

Energy Food Bites Dispenser

Develop a dispenser for the inside of the space suit that will allow the astronaut to get a variety of food bites without using their hands while working on the moon.



Food Bite Dispenser

Problem:

Astronauts will be walking around on the Moon or Mars in their space suits for 6 to 8 hours at a time. It would be valuable for them to have access to some kind of snack to keep their energy up during the long activity. Another team is developing energy bites. By having bites instead of a bar means that not every bite has to be the same, the astronaut would be able to have variety during the space walk where some are energy bar, some bites could be beef jerkey, some could be hard candy to suck on and the last bite could be chewing gum (don't blow bubbles).

Objective:

Develop a dispenser for astronaut food bites that would be used in the helmet of the new space suit to be used on the Moon and Mars.

- Pellet size should be around = 1" x .75" x .5" (a little smaller than a fun size candy bar)—the exact shape and the size of the pellets should be dictated by a good edible size and a shape that goes through your dispenser without clogging or jamming.
- Holds at around 5 to 8 pellets per cartridge
- Must be able to eat all of the pellets without use of hands.
- Person has to remove pellet from dispenser, can't fall of in the helmet or shoot at the person's face. (ex. Pez dispensers make you pull the candy from the dispenser.)
- Could use electric motor to aid in the dispense but you will have to account for the volume of the batteries.

Tips:

- This will only be used in gravity so floating around is not a problem but crumbs in the suit could still be a problem.
- How will the dispenser attach in the helmet? Will Velcro be ok?
- Where would you place it in the helmet so they can still reach it?
- Could part of the dispenser itself also be edible? Pasta? Rice paper? Rigid cookie or candy?
- **Keep it simple.**
- **Keep it as small as possible but supply enough food to be worth having.**



CLIP



MAGAZINE



Bullet magazines and clips are curved because the cartridge side of the bullet is larger than the projectile.



Shape and size of bites?

A sphere gives the largest volume for the smallest surface area. Round shapes may be easy to make and can fit in the mouth easily, but they don't pack into containers easily. Choose a shape and size that provides a good amount of food but doesn't get stuck in the dispenser. I'm sure hard candy may be one possible food but something besides sweets will be important to staying energized while working all day.

Edible coverings?

From the time food is prepared and packaged to the time it is eaten could be as long as three years for food on the ISS. We should expect a similar time frame or longer for food for the Moon or Mars. These will be sent in a plastic or aluminum packet to keep them fresh before it is eaten. Not only do we want it to still be good to eat, we also don't want it to be stuck to the wrapper or to each other. Food packaging has many techniques for preventing sticking. It may be smart to look at many different options like rice paper, gel coatings, powder coatings, pasta covers, Information from NASA about the types of food items they are considering. This should not limit you.

[https://ntrs.nasa.gov/api/citations/20220019344/downloads/Recommendations for In-Suit Nutrition 2022-12-31 STRIVES.pdf](https://ntrs.nasa.gov/api/citations/20220019344/downloads/Recommendations%20for%20In-Suit%20Nutrition%202022-12-31%20STRIVES.pdf)



