HUNCH
Fungus and Bacteria Abatement Kit

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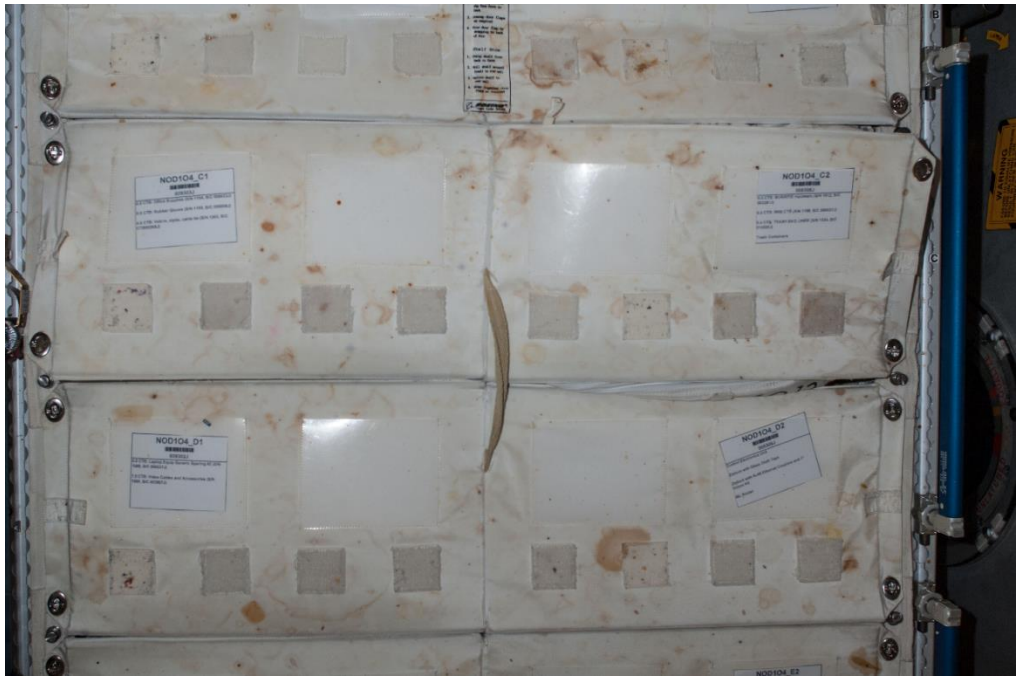
Students from many high schools across the country including:
Fairport H.S. in Fairport, NY,
Clear Springs H.S in League City TX
Warren Tech H.S in Lakewood CO
Lakewood H.S in Lakewood, CO
Ischool H.S, Lewisville TX
Cypress Wood H.S s in Cypress , TX

With the goal of providing the ISS with a bevvy of cleaning materials and tools to keep the crew and environment safe and clean.



Node 1 ZSR with Food Stains

FGB panel with cover

FGB panel with fungus

Problem:

The ISS has trouble killing off bacteria and fungus on the Station.

- This difficulty stems from complications related to material compatibility with the ISS atmosphere, water and other consumables. This limits the Stations cleaners to a small number that may one day allow for other bacteria and fungus to grow unchecked as well as let others grow resistant to the current materials available.
- Bacteria is controlled mostly by cleaning with Disinfectant wipes with the active ingredient as Benzalkonium chloride-- BZK. Huggies wipes are also used to clean surfaces where the soap helps remove oils to minimize food sources for microbes. There is also a very limited amount of alcohol but this needs to be carefully controlled to prevent contamination of the Russian water supply.
- Although BZK controls many types of bacteria, no biocide kills all types of bacteria. Wipes don't get into cracks and crevices.
- The Disinfectant wipes have a limited capability because the BZK material is only available in a wipe making it difficult to clean a soiled cloth material or rough surfaces with crevices.
- Fungus is controlled using Russian fungistat wipes which we have limited access to.
- These difficulties with the Disinfectant Wipes are similar with the Fungistat Wipes.
- Residues from any alternate cleaners would need to not be food for other bacteria.

One possible Solution?

