NASA's Revised Planetary Protection Policy and Implementation

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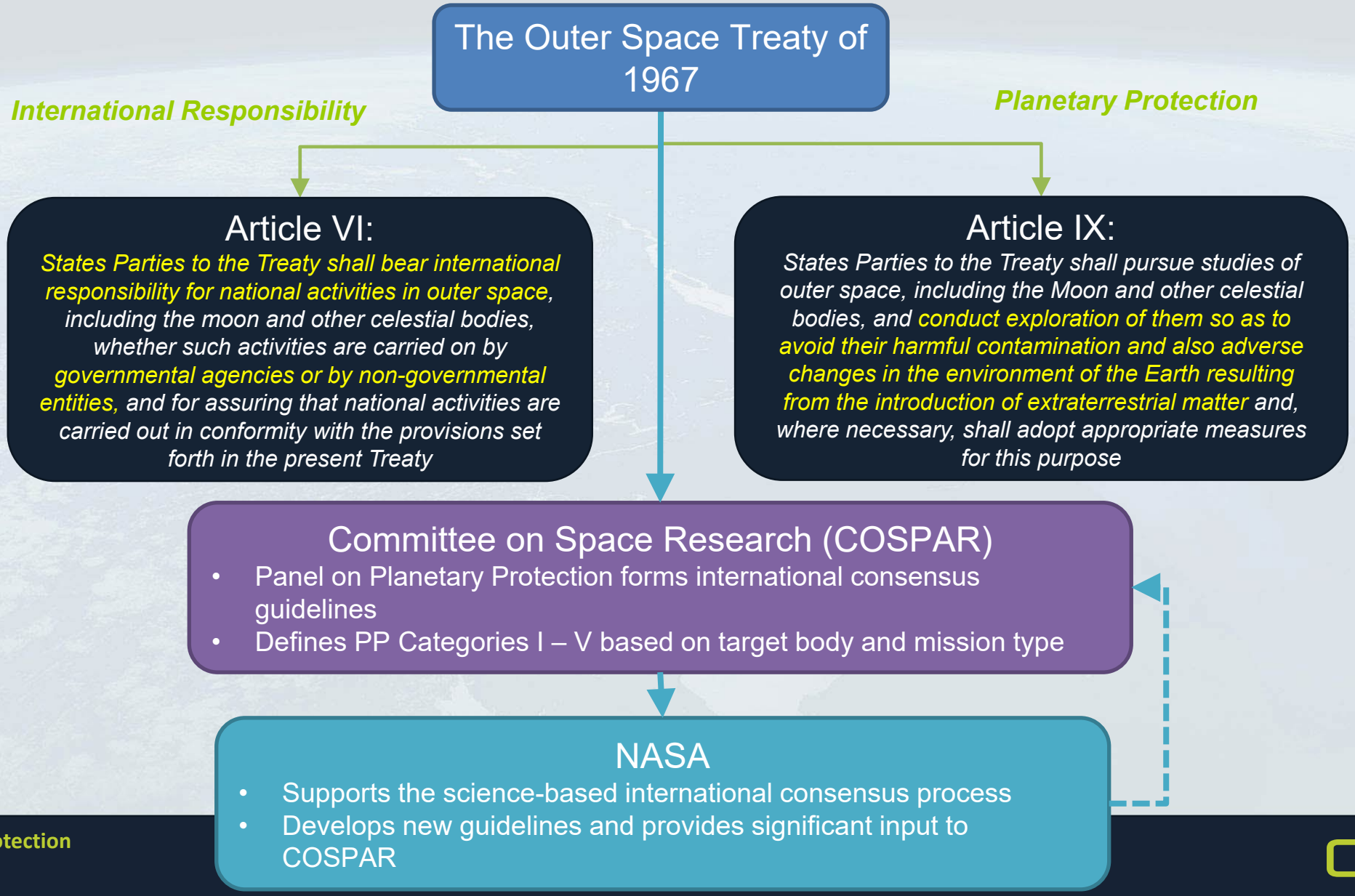
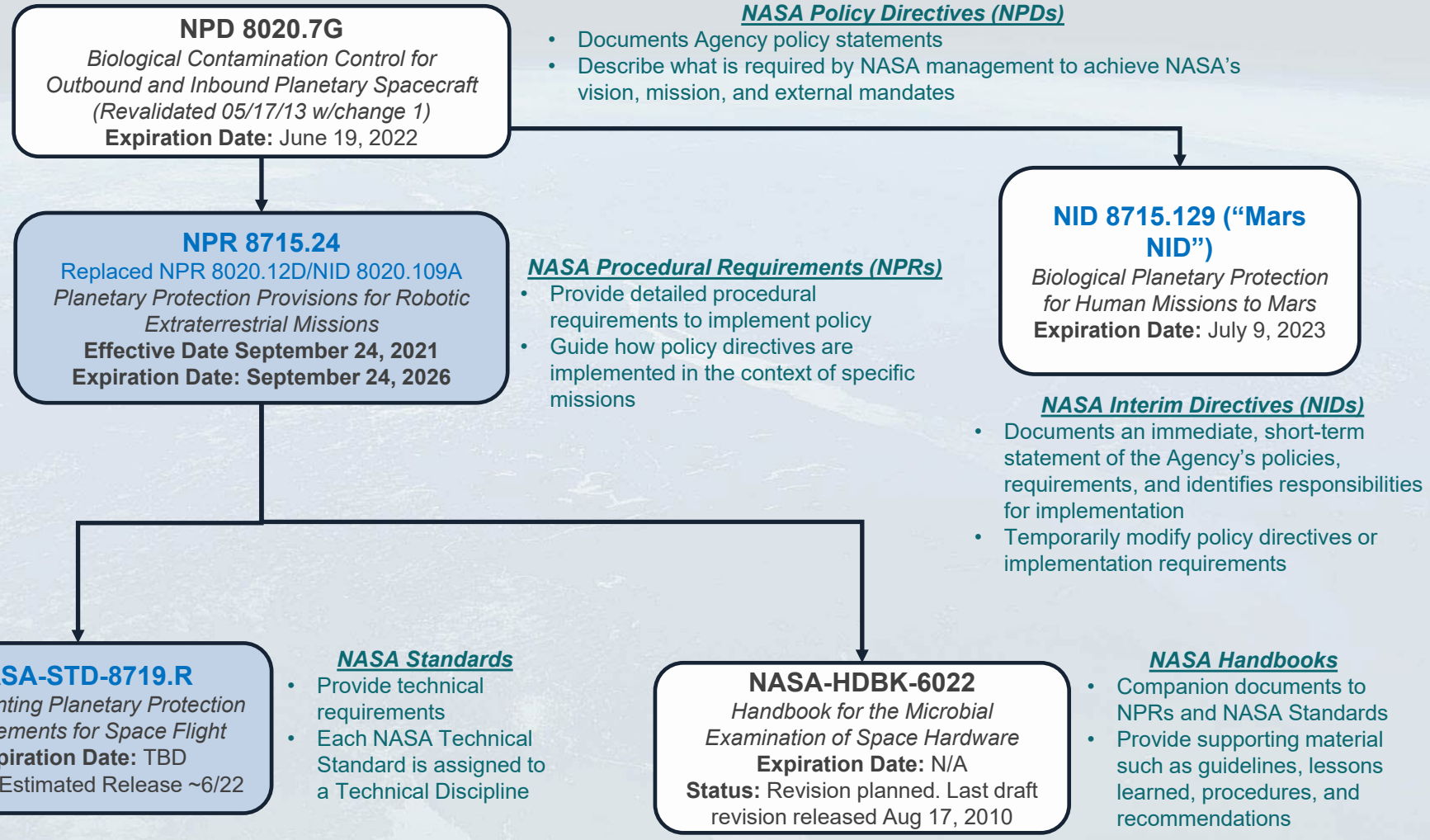
Planetary Protection Policy