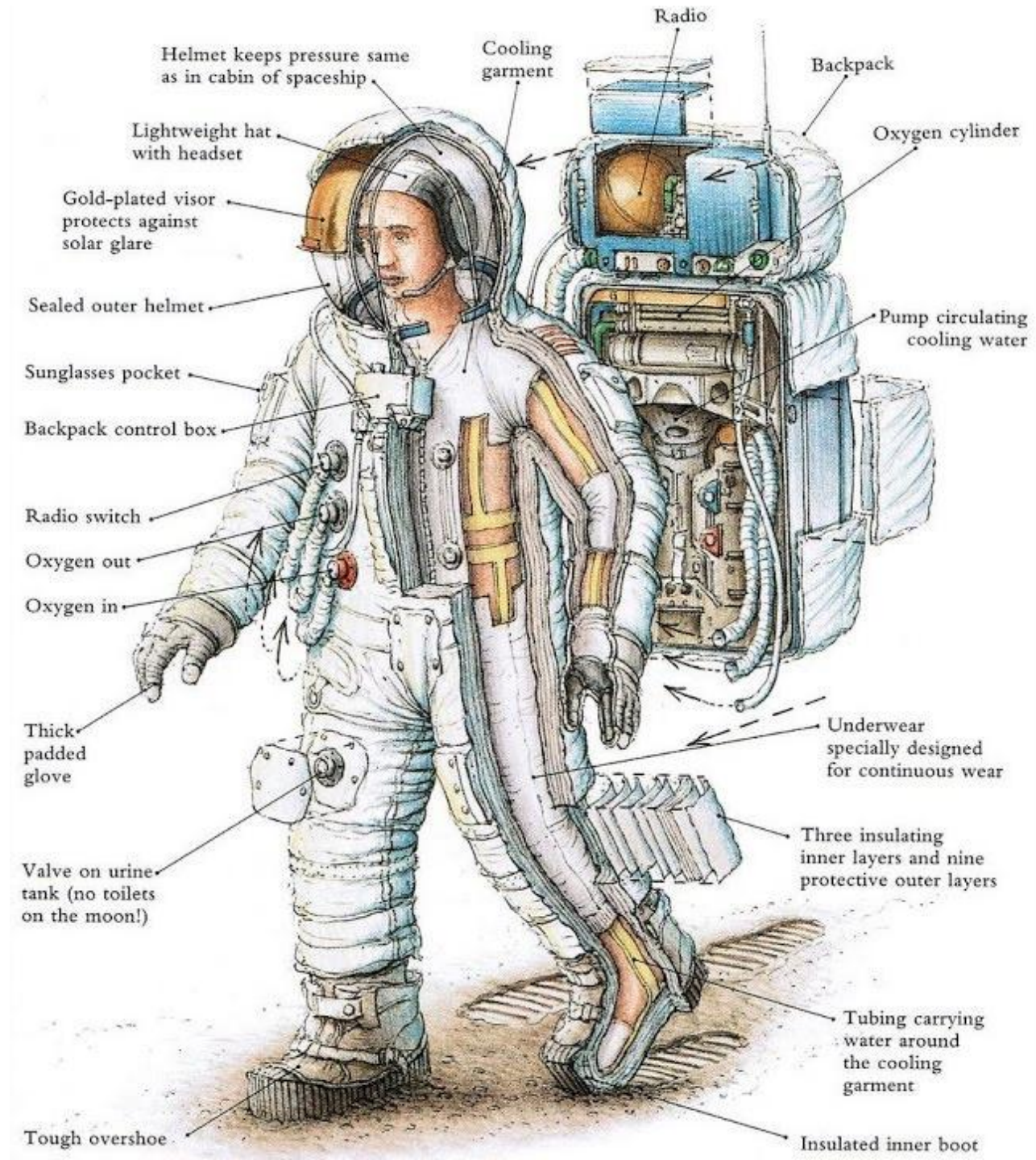


The whole front of the helmet is a bubble to give as much visibility as possible so keeping the dispenser small is important. The exact location for the dispenser is going to be difficult and could be different for each astronaut. I could see it being down close to the bottom of the bubble near their chin or over to the side. In some photos (and perhaps versions) the air flow came from a vent above the head (to prevent fogging of the visor) and returned through two grills on either side of the face about eye level. This means crumbs would be unlikely to cause problems with air flow. But we still want to avoid crumbs. Since they are no longer using the old style “Snoopy caps” for the audio systems, could the dispenser attach to their head some how? If worn on the face, could there be a dispenser button that is pushed by bumping it into something on the helmet? Voice activated? You don’t want to dispense while talking to the ground or your partner.

Estimating with a ruler and my hands to simulate what I see in the picture, I estimate that the outer dimension of the helmet is about 13 to 14” in diameter. I would then estimate the interior diameter would be about 11 or 12” because of the double pane which appear to be separated by $\frac{3}{4}$ ” to 1”. I expect all the helmets will be the same size so they will be interchangeable.

