the open sharing of research outputs, including, but not limited to, open access and open data). Describe the impact that your openly available research outputs have had from the research, public policy, pedagogic, and/or societal perspectives.

SENDING SIGNALS RUBRIC

This rubric complements the "Suggested Open Science Signaling Language" document produced by the same authors, which can be used by universities, agencies, philanthropies, and other stakeholders to highlight an organization's interest in open science activities at specific points of high leverage (such as grant applications, job postings). The rubric can be used by tenure and promotion committees, program managers, department chairs, hiring committees, and others tasked with evaluating the absolute and relative merits of responses to the signaling questions.

This workbook contains four sheets—one each with language pertaining specifically to articles, data, and other forms of research outputs at both application and reporting stages. The first sheet (Tables 1 and 2) is the amalgamated version, the second sheet (Tables 3 and 4) includes the articles version, and the third sheet (Tables 5 and 6) provides the data version. The fourth sheet (Tables 7 and 8) is the other output version that provides combined language encompassing all of these types of open science activities.

Please note that both the Sending Signals Language and the Sending Signals Rubric can be adapted to address the unique considerations, priorities, and norms of a specific community.

Table 1 Amalgamated Version – Application Stage

Application Stage (e.g., jobs, grants)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
Describe instances where you have engaged in "open" activities (such as making articles open access and sharing data/code according to FAIR principles), including representative examples	The researcher has not, in their recent research (<5 years), demonstrably engaged in open science practices such as making articles, data, and other research outputs openly available for access and reuse.	The researcher has sometimes engaged in open science practices. This is defined as occasionally making recent research (<5 years) available openly for access and reuse. Specific activities include (a) making at least one of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making at least one of these datasets available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making at least one of these materials openly available for access and reuse. Additionally, the researcher demonstrates at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently engaged in open science practices. This is defined as often making recent research (<5 years) available openly for access and reuse. Specific activities include (a) making some (more than one, but less than most) of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making some (more than one dataset, but less than most) of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making some (more than one, but less than most) of these materials openly available for access and reuse. Additionally, the researcher frequently demonstrates good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has consistently engaged in open science practices. This is defined as making the majority of recent research (<5 years) available openly for access and reuse. Specific activities include (a) making the majority of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making the majority of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making the majority of these materials openly available for access and reuse. Additionally, the researcher consistently demonstrates good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

continued

Table 1 Continued

Application Stage (e.g., jobs, grants)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
Provide examples of how your open research outputs have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs, if possible)	The researcher cannot provide qualitative and/or quantitative evidence that any of their recent (<5 years) open research outputs have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their recent (<5 years) open research outputs has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their recent (<5 years) open research outputs have been used by others; and/or (b) a narrower range of their recent (<5 years) open research outputs have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their recent (<5 years) open research outputs have been used by others; and/or (b) a narrower range of their recent (<5 years) open research outputs have been used deeply within a specific community.

Enumerate your plans to engage in open activities in the future	The researcher has not articulated a clear plan to make at least some research outputs (including, but not limited to, articles and data) available openly for access and reuse.	The researcher has articulated a clear plan to make at least some research outputs (including, but not limited to, articles and data) available openly for access and reuse. Specific activities include (a) making at least some of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making most of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making at least some of these materials openly available for access and reuse. Additionally, the researcher has articulated a plan that demonstrates an awareness of at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make most research outputs (including, but not limited to, articles and data) available openly for access and reuse. Specific activities include (a) making most of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making most of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making most of these materials openly available for access and reuse. Additionally, the researcher has articulated a plan that demonstrates an intent to engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make all appropriate research outputs (including, but not limited to, articles and data) available openly for access and reuse. Specific activities include (a) making their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making these materials openly available for access and reuse. Additionally, the researcher has articulated a clear and consistent plan to engage in good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

NOTE: FAIR – Findability, Accessibility, Interoperability, and Reuse of digital assets; ORCID – Open Researcher and Contributor ID; DOI – Digital Object Identifier.

