The Lifetime Surveillance of Astronaut Health

NEWSLETTER

April 2026 | Vol 31 Issue 1

Editor's Note

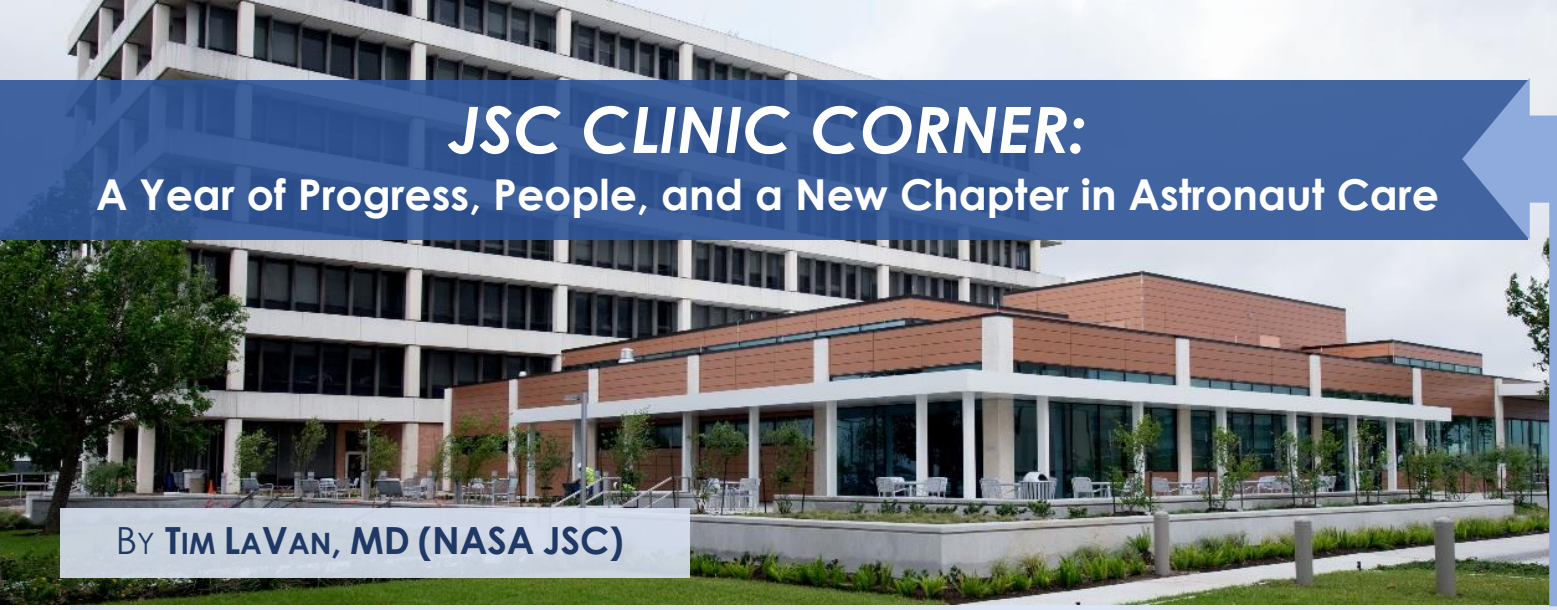
BY **RONNIE RAFANAN (Aegis Aerospace)**

Welcome to the April 2026 issue of the Lifetime Surveillance of Astronaut Health (LSAH) Newsletter. In this issue, we will focus on the recent Artemis II mission as it compares to previous NASA missions, inform you of some of the many HRP studies performed during this historic mission, all in the effort of collecting and analyzing astronaut health data to help shape the future of manned spaceflight. Be sure to check out our recurring JSC *Clinic Corner* and *Formers' Corner: Travel Tips* sections as well. *Enjoy!*

In this Issue…

JSC CLINIC CORNER:

A Year of Progress, People, and a New Chapter in Astronaut Care



BY **TIM LAVAN, MD (NASA JSC)**

Your Johnson Space Center Medical Clinic has stayed busy supporting today's astronaut corps and retired astronauts, as well as future astronauts. As this was a selection year, the Clinic was excited to participate in another round of candidate physicals and to see the new astronaut class form. While the fundamentals haven't changed — thorough exams, careful screening, and close attention to details — the clinic spent a fair amount of time smoothing out the flow of candidate evaluations. We refined several steps to reduce bottlenecks and make long days of assessments a bit more efficient for everyone involved. We also continued to evolve the selection process and have added new testing to the schedule. Throughout it all, clinic staff were happy to get to know many of the applicants at the earliest stage in their careers.

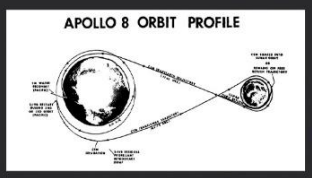
The other major project the clinic is involved in this year is the selection and rollout of a new electronic health record. The old system, Athena, is scheduled to sundown on July 31st. We have selected a new system from Enterprise Health which continues to bring together the pillars of clinic functions, space medicine, astronaut surveillance, and occupational medicine, in one place. The aim is to maintain the continuity of health information across a person's entire NASA career. Practically speaking, the new system will help the medical team evaluate long-term trends more easily, coordinate care with specialty partners, and make better use of data for mission readiness, research, and fitness for duty decisions. The new system reinforces protections around sensitive medical information, always a priority in astronaut care. The transition has required considerable effort on the part of the clinic team, especially the medical records and clinical informatics staff. It will also provide a cleaner, easier to use patient portal, which will make it easier to complete questionnaires and receive results of exams. This should be a big benefit for those completing LSAH exams!

Speaking of LSAH exams, we are pleased to note that attendance at exams is now solidly back at or above pre-COVID levels, so we encourage retired astronauts to continue to schedule and come back to JSC to complete them. Even if you have not completed an exam or not completed one recently, we would encourage you to come in for one. Every exam provides data that we can use to better assess the impact of spaceflight on the short- and long-term health of astronauts. However, for those who don't have the time, desire, or capacity to travel to Houston for their physical, this is another reminder that we still offer the option of a virtual surveillance visit with one of our physicians. They will review the labs we can order for you at your local Quest Diagnostics.

Please feel free to reach out to us at the clinic with any questions. We look forward to seeing you in the next year for your next exam.

If you are interested in scheduling your annual visit, on-site or virtual, please feel free to call the FMC and we will help you get it set up. **Flight Medicine Clinic (FMC): (281)483-7999**

APOLLO 8 VS ARTEMIS II

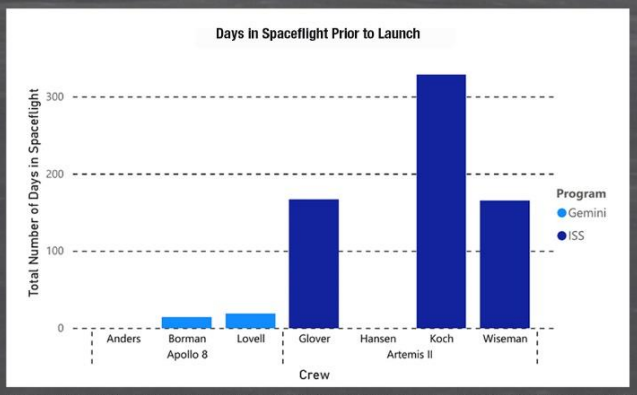


Frank Borman, Jim Lovell, William Anders

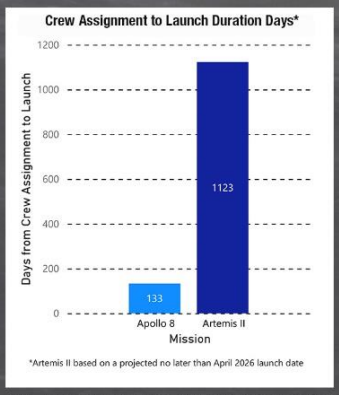
The Artemis II Mission will mark the first crewed mission to the vicinity of the Moon since 1972.

