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.

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

- Biotechnology Space Support Center
- 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**
BIOLAB - Multi-user science payload in the Columbus laboratory

- Spectrophotometer and microscope
- Automated storage unit
- Injection mechanism
- Centrifuge
- Glove box
- Cooling unit
- Software
Columbus science laboratory

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

• 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

Proliferaion of cells

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

- International Space Station (ISS)
- Sounding rockets
- Parabolic flights
- Random Positioning Machine

![Parabolic flight diagram](source: ESA)
Video clip