

Facial Irritation Relief Device

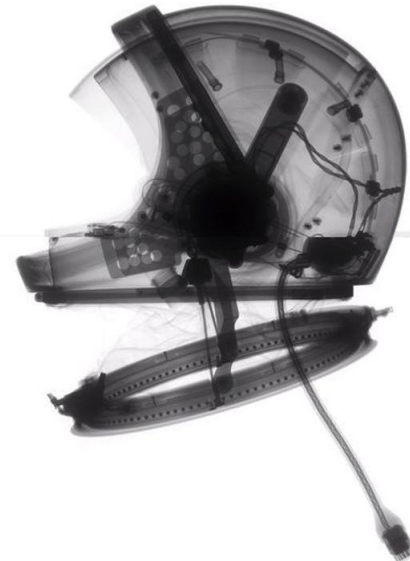
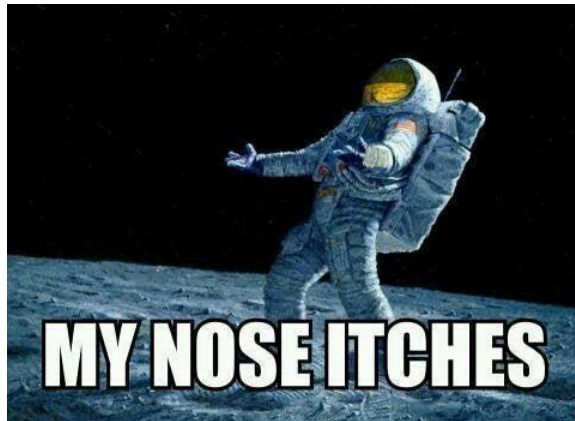
(nose scratcher)



Z-2 Suit



What kind of device could we develop that would allow astronauts to scratch various parts of their face when they are in their space suits for several hours in a day.



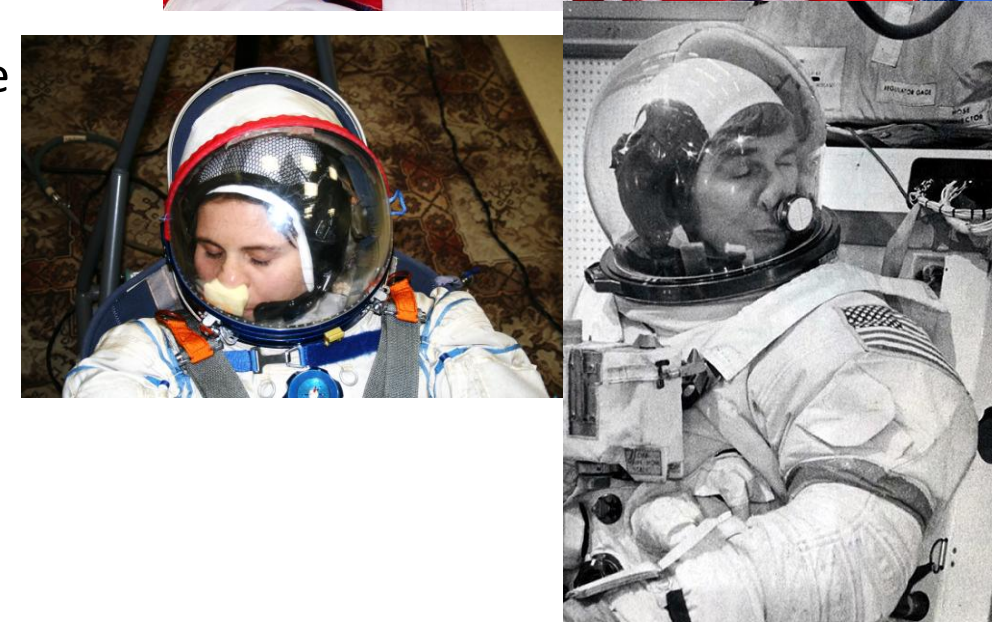
Irritation Relief Device

Problem:

- There are few things as annoying and able to distract you from your work than an itch that you can't scratch. Imagine an itch on the side of your cheek or right next to your eye but you are unable to scratch it and it's making your eyelid twitch. What if you were in a helmet where it was not possible to touch your face for 8 hours? How many times in the 8 hours might you be distracted from your job because of an itch or a drop of sweat rolling down your brow into your eye?
- The new EVA helmet is a double paned, polycarbonate, hemisphere. There is no method of touching your face with your hands inside a helmet. There is not anyway to wipe a drop of sweat that is making its way to your eye. There is a piece of rubber inside the helmet that is used for pinching your nose to help when the pressure in the suit is changing and can be used for nose scratching. Unfortunately because of the size and location, that is about the only itch it can help with.

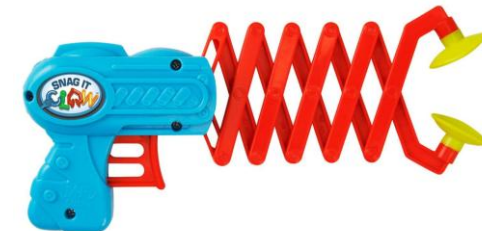
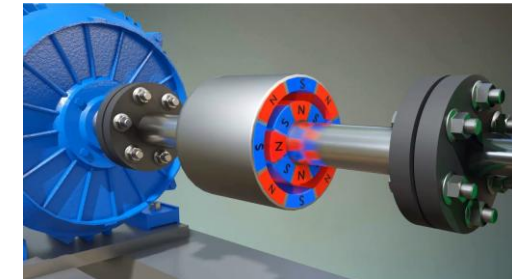
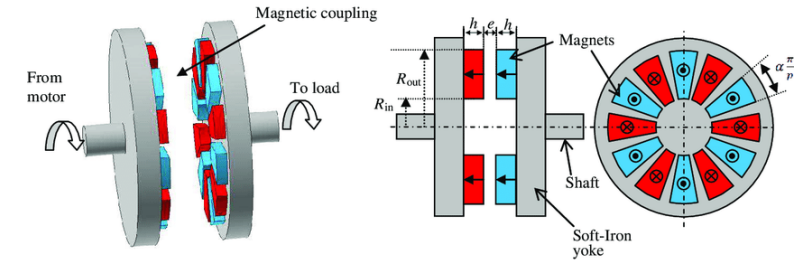
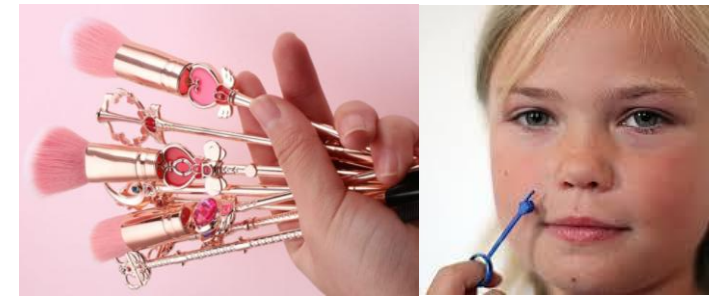
Objective:

