SpaceX CRS-4

Fourth Commercial Resupply Services Flight to the International Space Station

National Aeronautics and Space Administration

September 2014

OVERVIEW

The Dragon spacecraft will be filled with more than 5,000 pounds of supplies and payloads, including critical materials to support 255 science and research investigations that will occur during Expeditions 41 and 42. Dragon will carry three powered cargo payloads in its pressurized section and two in its unpressurized trunk. Science payloads will enable model organism research using rodents, fruit flies and plants. A special science payload is the ISS-Rapid Scatterometer to monitor ocean surface wind speed and direction. Several new technology demonstrations aboard will enable bone density studies, test how a small satellite moves and positions itself in space using new thruster technology, and use the first 3-D printer in space for additive manufacturing. The mission also delivers IMAX cameras for filming during four increments and replacement batteries for the spacesuits. After four weeks at the space station, the spacecraft will return with about 3,800 pounds of cargo, including crew supplies, hardware and computer resources, science experiments, space station hardware, and four powered payloads.

DRAGON CARGO

	LAUNCH ITEMS	RETURN ITEMS
TOTAL CARGO:	**4885 lbs / 2216 kg**	**3276 lbs / 1486 kg**
· Crew Supplies	1380 lbs / 626 kg	132 lbs / 60 kg
Crew care packages		
Crew provisions		
Food		
· Vehicle Hardware	403 lbs / 183 kg	937 lbs / 425 kg
Crew Health Care System hardware		
Environment Control & Life Support equipment		
Electrical Power System hardware		
Extravehicular Robotics equipment		
Flight Crew Equipment		
Japan Aerospace Exploration Agency equipment		
· Science Investigations	1644 lbs / 746 kg	2075 lbs / 941 kg
U.S. investigations		
Japan Aerospace Exploration Agency investigations		
European Space Agency investigations		
· Computer Resources	101 lbs / 46 kg	11 lbs / 5 kg
Command and Data Handling		
Photo and TV equipment		
· EVA equipment	55 lbs / 25 kg	121 lbs / 55 kg
ISS-RapidScat (unpressurized)	1298 lbs / 589 kg	

RENDEZVOUS AND RETURN

About 10 minutes after launch, Dragon reaches its preliminary orbit. It then deploys its solar arrays and begins a carefully choreographed series of thruster firings to reach the space station. After a two-day trip, Expedition 41 Flight Engineer and European Space Agency Astronaut Alexander Gerst, with assistance from NASA Astronaut and Flight Engineer Reid Wiseman, will use the station's 57.7-foot (17.6-meter) robotic arm to reach out and capture the Dragon spacecraft as they operate from the station's cupola. Ground commands will be sent from Houston for the station's arm to install Dragon on the bottom side of the station's Harmony module for its stay at the International Space Station. By the next day, crew will pressurize the vestibule between the station and Dragon and will open the hatch that leads to the forward bulkhead of Dragon. During the next four weeks, the crew will unload the spacecraft and reload it with cargo to return to Earth. About five and a half hours after it departs the station, it will splash down in the Pacific Ocean off the coast of Baja California. This is the fourth of 12 missions under the SpaceX Commercial Resupply Services contract with NASA. Under the contract, SpaceX will deliver a minimum of 20 metric tons of cargo to the space station.

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RESEARCH HIGHLIGHTS

3D Printing In Zero-G will use relatively low-temperature plastic feedstock to demonstrate that a 3-D printer works normally in space, the first step toward establishing an on-demand machine shop in space, a critical enabling component for deep-space crewed missions and in-space manufacturing.

Biological Research in Canisters (BRIC) will focus on how the microgravity environment affects the patterns of growth and gene expression in Arabidopsis thaliana seedlings and could lead to a better understanding of how to grow fresh food for astronauts on future missions.

Bone Densitometer (BD) uses X-rays to measure the bone mineral density (and the lean and fat tissue) of mice living aboard the orbiting laboratory to develop medical technology that will combat bone density loss in space and on Earth, helping millions of senior citizens who suffer from osteoporosis.

Cyclops, also known as the Space Station Integrated Kinetic Launcher for Orbital Payload Systems (SSIKLOPS), will use the station's robotic arms to deploy nanosatellites inserted into the platform inside the Japanese module airlock to the outside of the space station.

Factors Contributing to Food Acceptability and Consumption, Mood and Stress on Long-Term Space Missions (Astro Palate) studies the relationship between emotions, mood, stress and eating during spaceflight and explores ways to minimize stressful aspects of the eating situation and ways to use eating to reduce stress or negative moods crew members might normally experience in flight.

ISS-RapidScat Scatterometer will measure near-surface wind speed and direction over the ocean for use in weather forecasting and for monitoring large-scale changes in the Earth's climate.

Micro-8 will expand our understanding of the fundamental basis of how space flight affects the biological and molecular functions of the cell and the molecular mechanisms by which cells and tissues respond to spaceflight conditions.

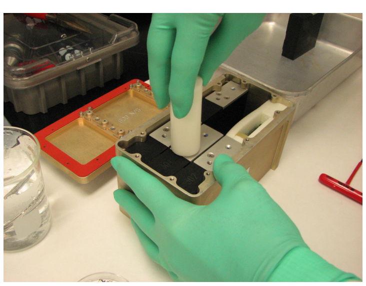
NanoRacks-Ames Fruit-Fly Experiment (NanoRacks-AFEX) will study neurobehavioral changes in the fruit fly during space flight and map these changes to alterations in oxidative stress pathways. Fruit flies have similar genetic patterns to humans.

NanoRacks-COBRA PUMA GOLF-Electroplating investigates microgravity effects on electroplating of metals. The experiment requires post flight Atomic Force Microscope analysis.

Rodent Research-1 enables researchers to study the long-term effects of microgravity—or weightlessness—on mammalian physiology. The rodents will launch in a transporter then will be transferred to two habitats. Half of them will return with this mission, and the remaining half on the fifth SpaceX commercial resupply flight.

Seedling Growth-2 will help us gain a better understanding of the basic mechanisms of light- and gravity-sensing in plants. Research results have potential uses both for improving the long-term sustainability of agricultural production on Earth and also for developing plant-based bio-regenerative life support systems needed for humans to colonize other worlds, such as the moon and Mars.

Special Purpose Inexpensive Satellite (SpinSat) will test how a small, 22-inch diameter satellite moves and positions itself in space using new micro-thruster technology.



BRIC Project Engineer Susan Manning-Roach of Stinger Ghaffarian Technologies removes a petri dish from its fixation unit after the Science Verification Test.

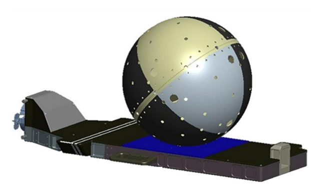


Illustration of Cyclops flight hardware with SpinSat satellite attached.

In the company's cleanroom, Mike Snyder and Jason Dunn of Made In Space, assemble the 3-D printer bound for the space station.