Table 2 Amalgamated Version – Reporting Stage

Reporting Stage (e.g., faculty tenure and promotion reviews, interim and final grant reports)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
For your work (related to this grant/during this time period), describe instances where you have engaged in "open" activities (such as making articles open access and sharing data/code according to FAIR principles), including representative examples	The researcher has not, in their research (for this project/ period), demonstrably engaged in open science practices such as making articles, data, and other research outputs openly available for access and reuse.	The researcher has sometimes engaged in open science practices. This is defined as occasionally making research (for this project/period) available openly for access and reuse. Specific activities include (a) making at least one of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making at least one of these datasets available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making at least one of these materials openly available for access and reuse. Additionally, the researcher demonstrates at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently engaged in open science practices. This is defined as often making research (for this project/ period) available openly for access and reuse. Specific activities include (a) making some (more than one, but less than most) of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making some (more than one dataset, but less than most) of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making some (more than one, but less than most) of these materials openly available for access and reuse. Additionally, the researcher frequently demonstrates good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has consistently engaged in open science practices. This is defined as making the majority of research (for this project/period) available openly for access and reuse. Specific activities include (a) making the majority of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making the majority of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making the majority of these materials openly available for access and reuse. Additionally, the researcher consistently demonstrates good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

For your work (related to this grant/during this time period), provide examples of how your open research outputs have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs, if possible)	The researcher cannot provide qualitative and/or quantitative evidence that any of their open research outputs (for this project/period) have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their open research outputs (for this project/period) has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their open research outputs (for this project/period) have been used by others; and/or (b) a narrower range of their open research outputs (for this project/period) have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their open research outputs (for this project/period) have been used by others; and/or (b) a narrower range of their open research outputs (for this project/period) have been used deeply within a specific community.

continued

Table 2 Continued

Reporting Stage (e.g., faculty tenure and promotion reviews, interim and final grant reports)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
For your work (related to this grant/during this time period), enumerate your plans to engage in open activities in the future	The researcher has not articulated a clear plan to make at least some research outputs (including, but not limited to, articles and data) available openly for access and reuse.	The researcher has articulated a clear plan to make at least some research outputs (including, but not limited to, articles and data) available openly for access and reuse. Specific activities include (a) making at least some of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making most of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making at least some of these materials openly available for access and reuse. Additionally, the researcher has articulated a plan that demonstrates an awareness of at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make most research outputs (including, but not limited to, articles and data) available openly for access and reuse. Specific activities include (a) making most of their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making most of these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making most of these materials openly available for access and reuse. Additionally, the researcher has articulated a plan that demonstrates an intent to engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make all appropriate research outputs (including, but not limited to, articles and data) available openly for access and reuse. Specific activities include (a) making their articles available in open access journals or repositories; (b) to the extent that the researcher has generated research data, making these data available in accessible repositories under adherence to the FAIR principles; and (c) to the extent that the researcher has generated research outputs beyond articles and data, making these materials openly available for access and reuse. Additionally, the researcher has articulated a clear and consistent plan to engage in good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

NOTE: FAIR – Findability, Accessibility, Interoperability, and Reuse of digital assets; ORCID – Open Researcher and Contributor ID; DOI – Digital Object Identifier.

Table 3 Articles Version – Application Stage

Application Stage (e.g., jobs, grants)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
Describe instances where you have engaged in making articles open access, including representative examples	The researcher has not, in their recent research (<5 years), demonstrably engaged in making articles openly available for access and reuse.	The researcher has sometimes engaged in open access practices. This is defined as occasionally making recent research articles (<5 years) available openly for access and reuse. Specific activities include (a) making at least one of their articles available in open access journals or repositories; and (b) demonstrating at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently engaged in open access practices. This is defined as often making recent research articles (<5 years) available openly for access and reuse. Specific activities include (a) making some (more than one, but less than most) of their articles available in open access journals or repositories; and (b) frequently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has consistently engaged in open access practices. This is defined as making the majority of recent research articles (<5 years) available openly for access and reuse. Specific activities include (a) making the majority of their articles available in open access journals or repositories; and (b) consistently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

continued

Table 3 Continued

Application Stage (e.g., jobs, grants)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
Provide examples of how your open access articles have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs if possible)	The researcher cannot provide qualitative and/or quantitative evidence that any of their recent (<5 years) open access articles have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their recent (<5 years) open access articles has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their recent (<5 years) open access articles have been used by others; and/or (b) a narrower range of their recent (<5 years) open access articles have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their recent (<5 years) open access articles have been used by others; and/or (b) a narrower range of their recent (<5 years) open access articles have been used deeply within a specific community.
Enumerate your plans to engage in open access activities in the future	The researcher has not articulated a clear plan to make at least some research articles available openly for access and reuse.	The researcher has articulated a clear plan to make at least some research articles available openly for access and reuse. Specific activities include (a) making at least some of their articles available in open access journals or repositories; and (b) articulating a plan that demonstrates an awareness of at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make most research articles available openly for access and reuse. Specific activities include (a) making most of their articles available in open access journals or repositories; and (b) articulating a plan that demonstrates an intent to engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make all appropriate research articles available openly for access and reuse. Specific activities include (a) making their articles available in open access journals or repositories; and (b) articulating a clear and consistent plan to engage in good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

NOTE: DOI – Digital Object Identifier; ORCID – Open Researcher and Contributor ID.

