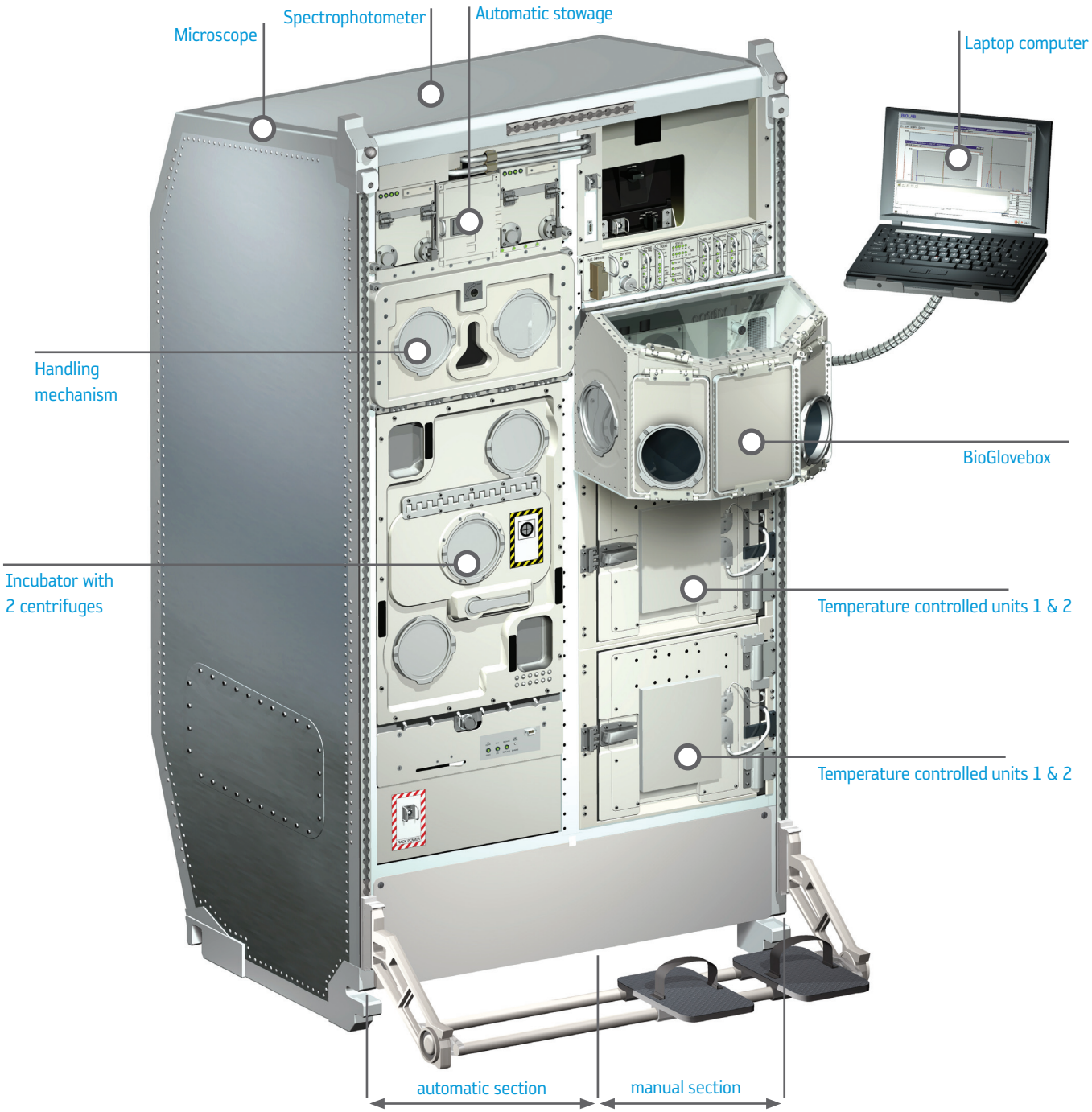
BIOLAB

Biological laboratory in Columbus

The Biolab facility is the laboratory designed to support biological experiments on micro-organisms, cells, tissue cultures, small plants and small invertebrates. The major objective of performing Life Sciences experiments in space is to identify the role that microgravity plays at all levels of an organism, from the effects on a single cell up to a complex organism including humans.



