



# Talkin' Trash...Space Trash

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# Trash onboard the ISS

- Do astronauts generate trash?
- Do they bag their trash?
- How is trash onboard the ISS different than trash on earth?
- Do they recycle on the ISS?
- How do they get it off the ISS?
- Is there a space trash truck?
- What happens to it after it gets off the ISS?
- What new ways are being considered to get rid of the trash?
- What's in store for the future?





# Astronaut Trash

- YES! Just like everyone else, astronauts generate trash
  - 4 astronauts can generate up to 2,500 kg of trash per year
  - That's over 100 standard trash cans per year
  - Or ~2 trash cans per week
  - About the same as a family on earth!
- YES! They bag their trash
- They have cleanup days and chores to keep the space station clean!



# Packing the Trash

NASA astronaut Mike Fossum demonstrates in a video how to pack trash Credit: NASA

<https://www.youtube.com/watch?v=JP5D0QK88Lw>





# What is in ISS Trash?

Brainstorming session  
on what you might think  
that is

List some of those  
things



Some normal things in ISS trash – Similar to your trash

- Food wrappers and containers
- Drink pouches
- Experiment packing materials (foam)
- Containers for experiments (syringes, applicators, etc)



Some not so normal things!

- Broken equipment
- Old science experiments
- Clothes – No washing machine in space
  - Water is scarce
  - 1 pair of socks per week
  - 1 tshirt per month
- Poop – No sewer system or treatment center
- Hair – Periodic hair cuts



# What about recycling?

The Space Station is one of the kings of recycling!!!

They recycle as much as they possibly can to prevent having to launch those things