Christina Koch, Victor Glover, Reid Wiseman, Jeremy Hansen

The Crew



Prior to launch, much of the spaceflight experience of the Apollo 8 crew members was gained through short-duration Gemini missions. The upcoming Artemis II crew will bring their experience from long-duration ISS expeditions.



The Apollo 8 mission underwent several changes to its mission profile and crew assignments before launch, with the final crew being set on August 10, 1968. In comparison, the Artemis II crew was announced on April 3, 2023, and began training shortly thereafter.

Artemis II crew members during training in Building 9.

Apollo 8 crew members during centrifuge training.

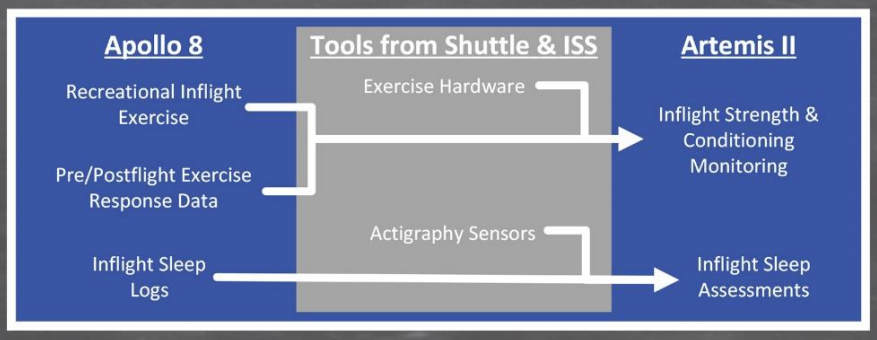
Spacecraft Habitability

Cabin space: The Orion crew module has 330 cubic feet of habitable space. That's 60% more than the Apollo command module's 210 cubic feet, but with one more crew member on Artemis II, there will be about 20% more space per person. Orion also features noise reduction and an environmental monitoring system designed to minimize excess heat, odor and humidity, none of which were available for the Apollo 8 crew.

Food: Apollo 8 cuisine was made up of freeze-dried, vacuum-packed dishes that were rehydrated and squeezed from a pouch and bite-sized cubes of concentrated food. The one exception was the astronauts' Christmas dinner of turkey with gravy, NASA's first-ever wetpack of thermostabilized space food that kept its color, texture, and aroma and could be eaten with a spoon. In addition to being a food innovation, the meal showed the importance of food and mealtimes for astronaut morale. For Artemis II, the crew chose menus from the diverse options provided by the Food Lab at JSC.

Evolution of Health Monitoring

Some of the inflight data planned for collection during Artemis II can trace their scientific roots back to the early Apollo missions. The collection of this new data is aided by tools and hardware developed during Shuttle and ISS.



Infographic developed by Brenna Wheeler, Sara Jorgensen, and Robert Beaton, with documentation from NASA's Life Sciences Data Archive Legacy Media Collections.
*Photo by Eric F. Long, Smithsonian National Air and Space Museum (NASM 2009-4775). All other images courtesy of NASA.

Infographic by **Brenna Wheeler, MSIS (Aegis Aerospace); Sara Jorgensen, PHD, MSIS (Aegis Aerospace); & Robert Beaton, MSLS (Aegis Aerospace)**

From Friction to Flywheel:
The Evolution of Apollo to Artemis Exercise

BY **JUDITH HAYES, PHD (NASA JSC)**

As NASA prepares to return humans to the Moon with the Artemis program, the challenge of maintaining astronaut performance during exploration-class missions remains a priority. Reflecting on lessons learned from Apollo, it is evident that Artemis will challenge its crews differently, characterized by longer transit times and extended lunar surface stays involving high-tempo EVAs, with total mission durations gradually reaching 30-days or more. It is well understood that prolonged exposure to microgravity results in deconditioning that can be mitigated through inflight exercise. Thus, a comparative review of the **Apollo Exer-Genie** and the **Artemis Orion Flywheel** reveal an evolution in the NASA approach to human performance in both engineering and exercise physiology, moving from simple friction to high-tech inertia to sustain peak performance during prolonged space operations.

