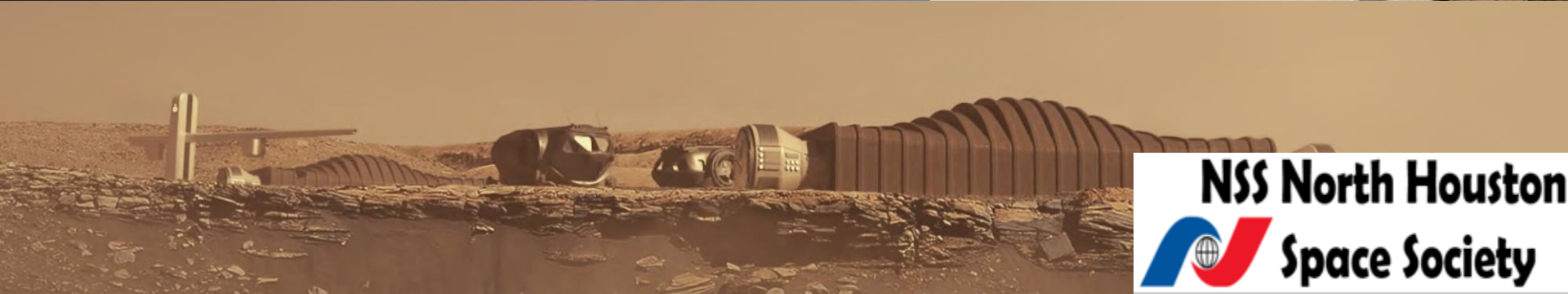
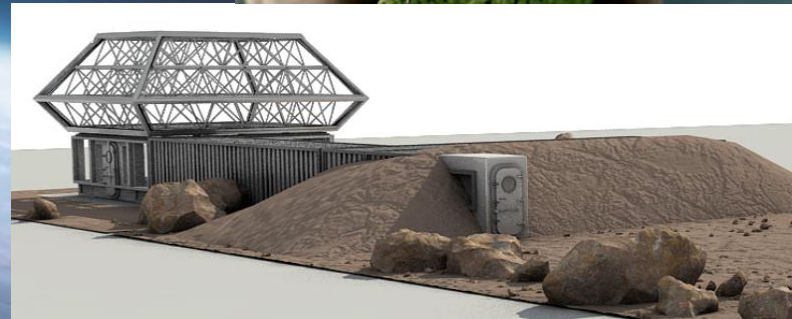


Monthly Space News

Greg Stanley

Oct. 2, 2021



Low Earth Orbit (LEO) news

- All-private space tourism reaches LEO
- Some interesting recent experiments carried in cargo to the ISS (Space Station)



Image credit: NASA

Serious space tourism: Inspiration4

- Fully commercial 3-day spaceflight on modified SpaceX Crew Dragon capsule
 - First all-private orbital mission (4 private citizens, no government astronauts)
 - Higher orbit (364 miles) than ISS – higher than any person has flown in two decades
 - Fully automated, but crew trained for 6 months to handle emergencies
 - Fundraising effort for St. Jude Children's Research Hospital by billionaire Jared Isaacman
 - Services were purchased *from* NASA for communications, training, etc. (Not for ISS)
 - Future improvements
 - Wi-Fi from Starlink
 - Better toilet
- Consistent with new NASA expectations
 - Commercial interests to run all low earth orbit operations (including space stations)
 - NASA will purchase services as necessary and focus on deep space



Experiments recently carried to ISS

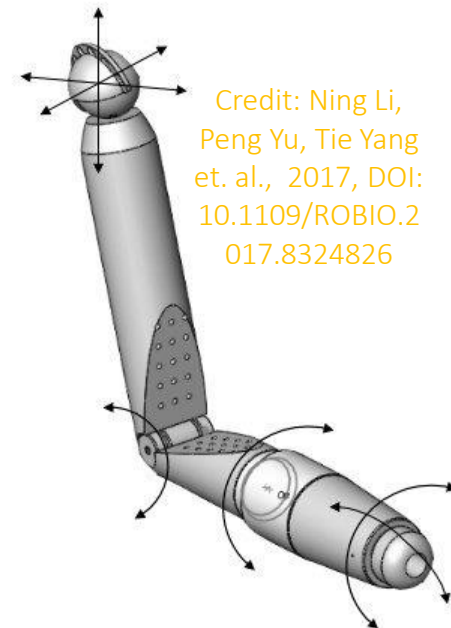
- 3D printing using simulated lunar regolith
 - Leading to habitat construction
- Small (1 meter) GITAI robot arm designed for space
 - Japanese startup company with an ambitious goal
 - Do all the work in space after the launch companies get us there!
 - 8 degrees of freedom + whatever is in the attached hand
 - Demo tasks like assembly and cabling in space
 - Mostly autonomous tests, some remote operation
 - Run inside Bishop airlock, by Nanoracks ground control



