Space Biological Experiments Subcommittee

Construct a democratized space biological experiment platform using satellite payloads from Japan

- Leader Company　IDDK Co., Ltd.
- Representative　Soichiro Ueno (IDDK CEO)
- Leader　Wataru Ikeda (IDDK CSO)
- Social Issues　All biotechnology fields

BiocK
Biocommunity Kansai

Benefits and Significance of Space Biological Experiments

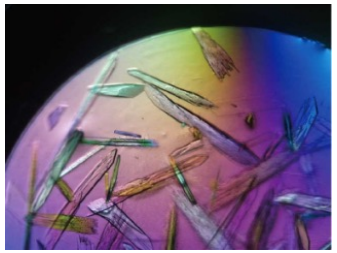
Benefits

Existence of experiments that can only be established in a microgravity environment.

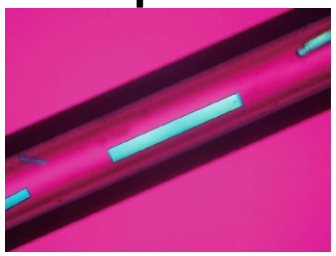
▶ The potential for space to become a suitable place for production and manufacturing.

<Protein Crystallization>

Ground



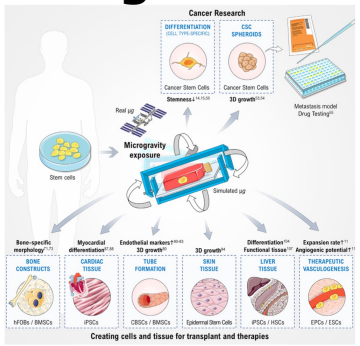
Space



High-quality protein crystals can be obtained in a microgravity, enabling high-resolution X-ray structure analysis.
Ex) Muscular dystrophy drug, anti-influenza medicine, EGF receptor inhibitor etc.

https://humans-in-space.jaxa.jp/kibouser/pickout/72802.html

<Organoid>



Some organoids have been reported to form only in a microgravity. These studies have the potential for generation of the transplant materials for regenerative medicine and for drug screening in pseudo-pathological tissue.
Ex) Bone, cartilage, vasculature, heart tissue etc.
Based on these achievement, Prometheus Life Technologies was founded in Switzerland in 2023.

Grimm et al., Stem Cells Translational Medicine, 2020

Significance

Space Biology : Astrobiology (Exobiology) such as the origin of life. Research related to food and resource productions using organisms in space.

Space Medicine : New medical research for manned space activities.

▶ Returning technology to the earth.

Most Important Significance

Fundamental research and development in the space environment and its application to support various space missions in the future

Contribution

The maintenance and improvement of QOL for space life.

・Accumulation of knowledge for medical care
・Things that can be used in space
・Production and supply independent on the earth

Current Status and Future Challenges

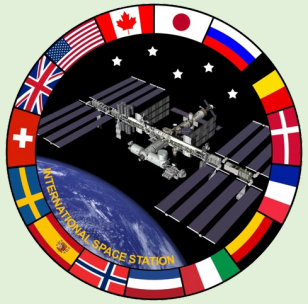
Future Space Mission Trends:
・Full-scale civilian space travel
・Artemis Program
1,000 people stay on the moon in 2040 on the assumption
・Full-scale manned Mars Mission

The challenge of extreme environments
→Expansion of human life sphere

To achieve future space missions, there are many issues that need to be resolved through research in the space environment

However, the ISS will be retired, and post-ISS commercial space stations cannot be expected to have significant scalable research capacities

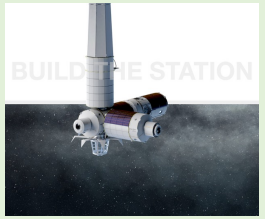
Current:
International Space Station (ISS)
The only space experiment environment

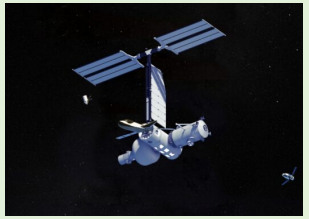


NASA JAXA esa

Retired in 2030

Future:
Commercial Space Station A
Commercial Space Station B
・・・
NASA led 4 candidates





As a method of significant increasing the number of places and opportunities for space biological experiments, construct a democratized space biological experiment platform using satellite payloads from Japan

JAXA led research in Japanese Experiment Module (JEM)

Japan will build only an experiment module (exclude Life support function)

“Micro Bio Space LAB” Concept by IDDK

IDDK develops and manufactures fully automated bio-experimental units with the smallest unit (approx. 10-cm cube, less than 1 kg) according to user needs. Main technology of IDDK is “Micro Imaging Device (MID)”, an ultra-compact semiconductor sensor-based microscopic observation device. The unit will be installed as a satellite payload for our space transportation service partner to provide microgravity and space radiation environments in low earth orbit. Capsule return of the payload will also be performed after the operation. FY2024 Demonstration test of our unit; service will begin in 2025. The target is to launch 60 units per satellite once a month in the future (the number of experiments per unit depends on the mission content), at a cost of 3.5 million yen per unit. The ISS is manned, therefore experiments are limited by strict safety standards, but this platform has the advantage of being able to conduct a variety of experiments.