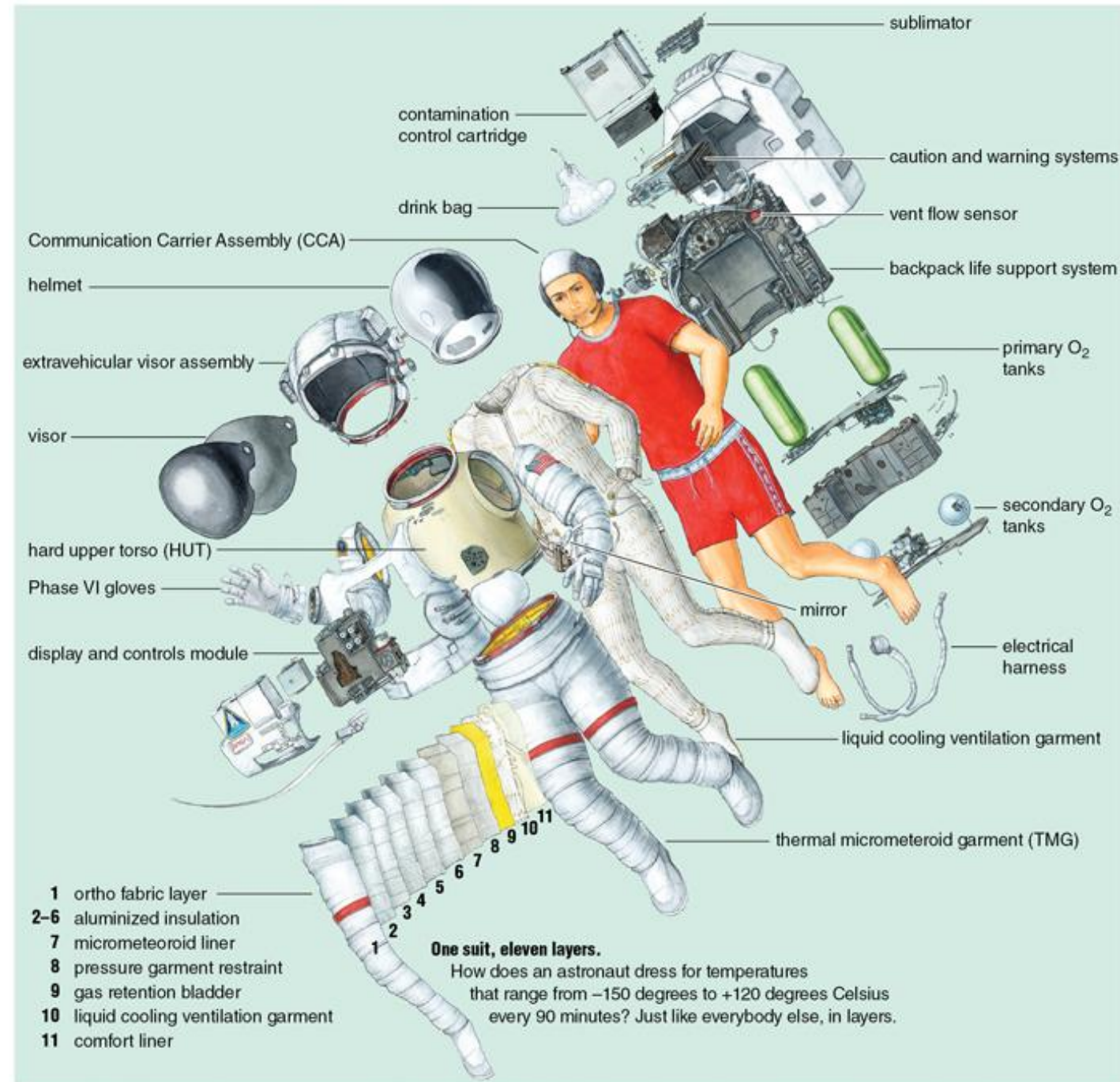
Space Suit Basics--Apollo

- 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.