During the Apollo missions, NASA's primary solution for in-flight exercise was the Exer-Genie (Figure 1), a commercial device originally marketed to athletes. Weighing less than two pounds and requiring no power, it was a work of 1960s' ingenuity. The device operated on a *friction-resistance* principle. A nylon rope was wrapped around a chrome-plated cylinder; the more wraps the astronaut added, the higher the resistance. Tethering to the spacecraft bulkhead while pulling the rope allowed for basic isotonic and isometric exercises. While manifested on every crewed Apollo mission, its success was mixed. According to the Apollo Flight Journals, astronauts on the early missions used it consistently twice a day for up to 30 minutes to alleviate "stiffness". However, by the later lunar landing missions, some crewmembers found it "cumbersome" or "messy" due to the heat generated by the friction and the accumulation of rope debris. Despite these challenges, it proved that compact hardware could provide meaningful physiological benefits in a tiny capsule.

Figure 1. Apollo Exer-Genie
(credit: Air & Space Museum)

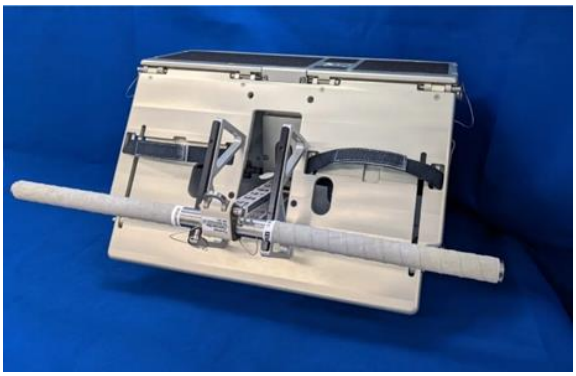


Figure 2. Orion Flywheel

The Flywheel represents advancement in capability from Apollo to Artemis (Figure 2). Developed to fit the tight confines of the Orion capsule, this device offers *rotational iso-inertial resistance* from a spinning disk**,** operating on a "yo-yo" principle. When the cable is pulled, the weighted disk (the flywheel) spins up, using inertia to create resistance proportional to user effort. The flywheel operates independent of gravity, providing the ability to adapt resistance dynamically to the user's output during both the pulling (concentric) and retracting (braking or eccentric) phases of the exercise. This means constant resistance is generated throughout the entire range of motion that automatically adjusts to match the user's effort with each stroke, something the Exer-Genie could not achieve.

The Flywheel introduces several critical engineering upgrades over its predecessor to meet the demands of Artemis with little overhead. Additionally, it serves a secondary purpose within the capsule as a structural step for crew ingress and egress through the side hatch to maximize efficiency within the Orion spacecraft volume limits (Figure 3).

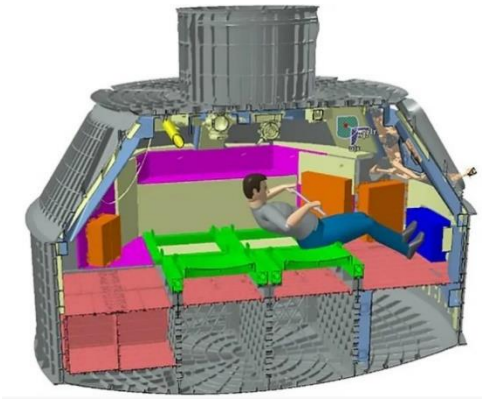


Figure 3. Orion Flywheel (in the blue box) positioned below the side hatch for ingress and egress of the spacecraft

Performance-wise, its mass can spin-up to provide loads of 400 lbs, allowing for aerobic exercise as well as high-intensity upper and lower body resistance exercises, like squats, dead lifts, and curls. Unlike its predecessor, the Flywheel synchronizes with a computer tablet to track fitness metrics and guide crew exercise, enabling physiologists and trainers to validate its operations and efficacy.

