ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Biotesc
Biotechnology Space Support Center

SPACE BIOLOGY GROUP

Research and Space Support Center

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www.spacebiol.ethz.ch

Historical review

The Space Biology Group was **founded in 1977.** Six years later, the group carried out its first experiment in space on board the Space Shuttle “Columbia”. Many further **space experiments** followed on from this event. The staff of Space Biology has till today gained profound knowledge in the **realization of biological experiments** under the unique environmental conditions presented by low gravity and also in the **design of the related supporting infrastructure**.

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In **2000**, the Space Biology Group established the **BIOTESC** center. This center is one of nine “User Support and Operation Centers” in Europe.

BIOTESC

- **Biote**chnology **S**pace Support **C**enter
- Since 2006 operative in the supporting of biological experiments on ISS
- Appointed by ESA as responsible center for **KUBIK** experiments and experiment responsible center for **BIOLAB**

BIOTESC team

BIOTESC control room

KUBIK

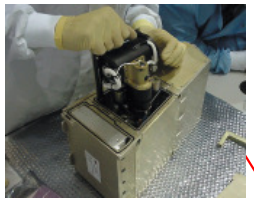
- **Dimensions**: 366 x 366 x 366 mm
- Temperature: 6° to 38° C (functioning either as an **incubator** or **cooler**)
- Exchangeable **inserts** available (centrifuge insert, passive insert etc.)
- **Centrifuge**: 0.2 g to 2 g
- Experiments need to run **fully automated**