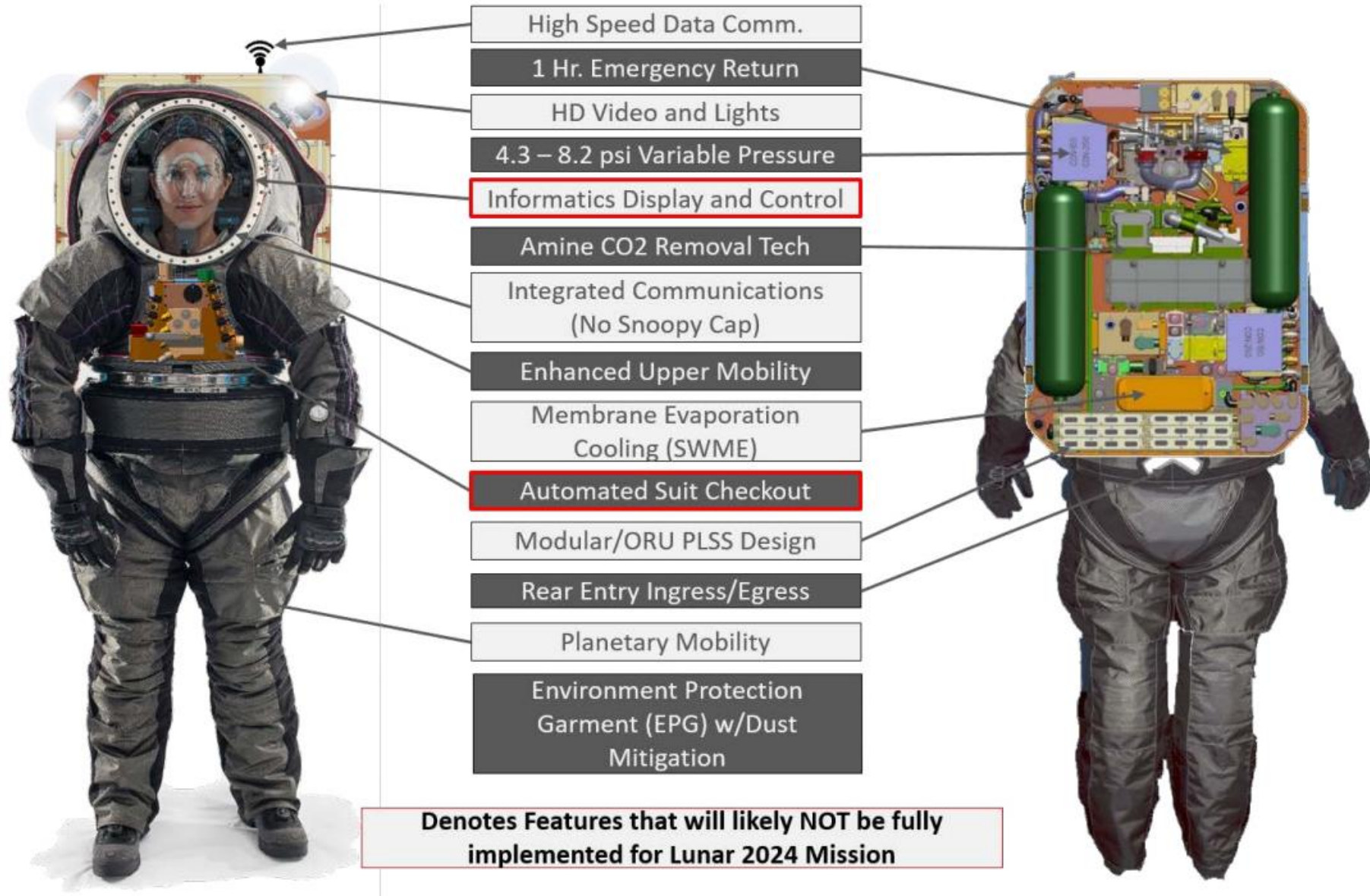


The New Suit--xEMU

- 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

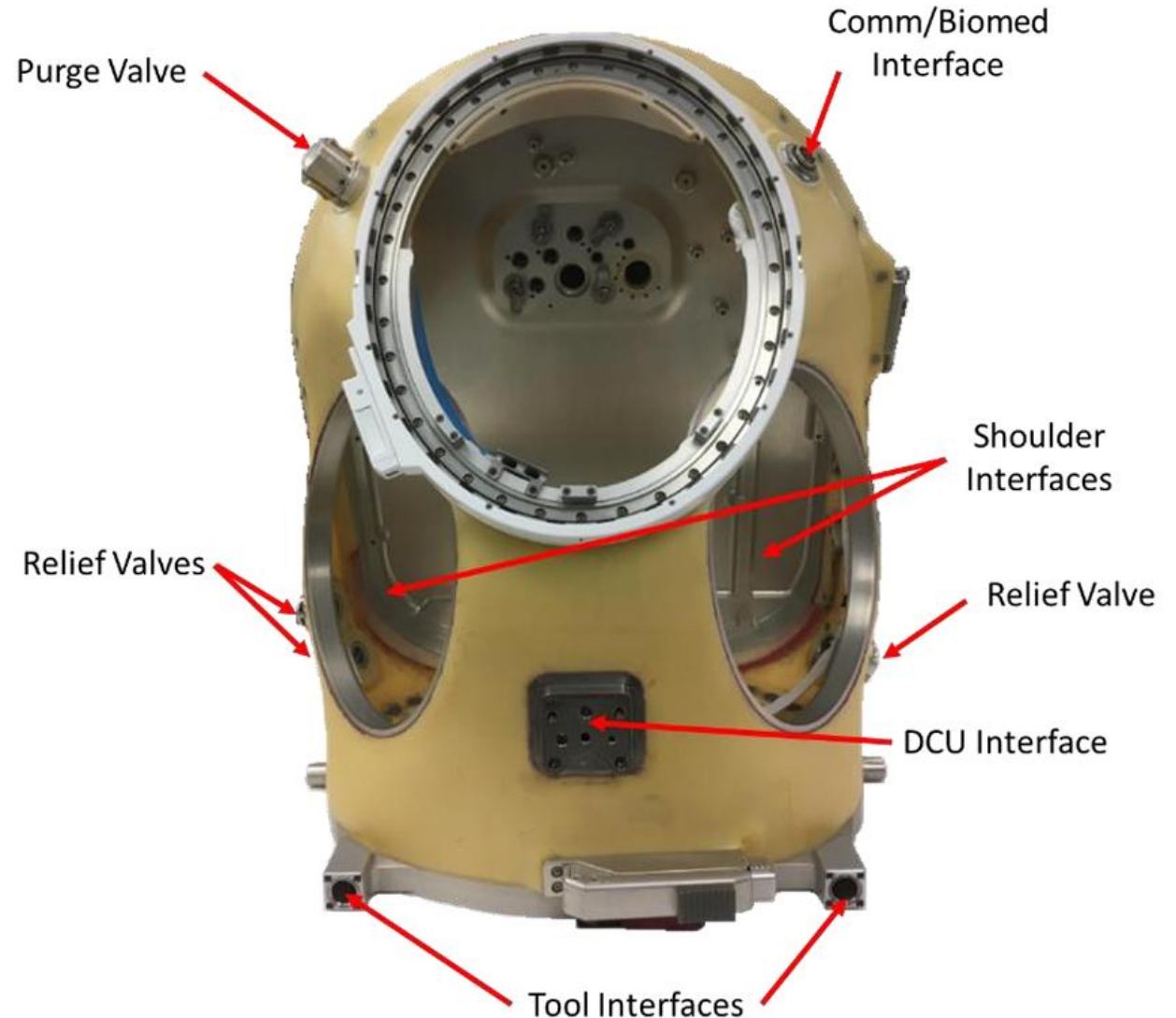


Figure 7: xEMU HUT External Interfaces

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.



Eric Canestorp's class--Conroe



Matt Brown's class—Warren Tech



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.

