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BIOLOGICAL AND PHYSICAL SCIENCES (BPS) DIVISION

BPS SCIENTIFIC DATA MANAGEMENT POLICY

Biological and Physical Sciences
Signature/Approval Page

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Biological and Physical Sciences

DOCUMENT HISTORY LOG

Document Version	Effective Date	Description
Baseline	11/3/2022	As part of the OSSI Working Group, Sam Gebre and team have been working on a data policy for BPS which complies with the SMD SPD-41 Data Policy. The document has been reviewed by Space Biology and Physical Sciences L2, L3 management and project scientist from several centers, over several months and updated to include version changes in the SMD SPD-41a Data Policy.
Revision A	8/27/2024	Updates made to Signature/Approval Page Updated in conjunction with revisions made to BPS PI Reporting Requirements, SMD Data Policy Updates, etc. • 1.5 Assumptions and Constraints • 3.1 BPS Program Leadership, Portfolio Management, and Grant Management • 3.2 BPS Open Science Data Repositories • 3.3 Investigations • 3.5 BPS Task Book Updates made to Appendix

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1 INTRODUCTION

To increase scientific research throughput and the transparency of government funded research, the National Aeronautics and Space Administration (NASA) seeks to transform the collection, archival/preservation, curation, and distribution of science data. These changes are intended to shift the conduct of NASA-sponsored research towards an “Open Science” framework, one in which all information necessary to support scientific reasoning are easily accessed by and precisely communicated to other researchers, and to the public. To that end, the Science Mission Directorate (SMD) has issued new policies as described in the [Scientific Information Policy for the Science Mission Directorate](#) (SMD Policy Document SPD-41a) and encouraged organizational divisions within SMD to specify these policies further as they see fit. These policies include direction for managers of data repositories to design their systems and processes to further the goals of Open Science, guided by the FAIR principles aimed at maximizing data findability, accessibility, interoperability, and reusability (FAIR).

Reproducibility of investigations is a pillar of Open Science and requires the provision to NASA of all data and metadata necessary to reproduce investigations regardless of their “success”. NASA-funded scientific data should be made accessible as soon as possible, but no later than the time of publication of any findings that leverage said data, or the end of the award/support period, whichever comes first. Research does not always lead to a publication of findings for a variety of reasons, not least of which is failure to disprove null hypotheses. Public access to all scientific data underlying [Biological and Physical Sciences \(BPS\) Division](#)-funded research are crucial components of accountability and transparency in publicly funded investigation processes.

In addition, to further specifying the SMD information policies to support open science, there is a need to reduce the burden on data producers in complying with these policies, and to increase the efficiency, transparency, and coordination of scientific data management processes. “The Open Data Policy-Managing Information as an Asset” Memorandum ([OMB-13-13](#)) sets forth policies to increase public access to scientific research data by directing U.S. government agencies to make such data as widely accessible as practicable. In addition, various scientific article publishers have their own requirements as to accessibility of data supporting article publications. Furthermore, particularly in the field of life and physical sciences, researchers often wish or need to share their data through community-managed data repositories. This has resulted in more time spent by data producers shepherding their data products (and all required metadata) to an increasing number of destinations. Thus, it is more important than ever for the BPS Division to maximize efficiency of its data management processes involving investigators.

Scientific information managed by NASA has long been governed by requirements for security, integrity, and sustainment. While these requirements endure, they are now to be augmented with new ones designed to support open science, interdisciplinary science, data science and the application of artificial intelligence and machine learning. These new information management requirements are designed to meet the goals originally described in the OMB-13-13 Memorandum and are the foundation of the new SMD Policy Document SPD-41a. Briefly, from the SMD policy “Data need not only to be archived but also to be curated – that is, the data are assured to have continued accessibility and usability for multiple decades.”

These new information management requirements necessitate changes ranging from the generation of solicited research announcements, to awards and contracts language and research data submission processes.

1.1 PURPOSE OF THIS DOCUMENT

The purpose of this document is to define the BPS policies and provide instructions by which scientific data are managed by BPS Division programs, projects, and repositories. This document is derived from the vision and goals of the “Scientific Information Policy for the Science Mission Directorate” (SMD Policy Document SPD-41a) and those of the [SMD’s Strategy for Data Management and Computing for Groundbreaking Science](#).