esa	PROJECT: International Space Station		
TITLE: Biolab		DOCUMENT N°: ESA-HSO-COU-008	REV. 2.0

Facility Description

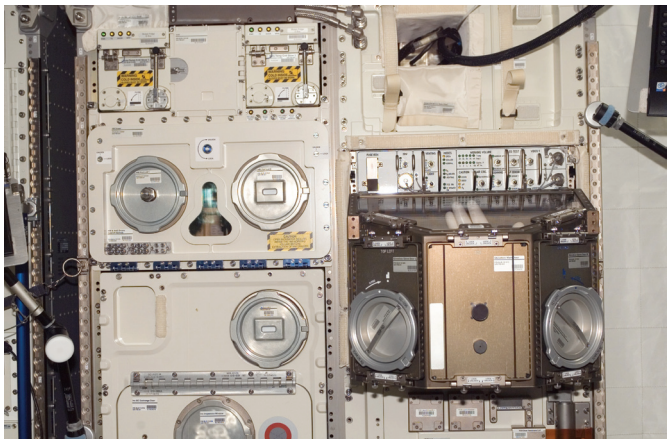
Biolab is integrated into a single International Standard Payload Rack and is divided physically and functionally into two sections:

- The automated section (Core Unit) on the left-hand side of the rack.
- The manual section on the right-hand side.

The main part of the experiment activities are performed automatically in the automated Core Unit, following a manual loading of the samples by a crew member. The Core Unit, therefore, features a large incubator equipped with two centrifuges, providing controlled levels of acceleration, including microgravity, to the samples placed into standard Experiment Containers. The methodology of containing the biological samples in standard Experiment Containers has been tried and proven successful in the numerous flights of the previous Biorack facility. These Experiment Containers provide standard external interfaces with the Biolab facility, therefore simplifying the design of the hardware contained in the Experiment Containers. The atmospheric environment in the Experiment Containers can be adjusted during centrifuge operations, to best suit the need of the biological samples. On top of the Incubator, the Handling Mechanism allows automatic operations on the samples, e.g. freezing and analysis of the samples.

The main objective of the Handling Mechanisms to significantly reduce the crew time needed to interact with the experiment and to allow full telescience capabilities with the scientists on the ground. In the manual section, as the name suggests, the crew performs all the required experiment preparation and completion activities. As part of the manual section, the BioGlovebox provides a clean, controlled and enclosed environment for manual operations and, as it is under negative pressure, prevents any possible contamination of the Columbus Laboratory.
The BioGlovebox is also equipped with an ozone generator, to perform sterilisation of the BioGlovebox working volume, allowing handling of delicate biological samples. Europe has a strong background in this area of reseach, gained by numerous flights of previous facilities, e.g. Biorack and Biobox, and the design of the Biolab facility is building upon this foundation.
The results from Biolab can strongly influence our lives here on Earth, particularly in the areas of immunology, bone demineralisation, cellular signal transduction and cellular repair capability. Such results could even have a significant influence on products in the medical, pharmacological and biotechnology fields.

