Strengthening Planetary Protection for Today's and Tomorrow's Missions Through JPL's New Organizational Structure

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Group Supervisor

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Overview

- Historically the disciplines of **Analytical Chemistry, Biotechnology, Contamination Control, and Planetary Protection** were applied in parallel but interdependent paths – each contributing critical expertise to mission success.
- Joint efforts on missions such as the recent Mars 2020 and Europa Clipper missions have demonstrated that integrating microbial, particulate, and molecular cleanliness insight is essential for modern exploration.
- The recent JPL reorganization formally unifies these disciplines, strengthening our ability to provide rapid, cross-cutting solutions and to partner seamlessly with flight projects and industry.
- Our combined strengths are already enabling new standards of contamination knowledge risk reduction, including tasks on the organic footprint of Lunar landing vehicles, and Launch Vehicle particle transport to assess spacecraft biological recontamination threats.
- This presentation briefly highlights the group history and the shared future we are building to support the development and execution of NASA and partner missions.

Group structure Circa September 2025

Jet Propulsion Laboratory
California Institute of Technology

353
Propulsion, Thermal, and Materials Section

353D
Contamination Control Engineering

We provide contamination control engineering expertise for technology development and flight projects from concept through end-of-life. We champion mission-specific protocols, modeling, and analysis that characterize and reduce the evolution, transport, and deposition of particulate, molecular, and other unwanted contaminants that degrade system performance.

353E
Analytical Chemistry and Materials Development

We maintain capabilities in chemical analysis, spectroscopy, materials, failure analysis, contamination analysis, experimental design and instrument R&D. The uniquely qualified staff and lab support the needs of flight projects, Caltech projects, science instrument development, and various research tasks.

353N
Biotechnology and Planetary Protection

We ensure mission compliance with international requirements, implement NASA policy, and provides advocacy and education across scientific and programmatic communities. To maintain our leadership, we continually adopt and develop new technologies to advance the planetary protection practice.

Group structure October 2025-Present

Jet Propulsion Laboratory
California Institute of Technology

353
Propulsion, Thermal, and Materials Section

353D
Biological & Chemical Analysis & Implementation Group

We deliver unified and integrated contamination control, analytical chemistry, biotechnology, and planetary protection expertise to safeguard mission integrity from concept through end-of-life. By uniting susceptibility analysis, risk assessment, modeling, advanced laboratory analysis, and policy and procedure implementation, we provide mission-specific cleanliness requirements and solutions, compliance assurance, and cutting-edge technologies that enable safe, high-confidence exploration capabilities across NASA and partner missions.

JPL Flight Project Missions involving Anal. Chem., PP, & CC*

Project	Launch Yr
Vikings	1975
Galileo	1989
Mars Global Surveyor	1996
Mars Pathfinder	1996
Cassini	1997
Deep Space 1	1998
Mars Climate Orbiter	1998
Deep Space 2	1999
Mars Surveyor 98 Lander	1999
Stardust	1999
Odyssey	2001
Mars Express	2003
Mars Exploration Rovers	2003
Rosetta	2004
Deep Impact	2005
Mars Recon. Orbiter	2005
Dawn	2007
Phoenix	2007

Project	Launch Yr
Juno	2011
Mars Science Laboratory	2011
TGO - Electra Transcievers	2016
InSight	2018
MarCO (Mars Cube One)	2018
Mars 2020	2020
Europa Clipper	2024
Mars Sample Return (MSR)	Planned

*Does not include project support on missions that were cancelled prior to launch (e.g. Europa Lander) or determined to not require PP support (e.g. Kepler)

JPL Flight Project Missions involving ATC, PP, & CC*

Project	Launch Yr
Vikings	1975
C[illegible]e	[illegible]
M[illegible]s [illegible]	[illegible]
M[illegible]s Pathfinder	1996
C[illegible]sini	[illegible]
D[illegible]o Sp[illegible]	[illegible]
M[illegible]s Climate Orbiter	1998
D[illegible]o Space[illegible]	[illegible]
M[illegible]s Survey[illegible]	[illegible]
S[illegible]dust	1999
O[illegible]ssey	[illegible]
M[illegible]s Express	[illegible]
M[illegible]s Exploration Rovers	2003
R[illegible]etta	[illegible]
D[illegible]p Impact	[illegible]
M[illegible]s Recon. Orbiter	2005
Dawn	2007
Phoenix	2007

