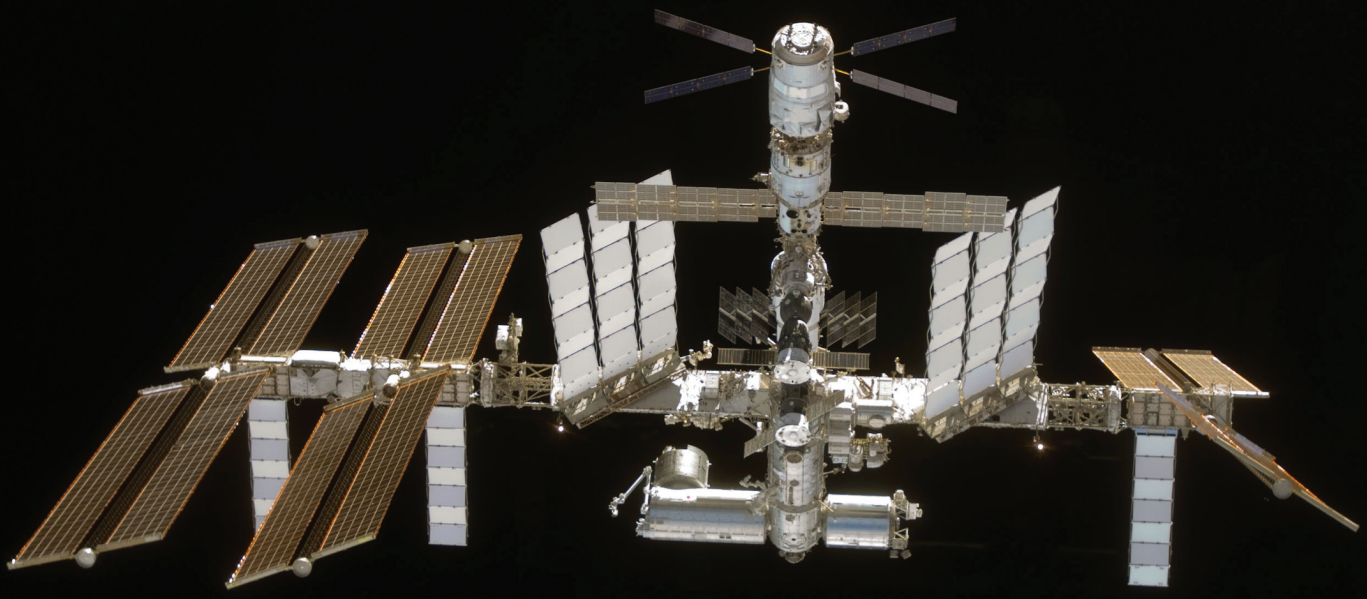
INTERNATIONAL SPACE STATION

All Laboratories Are

GO *. . . for Research!*



CSA ASC

esa

空へ挑み、宇宙を拓く

JAXA

NASA

ROSCOSMOS

ISS LABS ARE GO FOR RESEARCH!

The laboratories of the International Space Station (ISS) are almost complete and key research facilities—mini science laboratories—are up and running. In 2008, the European Space Agency's *Columbus* and Japan Aerospace Exploration Agency's *Kibo* laboratories joined the U.S. *Destiny* lab on orbit. Final research facilities will travel to the ISS on the remaining assembly missions.

Global interest is growing rapidly as all ISS partner nations begin their research and development programs. Over the final years of assembly 2009-2010, the initial experiments will be completed in the newest racks, the crew size onboard ISS will double to six astronauts/cosmonauts, and we will transition from "early utilization" to "full utilization" of ISS. The ISS labs are GO for research!

Early science on ISS has taught us much about what to expect when all research facilities are operational. From physiology to physics, many hypotheses about what will happen without gravity are being challenged. Data from ISS experiments are causing scientists to rethink existing models, and propose different approaches and observations, as they seek to understand new data from orbit. Rather than waiting years for the next flight opportunity, ISS discoveries generate new hypotheses that can often be tested in a short period of time—in the same way that scientists would follow provocative findings in a laboratory on Earth.

MULTIPURPOSE FACILITIES

Modular multipurpose racks provide cooling, power, data, vacuum, and nitrogen supply to a variety of different experiments.

- **European Drawer Rack** [ESA].
- **EXPRESS Racks** [NASA] eight onboard or planned.

