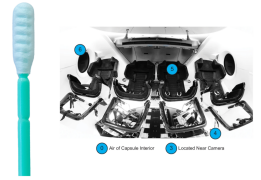


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CAMbank: Environmental Swabbing in Flight (v1)

DOI

<https://dx.doi.org/10.17504/protocols.io.bp2l6z9r5gqe/v1>



Elijah Overbey^{1,2,3}, Jaume Puig³, Jeremy Wain Hirschberg², JangKeun Kim^{2,3}, Christopher Mason^{2,3}

¹University of Austin (UATX); ²Weill Cornell Medicine; ³BioAstra



Elijah G Overbey

University of Austin (UATX), Weill Cornell Medicine, BioAstr...

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Protocol status: Working

We use this protocol and it's working

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Abstract

This protocol details the standardized collection of environmental microbial samples from spacecraft interiors during flight, using sterile swabs and nucleic acid preservative to enable downstream microbial community analyses. During the SpaceX Inspiration4 mission, environmental swabs were collected from predetermined high-contact and representative surfaces inside the Dragon capsule on Flight Days 1 and 2, as well as from a crew training capsule pre-flight. Ten locations were sampled at each timepoint, including control surfaces, instrument panels, viewing ports, waste locker lid, hatch handles, and crew seat headrests. For each site, sterile DNA/RNA swabs were pre-moistened with nuclease-free water (in-flight: hydrogen-infused water) and applied with firm pressure for 30 seconds, ensuring maximum surface coverage. Swabs were then placed in 2D matrix tubes containing DNA/RNA Shield preservative and stored at ambient temperature during flight. After return to Earth, samples were transferred to -80°C storage in the Cornell Aerospace Medicine Biobank (CAMbank). This method is compatible with metagenomic, metatranscriptomic, and targeted qPCR assays to characterize microbial composition, diversity, and potential pathogenicity in the spacecraft environment. The approach supports the Space Omics and Medical Atlas (SOMA) initiative's objective of developing standardized environmental biospecimen protocols to enable cross-mission comparisons and track microbe–crew–habitat interactions over time.

Materials

Sterile swabs (Isohelix DNA/RNA Swabs) (in-flight)

Pre-labeled 2D matrix tubes with Zymo DNA/RNA Shield (400 μL per tube/sample) (in-flight)

Sterile nitrile gloves (in-flight)

70% Ethanol in a spray bottle (ground)

VWR KimWipes (ground)

Cryogenic Freezer (ground)

Preparation

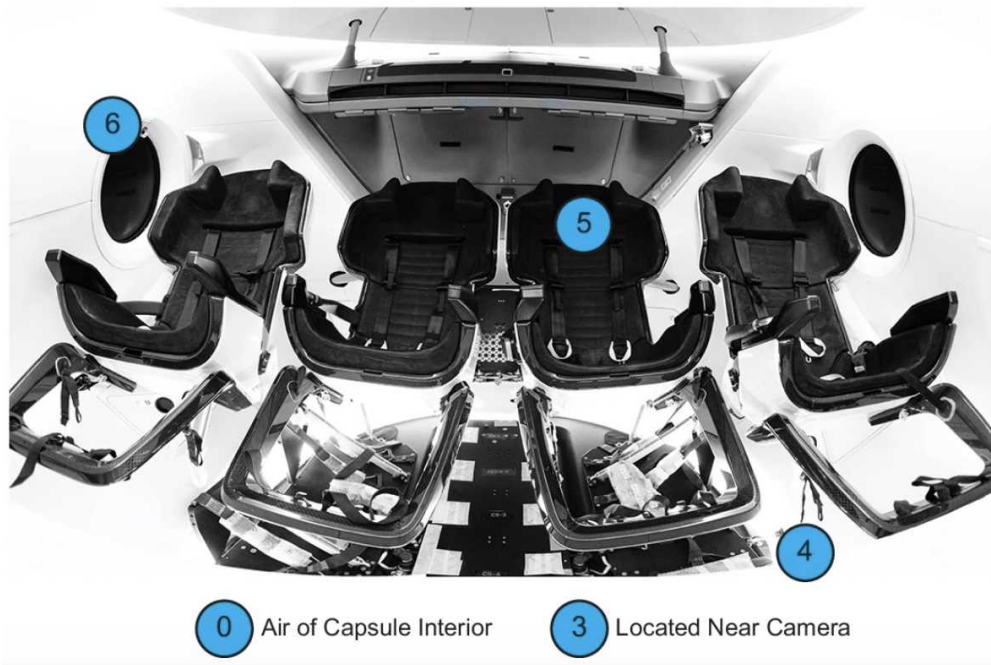
- 1 Locate all flight materials in the space capsule.
- 2 Put on nitrile gloves to ensure sterile handling of the samples.

Sample Collection

- 3 Swab pre-selected areas of the space capsule cabin by matching the IDs on the tubes to the areas of the capsule.
 1. Wet each swab with sterile water.
 2. Swab each area for 30 seconds. Use both sides of the swab.
 3. Open the 2D matrix tube and deposit the swab in the Zymo DNA/RNA Shield preservative.

Environmental Swab Locations

ID	Location	Description
0	Control Swab	Dampened swab; hold in air for 30 seconds.
1	Execute Button	Physical button on the control panel.
2	Viewing Dome	Bottom rim of the cupola, towards the crew entrance.
3	Side Hatch Mobility Aid	Side of the spacecraft. View from the camera angle in Figure 6b.
4	Lid of Waste Locker	Quarter turn screws and surface of panel was swabbed. Located towards the bottom-right floor of Figure 6b.
5	Seat 2	Upper section by the head area was swabbed.
6	Commode panel	Quarter turn screws and bottom part of panel was swabbed. Located at the top of Figure 6b.
7	Control Touch Screen	Left side of the screen.
8	Control Touch Screen	Right side of the screen.
9	G-meter Button	Under an acrylic barrier.



Control Panel



Cupola View



*swab collected on capsule interior



- 4 Return tubes to ambient cabin storage.

Storage

- 5 After landing, transfer samples to science team.
- 6 Science team performs an inventory and inspection of the samples.
- 7 Tube exteriors are sterilized with 70% EtOH and a KimWipe.
- 8 Science team stores samples at +4°C (if processing imminently) or at -80°C (for long-term storage).