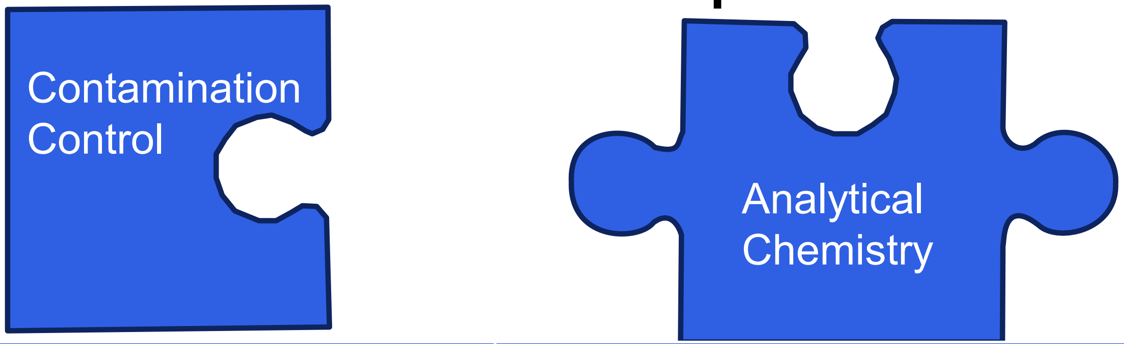
Project	Launch Yr
Juno	2011
[illegible] Science Laboratory	2011
[illegible] Electra Transcievers	2016
InSight	2018
[illegible]	2018
[illegible]	2020
Europa Clipper	2024
[illegible]	Planned

Phoenix	2007
Mars Science Laboratory	2011
Mars 2020	2020
Europa Clipper	2024

Collaboration among groups increased with each mission

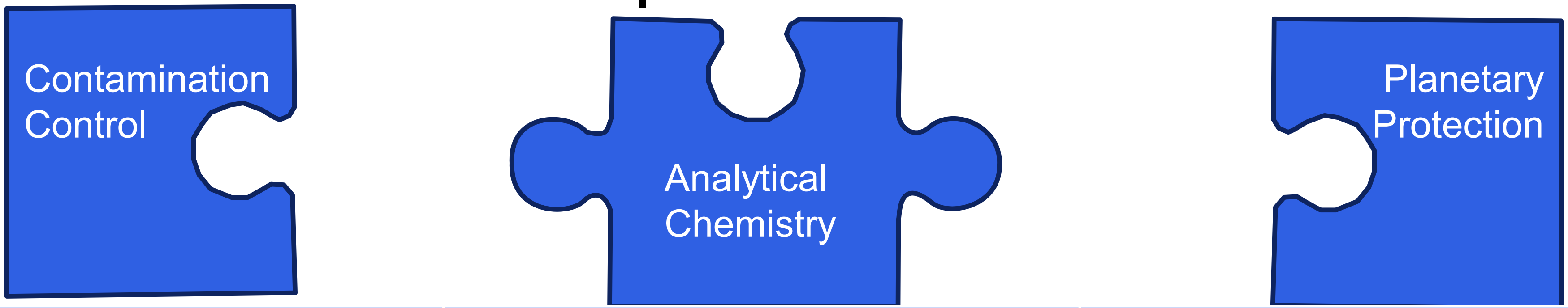
*Does not include project support on missions that were cancelled prior to launch (e.g. Europa Lander) or determined to not require PP support (e.g. Kepler)

A Shared Group Evolution



	Molecular/Particulate	Chemistry	Biological
Phoenix	• Surface cleanliness, outgassing, and verification • Organic Archive	• Material validation	• Spore counts • Biobarrier for sample collection arm.