KUBIK

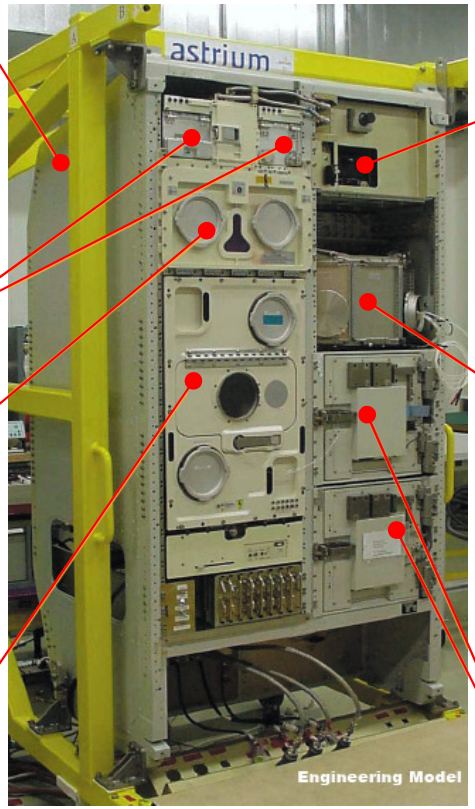
KUBIK in stand-alone configuration

BIOLAB - Multi-user science payload in the Columbus laboratory

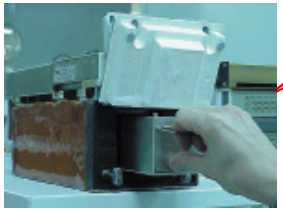
Spectrophotometer and microscope



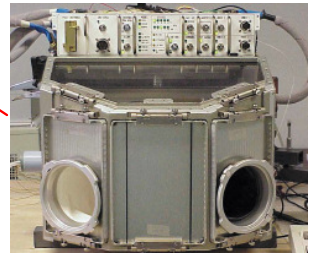
Software



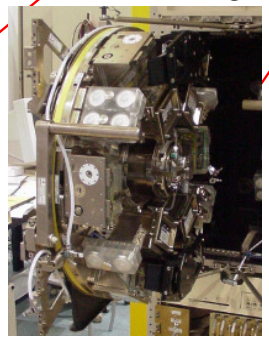
Automated storage unit



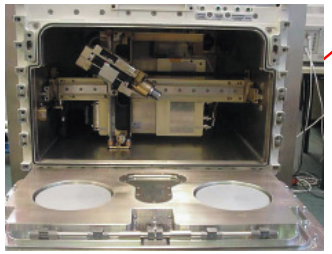
Glove box



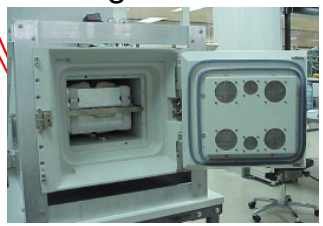
Centrifuge



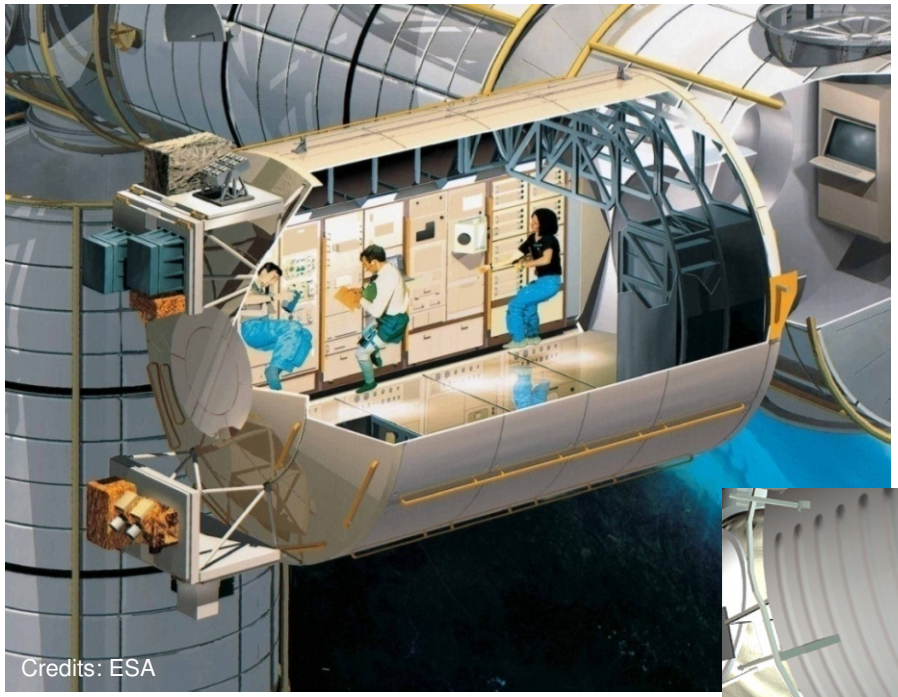
Injection mechanism



Cooling unit



Columbus science laboratory


Credits: ESA

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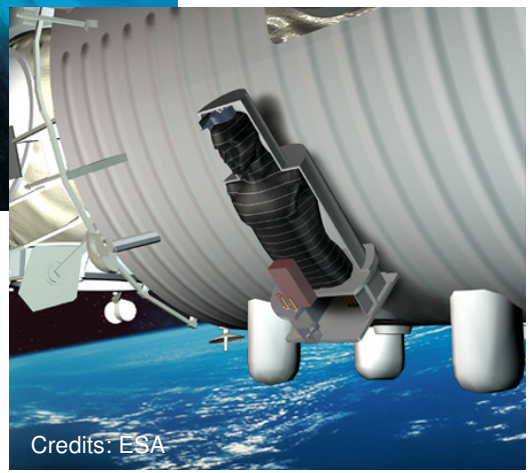

Credits: ESA

Technical description: Length 7 m, diameter 4.5 m, mass 10’300 kg

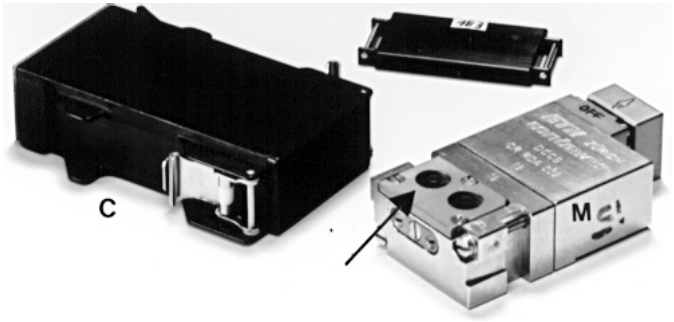
USOC tasks and responsibilities

- **Preparation of operations** in collaboration with ESA, industry and science teams
- Execution of **test runs**
- Preparation of **crew procedures** and **mission planning**
- **Training** of operators
- **Execution** of in-flight **operations**
- Real-time **monitoring** and **commanding** of facilities/experiments
- **Support of crew** activities