Credit: GITAI

- Bionic human arm for comparison (7 degrees of freedom):

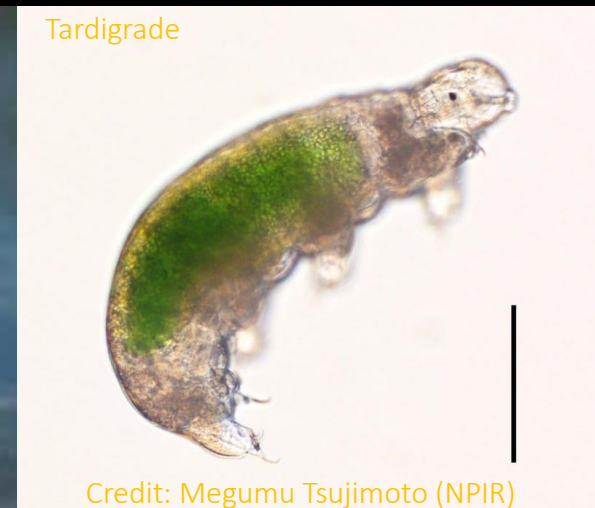
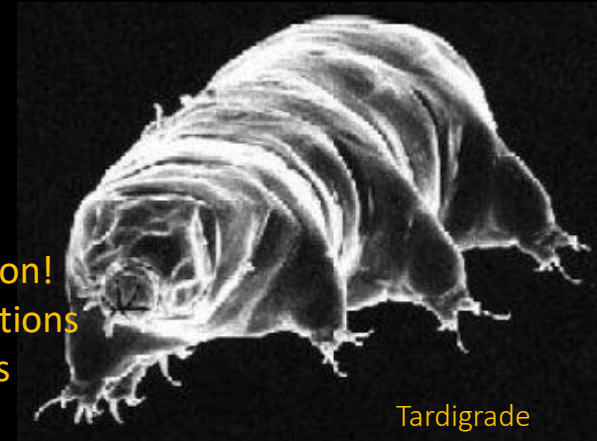
- Metal corrosion in space
- New CO2 scrubber technology (1 year test)
- Better heat dissipation for spacecraft
 - Heat shield tests in garbage when Cygnus cargo ship is filled with garbage and discarded in 3 months



Credit: Ning Li,
Peng Yu, Tie Yang
et. al., 2017, DOI:
10.1109/ROBIO.2
017.8324826

ISS biological experiments

- New automated labs reduce workload
- Biological studies in microgravity/high radiation
 - Effects on human muscle growth/loss
 - Effects on bone tissue growth (prevent spaceflight bone loss)
 - Plant germination and growth (for agriculture in space)
 - Effects on squid (microbes for immune system/digestion)
 - Effects on tardigrades
 - Can survive 30 years without food or water!
 - We already knew tardigrades can survive outer space, despite low temperature, low pressure, low gravity, lack of O₂, and high radiation!
 - Watch adaptation and gene activation in tardigrades over 4 generations
 - May learn ways to protect food, medicine, & people from extremes
 - Effects on brine shrimp, ants, slime molds



Lunar-related news: Continuing Artemis HLS saga

- Artemis: “Back to the Moon to stay”
 - American boots on the ground in 2024
 - Includes HLS (Human Landing System)
 - HLS awarded to SpaceX using Starship
 - HLS derailed by lawsuit from Blue Origin
- NASA threw a bone to losers in HLS competition
 - \$146 M to the 3 teams originally competing for HLS
 - “Appendix N” pays for studies for landings after Artemis 3
 - Concepts, risks, etc.