NASA's Planetary Protection Policy Documents (current)



All published documents found in NODIS: https://nodis3.gsfc.nasa.gov/ or the OPP website: https://sma.nasa.gov/sma-disciplines/planetary-protection

= New Documents

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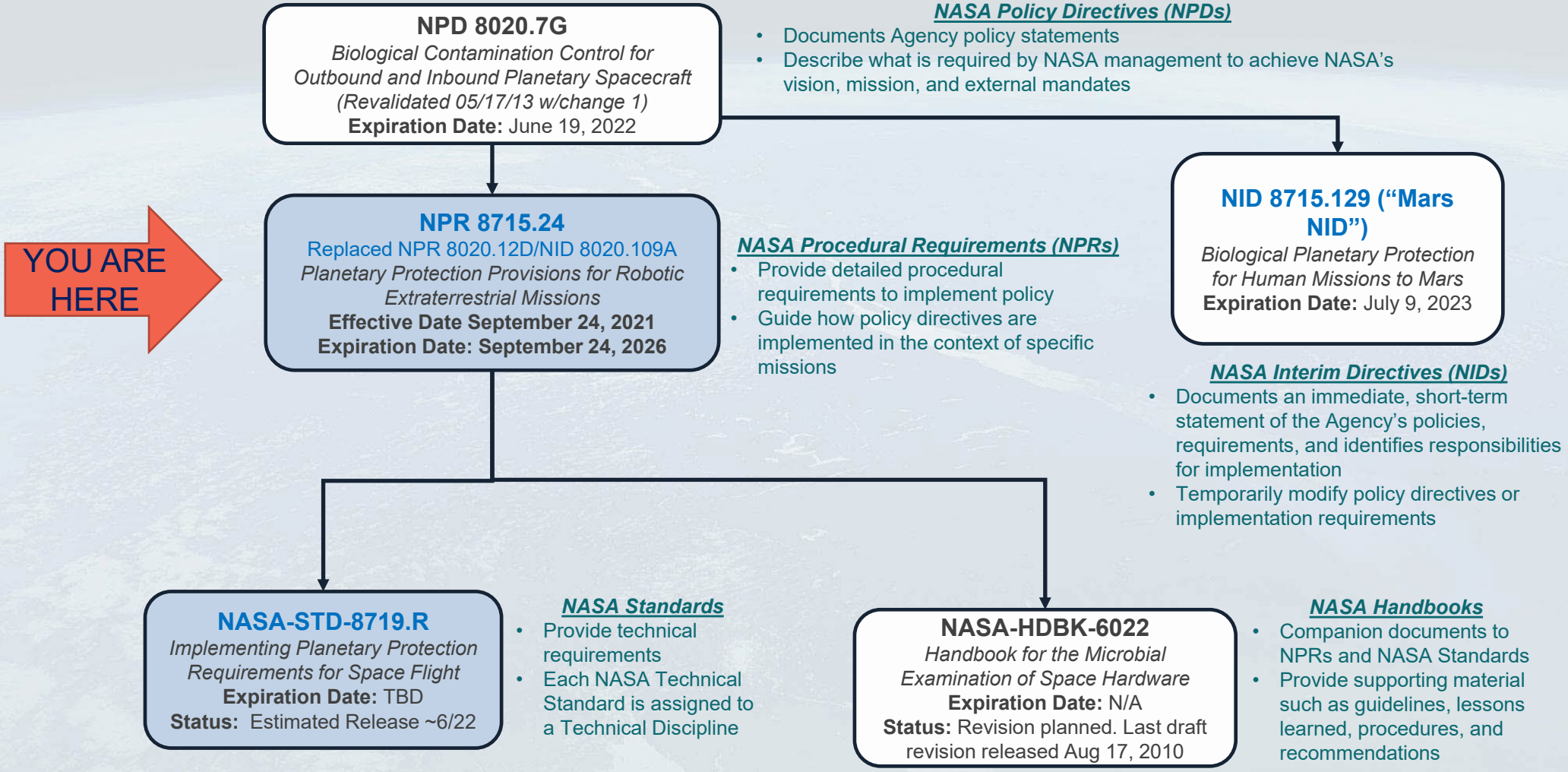

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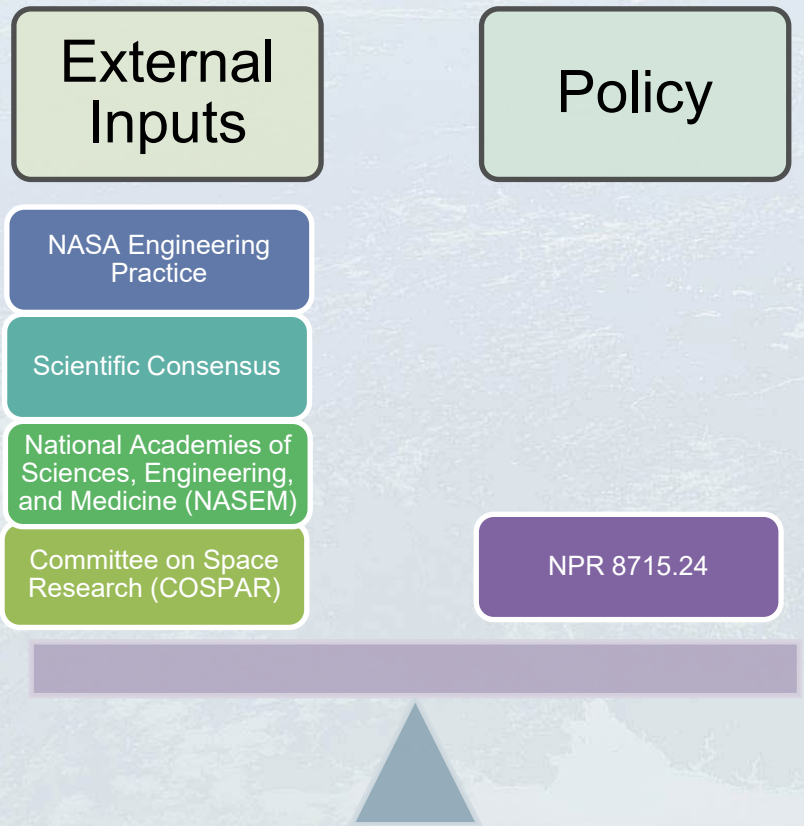
Purpose of NPR 8715.24 - *Planetary Protection Provisions for Robotic Extraterrestrial Missions*

- Defines NASA roles responsibilities and procedural requirements to implement PP on robotic missions.