The mission of BPS is to:

- Enable exploration to expand the frontiers of knowledge, capability, and opportunity in space.
- Pioneer scientific discovery in and beyond Low Earth Orbit to drive advances in science, technology, and space exploration to enhance knowledge, education, innovation, and economic vitality.

1.2 SCOPE OF THIS DOCUMENT

The scope of this document is to state the policies and instructions that encompass all phases of BPS science data planning and management, from pre-announcement, through proposal and throughout a project life cycle.

The following distinctions define data management roles and responsibilities:

1. **Research Data:** Data produced by investigations through all awards made by the Biological and Physical Sciences Division. The specific Research data required from each award will be defined by the Research Data Submission Agreements (RDSA), see below. Research data also includes:
 - a. Investigations funded via research sub-awards. These awards can include grants, cooperative agreements, contracts, task orders, interagency transfers, directed NASA funding, and other applicable funding vehicles.
 - b. Data derived from BPS data and resources such as from sample sharing and SMD-funded citizen science projects. (See NPD 1090.2 for more information about Citizen Science).
2. **Operations Data:** Includes data collected by NASA programs, projects, or missions that describe conditions and activities relevant to investigations conducted in flight and/or on the ground and typically informs or provides support for multiple investigations. Examples of operations data include environmental data from flight and ground-control analogs, animal husbandry data from flight and ground, and logs of flight operations activities. Some operations data may be generated by non-SMD funded programs and projects (for instance by ISS and commercial vehicles) and in these cases the data falls under the scope of these policies when they are received by the Open Science Data Repositories (OSDRs) as per data transfer agreements. Scientific data generated by the investigation is not considered operations data, nor is non-scientific information such as planning, budgetary and management documentation.

3. **Software:** Investigation tools or products developed with BPS funding, such as scripts, computer programs and 3-D printer instructions, either in source or object code, that provide users some degree of scientific utility, produce a scientific result or service, or are otherwise required to reproduce results. Example types of BPS research software include data transformation, mining, simulation, modeling, analytic and visualization software.

In this policy document, all mandatory actions (*i.e.*, requirements) are denoted by statements containing the term “shall.” The terms “may” or “can” denote discretionary privilege or permission, “should” denotes a good practice, and is recommended, but not required, “will” denotes expected outcome, and “are” or “is” denote descriptive material.

1.3 APPLICABLE DOCUMENTS

Applicable documents: are those specification, standards, criteria, etc. used to define the requirements of this document.

Document #	Document Title
NPR 2200.2	Requirements for Documentation, Approval and Dissemination of Scientific and Technical Information
SMD-SPD-41a	Scientific Information policy for the Science Mission Directorate
NPD 1090.2	Citizen Science
NPD 2230.1	Research Data and Publication Access
Document ID 20150020926	“NASA Plan for Increasing Access to the Results of Scientific Research”
2 CFR 200.338	NASA Grant and Cooperative Agreement Manual

1.4 OBJECTIVE

There are two drivers for the development of these BPS policies:

1. NASA’s open data policy of making high-quality data publicly available as soon as practical. This is achievable by following best practices, such as ensuring early and continuing usability, curation using standardized descriptions, requiring adequate supporting documentation, using sustainable and open formats, providing easy electronic access, and appropriate analysis tools, and long-term preservation. This also involves engaging the science community to participate as responsible partners in an ongoing effort to improve the data environment and quality of data products.
2. The [FAIR principles](#) (see Appendix A - Glossary for definitions of terms):
 - a) **To Be Findable:**
 - F1. (meta)data are assigned a globally unique and eternally persistent identifier.
 - F2. data are described with rich metadata.
 - F3. (meta)data are registered or indexed in a searchable resource.
 - F4. metadata specify the data identifier.
 - b) **To Be Accessible:**
 - A1. (meta)data are retrievable by their identifier using a standardized communications protocol.
 - A1.1 the protocol is open, free, and universally implementable.

A1.2 the protocol allows for an authentication and authorization procedure, where necessary.

A2. metadata are accessible, even when the data are no longer available.

c) **To Be Interoperable:**

I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.