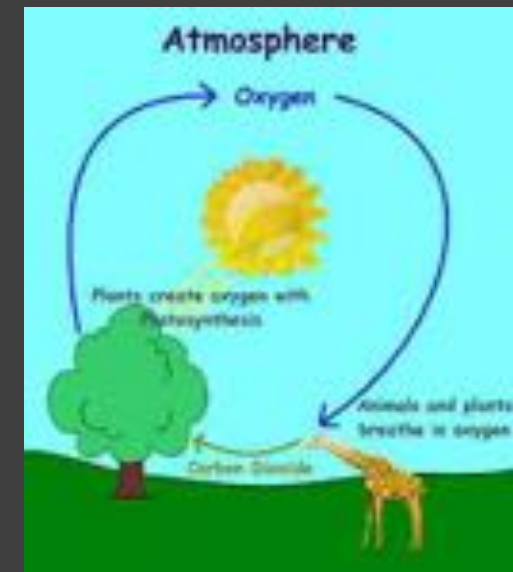
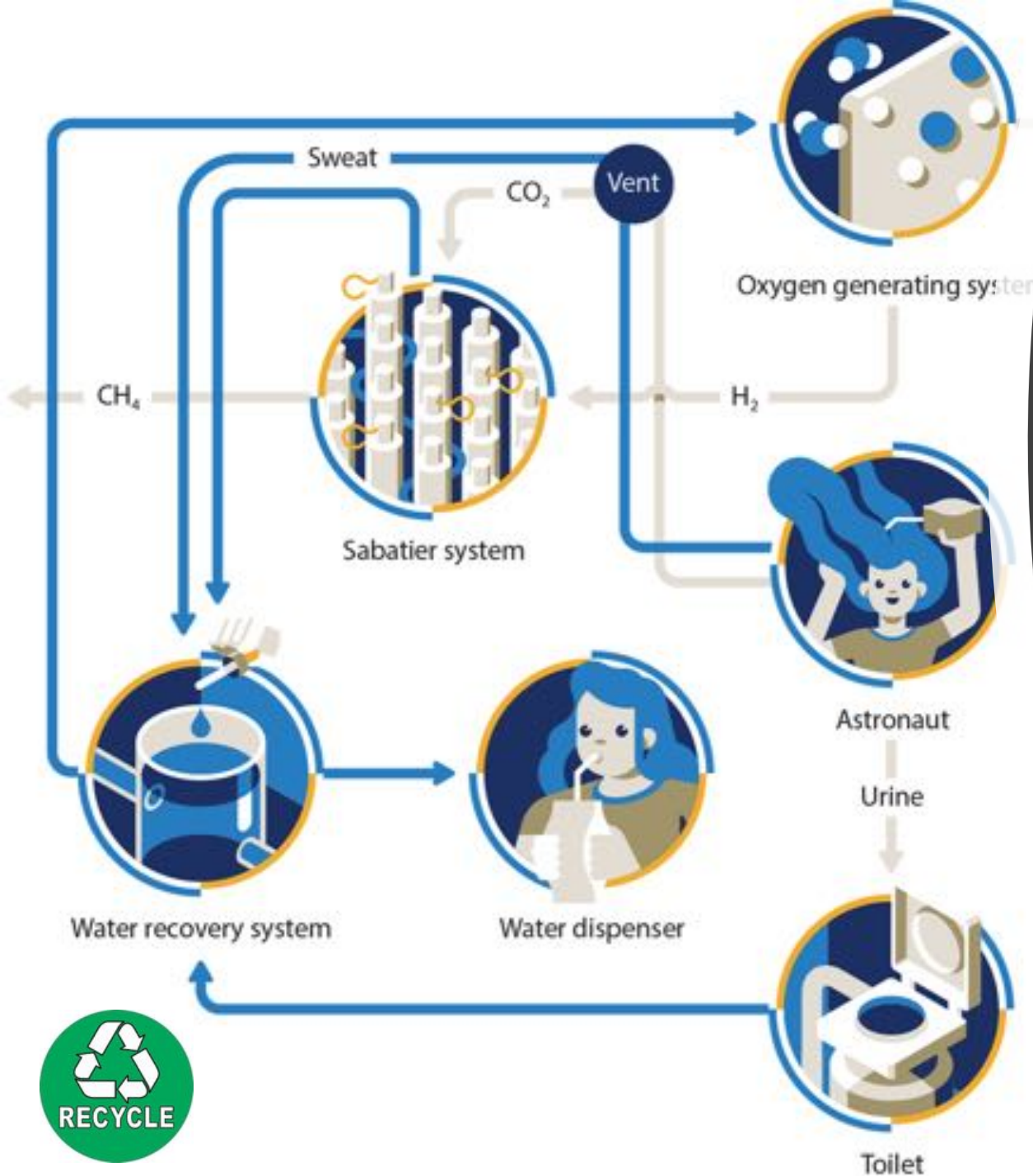
Water is one of the most precious resources

- 90% of the water is recycled (about 1,000 gallons a year)
- Recycle their urine
- Recycle their sweat
- Recycle their bathing water

Recycle their breathing air

No plants for photosynthesis like on Earth

Going forward on long space missions, we need even more recycling ideas!





# Bagging the Trash – Just like at home

However, can't put the  
trash outside or in the  
garage so it gets stowed  
somewhere on the space  
station

And then we wait for the  
trash truck....







## ***Space Trash Truck!!!***

Cygnus Spacecraft - Cygnus bring supplies to station and then returns with trash and burns up in the atmosphere

Other “trash trucks”:

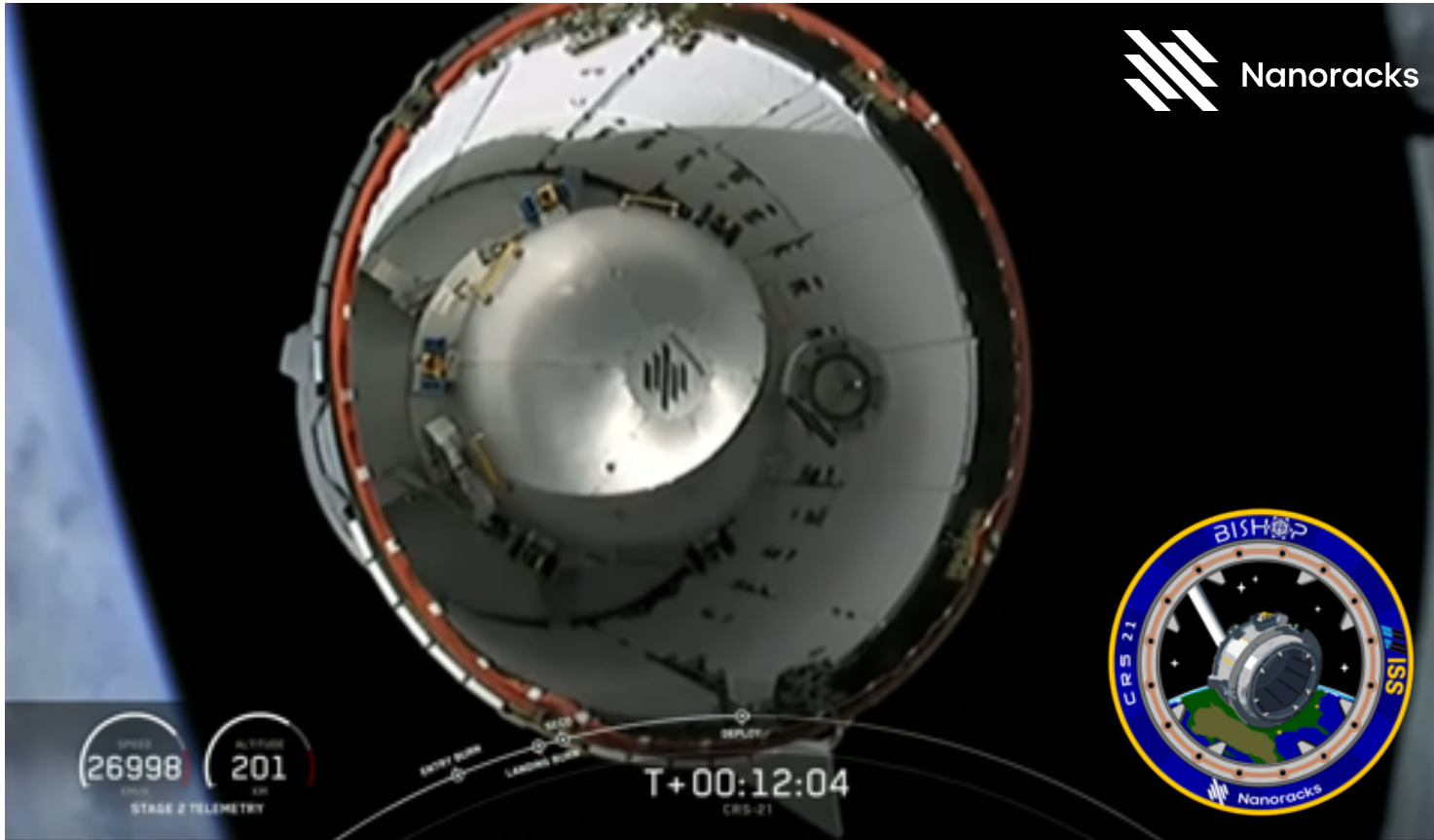
- Russian Progress
- Automated Transfer Vehicle (ATV; European cargo vehicle)
- H-II Transfer Vehicle (HTV; Japanese cargo vehicle)

The SpaceX Dragon spacecraft is typically not used to dispose of trash since it can re-enter and land on earth, it is used for returning science and equipment



However, it only comes once every 3 months!!!

What do you think that's like onboard the ISS?



# Nanoracks Airlock – A new module for the Space Station

What is an Airlock?