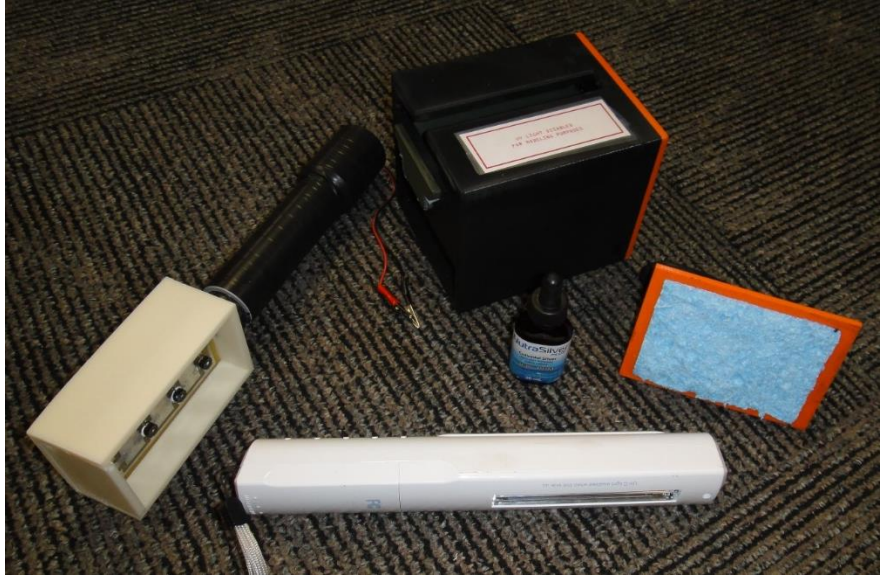
- Students from across the country participated by studying alternate cleaning methods and making suggestions.
  - Instead of detergents and soaps that leave residues that can grow microbes, students suggested enzyme cleaners.
  - Instead of alcohol and iodine, students suggested **colloidal silver**.

  Although many of the student suggestions were good, no single idea would solve all the ISS cleaning difficulties. After meeting with Bekki Bruce of the microbiology team, we walked away with the idea of using many student ideas instead of one to allow for a multi faceted approach to cleaning and killing bacteria and fungus.
- Similar to a janitor's closet that has a variety of cleaning materials and tools, HUNCH would like to provide a kit with a few different types of cleaning materials that will allow the crew and ground team to select the appropriate cleaning method.
- These materials should be effective at killing bacteria different from what BZK is already killing as well as benign to the Station environment.
- All of these materials would be in addition to the current cleaning supplies of the Station and would replace nothing.

The Proposed HUNCH Cleaning Kit

- Battery powered UV-C LED Light
- Scotch bright/sponge pads with Colloidal Silver biocide
- Scotch bright/sponge pads with Enzyme Cleaner
- Silver biocide pouch
- Enzyme cleaner pouch
- Spray nozzle

The HUNCH Project



UV light:

One important tool will be a UV-C LED light to kill off bacteria and fungus. UV-C is well documented to kill various kinds of bacteria and fungus. Selecting the proper LEDs with the correct range of UV is an important but a simple process. The tool will have to be specially designed for the ISS for safety reasons since none of the commercially available systems meet our needs to protect the crew from the UV light.

Cleaning solutions:

Enzyme solution—breaks up oils using enzymes that are biodegradable by way of benign bacteria but is not a detergent that would leave chemicals on the surface indefinitely. Low toxicity.

Colloidal silver—anti bacterial solution with similar properties to the biocide used in the Russian water system but in higher concentration. Low toxicity.

Cleaning tools:

Sponges and scotch bright pads--

We will be putting some modified sponges into some of the food style packets that will allow the crew to add hot water to the sponges that can then be used for one cleaning application and then disposed of. This will prevent contamination in another location.

Spray nozzle:

In order to clean a cloth with a deeply embedded food source for bacteria, saturation of the material may be necessary. There are also larger areas that could be cleaned quicker if more cleaning solution were available.

Consider the spray nozzle demonstrated by a crew members that connected to an ISS body wash bag (same as drink bag). This will allow the crew to saturate a location with more of the cleaning solutions. The challenge is to not allow the spray to get all over.

COTS UV Wand—won't work for ISS

- Glass bulb without cover—shatter hazard
- Must manually adjust height over treatment surface to kill off material—won't be able to ensure microbes killed.
- Has a safety switch to prevent exposure to eye that is gravity dependent—won't work in ISS.
- Power switch does not start or stop the light immediately—needs to have immediate response.