- Develop some kind of 'finger' that is fairly rigid so the astronaut can scratch their nose and/or rub their forehead and/or dab some sweat but weak enough so that they don't get hurt if they bump into it.

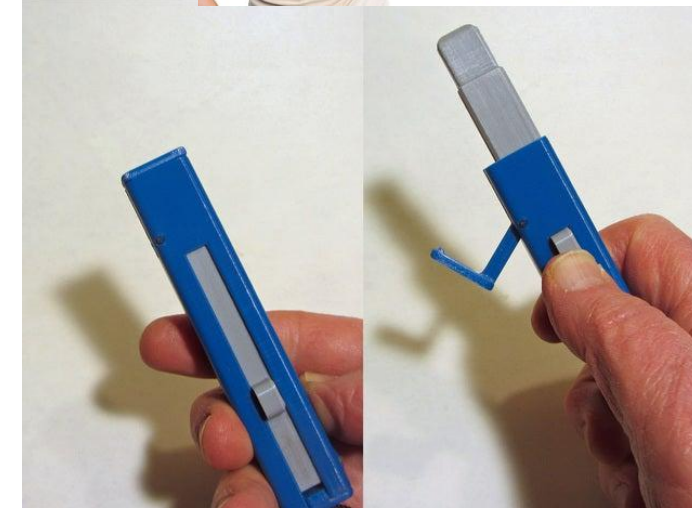
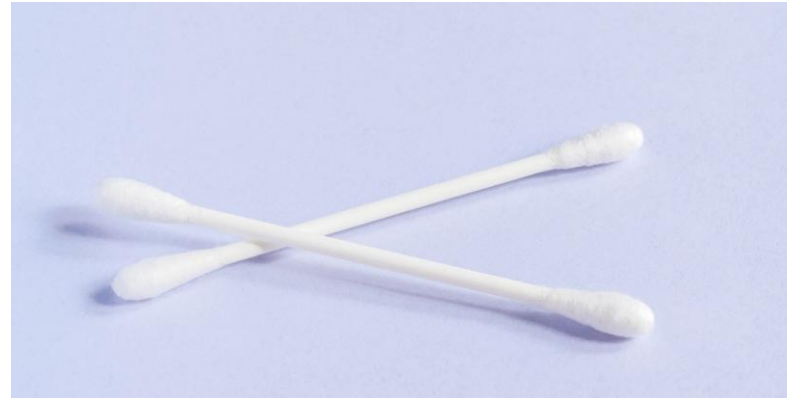
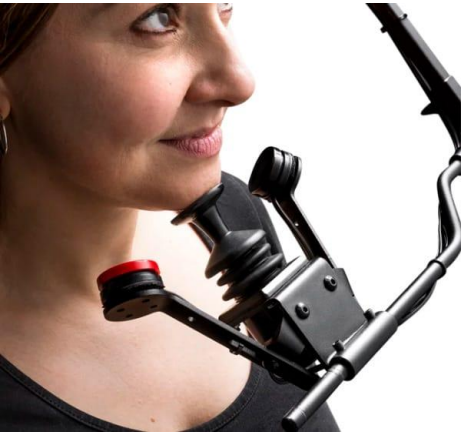


Potential Options:

- Stationary 'finger' held with Velcro to the inside of the bubble (**don't scratch the bubble**)
 - The 'finger' needs to be of a length that the astronaut needs to move their head to get to it (not continuous poking). There will probably need to be different lengths that astronauts can pick from so it fits their size.
 - The 'finger' might have a replaceable or optional cloth tips so it can scratch an itch and wipe sweat from brow depending on the astronaut preference.
- Magnetics
 - This could be done with a magnetic coupling—inside the helmet, between panes of polycarbonate, outside of helmet. The component on the outside of the helmet is a handle so the astronaut can move the 'finger' on the inside of the helmet to other locations for scratching or dabbing sweat.
 - If the 'finger' releases from the magnetic coupler the inside of the helmet, the astronaut will need to be able to manipulate the helmet and magnetics to re-attach it to the coupler of the helmet.
 - The control magnet on the outside needs to be easy to grab with gloves but small enough that it doesn't obstruct the visor.
 - The control magnet on the outside may need to have some felt to **prevent dust from scratching the outer surface** of the polycarbonate.
- Something an astronaut could blow into or bite that would make it extend and retract
 - Could party favors be altered to
 - Blow toward the face instead of away
 - Scratchier to help with an itch
 - More absorbent to help with dripping sweat
 - Sturdier to hold a position
 - Last longer than paper party favors



- What will the scratching surface look like?
- Are there make-up tools that could help with scratching or dabbing sweat?
- What kind of aids are there for People that have minimal use of their hands may have similar needs. What kind of help could they be?