Freezers allow freezing, storage, and transportation of science samples collected on ISS for later return to Earth.

- **GLACIER** refrigerators [NASA] are ultra-cold freezers that will store samples as low as -185 °C.
- **MELFI** [ESA-built, NASA-operated] freezers will store samples on ISS at temperatures as low as -80 °C.
- **MERLIN** incubators [NASA] will store samples at temperatures -20.0 °C to + 48.5 °C.

Gloveboxes provide containment of experiments, insuring that hazardous materials do not float about the cabin.

- **Microgravity Science Glovebox** [ESA-built, NASA-operated] is the largest glovebox ever flown in space, holding the equivalent of two airline carry-on bags.
- **Portable Glovebox** [ESA] can be transported around ISS and used in any laboratory module.

BIOLOGICAL RESEARCH (Incubators, Growth Chambers, and Centrifuges)

BioLab [ESA] is used to perform experiments on microorganisms, cells, tissues, plants, and small invertebrates. Biolab includes an incubator, microscope, spectrophotometer, and two centrifuges to provide artificial gravity.

Commercial Generic Bioprocessing Apparatus [NASA] provides programmable, accurate temperature control—from cold stowage to a customizable incubator—for experiments on cells, microbes, and plants.

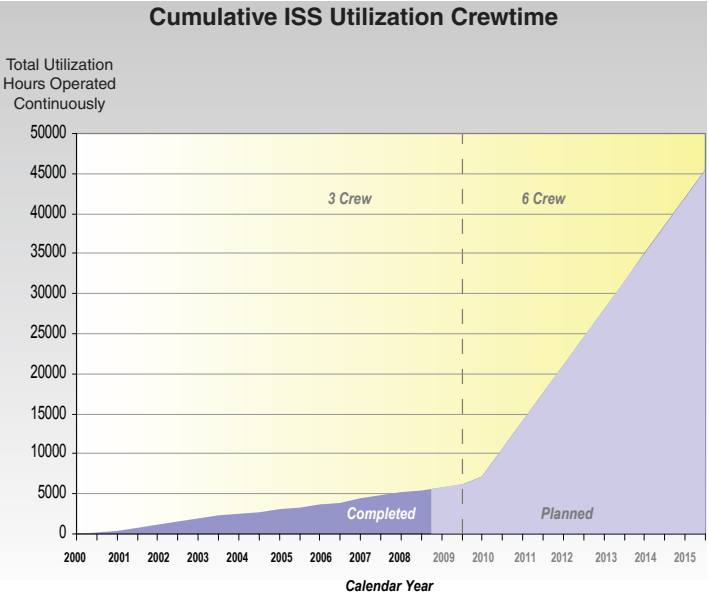
European Modular Cultivation System [ESA] allows for controlled cultivation of plants and other small organisms with two centrifuges that can operate between 0 and 2× Earth gravity.

Kriogem-3M [Roscosmos] is a refrigerator-incubator used for stowage of biological samples, and for the culture and incubation of bioreactors such as Recomb-K. Bioreactors are specialized hardware for growing cells, tissues, and microorganisms.

LADA Greenhouse [Roscosmos] supports a series of experiments on plant biology and space farming, growing multiple generations of sweet peas, wheat, tomatoes, and lettuce. Since its launch in 2002, the LADA greenhouse has been in almost continuous use on ISS for growing plants in the Russian segment.

OSTEO Bone Culture System [CSA] provides the right conditions to grow bone cells in microgravity. This culture system has been used successfully on U.S. Space Shuttle and Russian Foton recoverable orbital flights, and is also available for use in bone cell culture on ISS.

Saibo Experiment Rack [JAXA], which means "living cell," includes a Clean Bench glovebox with microscope that isolates the organisms being studied, and Cell Biology Experiment Facility that includes incubator and centrifuges.



HUMAN PHYSIOLOGY RESEARCH

European Physiology Module [ESA] is designed to investigate the effects of microgravity on the human body, and includes equipment for studies in metabolism, neuroscience, cardiovascular, bone, and muscle physiology.

Human Research Facility [NASA] enables study of the effects of long duration space flight on the human body. Equipment in the two racks includes a clinical ultrasound; refrigerated centrifuge; devices for measuring mass, blood pressure, and heart function; and the Pulmonary Function System for measuring lung function.