I2. (meta)data use vocabularies that follow FAIR principles.

I3. (meta)data include qualified references to other (meta)data.

d) **To Be Re-Usable:**

R1. meta(data) have a plurality of accurate and relevant attributes.

R1.1. (meta)data are released with a clear and accessible data usage license.

R1.2. (meta)data are associated with their provenance.

R1.3. (meta)data meet domain-relevant community standards.

1.5 ASSUMPTIONS AND CONSTRAINTS

The policies described herein apply to scientific data and software produced by all BPS-funded activities. This document applies solely to scientific information and does not apply to other kinds of information such as planning, budgetary and management documentation. In addition, this does not include laboratory notebooks, preliminary analyses, drafts of scientific papers or preprints, plans for future research, peer review reports, private communications with colleagues, or otherwise restricted information. Restricted information shall not be shared publicly, and if any material with restricted information is shared openly, then the restricted information shall be redacted prior to publicly sharing material. Data restricted from open publication shall be maintained and might be available through special data requests.

Investigations that will be required to comply with all BPS data sharing policies will be notified in the solicitation call and in award letters, or similar. Investigations funded after ROSES 2023 should adopt all parts of this policy consistent with available resources. Note: For investigations funded prior to ROSES 2023 refer to the relevant solicitation and Grant and Cooperative Agreement Manual (GCAM) for obligations related to data management.

2 BPS DATA MANAGEMENT ENVIRONMENT

The Biological and Physical Sciences Division Data Management Environment (DME, Figure 1) includes actors, processes, and systems working in concert to leverage and advance these sciences to realize the goals of NASA programs. As depicted in the figure, the environment supports the data management processes that create, transform, and transfer to the scientific community at large, various kinds of scientific information, with the goal of making high-quality, impactful contributions to the biological and physical sciences. The policies described in this document are each levied on the actors and entities that comprise this environment, as detailed in Section 4.