ESA astronaut Frank De Winne working with the BioGlovebox


Biolab and the BioGloveBox just after installation in the Columbus laboratory

Parameter/Components	Characteristics
INTERNAL USEABLE VOLUME	
Standard Experiment Container:	60 x 60 x 100 mm3
Advanced Experiment Container:	108 x 150 x 137 mm3
Filter system:	Particle filters with pore size < 0.2 micrometres
Power interfaces:	+/- 12 Vdc, 5 W max. & +5 Vdc, 10 W max.
Data interfaces:	RS-485 (serial); 5 analogue channels; 3 digital inputs/outputs
Video (Advanced Experiment Container only):	National Television System Committee (NTSC)
INCUBATOR	
Temperature range:	Selectable 18°C to 40°C
Centrifuges:	2
Centrifuge g-level control:	Selectable 10-3 g to 2 g
Number of containers:	6 per centrifuge
Observation resolution:	0.2 mm on a 40 x 40 mm field of view
LIFE SUPPORT SYSTEM	
Relative humidity:	Adjustable 60 - 90 %
Atmospheric concentration:	Adjustable CO2 , O2 and N2
Ethylene removal:	Yes
AUTOMATIC TEMPERATURE CONTROLLED STOWAGE	
Temperature controlled stowage capability:	89 vials; 2 millilitres/vial
Temperature range:	Adjustable -20°C to +10°C
AUTOMATIC AMBIENT STOWAGE	
Ambient stowage capability:	3.5 litres
ANALYSIS INSTRUMENTS	
MICROSCOPE	
Low resolution:	1.8 µm / 1.0 mm diameter field of view
High resolution:	0.6 µm / 0.25 mm diameter field of view
Mode:	Single step or scan / autofocus
Features:	Phase contrast, bright field, dark field
SPECTROPHOTOMETER	
Range:	220 - 900 nm
Resolution:	10 nm
Light sources:	Deuterium lamp (Ultra Violet); Tungsten lamp (Visible to Near Infrared)
HANDLING MECHANISM	
Piston speed:	Up to 20 mm/s
Piston movement:	45 mm
Push/pull force:	20 N
Rotation:	4 - 120 rpm, with 5 rpm steps
Torque:	0.1 Nm
BIOGLOVEBOX	
Workspace volume:	355 x 300 x 280 mm (width x height x depth) - (32 litres)
Operation mode:	Closed loop
Disinfection mode:	Ozone generator
Accessories:	Light source; Video camera; Restraint tools
Temperature controlled:	21°C to 38°C
TEMPERATURE CONTROLLED UNIT	
Units available:	2
Storage capacity:	12 Experiment Containers or 10 Automatic Temperature
CONTROLLED STOWAGE (ATCS) INSERTS	
Useable volume:	~ 23 litres
Temperature range:	-20°C to +10°C
Temperature accuracy:	+/- 1°C

Utilisation Relevant Data

ACCOMMODATION & TRANSPORT

The Biolab facility was launched inside the European Columbus Laboratory. Prepared standard Experiment Containers and vials are transported separately within the Multi Purpose Logistics Module (MPLM), which is a cargo carrier located inside the Space Shuttle cargo bay, or other available transport means such as the European Automated Transfer Vehicle (ATV), the Russian Progress vehicles or the Shuttle's mid-deck lockers.

OPERATIONAL CONCEPT

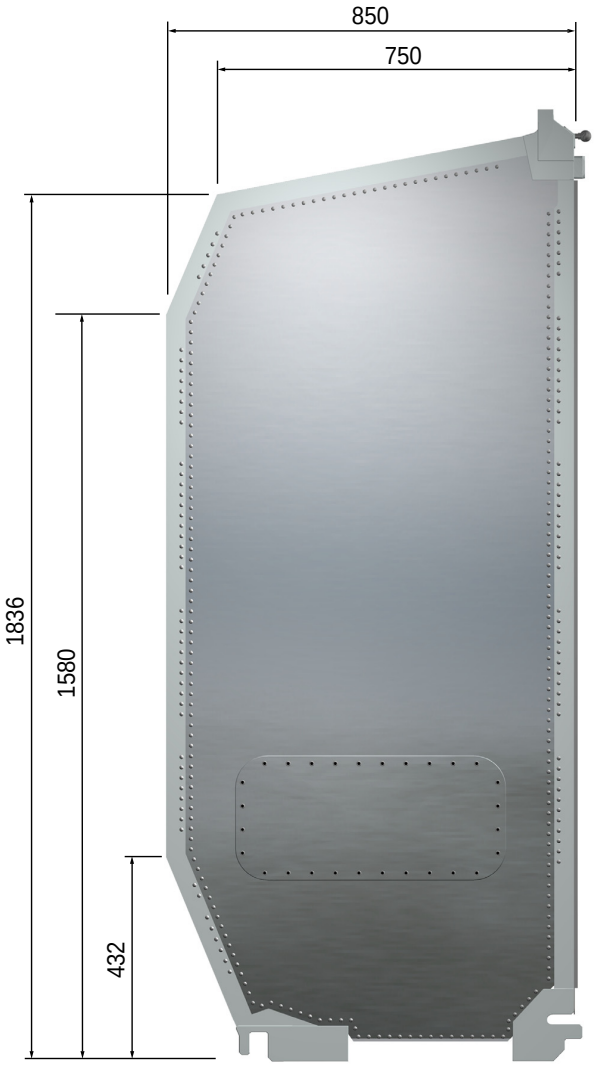
The biological samples, together with their ancillary items are transported from the ground to Biolab either within the Experiment Containers or in small vials.
The latter case applies if the samples require storage prior to use, like in the Minus Eighty Laboratory Freezer for ISS (MELFI). On-orbit, the Experiment Containers are manually inserted into Biolab for processing, whereas the frozen sample will first be thawed-out in the Experiment Preparation Unit (EPU) installed inside the BioGlovebox. Once this manual loading is accomplished, the automatic processing of the experiment can be initiated by the crew member. The experiments are undertaken in parallel on a 0g and a 1g centrifuge respectively, the latter providing the flight reference experiment, whilst the ground reference experiment is performed at the Facility Responsible Centre (FRC).
During processing of the experiment, the facility handling mechanism transports the samples to the facility's diagnostic instrumentation, where, through teleoperations, the scientist on the ground can actively participate in the preliminary in-situ analyses. Typical experiment durations range from 1 day to 3 months.