Forward Planetary Protection

- Control risk of **harmful contamination** to other bodies to protect science

Backward Planetary Protection

- Prevent **harmful contamination** to Earth's environment from extraterrestrial samples

P.1 Purpose

a. This directive defines NASA roles and responsibilities and the procedural requirements, informed by Committee on Space Research (COSPAR) Planetary Protection Policy and Guidelines (hereafter referred to as COSPAR policy and guidelines) and National Academies of Sciences, Engineering, and Medicine (NASEM) advice, to:

(1) Control the risk of harmful contamination to other bodies in the solar system, protecting the integrity of the search for and study of processes of chemical evolution or origin of life.

(2) Prevent potentially harmful consequences for humans and the Earth's environment due to the return of extraterrestrial samples from destinations or operations categorized as restricted Earth return.

Overview of NPR 8715.24 - *Planetary Protection Provisions for Robotic Extraterrestrial Missions*

Chapter 1. Introduction

1.1 Overview

1.2 Utilization of Current Scientific Consensus Throughout the Project

1.3 PP Considerations for Participation in Partnered Missions

1.4 Delegation of Responsibilities

1.5 Request for Relief

Chapter 2. Roles and Responsibilities

2.1 Mission Directorate Associate Administrator

2.2 NASA Project Manager

2.3 Chief, Safety and Mission Assurance

2.4 Planetary Protection Officer

2.5 Project-Level SMA Technical Authority

Chapter 3. Planetary Protection Procedural Requirements

3.1 Categorization and Planning

3.2 Verification, Assurance, and Pre-Launch Report Activities

3.3 Post-Launch/End of Mission

3.4 Restricted Sample Return and Containment

Chapter 1:

- Introduces risk-informed decision making
- Addresses how current scientific consensus is considered for missions
- Addresses missions with NASA partners / resources
- Baselines PP Relief using NASA General Safety Program Requirements

Chapter 2:

- Defines the key roles and responsibilities for executing PP
  - Previously, only the PPO role was defined
  - COSPAR Interfacing
- Merges PP into the regular mission and project management structure

Chapter 3:

- Provides the process for obtaining mission PP categorization
- Addresses PP documentation, review, and concurrence throughout the project lifecycle
- Defines independent verification/assurance activities as well as anomaly investigations
- Addresses sample return break-the-chain, containment and process.

Expanded Roles and Responsibilities

Programmatic

Mission Directorate Associate Administrator (MDAA)

NEW

- Provides PP Mission Categorization
- Provides resources for PP compliance
- Negotiates missions-specific process for partnered missions (consults with interagency, commercial and international partners)
- Supports R&TD to close knowledge gaps and develop PP requirements to enable future missions.

NASA Project Manager

NEW

- Submits PP Category Request to MDAA
- Identifies Agency PP requirements and standards
- Establishes planned implementation approach
- Coordinates verification and assurance activities with PPO
- Documenting implementation activities
- Coordinates extended mission activities and requirements

Safety & Mission Assurance (SMA) Technical Authority (TA)

Chief, SMA

- Concurrence on PP category proposals
- Consults with Chief HMO and Engineer on restricted Earth-return
- Monitors and tracks PP requirements
- Oversees extended mission activities
- Advises MDAA on partnered missions
- Office of PP established

NEW

Planetary Protection Officer

- Represent NASA in external activities
- Maintain policy
- Concurrence on PP category proposals
- Advise projects on PP approach
- Oversee and verify PP implementation
- Independent verification
- Coordinate with MDAA on R&TD
- Advises MDAA on partnered missions

Project-Level SMA TA

NEW

- Advises project to notify PPO
- Assures formulation and execution of implementation is sound
- Facilitates independent verification
- Coordinates with project to identify events of conditions for further investigation

Documentation Concurrence Authority

Allows flexibility to demonstrate compliance with PP requirements with a reduced document set.

Increased Biological Risk = Concurrence from Chief SMA

Planetary Protection Documentation	Planetary Protection Mission Category					
	Outbound				Inbound	
	I	II	III	IV	V(r)	V(u)
Final PP Mission Categorization	Concurrence from PPO		Concurrence from Chief, SMA based on recommendations from PPO			
PP Requirements Document	None required	Concurrence from PPO	Concurrence from Chief, SMA based on recommendations from PPO			Refer to outbound planetary protection mission category for concurrence authority
PP Implementation Plan			Concurrence from PPO			
Pre-Launch PP Report			Concurrence from Chief, SMA based on recommendations from PPO			
Post-Launch PP Report						
Extended Mission PP Report						
End of Mission PP Report						

NASA's Planetary Protection Policy Documents (current)

NPD 8020.7G
Biological Contamination Control for Outbound and Inbound Planetary Spacecraft (Revalidated 05/17/13 w/change 1)
Expiration Date: June 19, 2022

NASA Policy Directives (NPDs)
- Documents Agency policy statements
- Describe what is required by NASA management to achieve NASA's vision, mission, and external mandates