Battery Powered UV-C LED Light Design

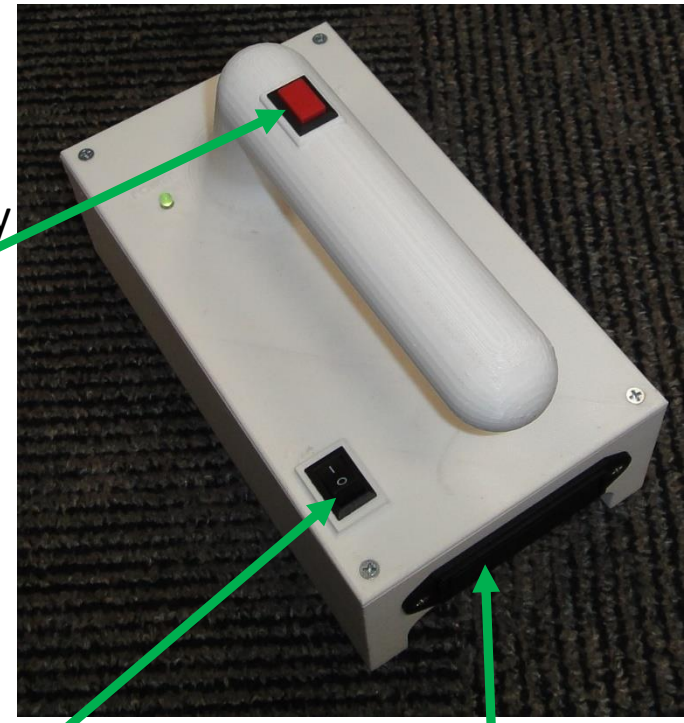
This prototype is solely for the purpose of demonstrating the majority of the safety requirements. The shape and designed could be altered to fit the safety and exposure needs of the ISS. The LEDs on this unit are only visible light—no UV.

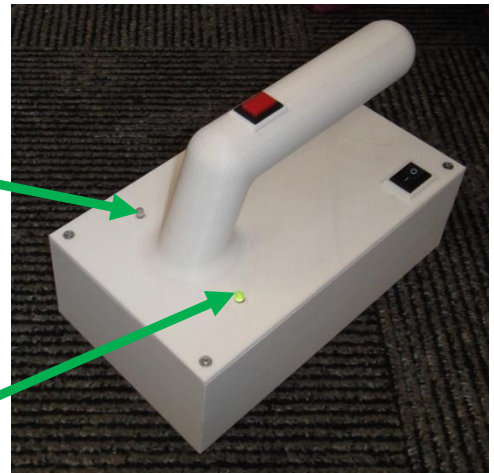
Electronics

- Battery powered to minimize difficulties with certification process, probably 4 to 6 AA batteries
- One switch to turn the device on and off (probably on the handle)
- Button must be depressed for it to work—crew attended, can't expose someone by accident
- Timer that can be adjusted for 15 to 90 sec (this is for testing initially but will probably be set for the flight unit)
- An LED that will flash when the UV LEDs are on (warning light)
- 6-10 LEDs depending on the spread of the light and the shape of the housing.
- The prototype UV light is Arduino based using student written code

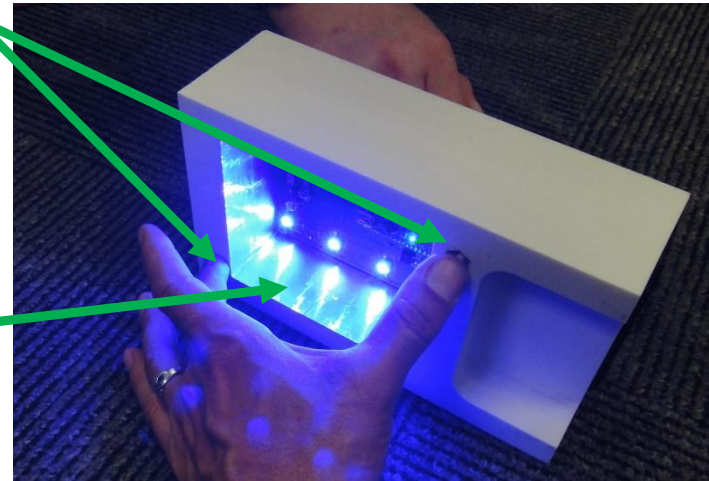
Housing

- The housing for the lights may be shaped kind of like an iron for clothing so that it can get into smaller corners (pointed in the front and wider in the back)
- Needs a good handle with the on/off switch located in an easy to reach position
- The LED bulbs are about 2" above the surface to provide a uniform radiation pattern.
- The housing needs to keep the user from being exposed to the UV light when it is placed on a surface
- Location for the battery pack and cover for batteries
- Location for the indicator bulb (easily visible by user)