In conclusion, from basic friction to high-tech inertia, NASA has traded basic conditioning for mission-critical performance. This evolution ensures Artemis crews arrive on the moon physically primed for the rigors of the new era of lunar exploration.

References

1. NASA Spinoff 1978. Body Building Boons from Apollo. https://spinoff.nasa.gov/back_issues_archives/1978.pdf
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3. Johnston, R.S., L.F. Dietlein, and C.A. Berry. (1975) *Biomedical Results of Apollo*. Scientific and Technical Information Office, National Aeronautics and Space Administration.
4. Smithsonian Magazine (2019, June 24). *How Neil, Buzz and Mike got their workouts in on their way to the moon and back*. Smithsonian. https://www.smithsonianmag.com/smithsonian-institution/how-neil-buzz-and-mike-got-their-workouts-their-way-moon-and-back-180972195/

HRP Corner:
Explore Videos from HRP that Quickly Explain our Artemis II Health Studies!

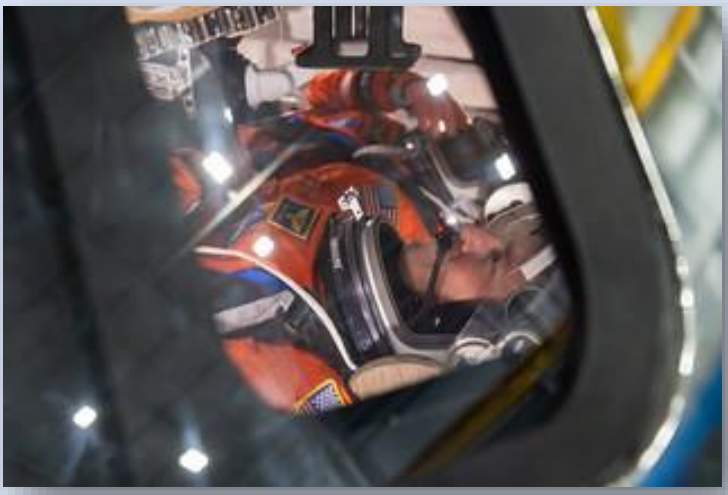
BY **MOHI KUMAR (PCI PRODUCTIONS)**

NASA's Human Research Program (HRP) is continuing to advance our knowledge about how spaceflight affects human bodies and behaviors through research conducted in laboratories, ground-based analogs, the International Space Station, and commercial missions.

Catch up on recent HRP research and funding highlights flying on Artemis II:

What Can Artemis II Astronauts' Saliva Tell Us?

Saliva can tell us a lot about astronaut health. Before, during, and after their trek around the Moon, Artemis II astronauts will collect saliva samples. These samples will help scientists probe into how the human immune system reacts to deep space, so NASA can ensure that humans, rather than viruses, thrive in space as we venture to the Moon, Mars, and beyond! Watch to learn more about HRP's Immune Biomarkers Study flying on Artemis II. https://www.youtube.com/watch?v=Vb2N-OzJ5C8



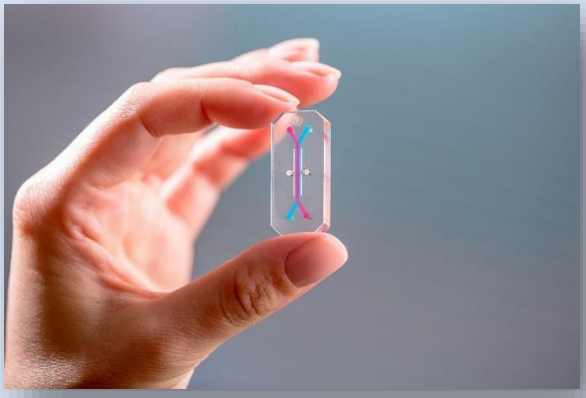
How Will Deep Space Travel Affect Artemis II Astronauts' Health and Performance?