NPR 8715.24
Replaced NPR 8020.12D/NID 8020.109A
Planetary Protection Provisions for Robotic Extraterrestrial Missions
Effective Date September 24, 2021
Expiration Date: September 24, 2026

NASA Procedural Requirements (NPRs)
- Provide detailed procedural requirements to implement policy
- Guide how policy directives are implemented in the context of specific missions

NID 8715.129 ("Mars NID")
Biological Planetary Protection for Human Missions to Mars
Expiration Date: July 9, 2023

NASA Interim Directives (NIDs)
- Documents an immediate, short-term statement of the Agency's policies, requirements, and identifies responsibilities for implementation
- Temporarily modify policy directives or implementation requirements

YOU ARE HERE

NASA-STD-8719.R
Implementing Planetary Protection Requirements for Space Flight
Expiration Date: TBD
Status: Estimated Release ~6/22

NASA Standards
- Provide technical requirements
- Each NASA Technical Standard is assigned to a Technical Discipline

NASA-HDBK-6022
Handbook for the Microbial Examination of Space Hardware
Expiration Date: N/A
Status: Revision planned. Last draft revision released Aug 17, 2010

NASA Handbooks
- Companion documents to NPRs and NASA Standards
- Provide supporting material such as guidelines, lessons learned, procedures, and recommendations

All published documents found in NODIS: https://nodis3.gsfc.nasa.gov/ or the OPP website: https://sma.nasa.gov/sma-disciplines/planetary-protection

= New Documents

NASA Standard: *"Implementing Planetary Protection Requirements for Space Flight"*

- Provides the technical requirements to satisfy forward and backward planetary protection

Forward Planetary Protection

- Control risk of **harmful contamination** to other bodies to protect science

Backward Planetary Protection

- Prevent **harmful contamination** to Earth's environment from extraterrestrial samples

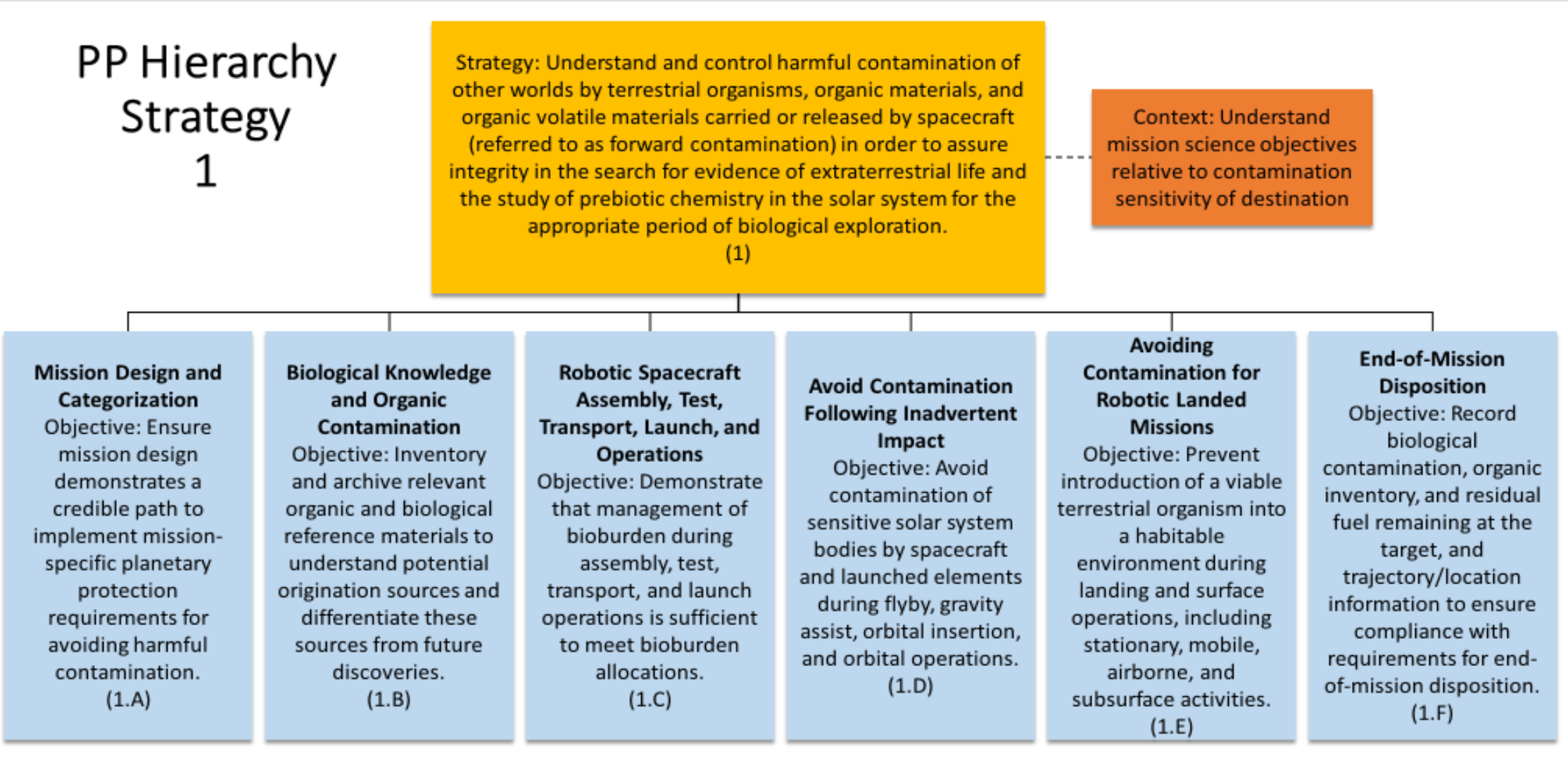
- Provides the required elements to be included in each document throughout the project lifecycle
- Provides requirements for the NASA accepted approach to performing spore assays (NASA Standard Spore Assay) for accounting bioburden