Credit: SpaceX

Mars-related news

- You just missed signing up for NASA's latest simulated Mars habitat ("Analog")
- Other past and future Mars habitat analogs

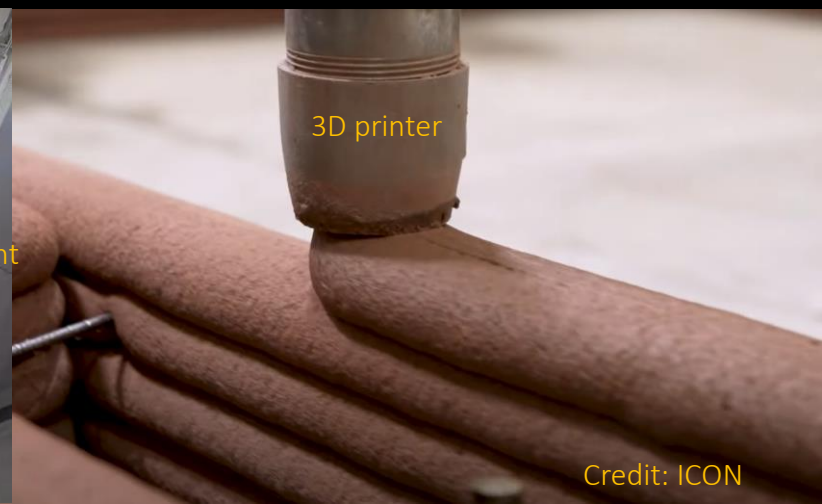
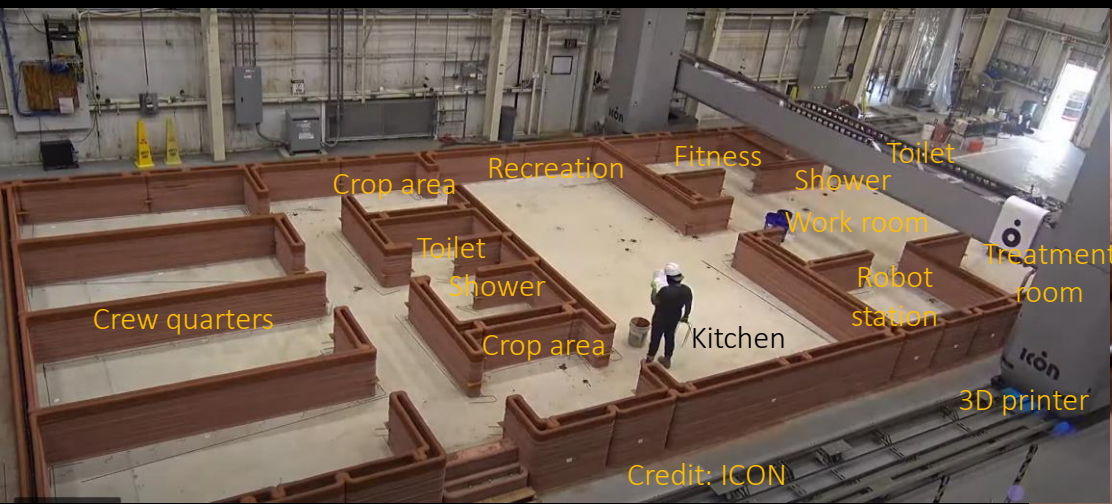


NASA simulated Mars mission: CHAPEA “Crew Health And Performance Exploration Analog”



Mars Dune Alpha Conceptual Render: Visualization on Mars. Credit: ICON

- Simulated Mars habitat (“analog”) at JSC
 - 1,700 sq.ft. 3D printed module by ICON, designed by BIG
 - Printer extrudes Lavacrete (Portland cement + lava) using H₂O. Mars application should melt local regolith
- Each of 3 missions will have 4 crew members, starting in Fall 2022
 - Applications for crew for the first 1 year mission just closed Sept 17
 - Future missions in 2024 and 2025
- Testing physical operations, human behavior, food systems
 - Simulated resource limitations, equipment failure, communication delays, etc.
 - Simulated spacewalks using Virtual Reality



Some other Moon/Mars “analog”, mostly on hold

- Mars Society
 - MDRS: Mars Desert Research Station (Utah)
 - Arctic Research Station (northern Canada) (to 2017)
- NASA HI-SEAS (Mauna Loa, Hawaii)
 - Hawaii Space Exploration Analog and Simulation
 - Was for Mars, will do lunar station simulation
- NEK facility/SIRIUS missions (Moscow)
 - Can be sealed airtight/pressurized, unlike most others
 - Russia’s Mars500 project (2007-2011)
 - Last mission 2019, more planned
- China’s “Mars Camp” (Gobi desert)
 - 1734 acres, including a tourism center, near Jinchang
 - Tourism, will eventually do some astronaut training
- China’s Mars Village (Tibet plateau) (Tourism)
- Some other past/current projects
 - Biosphere 2. Focus: ultimate sustainability/biology
 - D-Mars, MELiSSA (ESA), HERA, HMP, LSSIF, Lunar Palace 1, Lunaris, NEEMO