- Basically, a doorway to space from the inside of the Space Station to the outside (space)

Nanoracks Airlock is the fourth Airlock onboard the ISS

- US Crew Airlock (Quest) – Used for US spacewalks
- Russian Crew Airlock – Used for Russian spacewalks
- Kibo Airlock: Cargo and Experiment airlock on the Japanese Module
- Nanoracks Airlock: New cargo and experiment airlock on Node 3

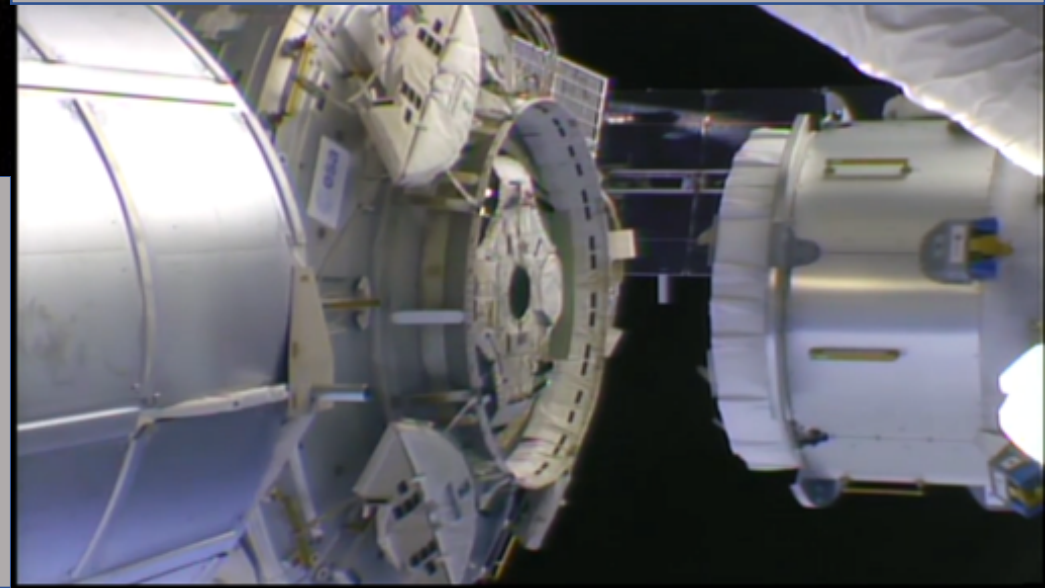
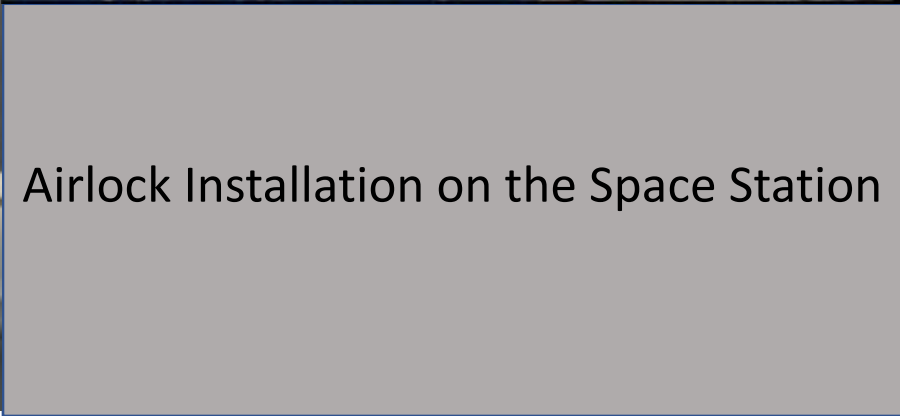
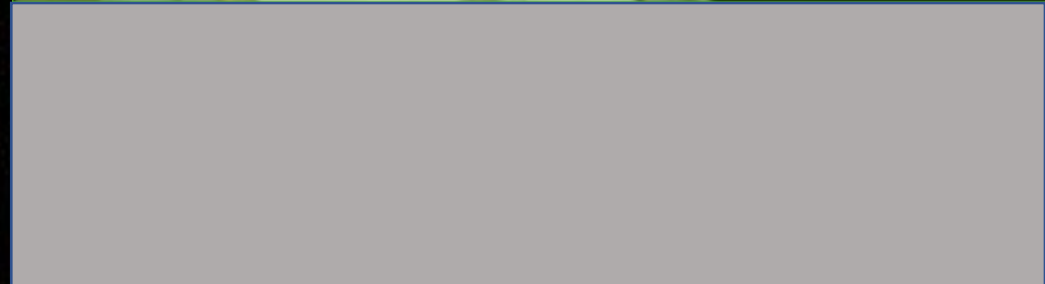
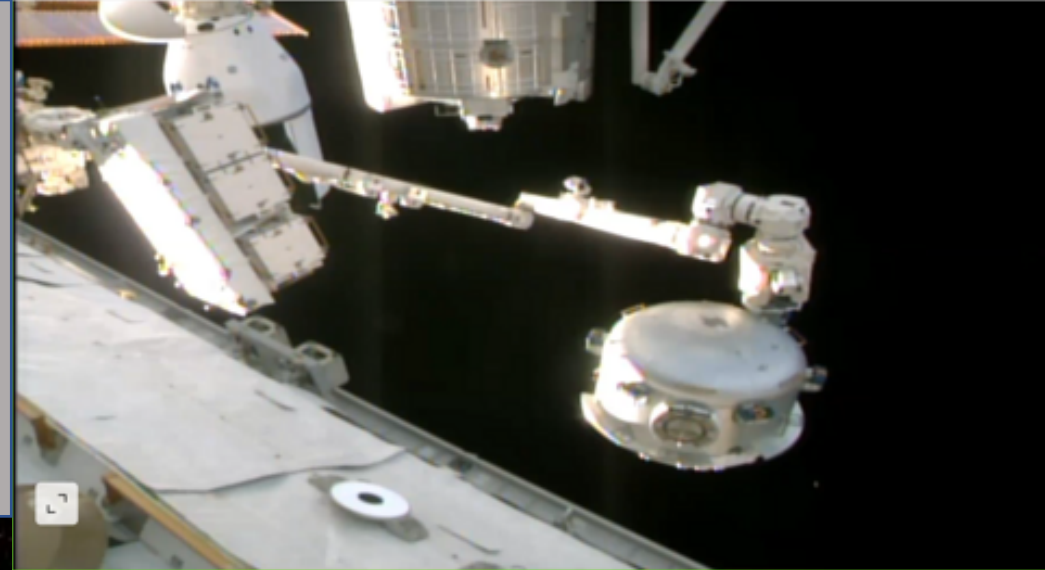
Nanoracks Airlock installed last month