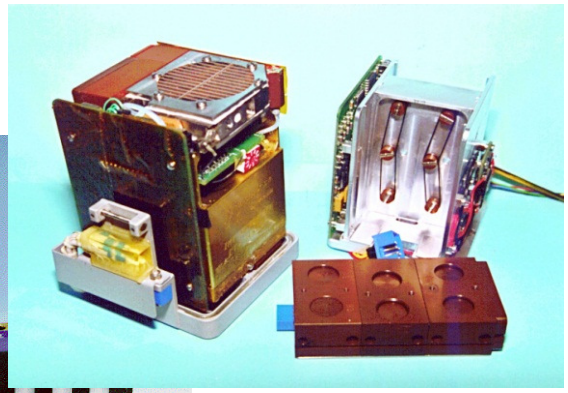
Research topics

Development of Space Bioreactors

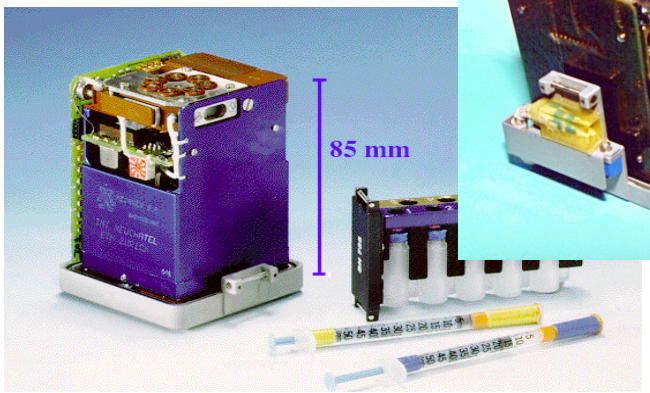
DCCS: Dynamic Cell Culture System



Space Bioreactor II



Space Bioreactor I

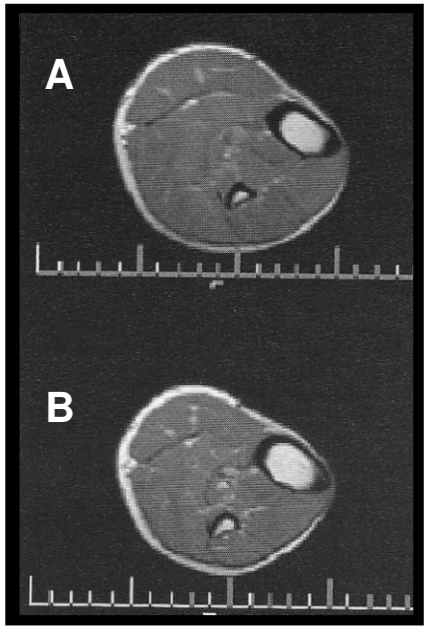


- Tissue engineering
- Recycling of waste products
- Production of oxygen, food, etc.
- Cultivation of cells for further space experiments

Research topics

Immune response under microgravity condition

Microgravity induced muscle atrophy



MRI images of the calf muscles taken before (A) and after (B) 90 days of bed rest

(ESA-LTBR 2001-1)

Age related muscle loss (Sarcopenia)

