SCIENCE AND RESEARCH ANNOUNCEMENT

Fram2 will advance humanity's capabilities for long-duration space exploration and understanding human health in space with 22 research projects from eight countries. The full list of experiments and partner institutions include:

Blood Flow Restriction | Hytro, Sheffield Hallam University and Northumbria University
Blood Flow Restriction (BFR) has been shown to increase efficacy of exercise on Earth, allowing users to either exercise for shorter durations or at a lower load, while getting the same benefits. This study plans to demonstrate BFR during exercise in Dragon with a passive (Hytro) and active system (Delfi), and if found to be effective, would enable astronauts to maintain muscle and bone health across long flights to Mars.

Bone Health | University of Calgary
The human skeleton loses bone rapidly when exposed to microgravity, with longer exposure leading to worse bone loss. Using advanced imaging, direct changes to the microstructure that underpins bone loss can be observed. Integrating knowledge from short, medium and long-duration space flight missions will help understand how a mission to Mars might impact the human skeleton. This knowledge will help to design countermeasures that maximize bone health of astronauts so that we can prevent fractures.

Brain Mapping | Center for Space Medicine Berlin, Charité
"Brain Mapping" uses a combination of brain imaging techniques, blood samples, and a newly developed cognitive test battery to assess visuo-spatial skills. These measures allow us to reveal what happens to the brain in space and identify biomarkers that can trace those changes. These data will also be related to the ability to process and recall spatial information, which is key to performing complex operational tasks as well as navigating in unfamiliar environments, such as exploring new planets. By leveraging a unique combination of cutting-edge brain imaging techniques, molecular markers, and innovative cognitive performance measures, the "Brain Mapping" experiment will provide a crucial piece to the puzzle when it comes to supporting astronauts traveling to Mars.

Brain MRI | Medical University of South Carolina
Fluid within the body shifts headward in spaceflight, resulting in a puffy face appearance and symptoms including brain fog, headaches, and potential vision changes. Brain imaging before and immediately after spaceflight will determine how the brain is affected by microgravity, providing additional answers that may help humanity identify and mitigate neurologic complications from long-duration spaceflight.

Capsule Egress | KBR/NASA JSC
The ability of astronauts to react to emergency situations shortly after landing on the Moon, Mars, or back on Earth after being in weightlessness is critical. Currently, astronauts receive aid from medical and operational personnel immediately after landing, so their ability to respond to an emergency is not well understood. However, astronauts will not have support crews to assist them after landing on the moon, Mars, or an unsupported Earth landing site. This study will help to characterize the ability of astronauts to

perform functional tasks related to getting the landing vehicle in a safe configuration and exiting the lander after both short and long durations in space. Performing this on Earth is the most extreme gravity case and provides the worst-case estimate of performance expectations since we would expect less gravity to be less of an overall problem.

Cognition | University of Pennsylvania
Cognition is a challenging series of quick cognitive assays delivered via laptop or tablet with the goal of investigating the effects of spaceflight on crew cognition and physiology. Crew cognition and physiology are challenged by multiple environmental, psychological, and operational stressors in space. High levels of cognitive performance and health are a prerequisite for mission success, especially on long-duration missions.

Crew Resilience | University of Bergen
This study investigates how intra-crew dynamics are associated with individual astronauts' stress responses and wellbeing. This research can provide important insights for optimizing crew composition, training, and psychosocial support, ultimately enhancing the overall psychological resilience and effectiveness of astronauts during a future Mars mission.

Glucose Regulation | SpaceX
One of SpaceX's driving goals is to make space accessible to a broader swath of the population. More than 10% of the world population is diabetic. With a better understanding of glucose regulation in space and the accuracy of glucose monitoring tools, SpaceX will gain confidence in providing a high quality of care to diabetic astronauts. The fluid shifts that occur in space may affect the accuracy of continuous glucose monitors, thus this study aims to validate a continuous glucose monitor over the duration of the Fram2 mission, as well as monitoring changes in glucose regulation due to exposure to microgravity.

MELITE | University of Malta
The MELITE study investigates how spaceflight, microgravity, and radiation affect the microbiomes of human skin and other tissues in diabetic patients, focusing on conditions like diabetic foot ulcers. By examining microbial changes across multiple body sites, both in space and on Earth, we aim to develop strategies to protect astronaut health on long missions, such as journeys to Mars. These insights can also lead to improved treatments for microbiome-related health issues on Earth, benefiting millions who face similar challenges.

Mission MushVroom | FOODiQ Global
Mission MushVroom will be the first study to cultivate and grow mushrooms in space. Oyster mushrooms are the perfect space crop, helping astronauts meet their nutritional needs on long-duration space missions like those to Mars, while closing the loop in plant agriculture and helping to minimise inputs and waste. They are quick to grow, double in size every day, and have nutrients found across food groups, including the unique ability to make vitamin D. Successfully growing edible mushrooms in space can revolutionize the space food sector and bring us closer to a delicious, nutritious, and sustainable space food production for future missions.

