

SURFACE, WATER, AND AIR BIOCHARACTERIZATION (SWAB) FLIGHT EXPERIMENT

V. A. Castro¹, C. M. Ott², and D. L. Pierson²

¹EASI/Wyle Integrated Science and Engineering Group (Houston, TX),

²NASA Johnson Space Center (Houston, TX)

The determination of risk from infectious disease during spaceflight missions is composed of several factors including both the concentration and characteristics of the microorganisms to which the crew are exposed. Thus, having a good understanding of the microbial ecology aboard spacecraft provides the necessary information to mitigate health risks to the crew. While preventive measures are taken to minimize the presence of pathogens on spacecraft, medically significant organisms have been isolated from both the Mir and International Space Station (ISS). Historically, the method for isolation and identification of microorganisms from spacecraft environmental samples depended upon their growth on culture media. Unfortunately, only a fraction of the organisms may grow on a specific culture medium, potentially omitting those microorganisms whose nutritional and physical requirements for growth are not met. To address this bias in our understanding of the ISS environment, the Surface, Water, and Air Biocharacterization (SWAB) Flight Experiment was designed to investigate and develop monitoring technology to provide better microbial characterization.

For the SWAB flight experiment, we hypothesized that environmental analysis using non-culture-based technologies would reveal microorganisms, allergens, and microbial toxins not previously reported in spacecraft, allowing for a more complete health assessment. Key findings during this experiment included:

- Generally, advanced molecular techniques were able to reveal a few organisms not recovered using culture-based methods; however, there is no indication that current monitoring is “missing” any medically significant bacteria or fungi.
- Molecular techniques have tremendous potential for microbial monitoring, however, sample preparation and data analysis present challenges for spaceflight hardware.
- Analytical results indicate that some molecular techniques, such as denaturing gradient gel electrophoresis (DGGE), can be much less sensitive than culture-based methods.
- More sensitive molecular techniques, such as quantitative polymerase chain reaction (QPCR), were able to identify viral DNA from ISS environments, suggesting potential transfer of the organism between crewmembers.

In addition, the hardware selected for this experiment represented advances for next-generation sample collection. The advanced nature of this collection hardware was noted, when the Sartorius MD8 Air Port air sampler from the SWAB experiment remained on board ISS at the request of JAXA investigators, who intend to use it in completion of their microbial ecology experiment.