MID core-unit

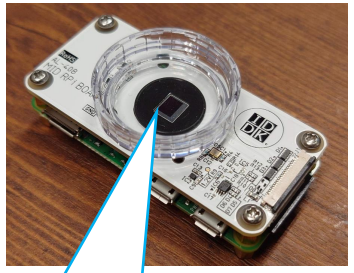
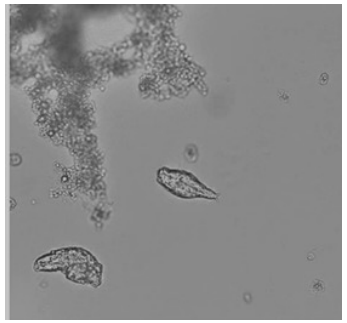
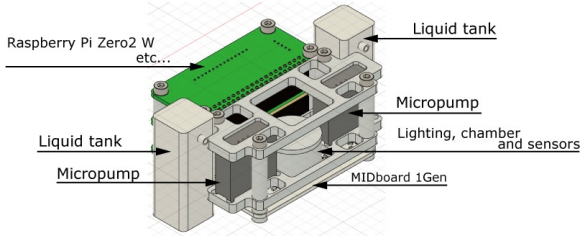


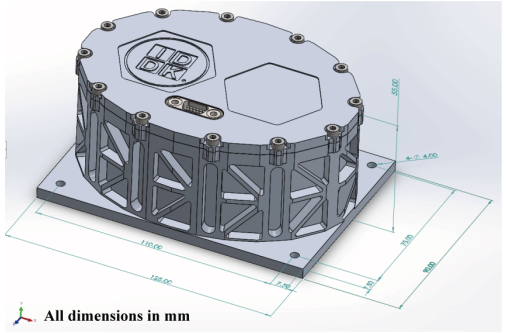
Image data by MID



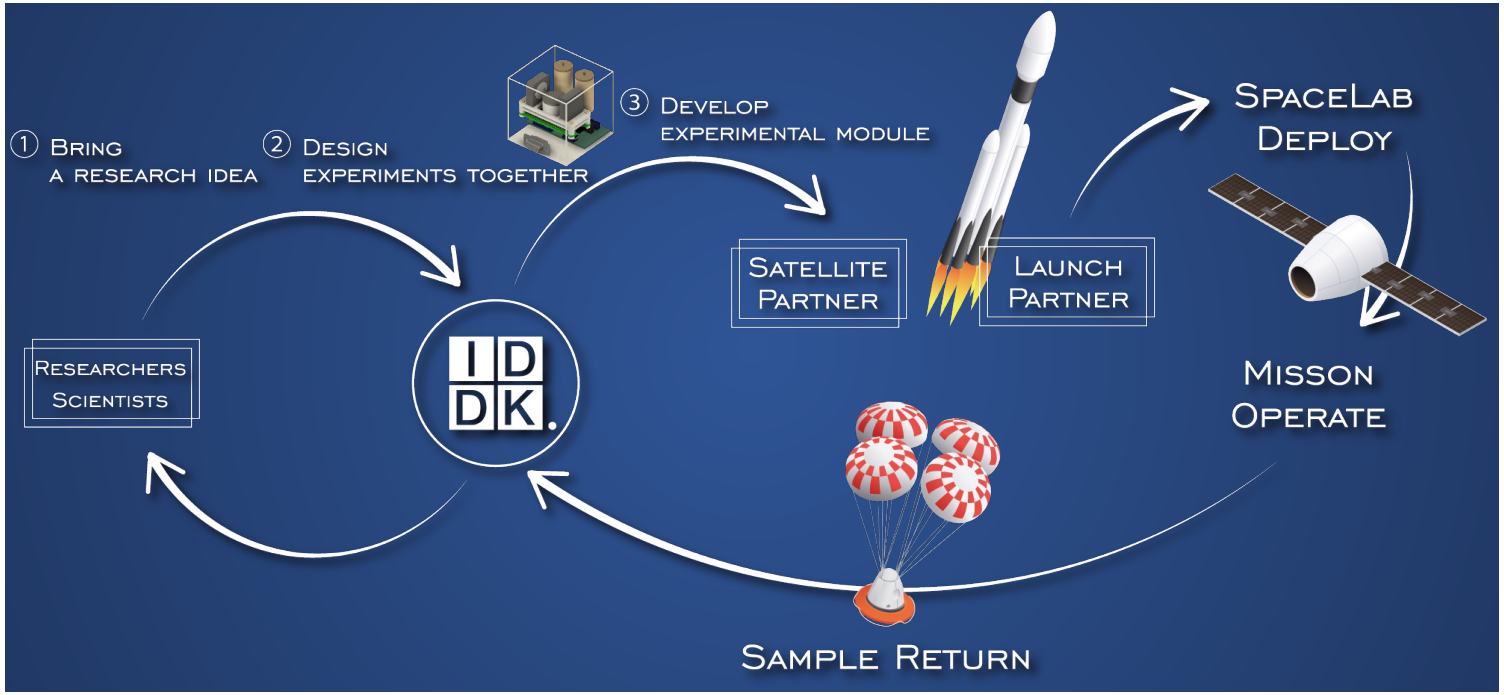
Inside of experimental unit



Exterior of experimental unit



One-stop shop service by IDDK



Vision and Mission of Subcommittee

Construction of Space Biological Experiment Platform

① Solving the technical issues for fully automated bio-experimental units for space