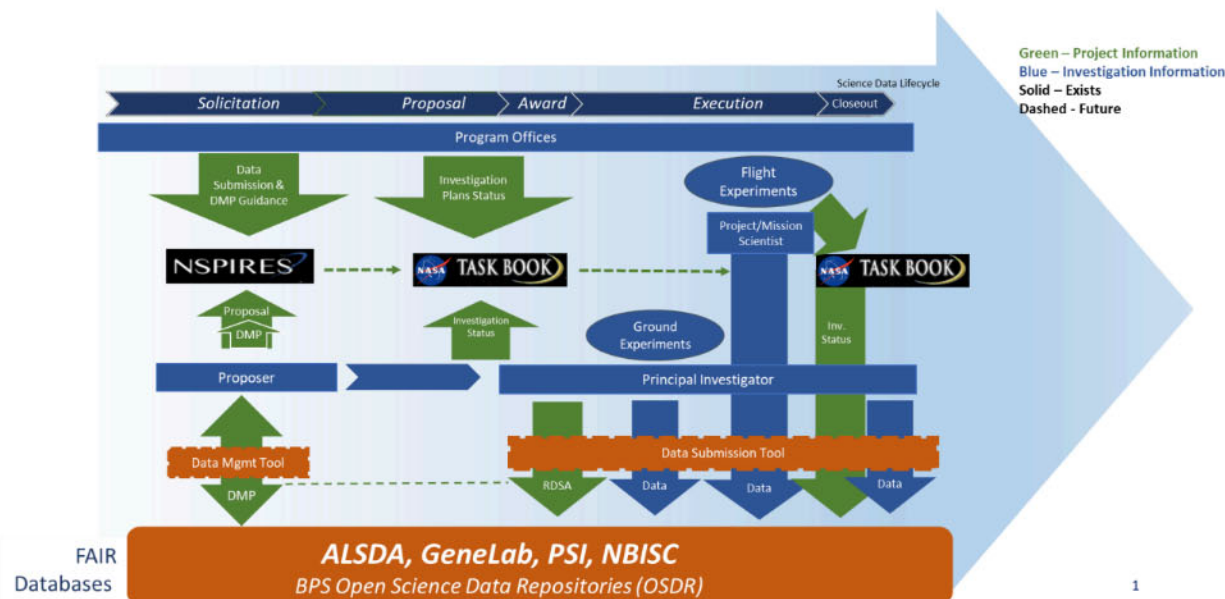


Figure 1 - The BPS Data Management Environment

The primary objective of these data management policies is to ensure the expeditious, consistent, and accurate capture, archival, curation and distribution the scientific data products and information from all investigations involving the Division. Furthermore, many policies aim to provide equitable access to these data and information for the scientific community at large, consistent with “open,” transparent scientific research, by minimizing delay between data acquisition and data delivery to archives for publication. Beginning in the research solicitation and data management planning phases of investigations, policies require the use of data management tools and templates that ensure consistency and completeness of data and metadata collection. Policies in the later phases of investigation execution and data product archiving aim to maximize data “findability, accessibility, interoperability, and re-use” as described in the FAIR principles. Policies regarding data findability stipulate the use of consistent, persistent identification of scientific data by open science data repositories, while accessibility principles require use of standardized protocols for data access. The goals of the interoperability principles include standardizing data and metadata semantics and vocabularies to expand and facilitate usability of the data across systems and communities. Reusability principles provide guidance for policies formalizing specifications for data distribution, alteration, and augmentation. All these principles when correctly applied to processes and systems in the data management environment will lead to increased, collaborative, cost-effective scientific data sharing, analysis, and more rapid scientific advancement.

3 ROLES AND RESPONSIBILITIES

The effective and prompt dissemination of research and operations data requires coordinated action by:

- BPS Program Leadership, Portfolio Management, and Grant Management
- BPS Open Science Data Repositories (OSDRs)
- BPS Funded Investigators
- BPS Projects

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The following sections describe the science data roles and responsibilities for each of these agents.

3.1 BPS DIVISION PROGRAM LEADERSHIP, PORTFOLIO MANAGEMENT, AND AWARD MANAGEMENT

The BPS Division Space Biology and Physical Sciences Program Leadership oversee the implementation of BPS Program-funded research investigations and is responsible for ensuring that all scientific and relevant operations data delivery requirements are in alignment with this data policy. Each BPS Program allocates budgets for awards and oversees all agreements with data providers necessary to achieve the goals set forth in this data policy. The awards include, in addition to the primary hardware deliverables and related measurement requirements, the requirements for data provision, access, and delivery. BPS Programs are responsible for managing research portfolios, including the creation and execution of research solicitations. The responsibility of consistent, reliable, and durable public access to the data products of these solicitations is ultimately the responsibility of the Program Management. Therefore, the BPS Programs will provide requirements to investigators for the conveyance of these data products into long-term, publicly available data archives through the award documents and instructions.

1. The BPS Program Management or delegate will designate in BPS Division ROSES solicitations the NASA Open Science Data Repository section that defines and provides the requirements to proposers about the *designated* OSDR.
2. The BPS Program Management or delegate will provide awardees specific requirements for OSDR data submission in the appropriate award document and agreement form.
3. The BPS Program Management or delegate will provide guidance and templates in sponsored research solicitations for types of data generated in typical investigations, and common templates for the data management plan development. A complete Open Science and Data Management Plan (OS-DMP) is required as part of all research proposals to ensure that submitted scientific data are standardized and organized in accordance with this Science Data Management Policy, enabling long-term accessibility and utility for the wider scientific community.
4. BPS Program Grant Management (as performed by, for instance: Grant Officers, Grant Managers, Grant Technical Officers):
 - a. Facilitates execution and implementation of awards with the NASA Shared Services Center (NSSC).
 - b. Ensures compliance with the terms of procurement instruments according to the Grant and Cooperative Agreement Manual (GCAM), Section 2.5.
 - c. Inform the Task Book with milestone and deliverable due dates for each award.
 - d. Verify deposition of all required data into the designated OSDR.
 - e. Verify that research data and metadata, as per the proposed investigation OSDMP and the subsequent RDSA, have been submitted to the OSDR, which is required for Award close out.
5. BPS Program Management will be responsible for Data Transfer Agreements (DTA) to be used by Projects to plan and establish technical details of the data formats, delivery methods and timeline.

