National Aeronautics and Space Administration

International Space Station

[MISSION SUMMARY]

EXPEDITION **60** began in June 2019 and ends in October 2019. This expedition will include research investigations focused on biology, Earth science, human research, physical sciences and technology development, providing the foundation for continuing human spaceflight beyond low-Earth orbit to the Moon and Mars.

THE **CREW:**

Soyuz MS-12 Launch: March 14, 2019

Nick Hague (NASA) – Flight Engineer

Born: Belleville, Kansas
Interests: Exercising, flying, snow skiing and scuba
Spaceflights: Soyuz MS-10, Exp. 59
Landing: September 2019
Bio: https://go.nasa.gov/2Qz3qZ1
Twitter: @AstroHague

Christina Koch (NASA) – Flight Engineer

Born: Grand Rapids, Michigan
Interests: Backpacking, rock climbing, paddling and sailing
Spaceflights: Exp. 59
Landing: February 2020
Bio: https://go.nasa.gov/2QCRHbX
Twitter: @Astro_Christina

Alexey Ovchinin (Roscosmos) – Commander

Born: Rybinsk, Russia
Spaceflights: Exp. 47/48, Soyuz MS-10, Exp. 59
Landing: September 2019
Bio: https://go.nasa.gov/2QAQBgu

Soyuz MS-13 Launch: July 20, 2019

Drew Morgan (NASA) – Flight Engineer

Born: Morgantown, West Virginia
Interests: Distance running, swimming, weight-lifting and reading space and military history
Spaceflights: First flight
Landing: Spring 2020
Bio: https://go.nasa.gov/2Su7ESF
Twitter: @AstroDrewMorgan

Luca Parmitano (ESA) – Flight Engineer

Born: Paternò, Italy
Interests: Weight-training, swimming, biking and running
Spaceflights: Exp. 36/37
Landing: February 2020
Bio: https://go.nasa.gov/2SuquJe
Twitter: @Astro_luca

Aleksandr Skvortsov (Roscosmos) – Flight Engineer

Born: Schelkovo, Russia
Spaceflights: Exp. 23/24, Exp. 39/40
Landing: February 2020
Bio: https://go.nasa.gov/2SLK4kq

THE **SCIENCE:**

What are some investigations the crew is operating?

During Expedition 60, researchers will 3D print organ-like tissues in microgravity, examine the physical interactions of liquid, rocks and microorganisms, evaluate the creation of novel silica forms and structures, and analyze the spreading and penetration of a liquid on a porous surface.

BioFabrication Facility (BFF)

Using 3D biological printers to produce usable human organs has long been a dream of scientists and doctors around the globe; however, printing the tiny, complex structures found inside human organs – such as capillary structures – has proven difficult to accomplish in Earth's gravity environment. To overcome this challenge, Techshot designed their BioFabrication Facility (BFF) to print organ-like tissues in microgravity. Microgravity may provide an additional solution to printing complex organ structures, as minimal gravity removes the need for scaffolding structures to support complex tissue shapes. Techshot intends to use the BFF as a platform for researchers to print organ-like tissues in microgravity, acting as a stepping stone in a long-term plan to manufacture whole human organs in space using refined biological 3D printing techniques.

Biorock

Microbes are able to weather down a rock from which they can extract ions. This natural process enables biomining, in which useful metals are extracted from rock ores. Already a common practice on Earth, biomining may eventually take place on the Moon, Mars and asteroids as we expand our understanding and exploration of the solar system. Biorock is expected to help gain additional insight into the physical interactions of liquids, rocks, and microorganisms under microgravity conditions for novel acquisition of materials in space. In addition, data from Biorock can be used to inform the development of life support systems involving microbial components on long-duration spaceflight missions.

Goodyear Tire

Pushing the Limits of Silica Fillers for Tire Applications (Goodyear Tire) evaluates creation of novel silica forms and structures, or morphologies, using traditional techniques to form silica fillers in microgravity. The space environment may yield results not possible in ground-based environments. Better understanding of silica morphology and the relationship between silica structure and properties may improve the silica design process and rubber formulation, as well as tire manufacturing and performance on the ground. Recent experiments in microgravity have generated novel mixtures of solids and liquids with the potential to improve silica morphologies and deliver better performance in the tire industry. A breakthrough in research on the effect of silica morphology on rubber compound properties may lead to significant improvements in fuel efficiency, creating transportation cost savings and helping to protect the environment.

Inertial Spreading

Inertial Spreading and Imbibition of a Liquid Drop through a Porous Surface (Inertial Spreading) observes a drop of water spreading over and through a sponge-like metal object. When water touches a sponge-like material such as dry soil, it penetrates microscopic holes too small to see; widening these holes makes the water disappear too quickly. Microgravity slows down this process, allowing use of larger holes for more detailed observations to create a benchmark for computer simulations. This investigation may support development of new technology based on wicking and capillary fluid motion that could ultimately support use of essential resources available on the Moon, Mars or asteroids, known as In-situ Resource Utilization (ISRU). A better understanding of the dynamics of coexisting liquid, gas, and porous solids has potential applications in flood control, irrigation, fuel cells, oil and gas exploration, and pharmaceutical production on Earth.

THE MISSION **PATCH:**

The Moon landing is one of the most extraordinary feats of humankind, an embodiment of ingenuity and desire for exploration. The patch of Expedition 60 commemorates the 50th anniversary of that landing: a constellation of three stars with the Moon superimposed forms the letter "L," the Latin symbol for 50. The Moon is depicted as a waxing crescent, as it was on July 20, 1969.

The familiar silhouette of the International Space Station is visible, flying across the night sky. Stars, numerous and bright as seen from the space station, form the shape of an eagle in the same pose as on the iconic patch of the Apollo 11 mission. The sunrise represents the fact that we are still in the early stages of humanity's exploration of space.

The hexagonal shape of the patch represents the space station's cupola, with the six points of the hexagon symbolizing the six crewmembers of Expedition 60. The names and nationalities are not present, as on the original Apollo 11 mission patch, to highlight that space missions – then, now, and in the future – are for Earth and all humankind.

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