Table 4 Articles Version – Reporting Stage

Reporting Stage (e.g., faculty tenure and promotion reviews, interim and final grant reports)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
For your work (related to this grant/during this time period), describe instances where you have engaged in open access activities, including representative examples	The researcher has not, in their research (for this project/ period), demonstrably engaged in making research articles openly available for access and reuse.	The researcher has sometimes engaged in open access practices. This is defined as occasionally making research articles (for this project/ period) available openly for access and reuse. Specific activities include (a) making at least one of their articles available in open access journals or repositories; and (b) demonstrating at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently engaged in open access practices. This is defined as often making research articles (for this project/period) available openly for access and reuse. Specific activities include (a) making some (more than one, but less than most) of their articles available in open access journals or repositories; and (b) frequently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has consistently engaged in open access practices. This is defined as making the majority of research articles (for this project/period) available openly for access and reuse. Specific activities include (a) making the majority of their articles available in open access journals or repositories; and (b) consistently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

continued

Table 4 Continued

Reporting Stage (e.g., faculty tenure and promotion reviews, interim and final grant reports)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
For your work (related to this grant/during this time period), provide examples of how your open access articles have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs, if possible)	The researcher cannot provide qualitative and/or quantitative evidence that any of their open access articles (for this project/period) have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their open access articles (for this project/period) has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their open access articles (for this project/period) have been used by others; and/or (b) a narrower range of their open access articles (for this project/period) have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their open access articles (for this project/period) have been used by others; and/or (b) a narrower range of their open access articles (for this project/period) have been used deeply within a specific community.

For your work (related to this grant/during this time period), enumerate your plans to engage in open access activities in the future	The researcher has not articulated a clear plan to make at least some research articles (including, but not limited to, articles and data) available openly for access and reuse.	The researcher has articulated a clear plan to make at least some research articles available openly for access and reuse. Specific activities include (a) making at least some of their articles available in open access journals or repositories; and (b) articulating a plan that demonstrates an awareness of at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make most research articles available openly for access and reuse. Specific activities include (a) making most of their articles available in open access journals or repositories; and (b) articulating a plan that demonstrates an intent to engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make all appropriate research articles available openly for access and reuse. Specific activities include (a) making their articles available in open access journals or repositories; and (b) articulating a clear and consistent plan to engage in good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

NOTE: DOI – Digital Object Identifier; ORCID – Open Researcher and Contributor ID.

Table 5 Data Version – Application Stage

Application Stage (e.g., jobs, grants)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
Describe instances where you have engaged in open data activities (such as sharing data according to FAIR principles), including representative examples	The researcher has not, in their recent research (<5 years), demonstrably engaged in making data available for access and reuse according to FAIR principles.	The researcher has sometimes engaged in open data practices. This is defined as occasionally making research data (<5 years) available for access and reuse according to FAIR principles. Specific activities include (a) making at least one of their datasets available in accessible repositories under adherence to the FAIR principles; and (b) demonstrating at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently engaged in open data practices. This is defined as often making recent research data (<5 years) available openly for access and reuse according to FAIR principles. Specific activities include (a) making some (more than one dataset, but less than most) of their research data available in accessible repositories under adherence to the FAIR principles; and (b) frequently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has consistently engaged in open data practices. This is defined as making the majority of recent research data (<5 years) available openly for access and reuse according to FAIR principles. Specific activities include (a) making the majority of their research data available in accessible repositories under adherence to the FAIR principles; and (b) consistently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