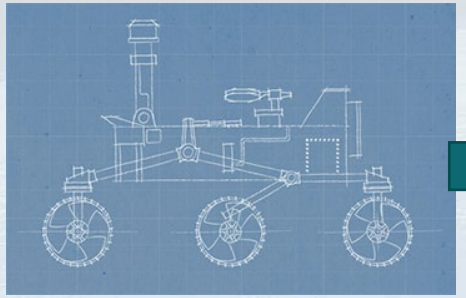




Strategy to Control Forward Contamination



Control of Forward Contamination



Mission Design & Categorization

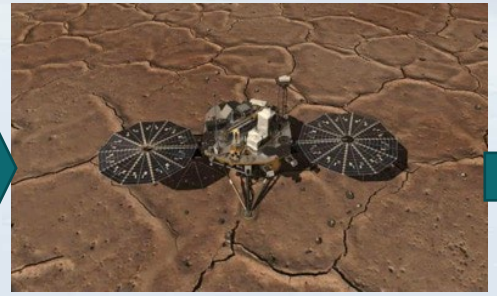
- Information to be included in the PP Mission Categorization Proposal
- Biological and organic contamination knowledge inventory materials

Robotic Spacecraft Assembly, Test, Transport, Launch, and Operations

- Controlled manufacturing environments and cleanrooms
- Bioburden Control Approach
- Analytical Approach
- Documentation requirements and communication of data/analysis updates

Avoiding Contamination following Inadvertent Impact

- Avoiding inadvertent impact of solar system bodies by spacecraft and launch elements during flyby, gravity assist, or orbital insertion
  - Jovian or Saturnian systems (Cat II)
  - Mars (Cat II-IV)
  - Sensitive Icy Worlds (Cat III or IV)
- Secondary and auxiliary payloads



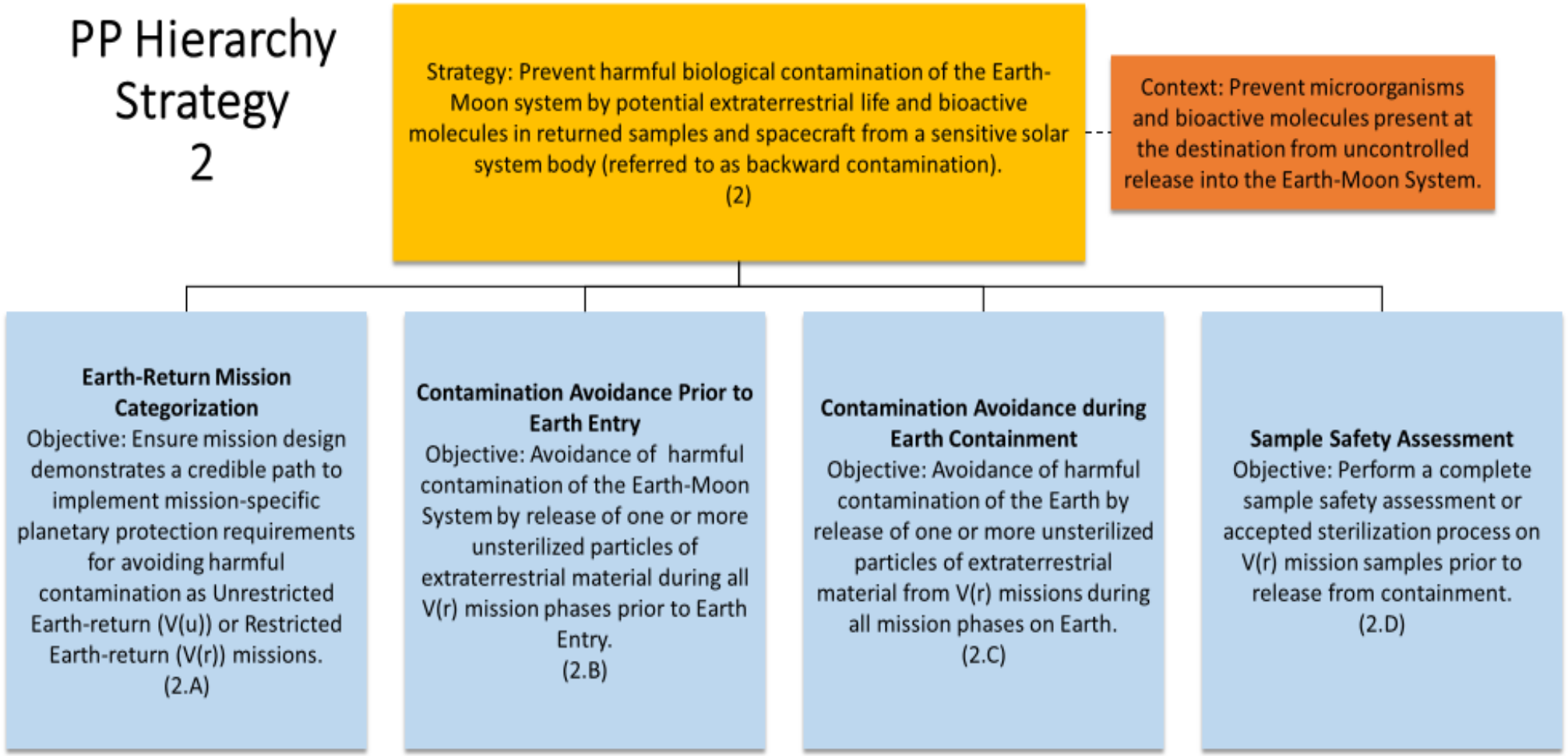
Avoiding Contamination for Robotic Landed Missions