A Shared Group Evolution



	Molecular/Particulate	**Chemistry**	**Biological**
Phoenix	• Surface cleanliness, outgassing, and verification • Organic Archive	• Material validation	• Spore counts • Biobarrier for sample collection arm.
M2020, MSR	• Surface cleanliness, outgassing, and verification • Organic Archive	• Material validation • Particle and molecular analysis	• Spore and viable organisms • Contamination Knowledge • Bio Organic Archive
	• Molecular transport modeling • Fairing particle redistribution	• Spore Adhesion analysis using AFM cantilever • Cell Stacking/Topography on coupons	
	• FMPB design, Particle transport model informed biological transport probability to sealed tubes		

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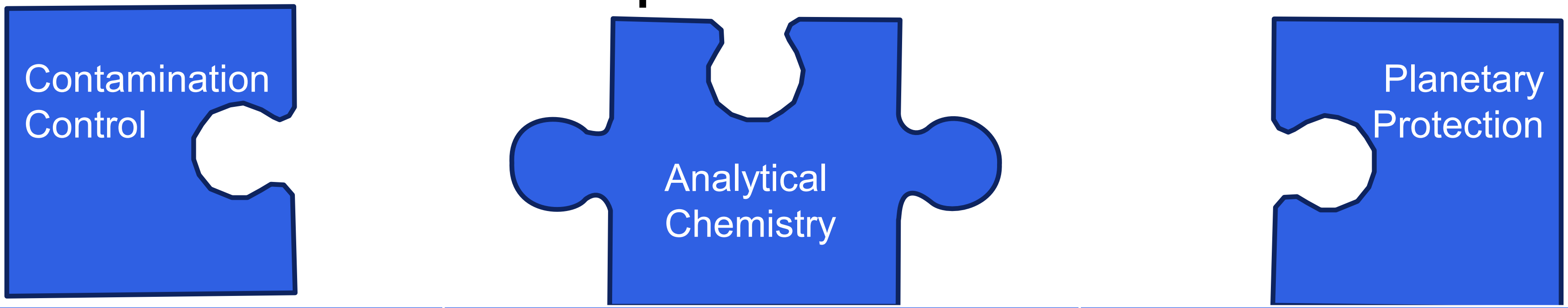
A Shared Group Evolution



<table>
<tr><th></th><th>Molecular/Particulate</th><th>Chemistry</th><th>Biological</th></tr>
<tr><td>Phoenix</td><td>• Surface cleanliness, outgassing, and verification
• Organic Archive</td><td>• Material validation</td><td>• Spore counts
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<tr><td rowspan="3">M2020, MSR</td><td>• Surface cleanliness, outgassing, and verification
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• Bio Organic Archive</td></tr>
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• Fairing particle redistribution</td><td colspan="2">• Spore Adhesion analysis using AFM cantilever
• Cell Stacking/Topography on coupons</td></tr>
<tr><td colspan="3">• FMPB design, Particle transport model informed biological transport probability to sealed tubes</td></tr>
<tr><td rowspan="2">Europa Clipper</td><td>• Surface cleanliness, outgassing, and verification
• Organic Archive
• Prop droplet, combustion by-products deposition/effects</td><td>• Material validation
• Particle and molecular analysis
• Outgassing and analysis
• Propellant droplet characterization</td><td>• Spore counts</td></tr>
<tr><td colspan="3">Particle transport in launch vehicle fairing in support of a biological redistribution risk assessment.</td></tr>
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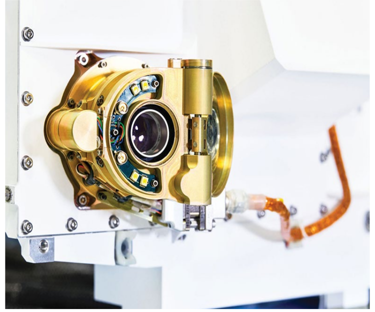
Areas of Expertise

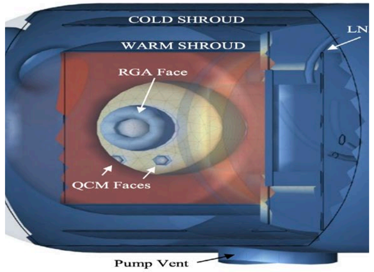
Flight Implementation

Organic and Microbial Archiving



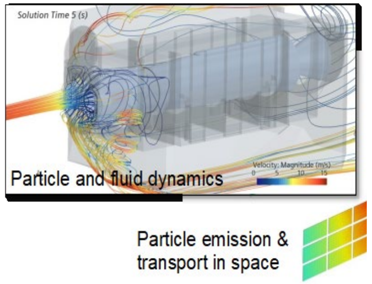
Biotechnology and Science Instrument Development