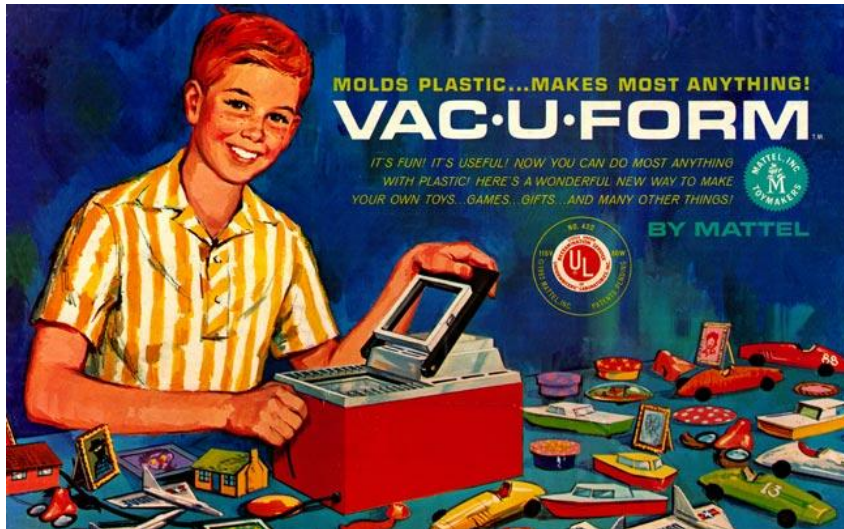


Fencing mask



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>

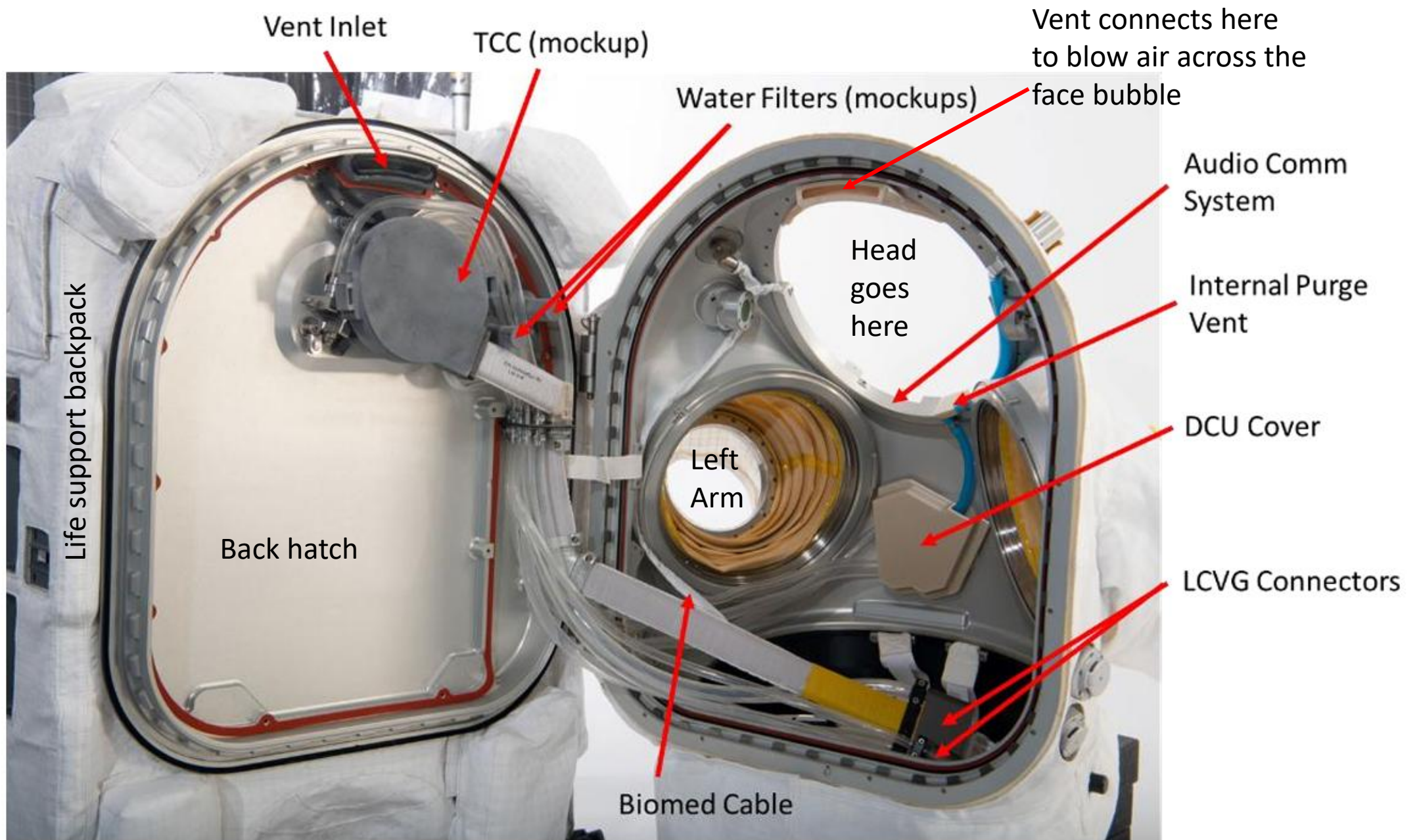


Figure 8: Internal HUT Interfaces