- Prevent occurrence of a biological inoculation event into a potentially habitable environment during landing and surface operations
  - Stationary and mobile activities
- Mars IVa, IVb, IVc requirements
  - Bioburden Control Approach
  - Analytical Approach
- Sensitive Icy World requirements

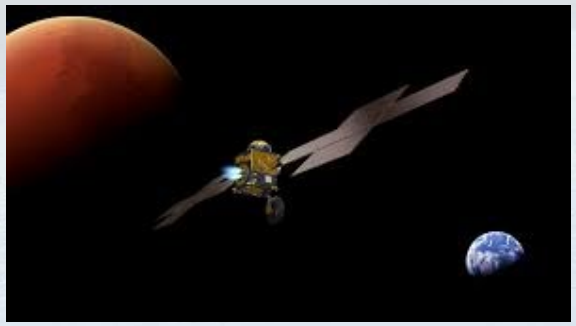
End of Mission Disposition

- Documentation of final disposition of hardware
- Updates to organic, biological, and combustion product inventories
- Information to be included in End of Mission PP Report

Strategy to Prevent Backward Contamination

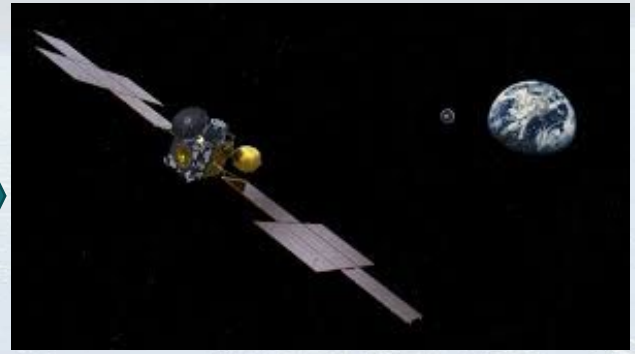


Prevention of Backward Contamination



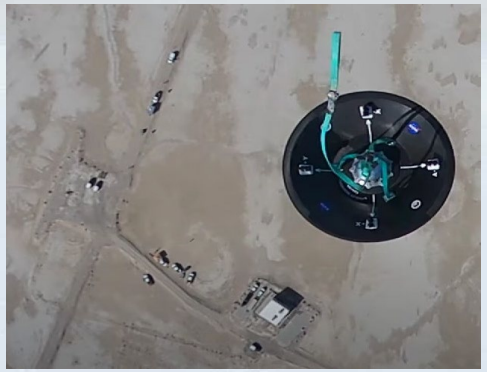
Earth-Return Mission Categorization

- Inbound categorization for Earth-return missions
  - Robotic restricted Earth-return V(r)
  - Unrestricted Earth-return V(u)
- Notional timeline for sample receiving facility (SRF) for V(r) missions.
- No further PP considerations for the return phase of V(u) missions