Future Mars habitat analogs

- Mars Science City (Dubai, 2022-2024)
 - Had been delayed by land acquisition issues
 - Now moving ahead
 - Tourist/research split is unclear
- SAM: Space Analog for the Moon and Mars (University of Arizona)
 - Sealed habitat for 1-4 people and plants, in construction, not fully funded yet
 - Starts with refurbished 480 m³ Biosphere 2 test module (near Tucson, AZ)
 - Adds adjacent workshop, living quarters, kitchen, common area, airlock, ½ acre yard, 30 ft. synthetic lava tube, gravity offset rig to simulate low G, pressure suits, simulated regolith, CO2 scrubber, ...
 - Studying a realistic transformation from mechanical life support to more biology
 - Greenhouse, farming, transforming regolith to soil, recycling air, water, food, waste management
 - Computer models will be developed in publicly-available SIMOC (free on the web)



How many launches since the last meeting (Sept 4)?

This includes failed launches only if they lift off the launch pad and only includes launches that attempt going into orbit



SpaceX Starlink launch from Vandenberg Space Force Base, on Falcon 9, long exposure photo. Credit: SpaceX

Launches since last meeting (Sept 4, 2021)

 Sept 6 – Long March 4C – Earth observation satellite

 Sept 9 – Long March 3B – TV broadcasting satellite

 Sept 9 – Soyuz 2-1v – Classified military satellite

 Sept 13 – Falcon 9 – 51 Starlink (internet) satellites (now 1520 total)

 Sept 14 – Soyuz – 34 OneWeb internet service satellites (now 322 total)

 Sept 15 – Falcon 9 – Inspiration4 (first all-private orbital tour)

 Sept 20 – Long March 7 – Resupply ship to dock with Chinese space station

 Sept 27 – Kuaizhou 1A – Earth observation satellite

 Sept 27 – Long March 3B – Classified satellite (FAIL)

 Sept 27 – Atlas 5 – Landsat 9 Earth observation satellite, 4 small rideshares

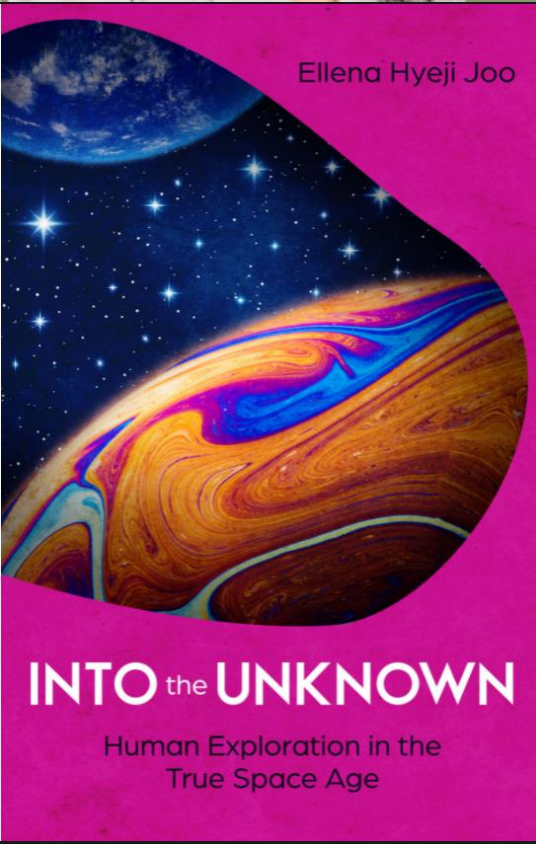
Discussion & questions?



Featured speaker: Ellena Hyeji Joo



- TOPIC: Into the unknown: human exploration in the true space age
- Thoughts on humanity's long range future in space, our values, what happens when we meet aliens, and how to prepare for that



- Grew up in 4 different countries, fluent in 5 languages
- BS in Foreign Service in International Politics (Georgetown University)