Provide examples of how your open datasets have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs, if possible)	The researcher cannot provide qualitative and/or quantitative evidence that any of their recent (<5 years) open datasets have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their recent (<5 years) open datasets has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their recent (<5 years) open datasets have been used by others; and/or (b) a narrower range of their recent (<5 years) open datasets have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their recent (<5 years) open datasets have been used by others; and/or (b) a narrower range of their recent (<5 years) open datasets have been used deeply within a specific community.
Enumerate your plans to engage in open data activities in the future	The researcher has not articulated a clear plan to make at least some research data available for access and reuse according to FAIR principles.	The researcher has articulated a clear plan to make at least some research data available for access and reuse according to FAIR principles. Specific activities include (a) making most of their research data available in accessible repositories under adherence to the FAIR principles; and (b) articulating a plan that demonstrates an awareness of at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make most research data available for access and reuse according to FAIR principles. Specific activities include (a) making most of their research data available in accessible repositories under adherence to the FAIR principles; and (b) articulating a plan that demonstrates an intent to engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make all appropriate research data available for access and reuse according to FAIR principles. Specific activities include (a) making their research data available in accessible repositories under adherence to the FAIR principles; and (b) articulating a clear and consistent plan to engage in good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

NOTE: FAIR – Findability, Accessibility, Interoperability, and Reuse of digital assets; DOI – Digital Object Identifier; ORCID – Open Researcher and Contributor ID.

Table 6 Data Version – Reporting Stage

Reporting Stage (e.g., faculty tenure and promotion reviews, interim and final grant reports)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
For your work (related to this grant/during this time period), describe instances where you have engaged in open data activities (such as sharing data according to FAIR principles), including representative examples	The researcher has not, in their research (for this project/ period), demonstrably engaged in making data available for access and reuse according to FAIR principles.	The researcher has sometimes engaged in open data practices. This is defined as occasionally making research data (for this project/period) available for access and reuse according to FAIR principles. Specific activities include (a) making at least one of their datasets available in accessible repositories under adherence to the FAIR principles; and (b) demonstrating at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently engaged in open data practices. This is defined as often making research data (for this project/ period) available openly for access and reuse according to FAIR principles. Specific activities include (a) making some (more than one dataset, but less than most) of their research data available in accessible repositories under adherence to the FAIR principles; and (b) frequently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has consistently engaged in open data practices. This is defined as making the majority of research data (for this project/period) available openly for access and reuse according to FAIR principles. Specific activities include (a) making the majority of their research data available in accessible repositories under adherence to the FAIR principles; and (b) consistently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

For your work (related to this grant/during this time period), provide examples of how your open datasets have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs if possible)	The researcher cannot provide qualitative and/or quantitative evidence that any of their open datasets (for this project/period) have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their open datasets (for this project/period) has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their open datasets (for this project/period) have been used by others; and/or (b) a narrower range of their open datasets (for this project/period) have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their open datasets (for this project/period) have been used by others; and/or (b) a narrower range of their open datasets (for this project/period) have been used deeply within a specific community.
For your work (related to this grant/during this time period), enumerate plans to engage in open activities in the future	The researcher has not articulated a clear plan to make at least some research data available for access and reuse according to FAIR principles.	The researcher has articulated a clear plan to make at least some research data available for access and reuse according to FAIR principles. Specific activities include (a) making most of their research data available in accessible repositories under adherence to the FAIR principles; and (b) articulating a plan that demonstrates an awareness of at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make most research data available for access and reuse according to FAIR principles. Specific activities include (a) making most of their research data available in accessible repositories under adherence to the FAIR principles; and (b) articulating a plan that demonstrates an intent to engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to make all appropriate research data available for access and reuse according to FAIR principles. Specific activities include (a) making their research data available in accessible repositories under adherence to the FAIR principles; and (b) articulating a clear and consistent plan to engage in good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

NOTE: FAIR – Findability, Accessibility, Interoperability, and Reuse of digital assets; DOI – Digital Object Identifier; ORCID – Open Researcher and Contributor ID.

Table 7 Other Outputs Version – Application Stage

Application Stage (e.g., jobs, grants)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
Describe instances where you have engaged in "open" activities beyond sharing articles and data, including representative examples	The researcher has not, in their recent research (<5 years), demonstrably engaged in making research outputs beyond articles and data openly available for access and reuse.	The researcher has (a) occasionally made recent (<5 years) research outputs beyond articles and data available openly for access and reuse; and (b) demonstrated at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently made recent (<5 years) research outputs beyond articles and data available openly for access and reuse. Specific activities include (a) making some (more than one, but less than most) of these outputs available for access and reuse; and (b) frequently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has (a) consistently made the majority of recent (<5 years) research outputs beyond articles and data available openly for access and reuse; and (b) consistently demonstrated good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