**TONGUE CONTROLS
WHEELCHAIR**

Testing

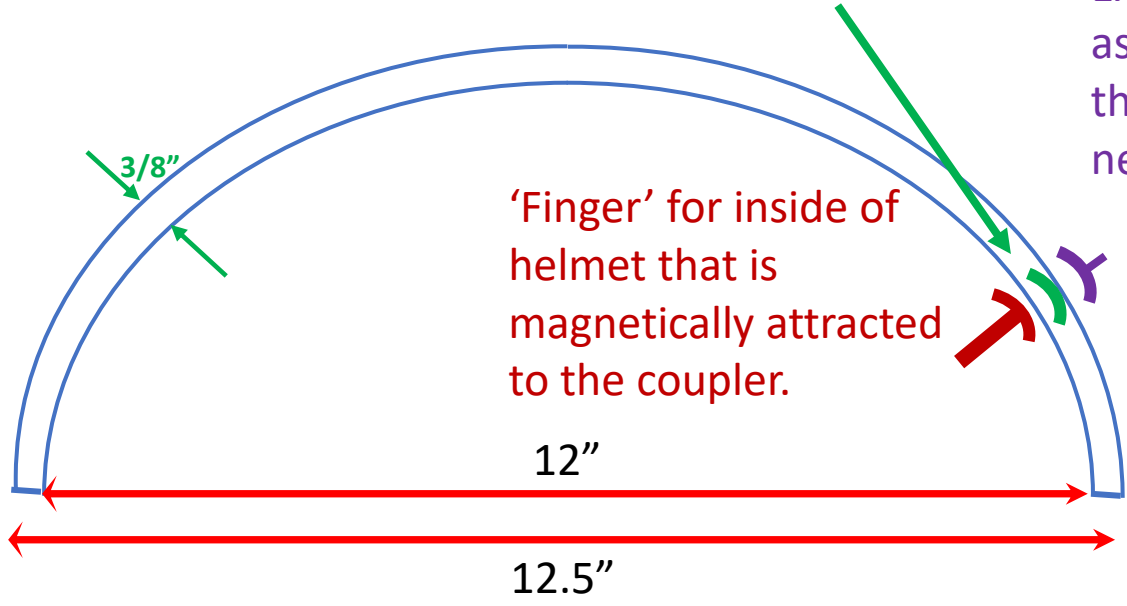
- Initial testing might be with two flat, parallel panes of glass or plastic but eventually it would be much better to have two plexiglass hemispheres with where one fits inside the other with a 3/8" spacing between. It would be nice if it was this was a full hemisphere, but a significant segment is all that is really required. Detailed information about the helmet is restricted but we don't need to be exact at this point since we are attempting to show the main concept—scratching an itch. Let's assume the outer diameter of the helmet is 12.5" and the inside surface of the helmet is 12". Each pane of plastic is 1/16" thick. That leaves a spacing between the two hemispheres as 3/8". (I am estimating from the picture and I am open to suggestions. There could me more space between but I'm allowing for some distortion from the multiple transparent surfaces.)



Double pane

Coupler magnets between the shells to connect between outside control and the interior 'finger'.

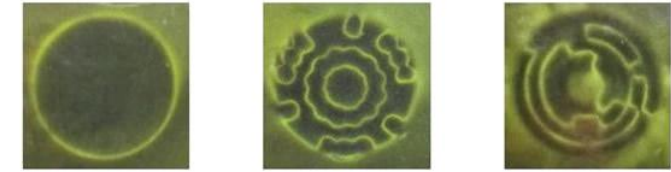
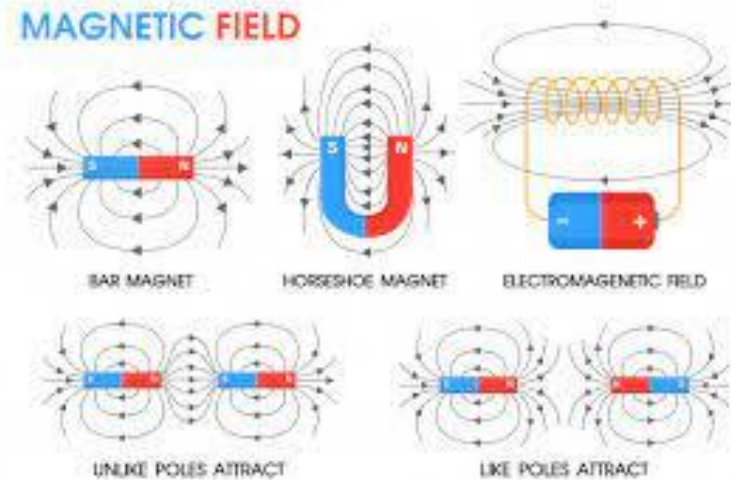
Exterior handle so astronaut can move the 'finger' to the needed location



Multiple N-S poles

Could this can be done with solid magnets that can be bought from the hardware store or from special sized rare earth magnets that can be bought on line? Polymagnets and others are doing some very interesting things where they are designing with solid magnets and magnetic fields similar to how people are printing objects with 3D printers. I am not suggesting that you have to design and purchase magnets from these companies but it may be valuable to study their ideas.

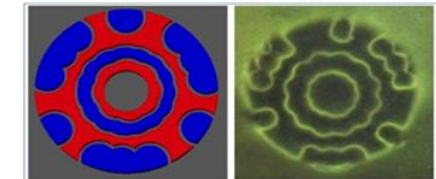
- <https://www.youtube.com/watch?v=IANBoybVApQ>
- Polymagnets
- <http://www.polymagnet.com/polymagnets/>
- <https://www.youtube.com/watch?v=9T26k2iFyNM>