Lab Services



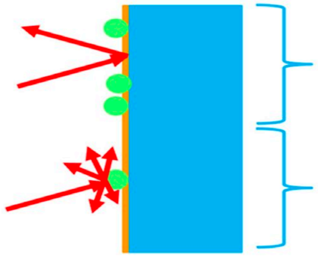
Experimental Design

Systems Engineering

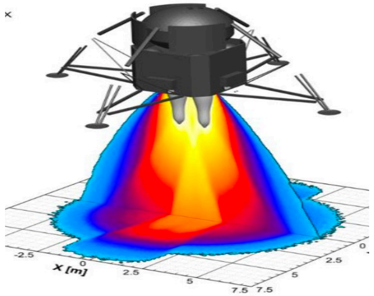


Modeling and Simulation

Materials Evaluation



Optical Systems Performance



Propulsion systems modeling

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Group Enhancements to Flight Implementation

Operational strategies, e.g.

- Hardware assembly to minimize cross-contamination.
- Strategic operations for contamination control

Mechanical design e.g.

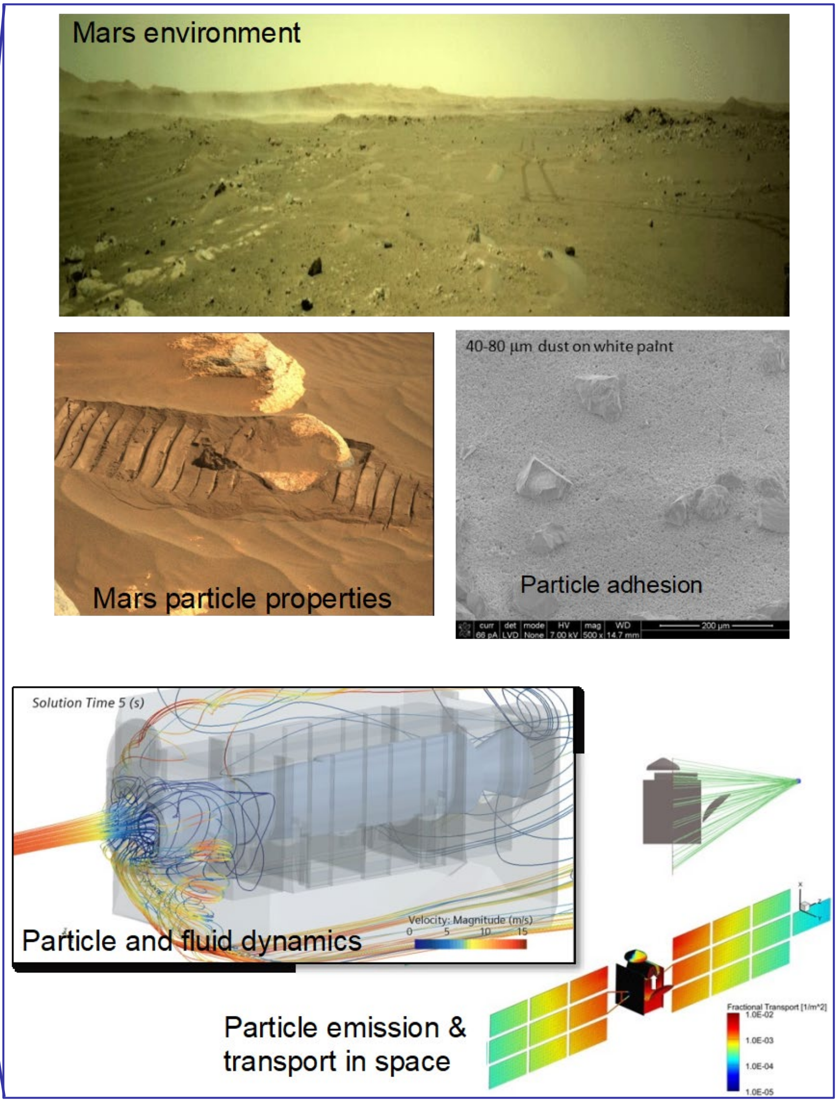
- Dust covers
- Fastener counterbores

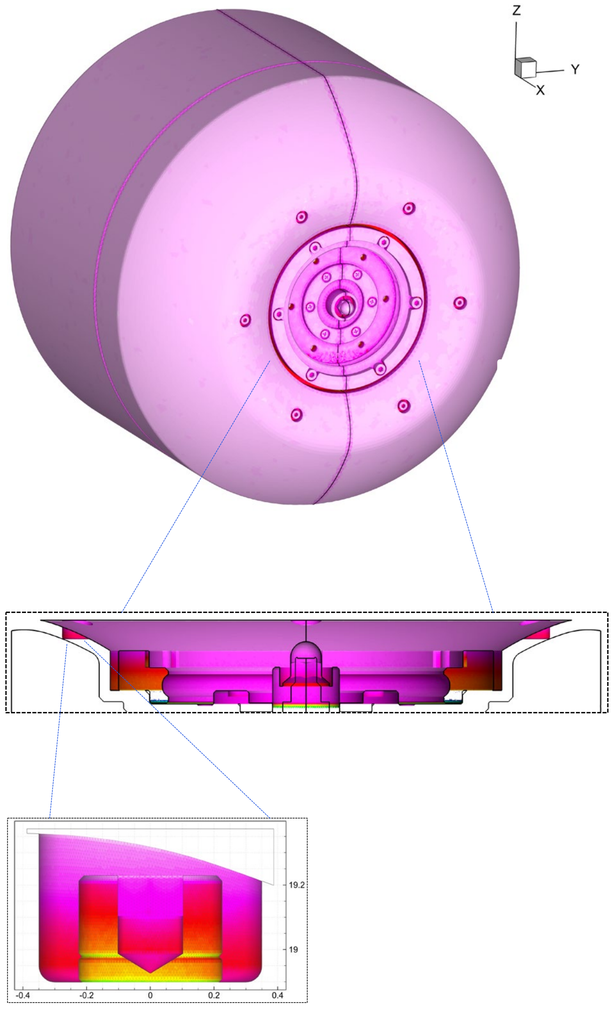
Particle transport and fluid dynamics modeling

- Informs hardware design and operations

Future Developments/opportunities, e.g.

- Updates to the current scientific knowledge that impact contamination risk assessments





1. Cooper, Moogega et al. (2024) Mars Sample Return Orbiting Sample as Primary Containment Vessel Backward Planetary Protection Design Considerations. 45th COSPAR Scientific Assembly. Held 13-21 July 2024.
2. Hoey, William et al. (2024). 3-D Ray-tracing Analyses and Design of the Mars Sample Return Orbiting Sample for Sterilization by Ultraviolet Radiation. 45th COSPAR Scientific Assembly. Held 13-21 July 2024.
3. Hoey, William, et al. "Launch recontamination: planetary protection models for particle transport in spacecraft payload fairing environments." 44th COSPAR Scientific Assembly. Held 16-24 July 44 (2022): 3287.
4. Shallcross, Gregory, et al. "Launch recontamination: the evaluation of particle adhesion and removal mechanisms in spacecraft payload fairing environments." 44th COSPAR Scientific Assembly. Held 16-24 July 44 (2022): 3283.
5. Mikellides, et al. "Experiments in particle resuspension and transport for the assessment of terrestrial-borne biological contamination of the samples on the mars 2020 mission, Planetary and Space Science, Volume 181, 2020, 104793.