Contamination Avoidance Prior to Earth Entry

- **PP Requirements Document:**
  - Reports and reviews to support decision making process for Earth-return, Earth-entry, and sample release from containment
- **PP Implementation Plan:**
  - Approach to demonstrate avoidance of contamination of the Earth-Moon System
- Data and analyses used to demonstrate compliance with requirements prior to samples returning to Earth
- Containment facility readiness prior to samples returning to Earth



Contamination Avoidance during Earth Containment

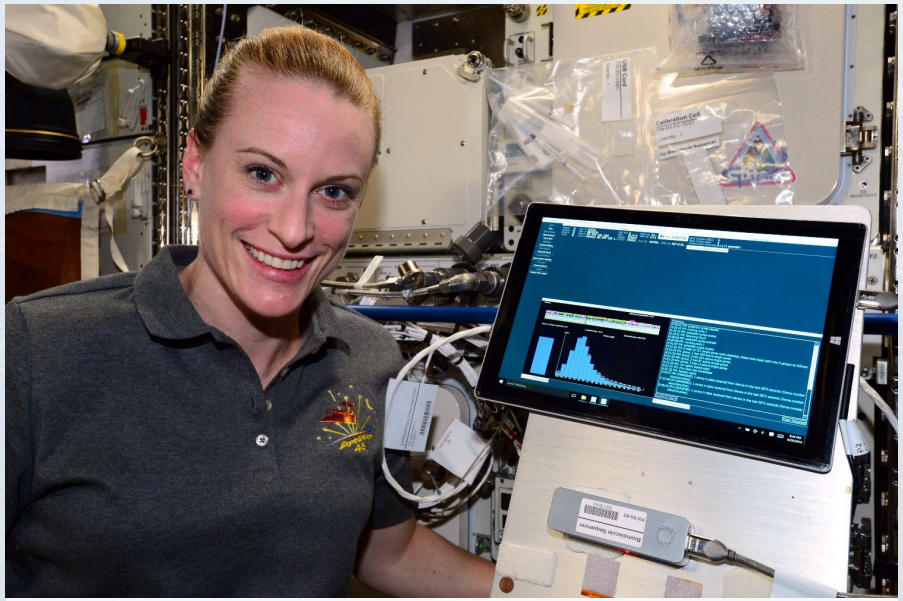
- Demonstrate avoidance of harmful contamination of the Earth by release of unsterilized extraterrestrial material:
  - At landing site
  - During transport
  - During storage, curation, and sample safety assessment activities

Sample Safety Assessment

- Sample sterilization to inactivate terrestrial bioactive molecules
- Strategies to avoid “false positives” and “false negatives” in life detection investigations or sample safety assessments
- **Sample Pre-Release Report:**
  - Approach to demonstrate avoidance of contamination of Earth
  - Feeds into the decision-making process for releasing samples out of containment

NASA's Future Planetary Protection Policy Efforts

- Planetary Protection Handbook
  - *Will document additional background, guidelines, lessons learned and the "how to" processes to support mission developers*
  - *Updated with new methods such as membrane filtration for bioburden assays and metagenomics*
  - *Increased focus of Quality Assurance and Quality Control (QA/QC) processes*
- Planetary Protection for Crewed Missions
  - *Future NASA Procedural Requirements (NPR) document to address PP for crewed lunar and Mars missions*
    - *Will replace current interim directive (NID 8715.129)*
  - *NASA PP Standard currently addressing robotic and crewed missions with updates planned as knowledge gaps are closed*



NASA Astronaut Kate Rubins sequenced DNA in space for the first time ever for the Biomolecule Sequencer investigation, using the MinION sequencing device.

Thank You!

NASA has and will continue to update its planetary protection policy and implementation approach in response to advances in scientific understanding of solar system targets, upcoming mission opportunities for exploration and sample return, and the private sector's emerging capability to plan missions to Earth's Moon and Mars.

Abstract

NASA has updated its planetary protection policy and implementation approach in response to advances in scientific understanding of solar system targets, upcoming mission opportunities for exploration and sample return, and the private sector's emerging capability to plan missions to Earth's Moon and Mars. In September 2021, the NASA Procedural Requirements NPR 8715.24, entitled "Planetary Protection Provisions for Robotic Extraterrestrial Missions" was released which repositions planetary protection in existing NASA mission and program management structures, introduces risk-informed decision making, expands on key roles and responsibilities for both programmatic and the Office of Safety and Mission Assurance, updates the categorization process and streamlines the planetary protection documentation approval and schedule. NASA is working on a more detailed technical standard to accompany NPR 8715.24 which will include the detailed technical requirements to address organic contamination, inadvertent impact avoidance, biological control and management, end of mission disposal and restricted Earth-Return sample safety and assurance. This report to the COSPAR community will describe the current NASA planetary protection policy and its alignment with the revised COSPAR planetary protection policy. NASA's plans for updating the supporting "Handbook for Implementing Planetary Protection Technical Requirements" and future policies for addressing planetary protection of crewed missions will also be presented.