Standard magnet

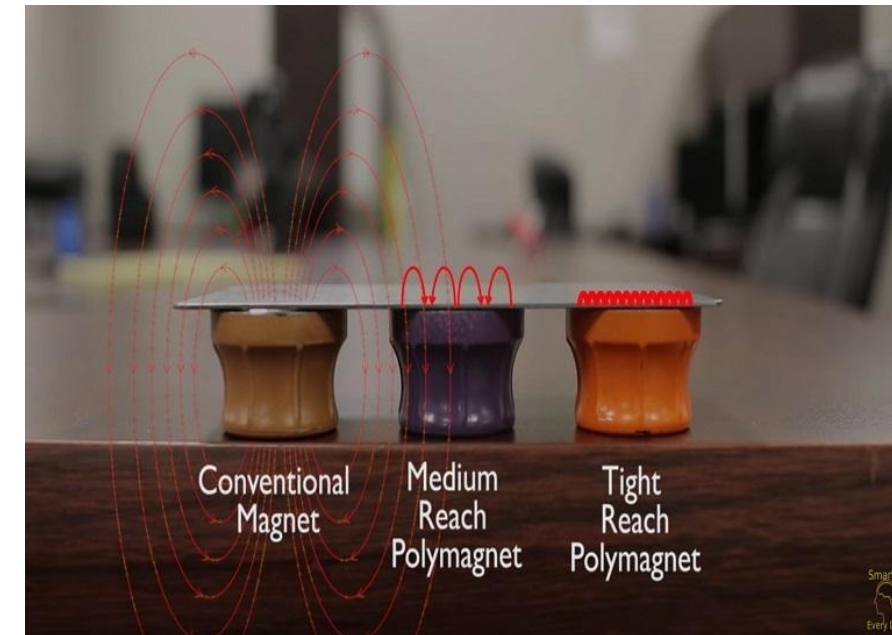
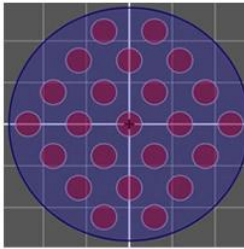
Rotate-release with alignment feature

Magnet for Hall effect sensor application



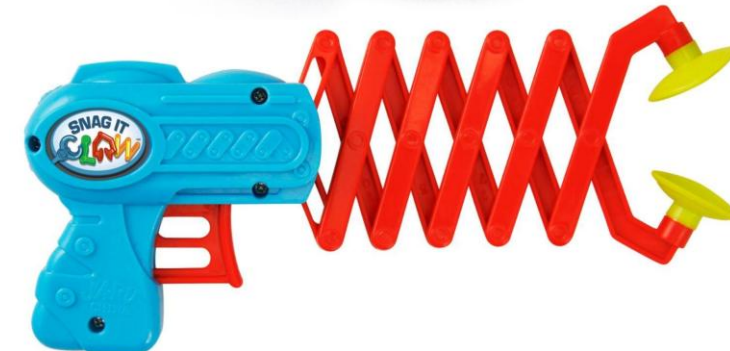
Magnetizing Pattern Design
Made By
Unique Software
MPCO
www.mpcomagnetics.com

Diverse Magnetic Region
Under
Green Magnetic Viewing Film



Toys have potential solutions

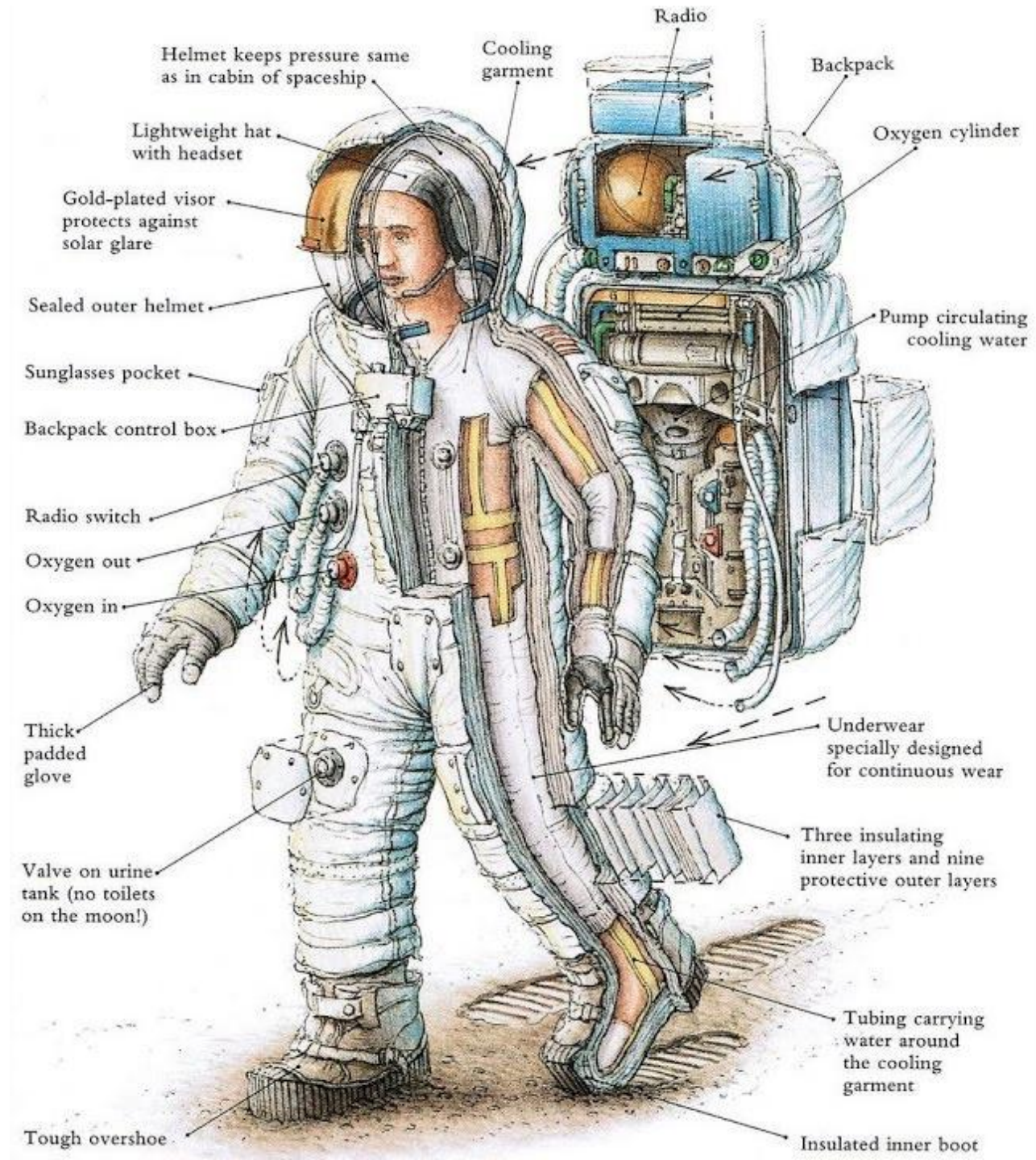
- What makes the party blowout return to the curled position? (take one apart—surprised me.)
- Can the return mechanism be repeated with another material
- Could you make it blow toward your face instead of away from your face—u shaped tube?
- Is paper important for the moving tube?
 - Must be thin material—saran wrap, wax paper, Tyvek?
- Is there another return mechanism that would be better—slap bracelet?
- What if the air is prevented from leaving the end of the tube?
- How important is the size of the tube you blow in or the paper tube?
- Is the noise maker important to the airflow? (maybe not but it could be funny)
- Push up puppets disassemble when you push the button on the bottom and release the tension in the strings that run through the body. Could that be reversed some how so the 'scratching post' extended only when needed and was loose most of the time?