- Was launched on SpaceX Dragon Cargo Vehicle (SpaceX – 21)

Why another cargo and experiment airlock?

- It's 5 times the size of the Kibo Airlock
- Kibo can accommodate a microwave size piece of equipment, Nanoracks airlock can handle up to a large refrigerator/freezer





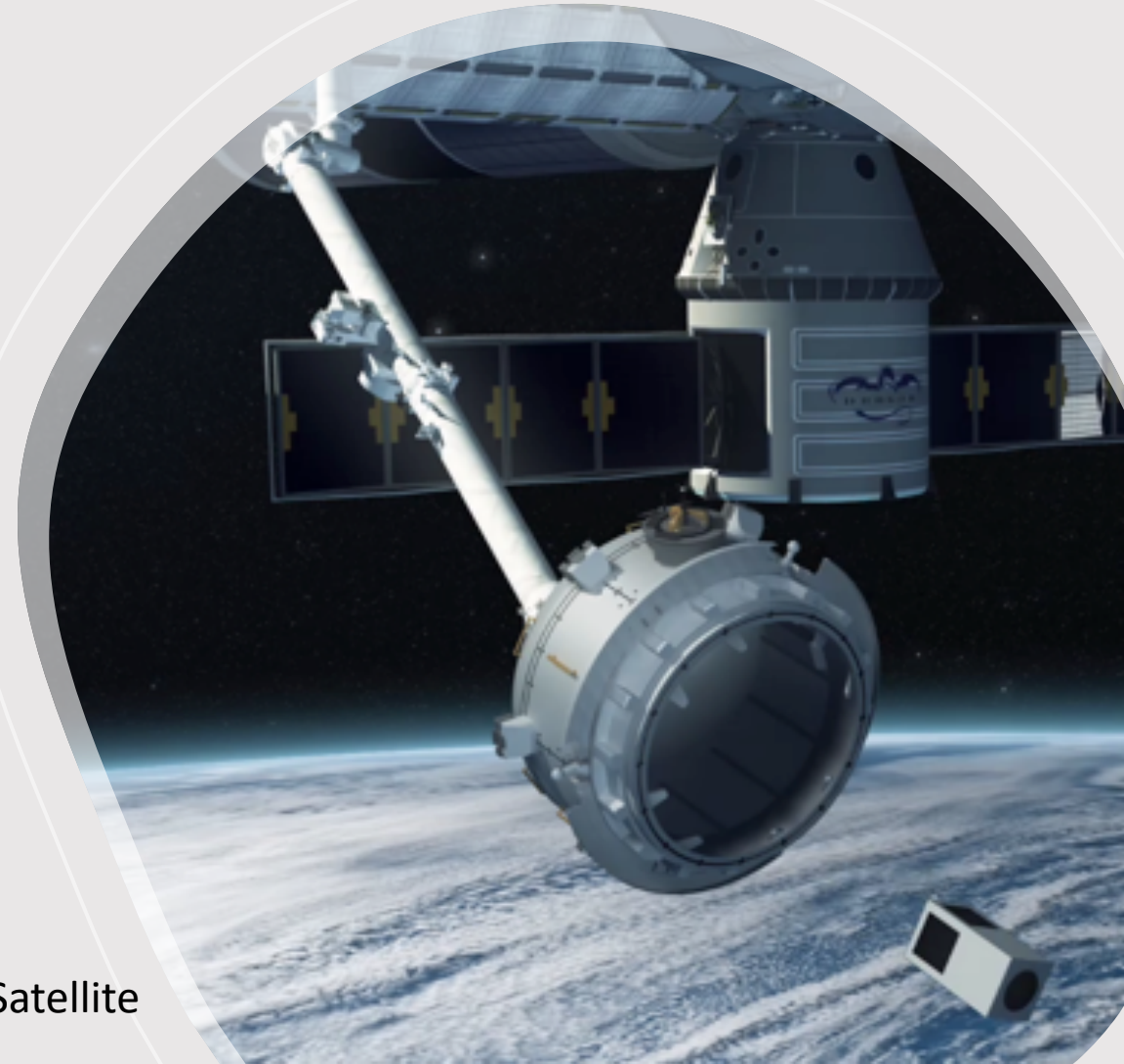
# How is the Airlock Used?

Deploy Satellites

Move equipment from the inside of the ISS to the outside (space)



Airlock installed on ISS




Airlock Deploying a Satellite



# Bishop Satellite Deployment Sequence





How can we use the  
Airlock to help with  
Trash?