3.2 BPS OPEN SCIENCE DATA REPOSITORIES

The BPS Open Science Data Repository is a data repository designed and dedicated to collecting science data and openly sharing that data without costs to the user and with minimal restrictions to the use of those data. BPS OSDRs are funded and managed by the BPS programs. Each OSDR is specifically designated for a certain scientific scope and sources of data. An OSDR is the location where researchers will submit data for archival, curation, and publication of research outputs, such as datasets, images, and videos. NASA BPS OSDRs include:

- a. The Physical Sciences Informatics (PSI) repository
- b. Ames Life Sciences Data Archive (ALSDA)
- c. GeneLab (GL)
- d. NASA Biological Institutional Scientific Collection (NBISC)

OSDRs shall follow the guidelines below:

1. OSDRs shall commit to the full and open publication of scientific data obtained from NASA BPS Division-sponsored programs, projects, and investigators by a release date authorized by all responsible parties (see below).
2. The OSDR assures the capability for timely and ongoing delivery of research and mission data by providing guidance and protected workspace and storage.
 - a. OSDRs shall provide protected collaboration workspace for the Principal Investigator (PI) and designated investigation team for collection of research data including flight, ground, raw, calibrated and analyzed data before such data is published.
 - b. OSDRs shall develop and maintain data management plan (OSDMP) templates tailored to the research area, for use by all proposers to BPS solicitations. These templates will include guidance regarding preferred data formats, file types, file naming standards and other information as appropriate to guide and assure maximum FAIR-compliance of the data as well as standard DMP submissions.
 - c. OSDRs shall provide a data submission tool (DST) that will provide capability for future automated delivery of data, with data pre-populated by the proposer's OSDMP and RDSA, leveraging the OSDR-provided and proposer-completed DMP templates at a minimum (and/or a future OSDMP tool). OSDRs will provide the DST with the capability to provide persistent unique identifiers for each investigation.
3. OSDRs shall provide BPS grant officers with on-demand status of data submissions made by investigators. The OSDR shall provide grant officers status of milestones as follows:
 - a. RDSA signed
 - b. Data delivery started
 - c. Data delivery completed, and
 - d. First significant public release of data.
4. OSDRs will provide public review capability of repository data, capturing and displaying all feedback.
5. OSDRs will enable and manage, within resources, curation of all submitted data packages.
6. OSDRs shall prioritize resources to ingest new data and use a level of effort approach to capture and secure older data. The more expensive curation of legacy data should be only done on an as-needed basis and the un-curated data shall be preserved as submitted.

7. OSDRs shall provide a vehicle to inform data consumers that all publicly available scientific information may be freely redistributed with acknowledgement of the data source (i.e., the OSDR)
8. OSDRs shall publicize data collected as part of crowdsourcing projects or citizen science projects as soon as possible, following submission.
9. OSDRs shall release operations data as soon as they are received and verified, per the Data Transfer Agreement.

3.3 INVESTIGATORS

This data sharing policy document defines and provides instructions for the equitable distribution of the NASA BPS requirements for data management and to automate wherever possible. It is not the intention to increase the burden on the funded investigators, but the investigator data are important, and investigators have the expertise to facilitate the curation of their data by the OSDR staff.

1. Investigators shall submit research data and metadata sufficient to replicate the investigation, as per the Research Data Submission Agreement (RDSA) (see next paragraph) to the OSDR designated in the research solicitation, award letter, and/or other award instructional documents funding the investigation.
2. Principal Investigators shall complete an initial RDSA based on their proposed OSDMP as soon as possible after award, working with the designated OSDR. The RDSA is the mechanism by which the investigator and the OSDR plan for the collection of information and data. The RDSA is the agreement between the principal investigator and the OSDR identifying the scope and type of data to be submitted, data standards to be used, and anticipated timeline for the submissions. The principal investigator is responsible for the identification and timely submission of all data generated by the award funding including data produced by Co-Investigators.
3. Investigators shall have a persistent identifier such as ORCID¹ and provide that ID as needed to trace and provide accurate attribution of data and software.
4. Investigators should submit research data throughout the course of the investigation, according to the schedule outlined in the RDSA. To allow the OSDR time to verify the data, a final submission of data shall be complete as possible at the onset of the peer-review process for the article that they support.
5. Investigators shall authorize OSDRs to publish research data no later than the publication date of the article or final investigation results (e.g., peer-reviewed, or non-peer reviewed article). Investigators may authorize release of the relevant research data prior to this time. No-cost extensions (NCE) to the grant may be requested directly to a NASA Grant Manager at the NASA Shared Services Center (NSSC) by the Investigator.²
6. Data from investigations, for which there are no published findings, shall be made public by the end of the award. No-cost extensions (NCE) to the award may be requested directly to a NASA Grant Manager at the NSSC by the Investigator.
7. Investigators shall deliver data corrections and re-calibrations to the OSDR as soon as they are available.

