**Fungus Nanolab questions**

Is there any external power or water sources?

All of the NanoLabs will receive power and data from the rack through the USB connections.  There is no water except for what you send up in the box.  This is only for 30 days and the box is mostly sealed so the water you send up will stay mostly in the box.

Is it possible the nanorack can refill the water storage?

No extra water available.

Can we have an external battery, if not can it be charged?

The rack supplies 5V and 3A.  If you would like to include an extra battery, you are welcome to.

**Questions for the Zero-g Bulk Transporter:**  
  
Bulk transfer questions

1. What primarily started this problem?

Every astronaut comments on the amount of trash and how they would like to decrease it.  One of the astronauts was commenting to me about how bulk items may help out with some of the small packaging and shared her thoughts.

1. How long has this issue been a problem?

Since the beginning of the space program.

1. Can you provide some statistics of the trash accumulated overtime?

I don’t have that kind of information.  Sorry.

May we normally open (via the zipper for the almonds and bag of M&M's) the bulk item bag in order to attach it to our equipment, or do we require a mechanism that prevents the bag from being opened and closed by its normal mechanism?

Keep it as simple as possible.  If the bag is already full of almonds or whatever, opening the top of the bag to insert your device will release the particles.  Your device may be something that is installed on the bag on the ground.  Try to keep the volume of your device as small as reasonable so it doesn’t add too much to the volume of trash.

Is it necessary to remove every individual item out of the bag, since if it's already at a servable size, wouldn't transferring it to a new container negate the point if it's already at a servable size?

Good comment.  If you have mostly emptied the bag and there is only one serving left in the bag then there is not a need to transfer the last portion to a smaller container.

Do you know where we could find information on astronauts' personal feelings on dealing with particles like almonds or bolts in micro-g?

The only place I know to look is on YouTube.  I just googled M&Ms in space and did not get a good video of astronauts eating M&Ms in space.  However, I did see an old YouTube video at [https://www.youtube.com/watch?v=pk7LcugO3zg](https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3Dpk7LcugO3zg&data=04%7C01%7Callison.r.westover%40nasa.gov%7C2f7d8e11a2dd4ee05f2508d97eb06110%7C7005d45845be48ae8140d43da96dd17b%7C0%7C0%7C637680118268327173%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=zDiXeU0qfs9jgSGb0kN%2BJo5nCsghF6aJ8TZaC8J%2F%2BZc%3D&reserved=0) of Astronaut Don Pettit on the ISS drinking from a cup he made by folding a sheet of flexible plastic and if the wetting angle is a certain degree the liquid will rise to the top and he actually could sip his coffee instead of drinking coffee from a straw.  This works well for liquids in space, could it possible also work for particles??  Attached is a picture of the hydrofuge experiment that went to the ISS and it used Don Pettit’s tear drop shape to have the water exit its tank.  Just a thought.  Who would think the liquid would behave like that in microgravity??  If you send me a list of specific questions for an astronaut to answer, I will forward it to one of my very favorite astronauts.

- Are there dimensions and descriptions for the "large containers" which our system would transfer objects from?  I do not know of such a list, and the issue is that we do not send a lot of food or small things in large bags because of the issue of things floating away.  I copied Glenn Johnson on this email because he might have a better answer.  The picture I have attached is a single serving of M&Ms it has about 30 M&Ms in the bag.  If we could send up a gallon or even 2 gallon plastic bag of M&Ms or bolts that would save a lot of trash.  I just receive a bag of astronaut food from the JSC food lab today.  That is were the M&Ms came from.  The bag they sent held 10 little containers of food in about 12 inches by 15

inches.  It probably could hold twice that amount.  One thing to also consider is medicines.  If we could send up a container of let’s say 100 pills and be able to take out one at a time that would be terrific!