NASA wants to know: How will Artemis II astronauts adapt to Orion's living space? Select crew members will wear wristband devices that record their sleep and movements. Data collected before, during, and after flight will provide scientists with valuable insights into how crews adjust to life in deep space. Watch to learn more about HRP's ARCHeR study flying on Artemis II. https://www.youtube.com/watch?v=fYX6Jq9Z7E8

What Human Health Data Is Being Collected From Artemis II Astronauts?

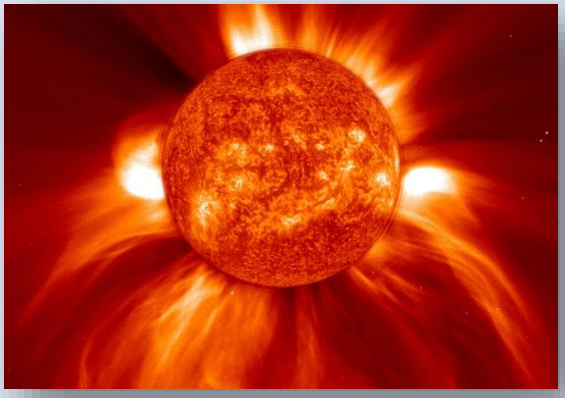
You know how your doctor always checks your heart rate, blood pressure, and other vital signs? NASA collects similar measurements on as many astronauts as possible. And that includes the Artemis II crew flying around the Moon. Before, during, and after their journey around the Moon, NASA will collect specific health information on crews' nutrition, heart health immune system, and more. Crews will get MRI scans, go through obstacle courses, and have their muscle health evaluated, among other things. Their work will help scientists explore how isolation, confinement, and microgravity affect the human body. Watch to learn more about HRP's Artemis II Spaceflight Standard Measures study. https://www.youtube.com/watch?v=TWfW3bCnRAM

Explore Videos From HRP Collaborators That Quickly Explain Artemis II Radiation Science and Hazards



AVATARs for Astronaut Health Are Heading to Space

NASA's AVATAR experiment is flying aboard Artemis II to study how deep space affects human health. Using innovative tissue chips containing astronaut cells, researchers will examine how radiation and microgravity impact human tissue. This research will help inform medical strategies for future long-duration missions to Mars and beyond. The findings could also contribute to biomedical advancements for patients on Earth, such as cancer treatments and pharmaceuticals. Watch to learn more about the AVATAR study. https://www.youtube.com/watch?v=ogb3eyY1Mhs



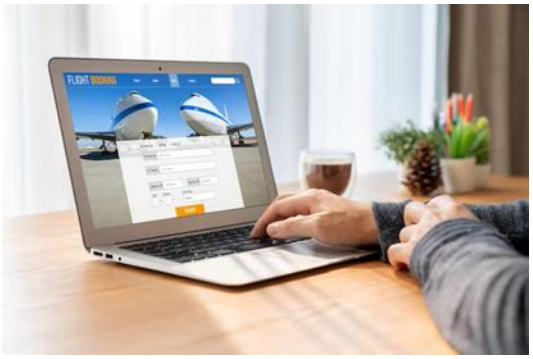
Artemis II: Into the Path of Solar Eruptions

For the first time in half a century, four astronauts are leaving Earth's protective magnetic field. They'll enter a realm where massive solar eruptions can unleash more energy than a billion hydrogen bombs. The Artemis II crew will fly through a dangerous environment, but they're not doing it alone. On the voyage, the astronauts and their Orion capsule are outfitted with radiation trackers as ground teams monitor solar eruptions 24/7. Here's how NASA and the National Oceanic and Atmospheric Administration (NOAA) are protecting explorers from the most powerful eruptions in the solar system. https://www.youtube.com/watch?v=bX0hv0EFKnI