¹ National Security Presidential Memorandum 33

² 2 C.F.R. 200.338 NASA Grant and Cooperative Agreement Manual

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8. Investigators are permitted to also deposit their data with other repositories. For example, submitting to a home university archive, model organism database, journal publisher's or other governmental repository.
9. Investigators shall submit status reports and a final report to the NASA Task Book per award.
10. Investigators shall submit any articles published from NASA awards to PubSpace (NPD 2230.1, and "NASA Plan for Increasing Access to the Results of Scientific Research" Document ID 20150020926.)
11. **Research software** developed using BPS funding and used in support of a scientific, peer-reviewed publication shall be released through the NASA Software Release Authority as open-source software along with documentation of that software, no later than the publication date in accordance with NASA requirements. Software should be released with an open, permissive license such as Apache 2.0, BSD 3-Clause "Revised" License, or MIT License. This does not include propriety or commercial software. To ensure reproducibility, investigators must, however, provide any numerical input and other information needed to replicate the experiment, used with commercial calculation packages.
12. **Data Rights:** As established by federal policy in Title 2 Code of Federal Regulations (CFR) 200.315(d), the federal government has a broad right to use and distribute, the data produced under a federal award. NASA policy in the Grants and Cooperative Agreements Manual (GCAM) Appendix D section 11 notes that for any NASA grant or award the recipient grants to the Federal Government, a royalty-free, nonexclusive and irrevocable license to use, reproduce, distribute (including distribution by transmission) to the public, perform publicly, prepare derivative works, and display publicly, data in whole or in part and in any manner for federal purposes and to have or permit others to do so for federal purposes only.
 - a. Publicly available BPS-funded data shall be reusable with a clear, open, and accessible data license.
 - b. If there are no other restrictions, BPS scientific data should be released with a Creative Commons Zero license. Legal limitations on data may include, but are not limited to, limited rights data. For data governed by incompatible licenses seek specific advice from the SMD Chief Science Data Office or Intellectual Property counsel, as needed.
 - c. Publicly available BPS-funded data collections shall be citable using a persistent identifier. Investigators and users are encouraged to cite the sources of the data used to conduct peer-reviewed, published research.
13. **Data Reuse:** Studies that make use of BPS data and resources, but not funded by BPS, such as Citizen Science, Analysis Working Groups (AWGs) and data science projects are invited to submit their results and data to the BPS OSDR.
14. **Presentations:** Investigators sponsored with BPS funding to attend science events open to the public, including but not limited to conferences, workshops, and symposia shall publish any public presentations through a designated NASA repository. Submissions to this repository can be made at any time but no later than end of award period of performance. Public sharing of the presentation may be asynchronous with submission but must be shared publicly by end of award.

3.4 PROJECTS

The policies in this section apply to NASA projects that are responsible for implementing research and/or a framework for research. Managers of such projects have responsibilities for delivering operations data to the OSDRs.