Could this be made to extend by biting it?

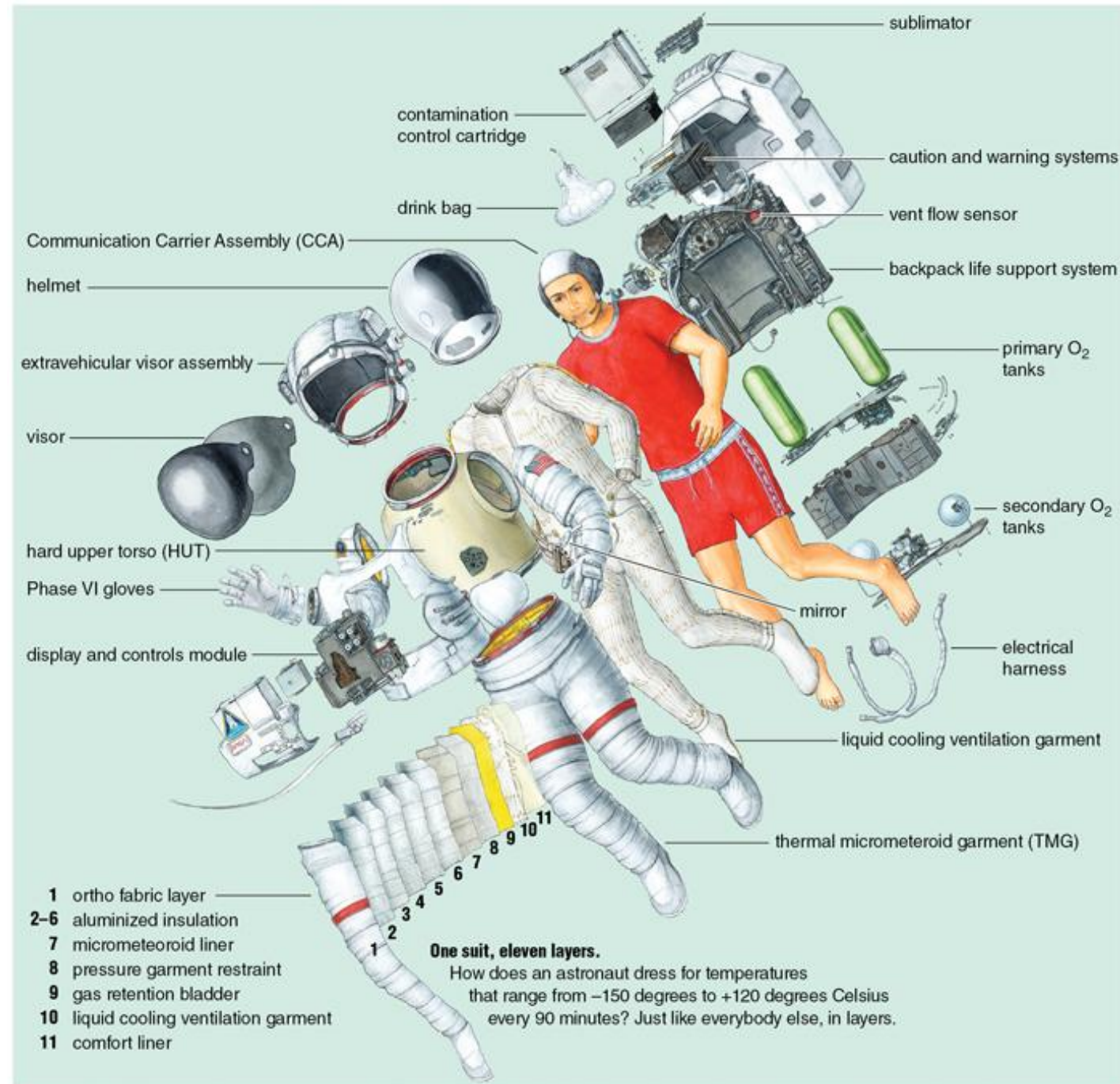
Space Suit Basics--Apollo

- The Space Suit is much more complicated than a pair of pants and a jacket. It would be better to describe it as a small, personal space craft that holds one person. The suit's first job is to keep the air around the person so they can breathe while walking in both the cold and hot vacuum of space. It contains a whole life support system to help control the person's body temperature from getting too hot or cold, supplies oxygen, cleans the carbon dioxide from their air, provides communication with the ground, has lights and video systems so both the astronaut and the ground can see what they are doing. Space walks can be several hours long, so the suit has to be able to handle use of the toilet. Some suits even have thrusters to push them back to the Space Station if they start floating away. Suits for the moon also had to protect them from the dry, glass like lunar dust.
- The Apollo suits were designed and built by Playtex who made women's undergarments along with other engineers familiar with pressure suits. The women who did the sewing on the suits knew the quality of their work could mean the life or death of their astronaut.
- Although this picture is a cut-a-way of the Apollo suit there are many similarities that can help you understand the new suits.
- This picture doesn't show it but the Apollo astronauts had a drink bag with Tang and an energy bar they could bite off while doing their moon walks.