NASA Standard Measures | NASA JSC
NASA’s Standard Measures study allows researchers to identify trends in how humans adapt to spaceflight both physiologically and psychologically. The study collects a consistent set of measurements from astronauts on various missions, using saliva, blood, survey responses, and more to assess biochemical markers, immunological status, sensorimotor function, sleep quality, physical performance, and other benchmarks of astronaut health. These data help NASA and its partners predict the adaptability

of astronauts, validate countermeasures or other technologies, and develop informed strategies to ensure that astronauts stay safe, healthy, and productive on missions to the Moon, Mars, and beyond.

Radiation Measurements | NASA JSC
This study will capture detailed radiation measurements inside the Fram2 cabin using a HERA radiation detector, as well as record individual radiation exposure levels for each crew member using personal radiation badges. Radiation exposure is a significant risk for long-duration space missions, such as those required for travel to Mars. These measurements will provide essential data to validate crew exposure levels for other studies and help improve models of spacecraft shielding to better protect crew members from radiation risks.

Sensorimotor Standard Measures | Johns Hopkins University School of Medicine
One component of sensorimotor standard measures involves the measurement of vestibular (balance) function, before and immediately after flying in space. The ability of the brain to adapt to slight asymmetries in the vestibular system, which we see in spaceflight, might be related to space motion sickness and postflight postural instability – both of which are important issues for astronauts when they arrive at locations far from Earth.

Sleep Hygiene | Medical University of South Carolina
Sleep is known to be disrupted in spaceflight, resulting in cognitive, mood, and physiologic impairments. This will be the first study to track sleeping patterns before, during, and after spaceflight, providing critical data in determining potential countermeasures to preserve sleep quality as we look to Lunar and Martian expansion.

SLICE | University of South Wales
The SaLiva In spaCE (SLICE) study will measure thousands of proteins in astronaut saliva to determine how their bodies respond to the stress of spaceflight and how this differs between males and females. Characterizing an astronaut's personalized space-stress 'signature' will improve our ability to monitor and mitigate health risks, refine countermeasures, to optimize crew health and performance for an upcoming mission to Mars.

Space Genomics | University of Zurich Space Hub
This experiment delves into the critical role of genomic architecture and adaptive mechanisms in enabling human survival and adaptation in space. Earth's gravity has shaped all terrestrial life, raising the profound question of whether humans can truly thrive beyond it. By exploring how prolonged microgravity affects gene expression and chromatin dynamics, this study aims to uncover the potential for long-term, environment-driven adaptations that could one day support sustained human life across planets, redefining our future as a spacefaring species.

Space Motion Sickness | University of Colorado
This study aims to quantifying the severity and time course of motion sickness in astronauts, using a standardized stimulus, during and following gravity transitions into space and returning to Earth. Motion sickness is one of the most salient experiences for astronauts during gravity transitions. Missions to Mars will involve a series of gravity transitions, negatively impacting astronauts, so it is critical to quantify the time course of the associated motion sickness.

Space Omics | Baylor College of Medicine, Human Genome Sequencing Center
The 'Space Omics' study, at the Baylor College of Medicine, Human Genome Sequencing Center, is designed to collect biospecimen from private space flight participants, for biobanking and analysis of the

effects of space travel using an array of standardized multi-omics assays, including generation of individual clinical reports. Findings of this study provides critical dataset for future missions and could be helpful to design tailored healthcare for optimal astronaut health during short-term as well as future Mars missions.

Space THAL | University of Malta
Space THAL explores how spaceflight and microgravity affect blood health, specifically focusing on anemia, a critical challenge for long-term missions like those to Mars. By understanding how red blood cell production is impacted during extended periods in space, we aim to develop solutions to protect astronauts from anemia, which is essential for their health and mission success. These findings also have the potential to improve treatments for anemia on Earth, helping millions of people who suffer from this condition.

Space Time | Liverpool John Moores University
As the limits of human space travel are pushed ever further, the duration of time that astronauts are required to spend in space is increasing. This study will measure how astronauts experience time during space travel. It hopes to establish how we can speed up the passage of time during space travel.

SpaceXposome | LMU University Munich
Stress in space can affect crew health, cohesion and performance, and hence overall mission success. SpaceXposome seeks to identify ways to enhance resilience and well-being among astronauts to enable successful exploration class missions and the establishment of sustainable human presence on the moon and Mars.

SpaceXray | St Louis University
X-ray imaging is an essential diagnostic capability that will allow astronauts to evaluate the integrity of structures supporting their survival: spacesuits, spaceships, and, perhaps most notably, the human body. The SpaceXray study will test the first portable X-ray system to ever fly to space, demonstrating this modality's dual-capability: to visualize organic structures like bones, lungs, and teeth and also critical flight hardware.

Women’s Health | Hormona
The Women's Health study will utilize the Hormona test and app to analyze microgravity and space radiation's impact on the female reproductive system. By understanding space travels impact on women's reproductive health, we hope to gain insight into its short and long term effects on our ability to reproduce in space.

Exercise Tech Demo | Exercise Demo
For future exploration missions, it is critical to have either backup or primary exercise hardware that is low mass, power, volume, and importantly, time. Short-duration Dragon missions are the ideal place to start learning about and testing these minimum viable, or "better than nothing" exercise devices.