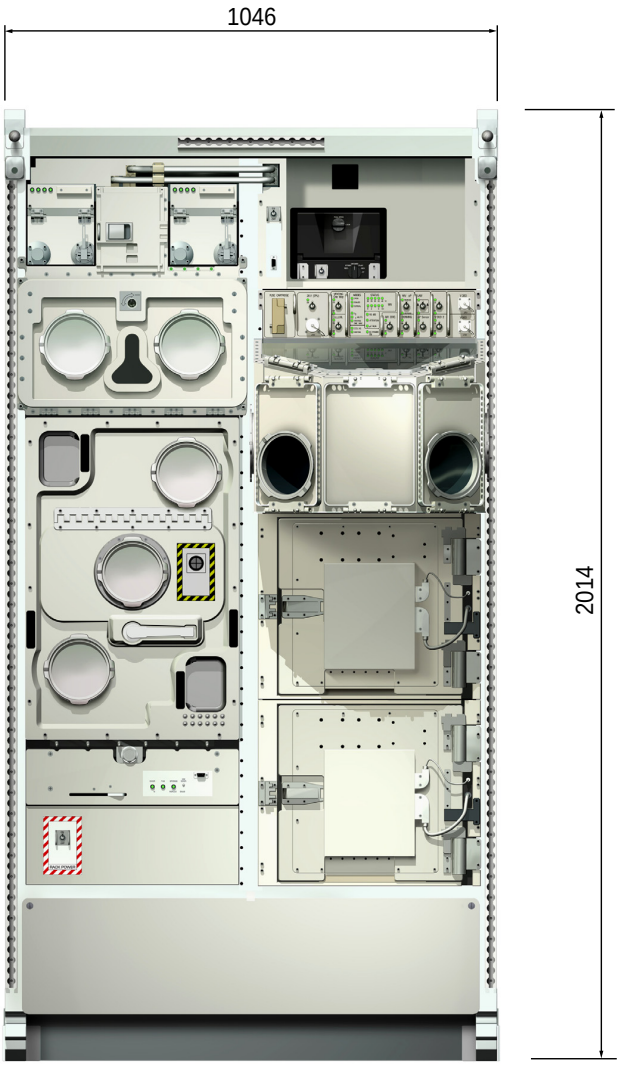
UTILISATION SCENARIO

The Facility Responsible Centre for the Biolab facility, has the overall responsibility to operate it according to the needs of individual Experiment Container providers. The individual Experiment Container providers monitor the processing of their experiments from own User Home Bases.

SCHEDULE

Biolab was launched aboard the Space Shuttle accommodated within the Columbus Laboratory on 7 February 2008.





Illustrations: ESA/D. Ducros