Frequently Asked Questions Design and Prototype 2019-2020

1. Is there a description of the moons surface?  the moon’s surface is very large so it will have a lot of different surface features depending on the location.  The students will be able to find more information about the 6 landing sites.  Use the internet to
2. How many lbs of thrust does a lunar lander have?  Available  on the internet.  Google search “lunar lander engine”
3. For their prototypes is it ok to do small or actual scale?   Make it as big as reasonable some sort of scale representation is a good idea.
4. On the lunar dust brush can they use static electricity or not?   Since the space suit is electrical, I think it would be best to avoid static electric charges that might damage the suit.
5. Are we able to get information about the size of the astronaut gloves and how thick they are? . I think we should suggest that the students practice with something like puffy ski gloves. Something more Restrictive than gardening gloves, Students should use good ski gloves to simulate the bulk of a space suit glove when testing how their hand works with their equipment for the moon.  This doesn’t have the push back from internal air pressure like a space suit but it does limit the dexterity.

Lunar Wheels:

We noticed that the wheel was to be used as a push cart, but also it was specified that it should be able to go 10 - 12 MPH. Would this wheel maybe be modified to go on some sort of motorized rover?

*I was allowing for fast motion of the astronauts.  I expect that would be a little faster than what they could move at.    I don’t expect it to be motorized.*

We were also wondering about the testing of the wheel in play sand.

During our research on the lunar dust it seems to be more like dry concrete powder rather than play sand. Is pulling the wheel through 2 inches of concrete powder a viable idea for testing rather than the play sand which was suggested?

*The moon will have different types of soil and soil thicknesses at different locations.  If you want to try your wheel in another type of soil as part of your testing, I think that is a good idea.  Play sand is relatively easy for everyone to get a hold of and is still a good simulator of lunar dirt.  Lunar soil will also be much lighter and will shift more under feet and wheels.  In terms of weight it may have some similarities with saw dust. For example a 50 lbs bag of dirt here would only weigh about 8 lbs. on the moon.*

Lunar Flagpole:

”For those of you working on the Lunar Flag Pole, it may be helpful to do a google search for beach umbrellas and look at the different methods they use to hold the umbrella into the sand or what keeps them from being blown away.”

Tent Stakes:

One question from todays meeting was should they attach the tent stakes to the lander legs?or somewhere else?

 I am sure that they will need to ride on the outside of the landing vehicle but exactly where they will be I don’t know. They may be in some kind of a toolbox that would attach somewhere easily accessible after the astronauts get off the ladder

Tarp

1. Will there be an electrical drill like they had for the previous moon mission?  If so, do we have any specifications that they can obtain?

The drill they take with them will probably be very similar to a battery operated drill like what we use on Earth.  It may have some different dimensions and different materials but it should operate the same and be very similar.  On the space station they are currently using a DeWalt 18V drill but you can use any drill to simulate how your stakes will be installed into the ground.

Sleep project for Artemis

1. Is there a way for them to get a general idea of the Artemis interior?

Unfortunately the new Lunar lander has not be built so no one knows what it will be like.  I expect that it may be similar to the Apollo interior but it is hard to say.  Doing a google search for the inside of the Lunar lander would be a good starting point.

1. In the notes you stated that it needs to be off the ground.  How high does it need to be off the ground.

The point is just to not be in the dust on the floor.  I suspect that one might be 6” or more off the floor (consider comfort of getting in and out of it) and the other might be a few feet above kind of like a bunk bed style.  How far apart do the two beds need to be?

On the Sleep Station

1. When collapsed fully what size should it be?

I have a hammock that rolls up to be about the size of a softball but I don’t think a hammock will serve the crew for a good, restful sleep.  So I expect yours will probably be bigger.  Since we don’t have much information about the lander, there is no specific size at this time so keeping it as small as reasonable should be your aim.

For the Washing Machine

Dirty Water Removal:

The international space station already has a water reclamation system. The system is currently able to handle urine as well as water vapor that is condensed from the air. There is no need for The washing machine to clean the water. The water reclamation system can handle the extra load that will be placed by the washing machine.

Teams that are working on the removal of water need to be concentrating on the rollers and the squeegees that are taking the dirty water off the clothes.  The squeegees are difficult because they are doing two things: concentrating the dirty water into a linear puddle as it comes off the clothes and the roller then there is some kind of  water collection ‘straw’ that slurps up the dirty water.

How many pieces of clothing are going in at once?

What is the minimum and maximum amount of water, water temperature, and time to wash?

I only expect to put one shirt through at a time.  I am thinking that a shirt will take around 10 min. to wash.

Right now I am expecting a shirt to require 500 ml of water.  Students last year were able to get about 200 to 300 ml of dirty water out of a shirt.  If we can prove the ability of this style of washing machine works for a shirt, the information on the “leader” of the control system will tell the washing machine how much water to be injected into a pair of pants or a pair of socks.

