:envihab and the German Life Sciences Program
- Perspectives for Exploration Research -

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German Aerospace Center (DLR)

- German Aerospace Research Center
e.g. Institute of Aerospace Medicine (Cologne)

- German Space Administration (Bonn)
acting on behalf of the German Government (RAÜG) with funding mainly from the Ministry of Economics (BMWi)

  - Definition of the Space Program
  - Implementation of the Space Program
  - International Representation and Coordination
German Space Program
Space for the benefit of Society

Applications
Institutional Costumer / Commercial Market

- Satellite Communication
- Navigation
- Earth-Observation

Science
Basic- / Applied Research

- Microgravity Research
- Extra-Terrestrial Science

Exploring New Worlds

- Exploration robotic
- Exploration manned

Space Technology
- Launcher

Test and Operation Center
- ISS

Industrial and Scientific Capacities

- ISS

Exploring New Worlds

- Exploration robotic
- Exploration manned
Program Research under Space Conditions
- Life and Physical Sciences in Space -

General Goals:

- to gain scientific knowledge
- to open up new application potentials
- to enable exploration
  by utilizing the extraordinary conditions of space, especially microgravity, on ISS and other platforms
Space Life Sciences Priorities

- Exploring Nature:
  - Gravitational, Radiation and Astro-Biology

- Improving Health:
  - Integrative Physiology, Diagnosis and Therapy, Telemedicine

- Enabling Exploration:
  - Biological Life Support Systems,
  - Health and Performance of Astronauts
How do we reach our goals?

- Funding of research in Life and Physical Sciences (universities; research institutes) + in-house research at DLR Institutes

- Development of experiment facilities:

- Flight Opportunities: Drop Tower, Sounding Rockets, Reentry Satellites, Parabolic Airplane Flights, ISS
Analogue Studies: Bedrest, Isolation, and Confinement

**Bedrest Facility at DLR**
Studies ongoing

**Mars500 at IBMP**
500d study ongoing

**SAHC at DLR Cologne**
National study to begin in June

**Concordia Station**
Utilization via ESA ongoing

**Neumayer Station III**
Agreement signed in Nov. 2009; National studies ongoing
National SAHC Study (2011/12)

S. Schneider (DSHS Köln): The effects of artificial gravity on cortical activation patterns

R. Herpers (FH Siegburg): Perception of upright under differing gravity states created by a centrifuge

H. Habazettl (Charité Berlin): Acute effects of hypergravity on the microcirculation

L. Beck (DLR Köln): Haemodynamic and cardiovascular autonomic effects
➢ Enabling Exploration

➢ Maintaining Health, Mobility and Quality of Life on Earth
Enabling Exploration

Two major responsibilities of Life Sciences for enabling exploration:

- Maintain the longterm health and performance of astronauts
  - Immobilisation/bedrest studies
  - Artificial gravity studies
  - Isolation and confinement

Based on the vast experience of the Institute, these studies will be continued and augmented in :envihab – supported by ESA and DLR

- Develop bioregenerative life support systems
Bioregenerative Life Support Systems with Aquatic Organisms (1)

- Phase 1: The CEBAS/Aquarack project (1986-2003)
  Three shuttle flights with the CEBAS Minimodule: STS-89, 90 (1998); STS-107 (2003);
  Research focused on morphology, physiology and development of fish

- Phase 2: The Aquacells/Omegahab project (1998-2012)
  Flights on FOTON M-1, M-2, M-3 and on BION M-1 (2012);
  Research focused on:
  - fish (especially development of vestibular system)
  - microalga Euglena
  - closed gas cycle (O₂ / CO₂)
Bioregenerative Life Support Systems with Aquatic Organisms (2)

- Phase 3: The ModuLES project (since 2008)
  development of a number of modules for research with different organisms to be combined for systems biology and life support;
  first module as result of a detailed user consultation: algal bioreactor

- In addition: project at Univ. Stuttgart to combine fuel cells with algal bioreactor

- Long-standing expertise especially for aquatic systems in science and industry
ACLS: Advanced Closed Loop System

Main functions
• CO₂ Concentration (CCA)
• Oxygen Generation (OGA); Electrolyser
• CO₂ Reprocessing (CRA); Sabatier
• Water Management (support function)

ASTRIUM project funded by ESA
envihab as chance to combine the expertise of the DLR Institute of Aerospace Medicine, of the German National Space Program as well as of German Industry
Industry
Technology development, Strengthening business place Germany

Terrestrial Application
isolation, ecosphere, resource protection, in-situ-analytics and monitoring, effective recycling, etc.

Spaceflight / Exploration

Level 3
Complete system (closed loop)
Regenerative life support system

Level 2
Subsystems, functional test and demonstrator units (for envihab, ISS, parabolic flight etc.)

Level 1
Research units/ -elements

Projects
Coordination
Space Administration
Modules, interfaces, sensor-, and control technique

KP-ME
Crew, test subjects

RD-RW
(FuW)
Modules for biological research

RD-RM
Physico-chemical, systems

CROP
Crew
Others

High press. electrolyser
Photo catalyster
Biogas reforming
:envihab and the German Life Sciences Program
- Summary: Perspectives for Exploration Research -

:envihab will become important facility for ground-based studies of

- Long-term maintenance of health and performance of astronauts as well as of health, mobility and quality of life on Earth
- Bioregenerative Life Support Systems as well as
- for Education and Outreach activities

Thanks for your attention!