Response to mechanical forces

Normal mechanical stimulation

Maintaining tissue homeostasis

Cell / tissue growth and remodeling

Differentiation

Protein synthesis

Induction of gene expression

Altered mechanical stimulation

Osteoporosis

Osteoarthritis

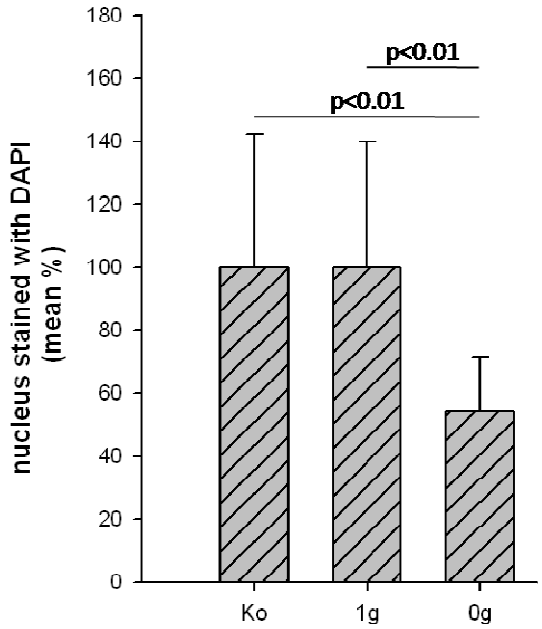
Tendinopathy

Atherosclerosis

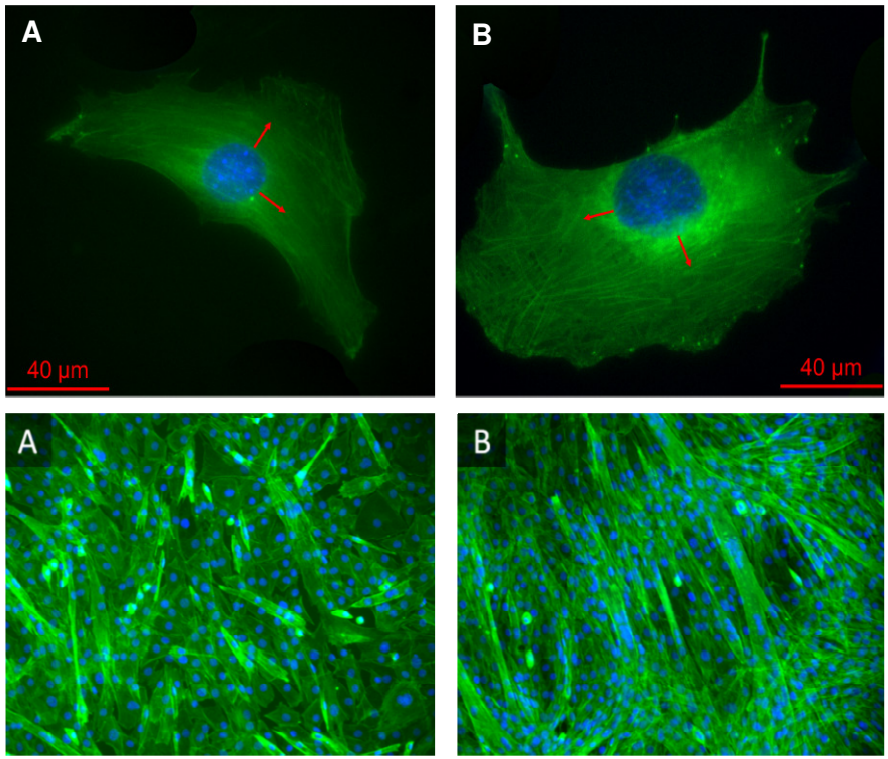
Fibrosis (in the bone, cartilage, tendon, vessels, heart, lung, and skin)

It remains unclear how the cells sense mechanical forces and convert such signal into biological responses

Muscle cell response to microgravity

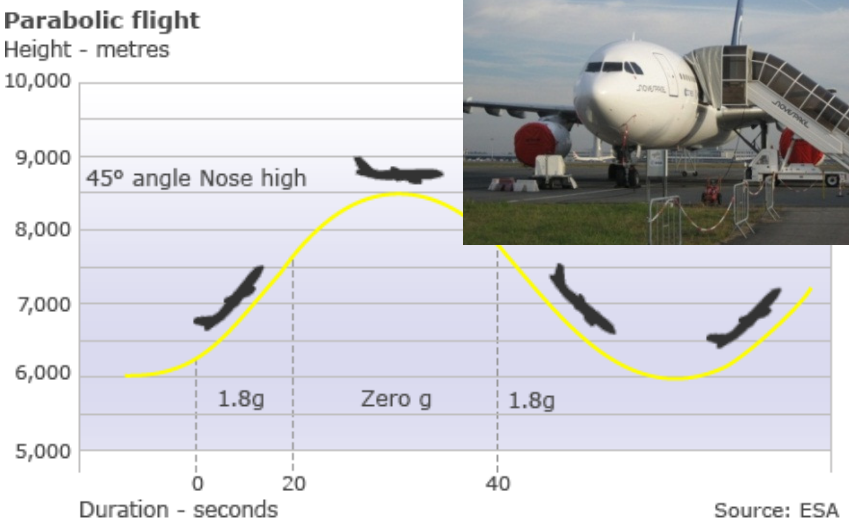


Proliferation of cells



Microgravity responses (A, 1 g; B, µg)

Microgravity platforms used



Video clip