If you use 1 gallon zip lock bags that will be a good size.  If your design can allow for bigger bags or a different type bags that is ok also

- Are there any parameters and or specifications which NASA needs from our system other than transferring specific amounts of objects?  I can think of a list of requirements that your system should fulfil.  For example, being able to keep the device clean.  Send me a list of requirements that you make up in order of importance and I would be glad to review it.

- Finally if there are any expectations or concerns you have for us this Wednesday please share them so we can prepare accordingly!  Sorry I totally missed this opportunity, and I sincerely apologize.  You all did a wonderful job presenting and I am truly looking forward to working with you and having you on the NASA HUNCH team.

1. Would biodegradable bags be beneficial in reducing trash in the space?

Biodegradable usually means something will decompose when in an ecosystem with running water and airflow.  As far as I know there is no such system currently on the ISS to help the biodegrading process. However this type of work could be looked at in the future, especially for long term missions like the Mars mission where  we don't have a planet to burn up materials for most of the trip.

1. How do astronauts prefer eating in space?

To clarify:

There are **Thermally stabilized** foods that are like the MREs that the military eat.  Some of these are also **irradiated** to ensure any bacteria are killed.  Only some food have to be irradiated.  As long as they are not opened, they won’t grow bacteria for at least 3 years.

There are **Freeze dried** foods that have to be rehydrated.  They can be kept good for at least 3 years if they stay sealed.  Once they are rehydrated, they can start to grow bacteria even if they are not opened.

**Fresh foods** are like apples, oranges, carrots,… that won’t keep very long after launch so they need to be eaten fairly quickly

**Natural form** foods are like peanuts, jerky, dried peaches, almonds, candy,….are taken out of the bulk bags they are sold in and transferred into smaller packages and vacuum sealed to keep them fresh for a longer time.  This is where HUNCH might be able to save some trash.  If students are able to develop a simple system for transferring controlled amounts of these bulk items, NASA might be able to send up the bulk bags more often and save on the individual packet trash.  This may not sound like a big deal but when these little packets are generated from 6 or 7 people per day three meals a day, they add up pretty quickly to a lot of filled trash bags.

Although the astronauts like the Russian food in the cans, they are not particularly fond of the cans as they take up a significant amount of space in the trash especially since they are more rigid.

1. What is the type of food in space that has the biggest mass?

I don’t know what kind of food has the biggest mass.  I would expect it to be something that has the most water.  The thermally stabilized food (both in cans and in packet) has all of the moisture in it from the cooking process.

**Questions regarding GUI**

• When will the GUI have to interact with multiple computers?

The Arduino/Raspberry Pi will only have to interface with the space station computers for downloading of data and any connection while it is on orbit.

If so, will it be through an internet connection?  
there will be no internet connection.  The only connection will be through the computers on the ISS to the computers at the company (NanoRacks)  
• What did they mean by downlink?

The computers on the space station are not in contact with the ground all the time.  The NanoLab will have to function on its own most of the time.  Occasionally the ground support team at NanoRacks can link to the NanoLabs and send commands and receive data from them—downlink.

• Would the GUI be hosted on our raspberry pi/Arduino or the NanoRACK computers?

The GUI should be on the raspberry pi/Arduino so that when people are loading up their experiment and setting parameters for lights, camera, motors,…it is easy to program and make changes.

If so, will we be able to use the NanoRACK for storage?

You should not need to store more than a couple of days of storage since the ground team will be downloading data on a regular basis. The raspberry Pi will be limited to what ever fits on the mini USB but that can be many gigs of data.

• When they toss the project, will the GUI go with it?

Most of the projects will be returned to whoever purchased the NanoLab so the software will come home too.

• How will we test the parts that can only be run in NASA beforehand?

All of the parts that you will be running would be in NanoLab.  There will be some coordination with the company (NanoRacks) for communication to and from your NanoLab through the USB connections.

• Are we required to create a tutorial for users to interface with the board?

A tutorial for the users is not a bad idea but the better your GUI, the less teaching you will have to do.