Human Research Hardware [CSA] includes radiation dosimeters (EVARM), and hardware and software for studying hand-eye coordination, visual perception (PMDIS, BISE) and neurophysiology (H-REFLEX).

Muscle Atrophy Research and Exercise System [ESA] will be used for research on musculoskeletal, biomechanical, and neuromuscular human physiology to better understand the effects of microgravity on the muscular system.

Matroshka [Roscosmos] is a series of investigations to measure radiation doses experienced by astronauts/cosmonauts outside and inside the ISS. It uses a mannequin of a human torso made of plastic, foam and a real human skeleton, and is equipped with dozens of radiation sensors.

Human Life Research [Roscosmos] includes a variety of equipment designed to study human life in space. Components of the system of equipment include the Cardiovascular System Research Rack, Weightlessness Adaptation Study Kit, Immune System Study Kit, and Locomotor System Study Facility.

PHYSICAL SCIENCE AND MATERIALS RESEARCH

Combustion Integrated Rack [NASA] includes an optics bench, combustion chamber, fuel and oxidizer control, and five different cameras for performing combustion experiments in microgravity.

Fluid Science Laboratory [ESA] is used to conduct fluid physics research to study processes like convection and fluid motions in microgravity conditions. Knowledge is applied to development of new fluid systems for future spacecraft design and development of advanced devices.

Fluids Integrated Rack [NASA] is a complementary fluid physics research facility designed to host investigations in areas such as colloids, gels, bubbles, wetting and capillary action, and phase changes including, boiling and cooling.

Materials Science Research Rack [ESA, NASA] is utilized for studies of metals, alloys, polymers, semiconductors, ceramics, crystals, and glasses undergoing phase changes. It will enable this research by controlling the thermal, environmental, and vacuum conditions of experiments.

Ryutai Experiment Rack [JAXA], which means “fluid,” is a multi-purpose payload rack system that includes a Fluid Physics Experiment Facility, Solution Crystallization Observation Facility, Protein Crystallization Research Facility, and image processing.

EARTH AND SPACE SCIENCE
(External and Internal)

Columbus External Payload Facility [ESA] provides four powered external attachment site locations for scientific payloads or facilities. The first NASA investigation is a testbed for materials exposure. The first two European experiments are EuTEF (European Technology Exposure Facility) and Solar (Sun Monitoring on the External Payload Facility of Columbus).

Cosmic Ray Detectors and Ionosphere Probes [Roscosmos] are important for studies of cosmic rays and the low-Earth orbit environment. Platan is an external detector for cosmic rays, BTN is an external detector measuring neutron flux, and Vsplesk is an external detector for gamma-rays and high energy charged particles. Two packages, Impulse and Obstanovka, include ionosphere probes and pulsed plasma source for making measurements of the ionosphere parameters and plasma-wave characteristics.

Earth Resources Sensing and Geophysics Instruments [Roscosmos] are used in studies of geophysics, natural resources, and ecology. Fialka is an ultraviolet imager and spectrometer used to study radiation emitted by reactions of propulsion system exhaust products. It is also used to study the spatial distribution and emission spectra of atmospheric phenomena, such as airglow. Rusalka is a micro spectrometer for collecting spectral radiance in the near infrared waveband for measurement of greenhouse gas concentrations in Earth’s atmosphere.

EXPRESS Logistics Carrier [NASA] is a platform designed to support external payloads mounted to the ISS starboard and port trusses with either deep space or Earthward views.

Japanese Experiment Module-Exposed Facility [JAXA] is an external platform that can hold up to 10 experiment payloads at a time outside *Kibo*. The first JAXA instruments are SEDA-AP (Space Environment Data Acquisition Equipment-Attached Payload) and MAXI (Monitor of All-sky X-ray Image). The first NASA instruments will be a hyperspectral imager and an ionosphere detector.

Window Observational Research Facility [NASA] provides a facility for Earth science remote sensing instruments using the *Destiny* science window with the highest quality optics ever flown on a human-occupied spacecraft.

FOR MORE INFORMATION

CSA - Canada
http://www.space.gc.ca/asc/eng/iss/

ESA - Europe
http://www.esa.int/esaHS/iss.html

JAXA - Japan
http://iss.jaxa.jp/en/

NASA - United States
http://www.nasa.gov/iss-science/

Roscosmos - Russia
http://www.energia.ru/eng/iss/iss-researches.html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