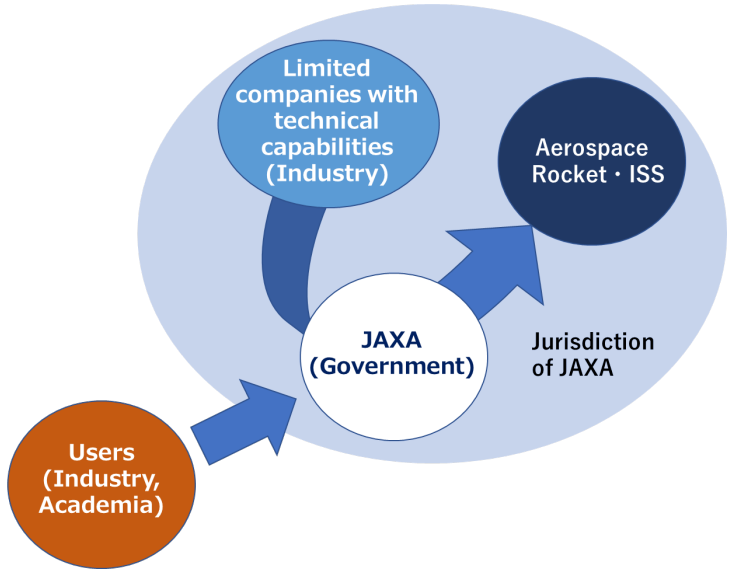
To respond various user's needs, academia experts and companies with proprietary technologies will collaborate to develop technologies that can respond to various space bio experiments under an all-Japan framework.

② Progression and Activation of Space Biological Experiments in Japan for Academia

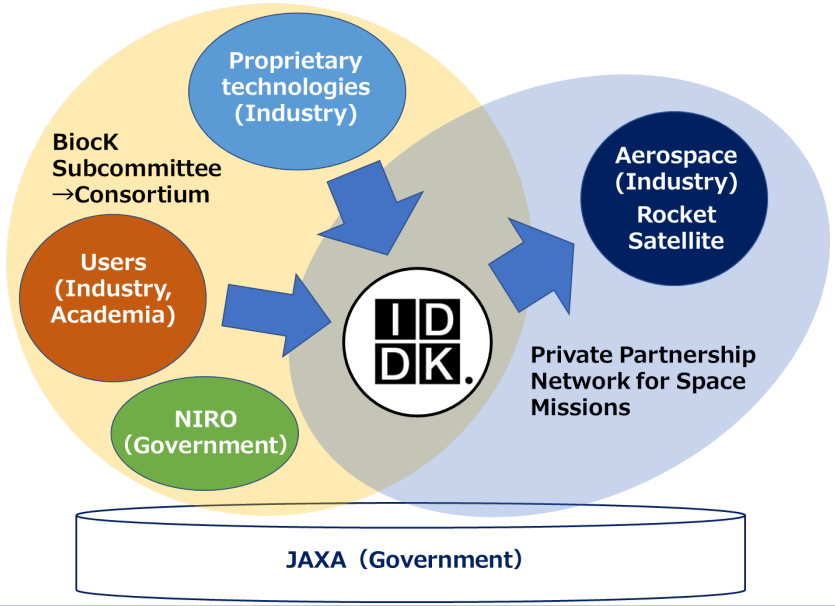
Japanese academia has mainly relied on JAXA now. They will lose opportunities to use commercial space experiment platforms, which will develop in the future and will fall behind the rest of the world without a breakthrough in the issues. The subcommittee will attempt to obtain large budgets or funds for their activation.

③ Establishment of Next-generation Research system

Current JAXA-centered research system



Next-generation research system



Action Plan

	2023	2024	2025	2026	2027	2030
ISS operation			● Reach the time limit for new mission and equipment			● Retirement →Commercial station
Micro Bio Space LAB Service	Start entry: Research hearing and feasibility study					
		Development of prototype unit for ground and demonstration experiments				
			Development of mission unit for space			
				Demonstration in space and service start Ahead of ISS retirement in 2023		
Issues that surfaced:			Development of option products for space according to advanced research needs	Research funds for using private services		Necessity of transition from public demand to private demand
Space Biological Experiments Subcommittee			Membership: academic experts, industrial engineers etc. Hold purpose-specific WGs and solve issues			Forming a consortium to lead Japan's space bio-experiments
				Technology WG: Vision & Mission ① → Develop products for space → Convert to general-purpose products for ground		
				Research funds WG: Vision & Mission ② → Support acquirement the funds → Revitalization by Acquisition of Large Budget		
				Research system WG: Vision & Mission ③ → Creation of a private-sector-led research system		

OSAKA, KANSAI, JAPAN EXPO2025