ISS Space Suit

- Inside the space helmet there is a lot of room for air flow, visibility, shifting of head, communication gear.
- Unfortunately, you can't reach up and scratch your nose when you have an itch. In Zero-g, loose drops and crumbs could float around in the helmet and clog airflow or float into eyes, ears and nose causing discomfort and distractions at minimum. Imagine a piece of a peanut being inhaled into your nose or floating into your eye but you are unable to get your hands up to your face to remove it. This is a serious issue that currently prevents Space Station astronauts from having anything in their suits with them with the exception of a 32 oz drink bag of water with a camel bag style of straw. Any drinks with sweeteners could leave sticky droplets that clog or damage suit equipment
- Occasionally space walks can last between 6 to 8 hours. For these extended lengths of time outside, the astronauts will need refreshments to keep them hydrated and energized. This will require some kind of water or liquid refreshment like gator-aid or power aid and some kind of power bar.

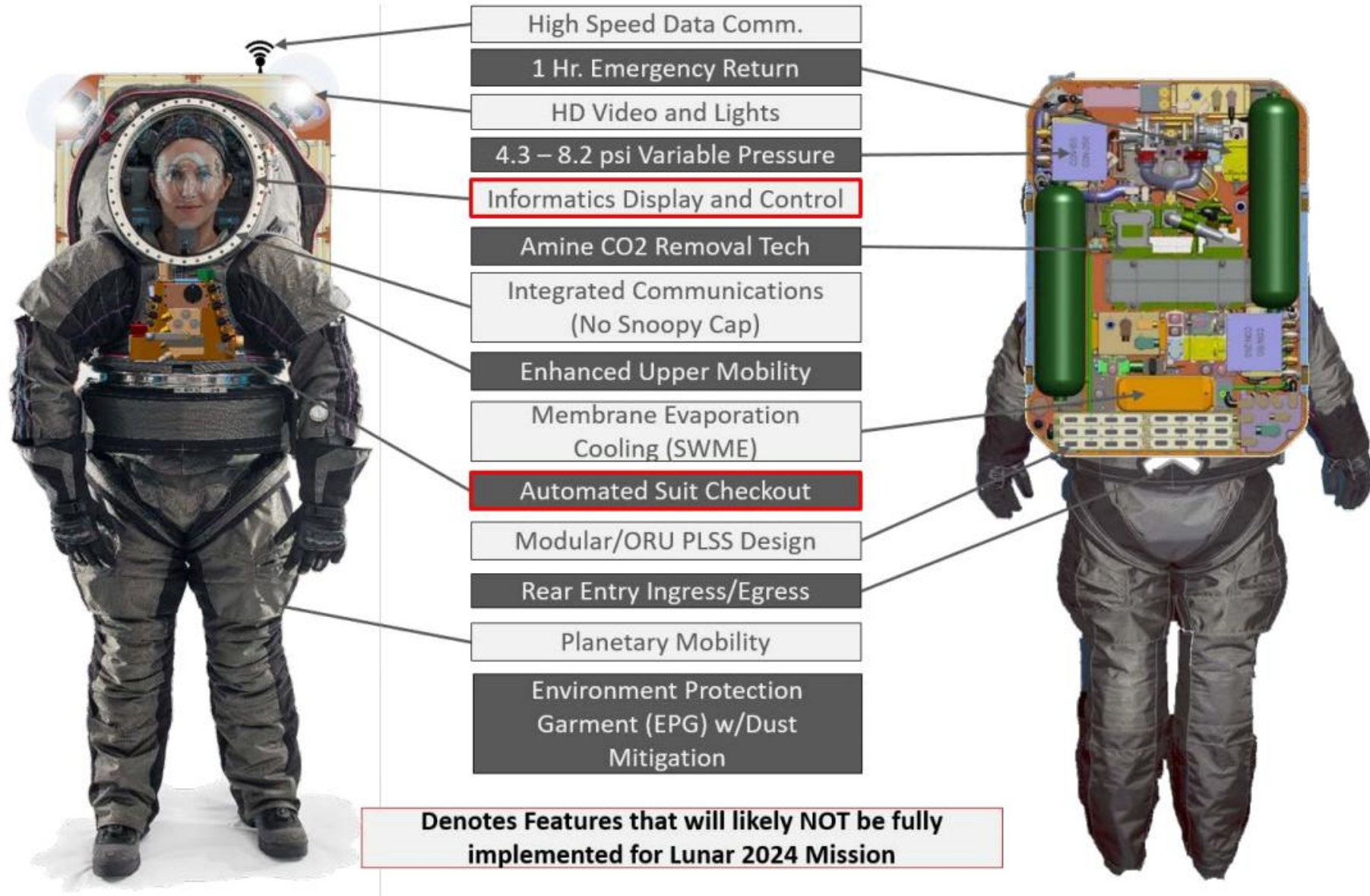


The New Suit--xEMU

- NASA has worked with some of its business partners in developing a space suit for walking and working on the moon and Mars. This suit was designed specifically for dusty, lower gravity environments-- not for zero-g. Astronauts will be expected to do lunar and Mars walks for up to 6 to 8 hours in a day. In zero-g the crew was not allowed to have food or drinks other than water for any of their space walks since any floating particles of food or sticky drinks could cause damage to the electronics, impair visibility, clog airflow or even get inhaled by the crew. Now that the astronauts will be in gravity using the new suits, some of these issues are not as big of a concern. During Apollo missions on the moon they had energy bars and drinks in their suits that helped them get through the long moon walks. They did have a few problems with some of the foods in the Apollo suits. These new suit will need new food dispensers and new food and drinks.
- Having full food bars that are bitten off can leave crumbs in the helmet. We would like to have bite size pellets of food bars that can be dispensed without the crumbs but easy for crew to grab with their mouths. They won't be able to reach their faces through the helmets or up through the neck connections so any kind of manipulations must be done solely with their mouths.

Video of getting into new space suit.