"Regarding the download of data/files, you say that we won't have internet, so do you mean that data will be extracted from our GUI then downloaded through another system? We are confused as to what you mean by download. Are you talking about file transfers? For example, using a USB to extract data from the GUI to another computer."

**download means to receive data from a remote system**

In this case, your Raspberry Pi or Arduino is a remote system.  Your system will be transferring the daily or weekly photos, temperature, humidity,… to another computer on the ISS.  That ISS computer will send it to a computer on the ground where it can be sent to you through the internet.  If the person who purchased the NanoLab and set up the experiment wants to make any changes to the operation, it will have to go through the ground control computer, up to the ISS computer and to your Raspberry Pi/Arduino.

The ISS is on a completely independent set of computer systems to avoid someone trying to hack into station through the internet.  The main connection to the ISS and other space craft are through the S-Band and KU-Band antennas.  They have good data transfer rates but the highest priorities are for the functionality of the ISS.  The ISS does have some internet capability but it is usually very spotty since it is traveling at 17,500 mph and doesn’t have a lot of ground support for it.  As you might imagine, the connectivity with the space station life support systems and the crew on the Station takes priority over shopping or google searches.  The connections with the experiments are limited both for bandwidth reasons and for safety reasons.

**Magnetic Boots Questions**

1. How do we measure if our boots can hold 20lbs? Does it mean 20lbs of downward pull or side pull? Or is it 20lbs of holding or lifting force?

20 pounds of straight pull

2. How does a typical astronaut boot look like and what is the average size of them?

The new spacesuit uses a work boot on the outside of the space suit. Use a shoe size that works for someone in your group. The boot itself is not as important as the functionality of the mechanism that allows for walking or other translation

3. What things should be kept in mind with an astronaut boot can we modify it? Or is there something that has been kept on there?

You may alter a boot or you may have some thing that attaches to the existing  boot

4. If we were to use electromagnets and we had batteries how much can an astronaut carry?

There won’t be any weight because this will be done in zero gravity. However the bulk will make it more difficult for them to move around. Try to keep things small and easy to work with

5. Any standards that should be kept? Is there something else required or that you're wanting? Specific materials?

The updated requirements and suggestions are on the website. The inclusion of wheels for gliding or skating is not a requirement but only an option. The most important component of this is making it easier for an astronaut to translate on the outside of the spacecraft and to work more effectively

**Destiny Project**

1. What is the budget? (actual product)

I don’t think we could build this for anything less than $15,000 but I don’t think we would want to spend more than about $50,000.

1. What are you planning to use to transport the mockup from location to location?

You get to determine that.  If you want to transport it all in 30 minivans that will mean more set up time at the airport.  If you want to use a semi with a low boy trailer, the assembly will go quicker.

1. How are you planning on getting the mockup into the airport?

That is up to your team to decide.

1. What machines are at our disposal to move the mockup within the airport?

I would imagine that there are some forklifts but you can determine the tools you need and rent them.

1. What all are we putting on the inside of the mockup?

See the updated description on the webpage.  Mostly touchscreens with a few experiment racks, lights, you will need some air blowing through.

1. Where are bay 1 starboard and bay 6 port?

See the updated description on the webpage.

1. Is there a weight limit?

There may be a limit on the floor but I’m sure it is much more than what you will design for.

1. Does the mockup have to be taken apart or put back together within a certain time frame?

No but you can imagine that faster is better.

1. How precise does the scale have to be?

The main goal of the scale is to make you model fit on a desk and be easy to transport.

**Lunar Supply Airlock questions**

1. What would you say are the main constraints for this project?

Getting the airlock to the moon is a significant problem because of the size that is needed.  It seems to me that this problem pushes airlock to being an inflatable.  Then the difficulty becomes how to have a good seal after bringing in the supply pod.  I think that dust is also a major difficulty related to the hatchway.

Not many people are working on this so I’m glad you are working it.