Provide examples of how your open research outputs beyond articles and data have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs if possible)	The researcher cannot provide qualitative and/or quantitative evidence that any of their recent (<5 years) open research outputs beyond articles and data have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their recent (<5 years) open research outputs beyond articles and data has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their recent (<5 years) open research outputs beyond articles and data have been used by others; and/or (b) a narrower range of their recent (<5 years) open research outputs beyond articles and data have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their recent (<5 years) open research outputs beyond articles and data have been used by others; and/or (b) a narrower range of their recent (<5 years) open research outputs beyond articles and data have been used deeply within a specific community.
Enumerate your plans to engage in open activities in the future, beyond the open sharing of articles and data	The researcher has not articulated a clear plan to make at least some research outputs beyond articles and data available openly for access and reuse.	The researcher has articulated a clear plan to (a) make at least some research outputs beyond articles and data available openly for access and reuse; and (b) engage in at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to (a) make most research outputs beyond articles and data available openly for access and reuse; and (b) engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to (a) make all appropriate research outputs beyond articles and data available openly for access and reuse; and (b) engage in consistent good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

NOTE: DOI – Digital Object Identifier; ORCID – Open Researcher and Contributor ID.

Table 8 Other Outputs Version – Reporting Stage

Reporting Stage (e.g., faculty tenure and promotion reviews, interim and final grant reports)	**Beginning 1**	**Developing 2**	**Accomplished 3**	**Exemplary 4**
For your work (related to this grant/during this time period), describe instances where you have engaged in "open" activities (beyond sharing articles and data), including representative examples	The researcher has not, in their research (for this project/period), demonstrably engaged in making research outputs beyond articles and data openly available for access and reuse.	The researcher has (a) occasionally made research outputs (for this project/period) beyond articles and data available openly for access and reuse; and (b) demonstrated at least some open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has frequently made research outputs research (for this project/period) beyond articles and data available openly for access and reuse. Specific activities include (a) making some (more than one, but less than most) of these outputs available for access and reuse; and (b) frequently demonstrating good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has (a) consistently made the majority of research outputs research (for this project/period) beyond articles and data available openly for access and reuse; and (b) consistently demonstrated good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

For your work (related to this grant/during this time period), provide examples of how your open research outputs beyond articles and data have been used by others in your discipline, in other disciplines, and/or outside of academia (include DOIs, if possible)	The researcher cannot provide qualitative and/or quantitative evidence (for this project/period) that any of their open research outputs beyond articles and data have been used by others.	The researcher can provide qualitative and/or quantitative evidence that at least one of their open research outputs (for this project/period) beyond articles and data has been used by others.	The researcher can provide qualitative and/or quantitative evidence that (a) some of their open research outputs (for this project/period) beyond articles and data have been used by others; and/or (b) a narrower range of their open research outputs (for this project/period) beyond articles and data have been used deeply within a specific community.	The researcher can provide qualitative and/or quantitative evidence that (a) a wide range of their open research outputs (for this project/period) beyond articles and data have been used by others; and/or (b) a narrower range of their open research outputs (for this project/period) beyond articles and data have been used deeply within a specific community.
For your work (related to this grant/during this time period), enumerate your plans to engage in open activities beyond sharing articles and data in the future	The researcher has not articulated a clear plan to make at least some research outputs beyond articles and data available openly for access and reuse.	The researcher has articulated a clear plan to (a) make at least some research outputs beyond articles and data available openly for access and reuse; and (b) engage in at least some aspects of good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to (a) make most research outputs beyond articles and data available openly for access and reuse; and (b) engage in good open science hygiene in most instances (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).	The researcher has articulated a clear plan to (a) make all appropriate research outputs beyond articles and data available openly for access and reuse; and (b) engage in consistent good open science hygiene (e.g., use of DOIs, ORCID iDs, Creative Commons licenses).

Table 8 Notes:

- The rubric can and should be adapted to reflect the questions being asked of researchers (e.g., if a grant report form does not ask about data sharing, the data sharing elements of the rubric can be excised).
- The "Reporting" language can be customized for grant reporting vs. departmental reporting.
- Researchers who generate data with personal identifiable information (PII) or other sensitive details that cannot be openly shared may indicate as such in their response.
- While the FAIR (Findable, Accessible, Interoperable, Reusable) data principles support open research, data can be FAIR without being open. The FAIR principles can accommodate legitimate exceptions to open sharing practices such as data with PII, as mentioned above.
- "Other Outputs" include a range of research products such as the National Academies Roundtable on Aligning Incentives for Open Science list enumerated in VI. Reimagining Outputs Worksheet.
- DOI – Digital Object Identifier; ORCID – Open Researcher and Contributor ID.