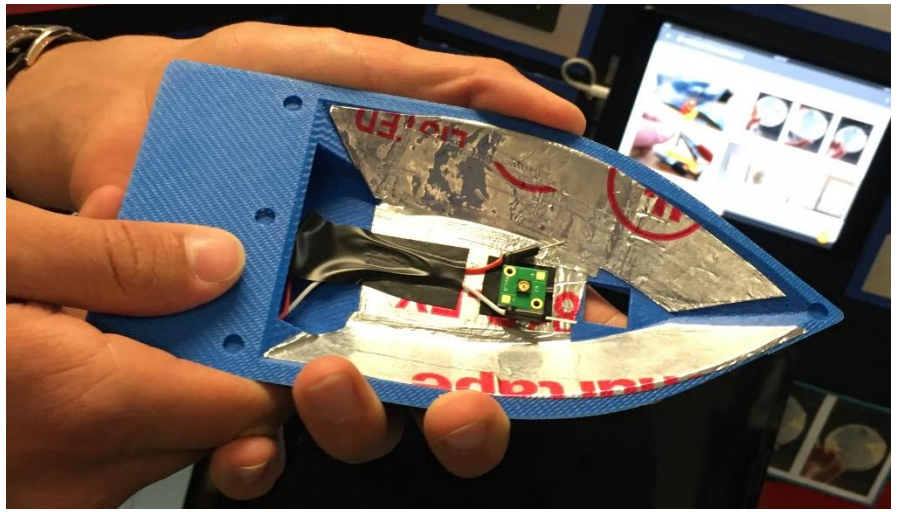


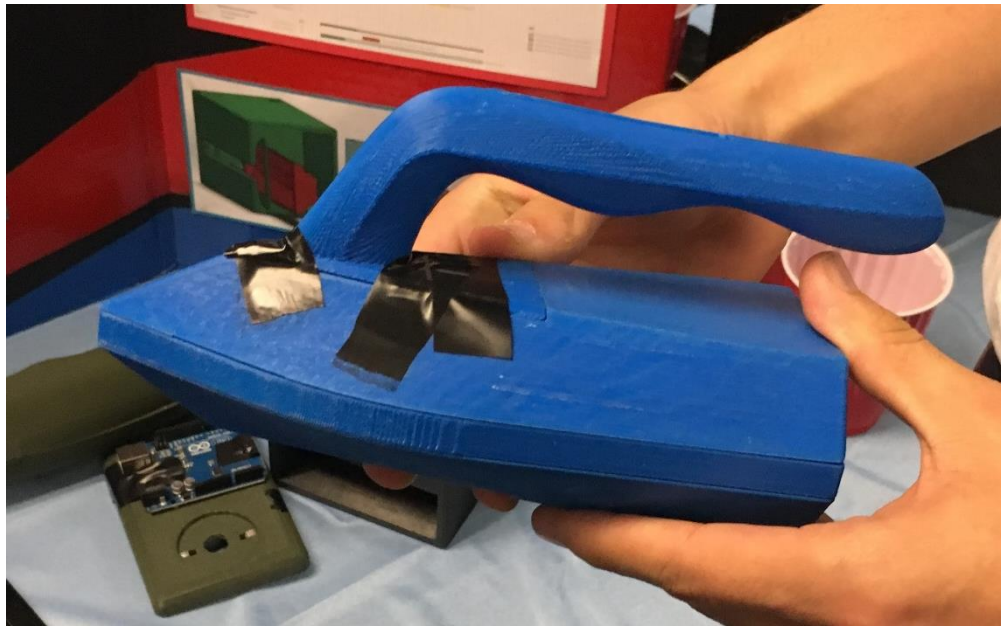
Safety buttons must be depressed for LEDs to turn on