FORMERS' CORNER:
Travel Tips and Reimbursements

BY **DENISE PATTERSON (KBR)**

KBR reviews Expense Reports/Professional Services Invoices to the KBR Travel Policy. As a Government Contractor, our policy must be FAR (Federal Acquisition Regulation) compliant. The FAR is established so that there are uniform policies and procedures for purchase acquisitions by all executive agencies of the U.S. Government.



Questions come up from time to time regarding travel arrangements, here are some reminders and updates to make your reimbursement a smooth process.

- **Airfare should be booked by utilizing non-refundable economy/coach/Choice airfare.** First, Business class or private planes will be reimbursed at the economy/coach or Choice class fare. Unrestricted coach is considered an upgrade from coach/economy and should not be chosen; a comparison fare will be used for reimbursement when the allowable fare is not selected. The airline ticket/invoice must provide detailed flight information, routes, dates, class of service, and price with form of payment used. Please make your travel arrangements early as possible for preferred pricing.
- **Travel points to purchase airline tickets and Early Bird check-in are not reimbursable.** Use of third-party travel agencies (whether offline or online, booking directly on alternative booking sites—such as Priceline, Expedia, etc.—is prohibited. A comparison will be necessary if using third party agencies, and NASA Management approval will be required.
- **If you choose to drive to Houston, you will be reimbursed at the lower rate of either the economy/coach, or Choice fare, or the mileage.** Airfare comparison is required if traveling over 400 miles one way at the non-refundable economy fare and reimbursed at the lower of the two rates. Lodging enroute to Houston is not reimbursable.
- **Government travelers are required to exercise the same care incurring expenses that a prudent person would exercise if traveling on personal business when making official travel arrangements and, therefore, should consider the least expensive class of travel that meets their needs.** Receipts are required for any expense over $75; however, receipts are required, regardless of value, for expense incurred by airline, hotel, and rental car companies.
- **The current US General Services Administration (GSA) Houston lodging rate is $128 a night plus tax. and you will receive 1.5 days per diem ($120.00), rental car, fuel, parking, taxi/uber, etc.** Lodging booked above the per diem rate will be calculated to the GSA rate plus tax.
- **Please note, the Nassau Bay Hilton, one of the preferred hotels, will be closing in 2026 and will be rebranded as Margaritaville.** Rates are not yet available.

A travel guideline is included in all LSAH invitational packets and reminder letters. If you must purchase something outside of the guidelines, or have additional questions, please call **Denise Patterson at 281-244-5195** or email denise.a.patterson@nasa.gov prior to purchasing for assistance.

Thank you for your continued participation in the LSAH program. Your participation makes a vital contribution to NASA in providing follow-up health data to develop health programs for future space endeavors.

Safe travels!

Let us know how you're doing!

What have you been up to lately? Please feel free to send us any pictures you would like to share, along with a brief description/quote, and we will be happy to publish it here for all your fellow formers to enjoy! Email us at jsc-lsah@mail.nasa.gov and include "**Formers Corner**" in the subject line. Looking forward to hearing from you!

Ask LSAH…

Do you have any questions you would like the LSAH team to answer? We would love to hear from you! Please send your question(s) for us to answer in the upcoming issues of the LSAH Newsletter. Email us at jsc-lsah@mail.nasa.gov and include **"Q&A: Crew Questions"** in the subject line. Looking forward to hearing from you!

Did you move? New email address? Remember to update us so we can continue to send you the LSAH Newsletter, LSAH invitational physical exam letters, and any other news we may need to share with you. Contact Denise Patterson at 281-244-5195 or denise.a.patterson@nasa.gov.

You may also write us at

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For past newsletters, please visit the LSAH website on the new NASA Life Sciences Portal

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