- <https://www.youtube.com/watch?v=ddWCp5qh6lw>



Space Suit Mock-up Information

- You can find detailed information about the new space suits at this website. This has been declassified so researchers and manufacturers can use the same space suit mock-ups used at Johnson Space Center in Houston. [You are now a researcher!!!](#)
- “IKEA” manual for building a version of our spacesuit simulator: https://ntrs.nasa.gov/api/citations/20260000671/downloads/EEPL_HS3_NASATP20260000671_20260204.pdf

CAD information

Go to this website

<https://ntrs.nasa.gov/citations/20260000671>

and download CAD Files.zip

You want: **HUT – Largest.stl**

When you open the STL, some slicers will bring it up in mm and it will look tiny. Try switching to inches and it should end up being around 24 inches tall

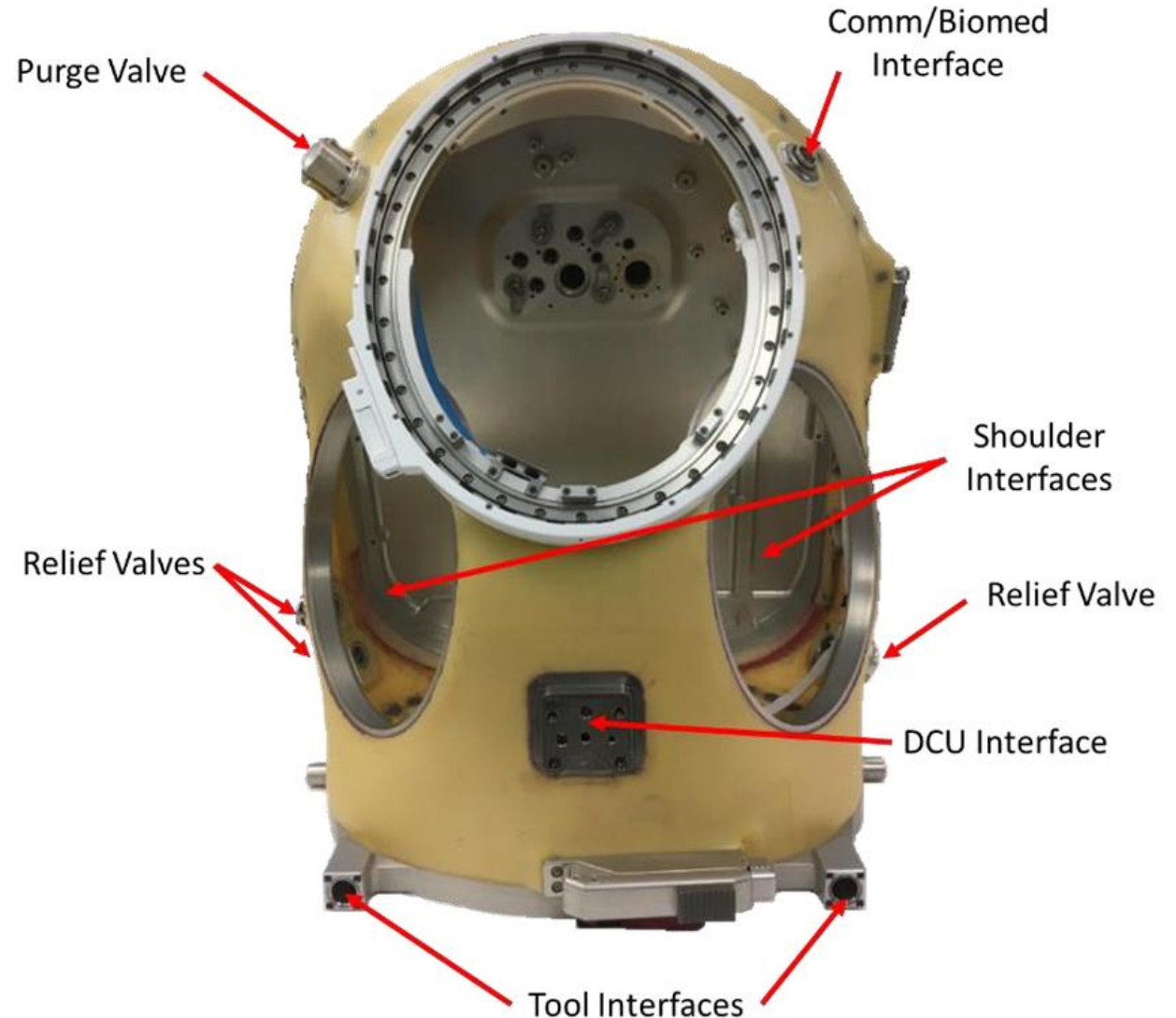


Figure 7: xEMU HUT External Interfaces

File to download



HUT – Largest.stl

This is the file you need to download and print. It is large so, you will probably have to print parts and then glue them together. You don't need the arm holes but it could be helpful for positioning yourself into the suit. If you print in PLA, don't leave it in a hot car or it will warp. You are welcome to print more parts of the space suit as you desire but this is the main component that will help with the Nose Scratcher and the Food Bites Dispenser projects.

With this frame of the xEMU, you will be able to work with developing how you want to position a Nose Scratcher or a Food Bites Dispenser.

If you want to make the bubble for the face, it might be done by making a 3D printed form for the shape you want and doing a vacu-form to shape some acrylic sheet. However, you might be making a lot of fog in your bubble when using it. Consider making your bubble out of metal screen material instead. It would let your breath go through but still allow for positioning and spacing. Let me know what you try and your results.

Some ideas and suggestions

Matt Schwieterman broke it up into 12 pieces to fit it into his printer. I like the different colors—reminds me of Dolly Parton's coat of many colors. I suspect he had some partial rolls of filament he wanted to finish up.

It isn't necessary to print up the whole thing but it sure helps out with understanding how the astronauts fit into the volume.



I don't know details but I am guessing that the outer bubble doesn't hold pressure but is a replaceable piece that might get scratched or damaged while the astronaut is working.