1. Projects are responsible for creating and maintaining operations data during the pre-flight, active project phase, extended project (if applicable), and any project phase re-runs. Data product planning and formulation should be carried out in collaboration with the OSDRs, in accordance with OSDR data standards and requirements, and cognizant of available data access and analysis tools.
2. The Project Scientist shall be responsible for defining requirements for operations data and documenting those requirements in the Data Transfer Agreement (DTA), which is enacted between the Project, the science data provider and the OSDR. These activities are facilitated through early interaction with the OSDRs.
3. The Project shall be responsible for assuring the quality and timely delivery of operations data to the OSDRs, per the DTA. The DTA should include information such as planned data delivery timelines, investigation design characteristics, flight experiment platforms, ground control operations locations, science objectives, anticipated datasets and parameter information, details of payload hardware and sensors to be employed, and technical points of contact in advance of each mission.
4. Projects shall be responsible for ensuring that the operations data are prepared, documented, and transferred per the DTA to ensure its quality, completeness, accuracy, uniformity, and stability. This minimizes error and avoids excessive use of government resources for its processing, curation, and preservation.
 - a. Delivery to the OSDR shall be made as soon as practicable but no later than 6 months after the completion of data acquisition and no later than 1 month after data validation.
 - b. The OSDR shall deliver relevant operations data to investigators per RDSA.
 - c. The OSDR shall make operations data available to the public per the DTA.
5. Projects shall be responsible for ensuring that the operations data requirements are met by the delivered data sets. Biological and physical science data requirements should be interpreted as expansively as possible when determining the scope of operations data collected and delivered to the OSDR. All data that could have impacts on measurements collected as part of an investigation (for example, ground analog data) should be included in definitions of operations data requirements.
6. Operations software that has scientific utility shall be released, along with sufficient documentation, through the NASA Software Release Authority.³ This does not include single use software or commercial software. Examples include software used to transform, mine, model, analyze or visualize data. BPS-funded software shall be reported by the developers of the software so that it can be indexed as part of the NASA catalog of software.^{4,5} BPS-funded software shall be releases under a permissive licence that has broad acceptance in the community.

³ NPR 2210.1C

⁴ NPR 2210.1C

⁵ NASA Grants and Cooperative Agreements Manual

3.5 NASA TASK BOOK

The BPS Division and the Human Research Program within the Space Operations Mission Directorate utilize [Task Book](#), an online database of research projects that includes project descriptions, annual research results, research impacts, funded presentations and a listing of publications resulting from NASA-funded research.

3.6 PUBLICATIONS

BPS-funded authors deposit copies of their peer-reviewed scientific publications and associated data into NASA's publication repository, PubSpace, to increase public access to scientific publications and research data resulting from NASA-funded research. PubSpace has been moved to replaced by NASA's Scientific, Technical and Research Information DiscoV^Ery System ([STRIVES](#)).

Open Access publication: Although there are various uses of the term 'open access', this guidance document uses the term to refer to a method of publication in which the publisher makes the article and related content available online, free of charges or other barriers to access, immediately at the time of publication. Such articles are often licensed for sharing and reuse under a Creative Commons or similar license-type agreement that allows the authors to retain copyright while allowing others to copy, distribute, and reuse their work.

3.7 EVENTS

This BPS policy will apply to any public, BPS-funded science events including, but not limited to conferences, workshops, and symposia, in the following way:

1. An event for which BPS is the primary sponsor shall make conference proceeding publicly accessible in an appropriate NASA designated repository.
 - a. This same repository can also be used to publish presentations, media, or other materials produced as part of the event.
 - b. This does not include laboratory notebooks, preliminary analyses, drafts of scientific papers or preprints, plans for future research, peer review reports, private communications with colleagues, or otherwise restricted information. Restricted information shall not be shared publicly, and if any material with restricted information is shared openly, then the restricted information shall be redacted prior to publicly sharing material.
2. Participants sponsored with BPS funding to attend conferences, workshops, or symposia shall deposit their public scientific publications produced for the event in the appropriate NASA designated repository.
3. BPS-related events for which BPS is not the primary sponsor shall be encouraged to make the publications produced as part of the event publicly accessible.

4 DATA TOOLS AND SCIENCE COMMUNITY INVOLVMENT

The goals of Open Science are met through making data findable, accessible, interoperable, and reusable (FAIR). This is accomplished through careful curation making use of widely accepted data format standards and ontologies.

To increase the ease and efficiency of collecting, curating, and disseminating new data, BPS provides the BPS Open Science Portal as a single point for entry for biological data submission, curation and data search and retrieval for BPS science data.