Brainstorming session on  
how you might use this  
new technology

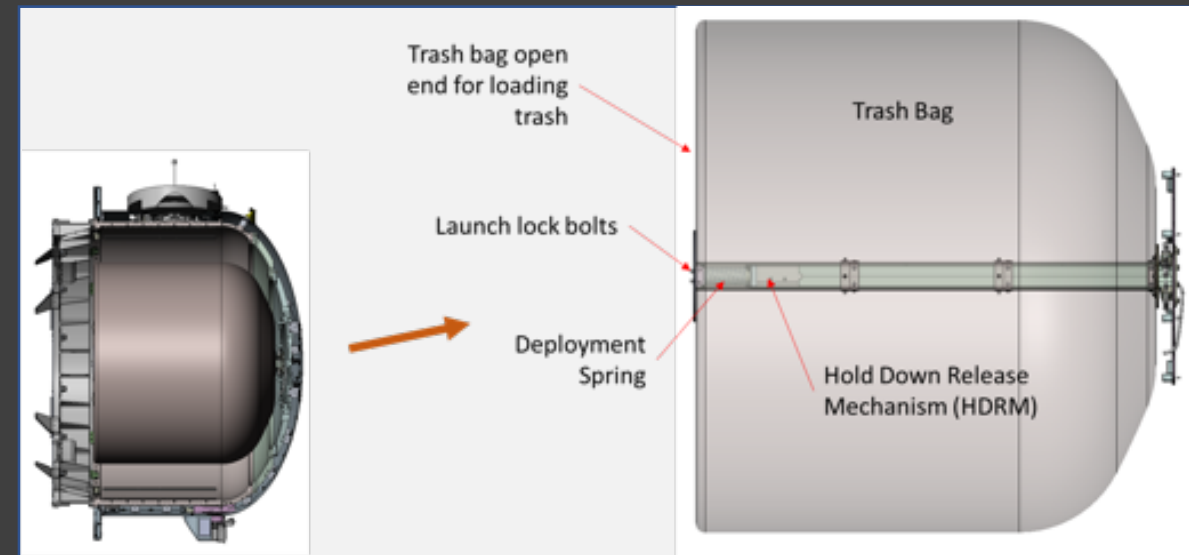
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# Here's what we are working on!

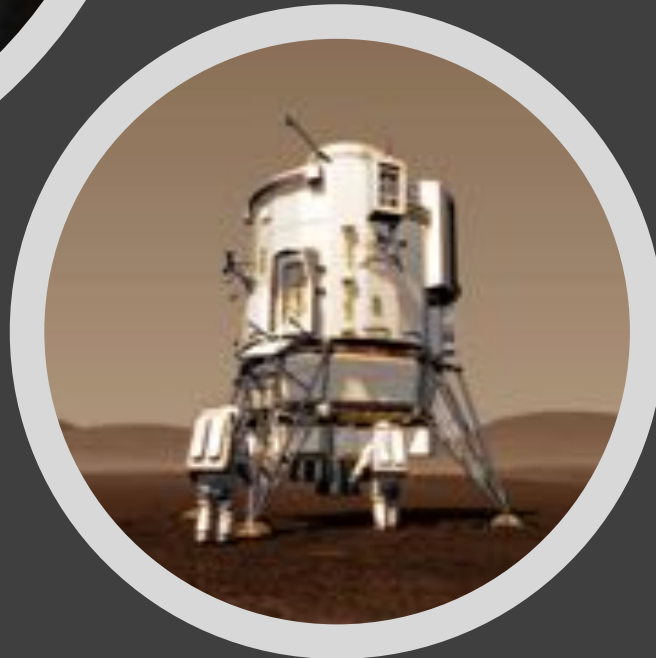
- Deploy a large trash bag off the space station just like a satellite
- Big Bag - Up to 270 kg and the size of a refrigerator/freezer
- One large bag to minimize space debris
- Must be guided out so it doesn't tumble and get stuck in the Airlock
- Will burn up in the atmosphere like the Cygnus vehicle





# What's Next?

- How do we get rid of trash on Moon visits, Mars visits and deep space missions?
- How can we recycle more materials?
- How can we minimize our trash?



We need smart people like you to solve these problems in the future!





# Airlock Model in Google Drive.



## Nanoracks Bishop Airlock Paper Model Scale: 1/40

Legend  
 EVA Handrail  
 Robotic Grapple Fixture  
 External Payload Mount

**1. Cylinder**  
 Roll to cylinder fold under white edge and tape together



**2. Dome**  
 Cut out blue triangle sections to help form a dome



**3. Assembly**  
 Tape dome to cylinder to form a belljar shape. Overlap white areas and tape cylinder and dome together