Right now we don’t get any variation of water temperature, it will be about 71 degrees F.  Just like at home all the water for the ISS is at room temperature and we have to have a water heater to get hot water.  Right now the only hot water comes out of the Potable Water Dispenser and that is mostly for food.  It doesn’t have the capacity for much more volume.  Remember, the first washing machine is simple and is just proving the idea.  Hot water will be a great improvement but that requires another system we don’t have yet.

 The Controller:

Just as a washing machine at home has its own control panel, you would be coming up with the control panel for this one.  We are wanting the control panel/astronaut interface panel to be as simple and intuitive as possible so they need as little training as possible.  The Arduino or Raspberry Pi that controls all of the internal rollers, water valves, lights and safety checks will be programmed by an outside computer but the washing machine controls will stand alone most of the time when in operation.  There is a suggested layout of what the astronaut interface may look like on one of the pages describing the controls.  Last year I had one team that worked on controls (Raspberry Pi) and seemed to have a good idea of how to control all the motors for normal use.  They had several small motors they were turning on and off in the sequence to mimic the operation of the washing machine as described in the project.  This year they are planning to work on what happens when an article of clothing gets jammed or water builds up in a location—working on the off-nominal conditions.

For the CQ diverter: Information on Airflow characteristics : Good technical paper on acoustics and airflow- <https://arc.aiaa.org/doi/pdfplus/10.2514/6.2010-6018>

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20130011142.pdf>

1. What air speeds are seen in the CQ:

CFM at the 3 fan settings is:

low 58

Medium 75

High 95

What the max airspeed is when fan sitting on a table : airflow of 125 CFM, this is what it actually is: High setting:

This is the requirement : The Fan Assembly shall provide a maximum volumetric flow rate of 130 cfm at a voltage of 24 V (±0.001 V) with a backpressure of 0.0 inH2O.

CQ Exhaust Diverter

This is an exhaust vent near my desk at work.  Notice how the holes in the vent are not just strait up but angled to make the air swirl as it comes out the vent.  The diverter that you design does not have to be only a solid vent hood blowing the air in one direction but could also have holes that helps direct the air flow and spread it out.  (Look at pictures attached on the information/document page)

Heat Shield

1. How can they test this?

Look at slide 5 on the “No Heat Shield” supporting  documents page.  I have added several thoughts on testing including drop towers, drones, also using your oven and freezer for testing your electronics.

1) Do the forces of aerodynamics apply to an object in space?  If there isn’t any air, the aerodynamics forces will be either negligible or nonexistent.   A paper airplane in space will just tumble until it meets up with some air.  Paper air planes also depend on gravity to pull them down to make them go forward.  You can watch one of the astronauts throw a paper airplane on the ISS on youtube and the plane just tumbles.

2) How can we make an object fall in a specific orientation?  After your object starts coming back into the atmosphere, the aerodynamic forces will increase.  At first your object will do some tumbling but should orient itself according to how you have constructed it.

3) What form does our electronic package have to be in? Are there any specifications other than that constraints discussed on the project PDF?  You may configure it in any fashion you want.  The main thing you should be interested in is being able to track the location but it may cost very little in mass to add other capabilities like temperature probes or accelerometers.  I was just talking to Jim Langsted from Edge of Space Science who flies many high altitude balloons for student projects.  He was talking about the difficulties about how some batteries don’t work in low temperatures.

4) How can we create drag in a vacuum?  I don’t expect you can.  The space shuttle didn’t use its wings until it came back into the atmosphere.  The space station has to be boosted up into a higher orbit about every month because the very thin amount of air that it travels through slows it down just a tiny bit every day.  This happens to all satellites—more when they are closer to Earth and less for those that are in higher orbits.  Whatever your experiment looks like when it gets on orbit, it will be slowed down by the atmosphere and fall back to Earth at some point—it might be a very long time depending on how big and massive it is but it will come back.

In the description, I mentioned the possibility of dropping your project from various heights including maybe from a weather balloon.  I talked to Jim Langsted from Edge Of Space Science (EOSS).  He is part of a non-profit organization that sends up high altitude weather balloons several times a year.  I told him about the No Heat Shield project and he was very interested in what the students were doing.  EOSS is a team of volunteers that has the permits to buy, launch and track the balloons by car and with ham radio as they travel across a couple of states.  They do more balloons than anyone else in the country (maybe world I can’t remember).  This is not a free service as these guys need gas money and balloons are not free but this may be within a budget that a school can afford.  Although they are based out of Denver, they do projects for students from many states.  They would love to hear from any team.   There are some difficulties that we will need to work through.  Normally they are only dropping the package attached to the balloon—one object.  To drop something separate from the balloon from 100,000 feet we will need to get some permits from the FAA.  It may depend on the type of object being dropped so I don’t have specifics yet.  If you are interested in taking your idea to the step closest to space use the link below to learn what it will take to get it to the edge of space.

<https://www.eoss.org/>

Mouse Food Dispenser

To avoid having to buy a large bag of mouse food, one of my teams found this package of mouse food that has similar (but not the same) type of food pellets.  The type of pellets that your team uses doesn’t have to be identical to that pictured in the project.  The point is to show how your dispenser would work with a similar type of pellet style food. (See picture on the information/document page)