

## GLOVEBOX MOCKUPS AIDING MISSION PREPARATION AND LABORATORY PLANNING

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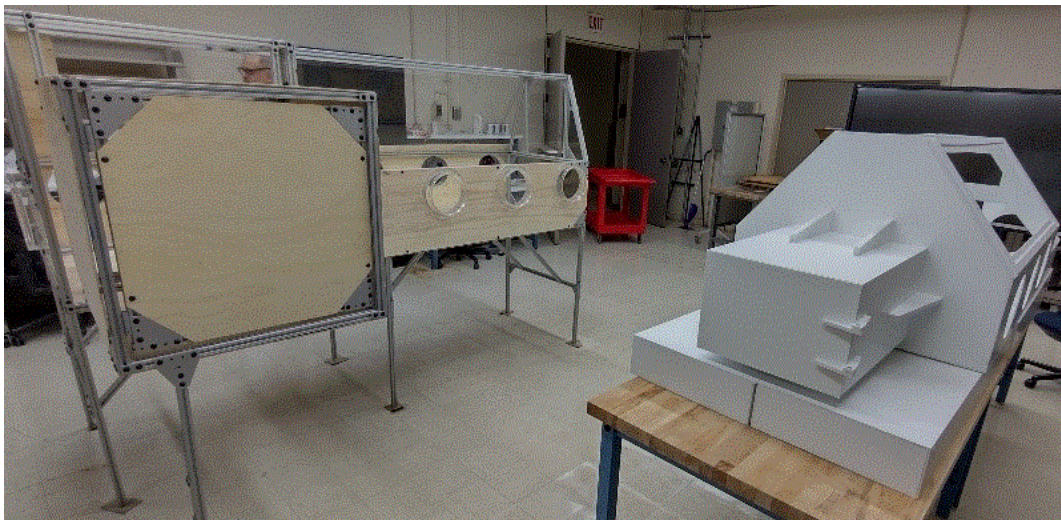
**Introduction:** Mockups are a common tool for understanding engineering problems, demonstrating concepts, and doing limited tests of a design. They can also be an important part of lab setup and planning. As OSIRIS-REx and Hayabusa2 labs were prepared for the return of their sample payloads, digital models and physical mockups provided vital information for laboratory planning and staging. However, as glovebox details and specific tasks and procedures were being cemented, digital designs were no longer as useful in determining what was needed. By building and using physical mockups to help figure out design restrictions, glovebox specifics can be easily and quickly redesigned to fit needs and ergonomic considerations. Even after those details are determined and a design is finalized, physical mockups can still serve a major role informing exercises for lab procedures and aiding in tool design.

**Digital Models:** The use of CAD and design programs to model equipment in scale can facilitate lab layout planning. While digital models can be updated easily and quickly, there are significant limitations to understanding the ergonomics and procedural needs that can't be fine-tuned in a virtual environment.

**Physical Mockups:** When exercises and activities call for a physical mockup one can be designed and built based off the digital model created previously. Mockups can either be partial designs such as one end of a glovebox, or they may be mockups of entire gloveboxes, allowing for a full team to run rehearsals together and enabling practice activities for the lab with realistic limitations. A full mockup also allows us to adjust the glovebox design to model ergonomic concerns and improve usability.

**Physical Mockup Materials:** Many different materials may be used for mockup construction, and using the design to make a cut list and materials list physical mockups can be quickly built by an experienced team. . Foamcore is ideal for many purposes as it comes in large panels, is cheap, widely available, and lightweight. It can be easily cut with a razor and assembled with hot glue and paper tape. When carefully constructed it can handle moderate weight loads and is easily modified, but will damage easily and fails catastrophically when overburdened. For mockups that support heavier equipment and exercises, building with a mixture of plywood, extruded aluminum beam, and polycarbonate makes a strong mockup that will stand up to repeated exercises with heavy equipment. Shown in Figure 1 are two mockups built to support OSIRIS-REx procedures, one from foamcore and hot glue, the other from extruded aluminum beam, polycarbonate, and plywood.

**References:** [1] Lauretta, D.S. et al. (2017) Space Science Reviews 212, 925-984. [2] Snead, C. J. et al. (2018) 49th Lunar Planetary Science Conference. Abstract #2426. [3] Pace, L.F. et al. (2018) 49th Lunar Planetary Science Conference. Abstract #2507.



*Figure 1: Mockups for OSIRIS-REx lab rehearsals at JSC*