Here are a few mediocre suggestions if you want to represent the bubble

- Bubble window made for putting on a fence so dogs can see out of the yard—amazon. Not quite the right size but getting close.
- I also found some bowls for holding plants that are thin, flexible and transparent at Ace Hardware
- Wire screen material, pulled across a similar sized shape (like a mixing bowl) to resemble the plexiglass bubble.



Fencing mask



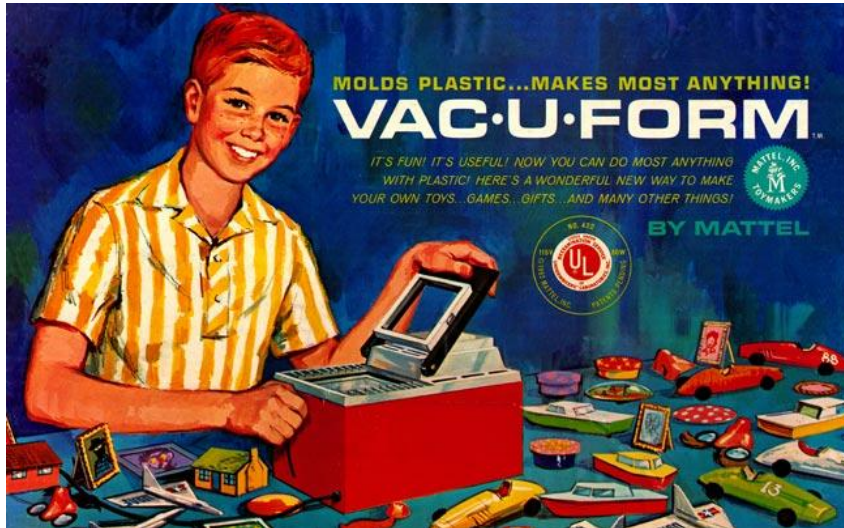
Eric Canestorp's class—Conroe, TX



Matt Brown's class—Warren Tech, CO

Vacu-form for making the bubble?—not required.

- Vacu-form is a cheap, easy way to make some thin, plastic shapes like the bubble of the space suit. Some school shop classes may have a bigger version of one and the teacher might be excited to use it.
- This is a toy version that was sold for kids back in the 60's



<https://www.facebook.com/watch/?v=297626144962221>

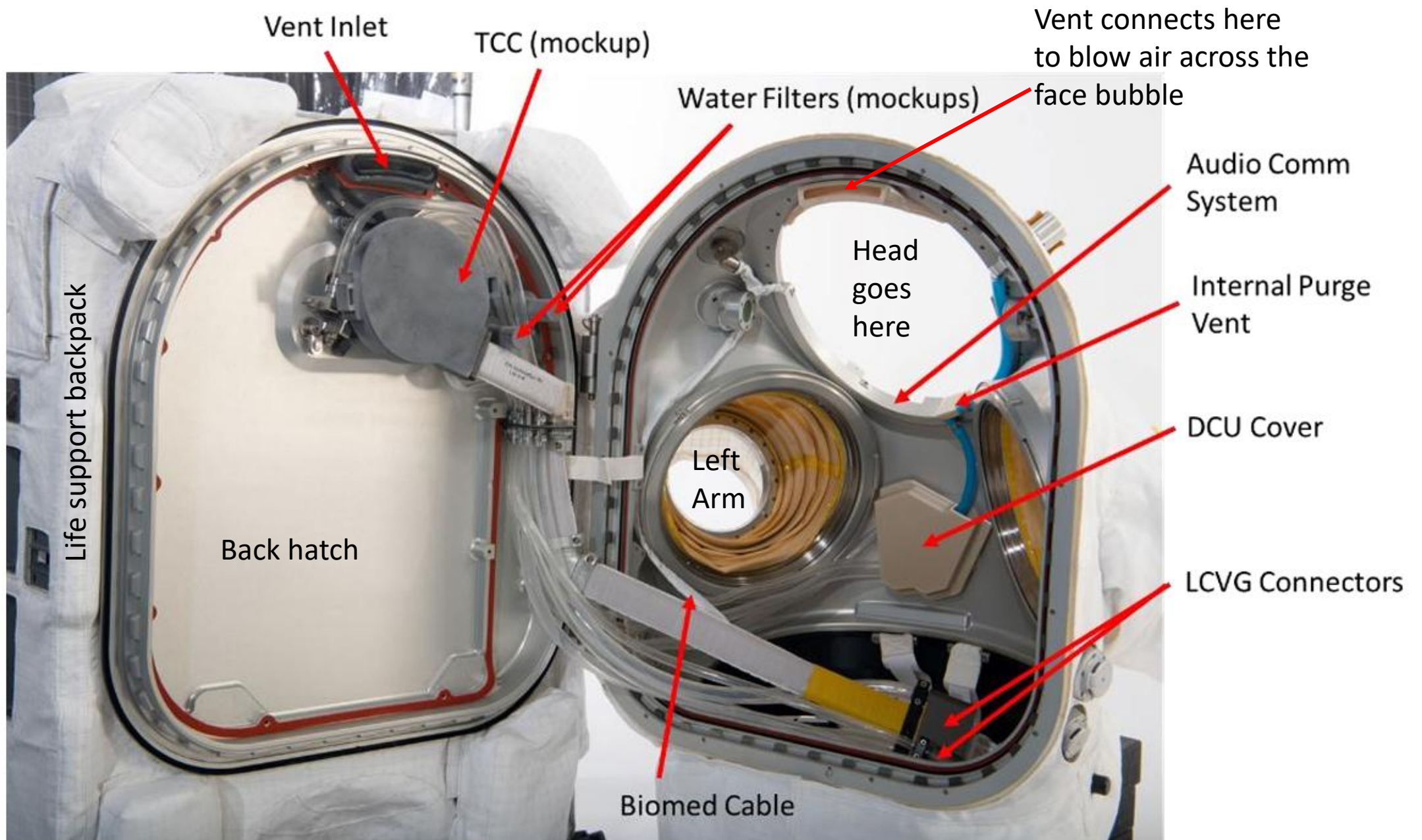


Figure 8: Internal HUT Interfaces