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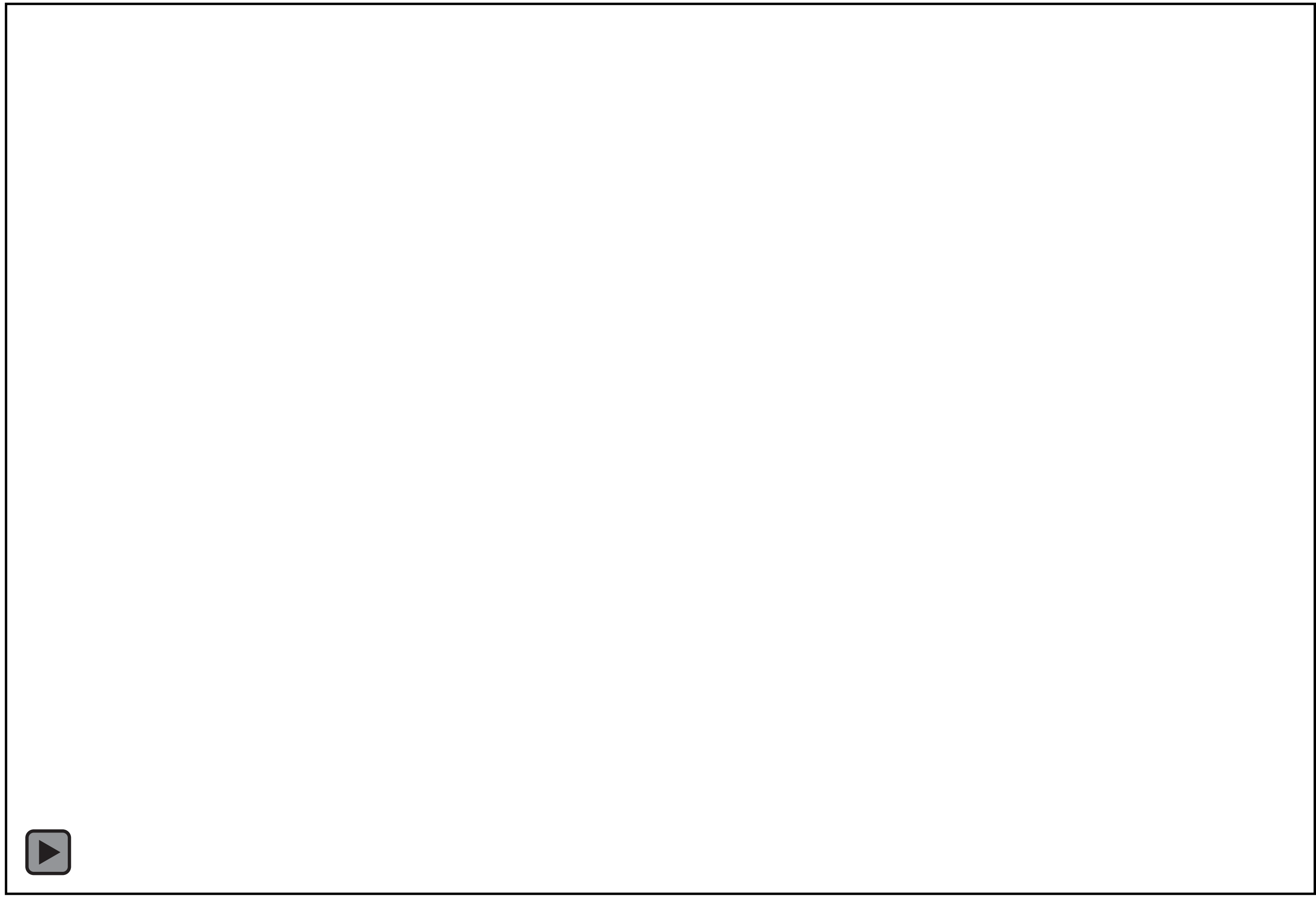
Current Work

- Assurance Technology Program Office (ATPO) funded by NASA HQ Office of Safety and Mission Assurance (OSMA) for synergistic projects
  - Launch Vehicle Recontamination Modeling
  - Organic Lunar Modeling – understanding the organic footprint for missions to the Moon
  - NASA Handbook on Planetary Protection involving updated approaches to low-cost mission – benefits from new streamlined group



Modeling applications for launch vehicle recontamination, supporting science, PP, and CC goals of the mission.

SOURCE: Hoey, William, Shallcross, Gregory, Martin, Maxwell, Soares, Carlos, Cooper, Moogega. “Launch recontamination: planetary protection models for particle transport in spacecraft payload fairing environments “ 44th COSPAR Scientific Assembly. Held 16-24 July, 2022.