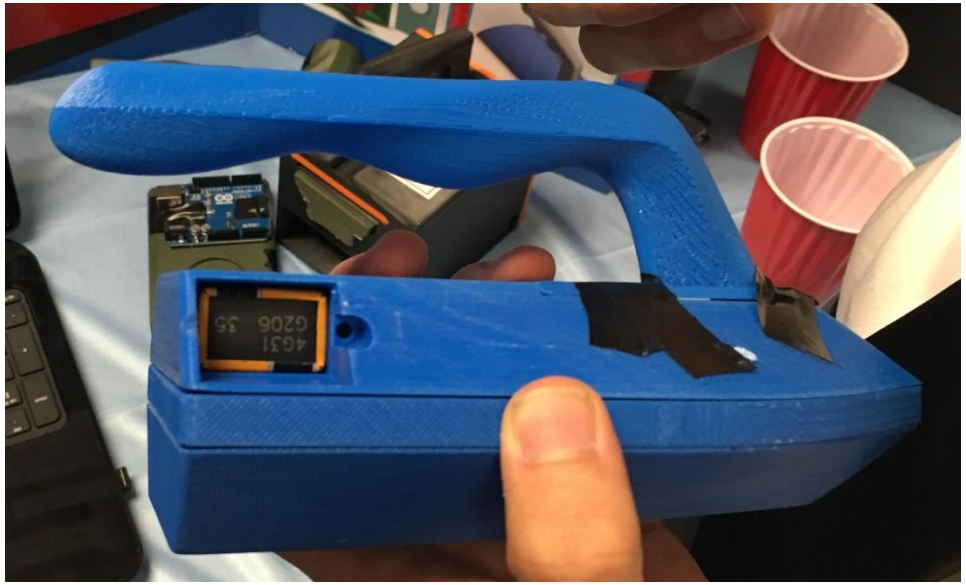


Alternate shape

Although this version is lacking in some of the safety features and the quantity of light, the smaller size allows for getting into smaller spaces and tighter corners. Shrinking the electronics and battery holders into another shape are options available depending on the specified needs for the UV light.







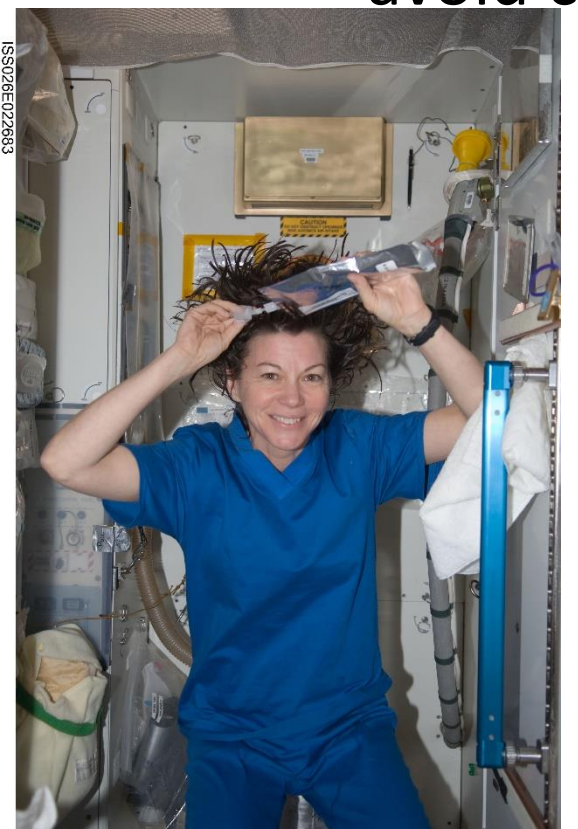
Other shapes, configurations and sizes could be worked for killing bacteria in various locations.

Cleaning pads for scrubbing

- Scotch bright pads with half as much sponge(micro biology suggested that there is a limit as to how much water they want in the sponge to minimize the potential mess).
- Impregnated with silver colloid or enzyme cleaner
- Flies up in a NASA drink pouch with septum
- Can be injected with ambient water or hot water from PWD to increase penetration and chances of killing the microbes or diluted to desired concentration.
- Could be flown as two smaller sponges to allow cleaning two separate locations without cross contamination and less trash.

Silver Biocide and Enzyme Cleaner pouches

- Use ISS drink to contain Colloidal Silver Biocide with specified amount of fluid.
- This will allow the ground team and the crew to select the proper material and concentration needed for the cleaning.
- Pouches could be specially labeled similar to the body wash bags to avoid crew inadvertently drinking from them.



Spray nozzle

Consider the spray nozzle demonstrated by a crew member that has connected it to an ISS body wash bag (same as drink bag). This allows crew to saturate a location with more of the cleaning solution.

There has been concern with the use of the body wash leaving a residue that bacteria can grow on.

HUNCH suggestion:

- Attaching it to a drink bag with silver colloid or enzyme cleaner would allow for disinfection or breaking up oils and fats.
- Spray nozzle could be fitted with a cone to prevent over spray
- It may also be helpful to have a rigidizing structure (stick) attached to the handle and extending down to the bag to prevent the bag of cleaning fluid from wiggling all over when cleaning.

Size of Kit Options.

The initial plan of the build and use of the Cleaning kit is to have more options when there is a specific problem. This allows the kit to be small consisting of a few of each of the sponges, liquid pouches, one or two spray nozzles and one UV-C LED Light. This would all fit in ½ CTB

If the kit were instead designed for weekly cleaning, many more pouches and sponges would be needed. This would require something closer to a single CTB and would need more restocking.