SPACEX CRS-9 MISSION OVERVIEW

SpaceX's ninth contracted cargo resupply mission with NASA to the International Space Station will deliver almost 5,000 pounds of science and research, crew supplies and vehicle hardware to the orbital laboratory and its crew. Launch is targeted for Monday, July 18, 2016.

The spacecraft will launch aboard a Falcon 9 rocket from Cape Canaveral Air Force Station in Florida and arrive at the space station two days later. **Expedition 48** crew members Jeff Williams and Kate Rubins of NASA, Takuya Onishi of the Japan Aerospace Exploration Agency and cosmonauts Anatoly Ivanishin, Alexey Ovchinin and Oleg Skripochka of Roscosmos are currently living aboard the orbiting laboratory. Williams and Rubins will use the station's robotic arm to capture Dragon when it arrives on station. The spacecraft will be berthed to the Earth-facing port on the Harmony module.

Dragon will carry hardware and supplies to support dozens of the of approximately 250 science and research investigations that will occur during Expeditions 48 and 49. The unpressurized trunk of the spacecraft will also hold the **International Docking Adapter**, connecting point for Boeing's CST-100 Starliner and SpaceX's Crew Dragon spacecraft which will bring astronauts to the station as part of **NASA's Commercial Crew Program**.

TOTAL CARGO:	**4975.8 lbs. / 2257 kg**
TOTAL PRESSURIZED CARGO WITH PACKAGING:	**3946.3 lbs. / 1790 kg**
• *Science Investigations*	*2050.3 lbs. / 930 kg*
• *Crew Supplies*	*815.7 lbs. / 370 kg*
• *Vehicle Hardware*	*617.3 lbs. / 280 kg*
• *Spacewalk Equipment*	*279.9 lbs. / 127 kg*
• *Computer Resources*	*2.2 lbs. / 1 kg*
• *Russian Hardware*	*119.1 lbs. / 54 kg*
UNPRESSURIZED	
• *International Docking Adapter (IDA)*	*1029.5 lbs. / 467 kg*

Installation and Undocking Overview:
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, Jeff Williams 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 for the station's arm to install Dragon on the bottom side of the Harmony module for its stay at the International Space Station. By the next day, the crew will pressurize the vestibule between the station and Dragon and open the hatch that leads to the forward bulkhead of Dragon.

During the next five 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.

SPACEX CRS-9 SCIENCE OVERVIEW

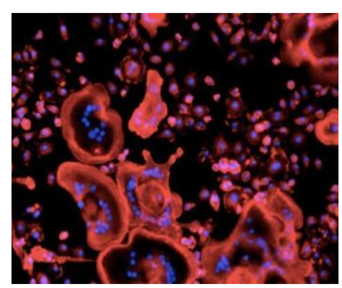
The new experiments arriving to the orbital laboratory will help investigators test the capabilities for sequencing DNA in space, regulating temperatures aboard spacecraft, understanding bone loss, and how the heart is changed by microgravity. Other investigations study how to protect computers from radiation in space and test an efficient, three-dimensional solar cell.

The MinION (Biomolecule Sequencer), a miniaturized DNA sequencer, will be enable the first DNA sequencing done in space.
Credits: Oxford Nanopore Technologies

Biomolecule Sequencer seeks to demonstrate, for the first time, that DNA sequencing is feasible in an orbiting spacecraft. It will test a miniature device to prove functionality and evaluate crew operability of a DNA sequencer in the space environment. A space-based DNA sequencer could identify microbes, diagnose diseases and understand crew member health, and potentially help detect DNA-based life elsewhere in the solar system.

Phase Change Heat Exchanger Project
Credits: NASA

Phase Change Heat Exchanger is a NASA investigation to test temperature control technology that could be used in future spacecraft. Maintaining safe temperatures is difficult in space, where there is no atmosphere to provide warmth in the shade or protection from the sun's heat. Phase-change material heat exchangers can help by freezing or thawing a material to maintain critical temperatures inside a spacecraft, protecting crew members and equipment. The Phase Change Heat Exchanger Project tests a new type of heat exchanger that could help offset heat on future spacecraft, enabling future missions to better regulate temperatures.



OsteoOmics is testing whether magnetic levitation accurately simulates the free-fall conditions of microgravity by comparing genetic expression in different types of bone cells.
Credits: Bruce Hammer

OsteoOmics (**CASIS/National Lab**) is testing whether magnetic levitation accurately simulates the free-fall conditions of microgravity by comparing genetic expression in different types of bone cells. Millions of Americans experience bone loss, which results from disease or the reduced effects of gravity that can occur in bed-ridden patients. New ground-based studies are using magnetic levitation equipment to simulate these gravity-related changes. Improved understanding of the mechanisms behind bone loss could lead to better ways to prevent it during space missions. This also could contribute to better prevention of and treatments for bone loss as a result of diseases like osteopenia and osteoporosis or from prolonged bed rest.

Heart Cells (**CASIS/National Lab**) is an investigation that studies how microgravity changes the human heart and how those effects vary from one individual to another. Future exploration of the moon, asteroids or Mars will require long periods of space travel, which creates increased risk of health problems such as muscle atrophy, including possible atrophy of heart muscle. For this investigation, scientists induced human skin cells to become stem cells, which can differentiate into any type of cell, and forced them to grow into human heart cells. These heart cells will be cultured aboard the space station for one month and analyzed for cellular and molecular changes. This will provide insight into how microgravity affects the heart. Results could advance study of heart disease and the development of drugs and cell replacement therapy for future space missions and people with heart disease on Earth.