Several mechanisms are employed for managing the capture and submission of new data. Refining these tools and developing functional requirements will improve the quality of curation, increase efficiencies, and reduce costs:

1. Open Science and Data Management Plan (OSDMP). The principal mechanism for managing expectations of investigators is the OSDMP. The OSDMP consists of a comprehensive listing of data parameters that will be measured during the investigation and the data products resulting from the investigation. These parameters and products vary with BPS disciplines so it will be helpful for the OSDR to provide proposers with templates and instructions. This can be accomplished through the solicitation by inserting links to the most current templates. It is the responsibility of the OSDR to maintain and update the OSDMP templates.
2. Research Data Submission Agreements (RDSA) between the Data Producer and the designated OSDR shall be required. Awardees are expected to sign a RDSA with the OSDR as soon as possible after award. These agreements can be based on the proposed DMP that specify the data and set the timeline for data submission to the OSDR as well as establishing public release timeframes.
3. Data Transfer Agreement (DTAs). Projects and OSDRs are expected to develop and finalize a DTA that specifies the scope and schedule for operations data to be delivered to OSDRs in support of BPS-funded investigations.

APPENDIX A: Glossary

Term	Definition
Citizen Science	A form of open collaboration in which individuals or organizations participate in the scientific process in various ways. Citizen science projects are science projects that rely on volunteers, often referred to as "citizen scientists". Citizen scientists collaborate with NASA scientists by formulating research questions, conducting experiments, collecting, and analyzing data, interpreting results, making new discoveries, and/or developing technologies and applications. i.e., NPD 1090.2
Data	Facts that can be analyzed or used to gain knowledge or make decisions, information. Statistics or other information represented in a form suitable for processing by computer.
Data Producer	The role played by those persons or client systems that provide the data to be preserved. This can include other repositories or internal OSDR persons or systems.
Data Usage License	The license agreement between a Depositor and a Downloader governing the limits and restrictions (or lack thereof) of how the downloaded User Submissions can be used.
Investigation	A plan for a coordinated set of actions and observations designed to generate data, with the ultimate goal of discovery or hypothesis testing.
Metadata	Data that provides information about other data". In other words, it is "data about data". Many distinct types of metadata exist, including descriptive metadata, structural metadata, administrative metadata, reference metadata, statistical metadata, and legal metadata.
Open Science	Open Science is the practice of science in such a way that others can collaborate and contribute, where research data, lab notes and other research processes are freely available, under terms that enable reuse, redistribution and reproduction of the research and its underlying data and methods (Foster).
Operations Data	Data collected or produced by NASA Projects as part of an investigation or experiment.
Provenance	Provenance – also known as "custodial history" – is a core concept within archival science and archival processing. The term refers to the individuals, groups, or organizations that originally created or received the items in an accumulation of records, and to the items' subsequent chain of custody .
Research Data	Data produced and collected by Investigators (or NASA on their behalf) as part of an investigation or experiment.
Scientific Utility	Information that is necessary to validate research findings or beneficial for future research activities.
Single use software	Software written for use in unique instances, such as making a plot for a paper, or manipulating data in a specific way.
Software Permissive license	Guarantee the free use, modification, and redistribution of software while still permitting proprietary derivative works.
Software project	An activity to develop software. A software project typically has a version control platform on which develop can occur collaboratively.

APPENDIX B: Acronyms and Abbreviations

ALSDA	Ames Life Sciences Data Archive
AWG	Analysis Working Groups
BPS	Biological and Physical Sciences
DME	Data Management Environment
DST	Data Submission Tool
DTA	Data Transfer Agreement (applies to operations data and software)
FAIR	Findable, Accessible, Interoperable, Reusable
GCAM	Grant and Cooperative Agreement Manual
GL	GeneLab
ISS	International Space Station
NASA	National Aeronautical and Space Administration
NBISC	NASA Biological Institutional Scientific Collection
NCE	No-cost Extensions
NPD	NASA Policy Directive
NRA	NASA Research Announcements
NSSC	NASA Shared Services Center
OMB	White House Office of Management and Budget
ORCID	Open Researcher and Contributor ID
OSDMP	Open Science and Data Management Plan
OSDR	Open Science Data Repository
OSSI	Open Source Science Initiative
PI	Principal Investigator
PSI	Physical Sciences Informatics
RDSA	Research Data Submission Agreement
ROSES	Research Opportunities in Space and Earth Science NRA
SMD	Science Mission Directorate
STRIVES	NASA's Scientific, Technical and Research Information DiscoVVery System