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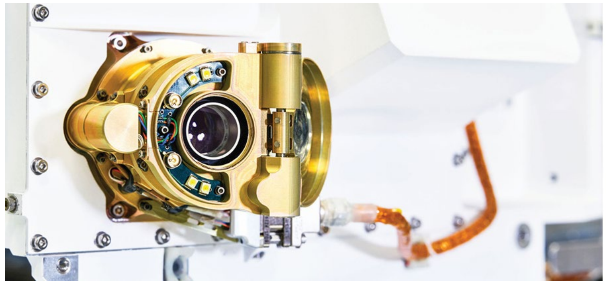
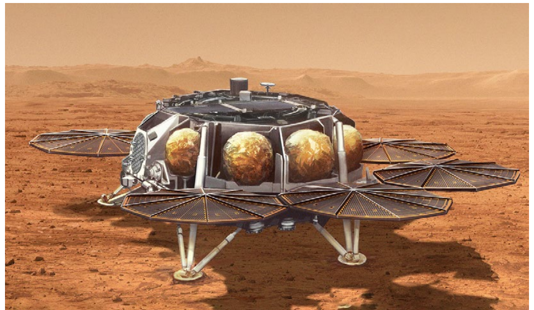
Future

- As NASA and partner missions push toward sample return and life detection, contamination knowledge becomes as important as detection itself
- "Cross-contamination knowledge" integrates microbial, particulate, and molecular data streams. This provides a
  - Unified risk posture for flight projects
  - More streamlined investigations and technical advancements for science/life detection work
- JPL is supporting this structure through internal burden funding on tasks to bridge these disciplines for the benefit of future missions
- Our goal is to highlight cleanliness knowledge as a mission-enabling capability.
- We invite you to bring your challenges — whether it's unknown organics, molecular transport, or planetary protection verification — and let's co-design the solution.




Who's Who?

Employee Name	Domain	Detailed domain
Alred, John	Modeling and Simulation	Organic Lunar Modeling, Launch Environment analysis, optical performance, radiation effects
Anderson, John	Modeling and Simulation	HEO Gateway modeling, Optical performances, radiation effects
Boeder, Paul	Contamination Control Engineering	Systems engineering, flight implementation, and optical performance
Chen, Fei	Planetary Protection Engineering	Flight implementation, Sterilization devices, ROSES
Chung, Shirley	Contamination Control Engineering	Flight implementation, Sterilization devices, ROSES
Ferraro, Ned	Contamination Control Engineering	Flight implementation, Systems engineering and optical performance
Fugett, Daniel	Contamination Control Engineering	Flight implementation, Systems engineering and radiation effects
Guan, Lisa	Planetary Protection Engineering	PP Implementation, UV and other sterilization tools, Metagenomics and sequencing for life detection
Heinz, Nicholas	Analytical Chemistry	Spectroscopy, surface analysis, life detection, instrument development, ATC lab superuser
Hinzer, Akemi	Planetary Protection Engineering	Flight implementation, Mission formulation PP (TeamX), sequencing
Hoey, William	Modeling and Simulation	Task lead: Organic Lunar Modeling, Launch Environment analysis, HEO Gateway modeling, Transport analysis.
Kim, Soon Sam	Analytical Chemistry	Analytical Chemistry
Ly, Cynthia	Contamination Control Engineering	Systems engineering, flight implementation, and precision cleaning process improvements
Maltais, Thora	Contamination Control Engineering	Systems engineering, flight implementation, and precision cleaning process improvements, collaborations with Laurie Barge on In-situ vent analysis and habitat hydro sys.
Mennella, Jerami	Analytical Chemistry	Technical Group Lead. Spectroscopy, surface analysis, life detection, instrument development
Parker, Ceth	Planetary Protection Engineering	Metagenomics, life detection, instrument development
Ricchiuti, Valentina	Contamination Control Engineering	Systems engineering, modeling and simulation
Schubert, Wayne	Planetary Protection Engineering	Planetary Protection Organic and Biological Archive, UV sterilization, technology development
Sylvia, Margarite	Contamination Control Engineering	Systems engineering, flight implementation, cleaning processes, and system performance
Warner, William	Analytical Chemistry	Spectroscopy, surface analysis, ATC lab superuser
Wong, Anthony	Contamination Control Engineering	Flight implementation, Systems engineering, pressure/chamber systems, and radiation effects