JAXA Cooperation Activities with Asian Countries on Kibo/ISS Utilization through APRSAF

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Japan Aerospace Exploration Agency

United Nation/Malaysia Expert Meeting

Basic Space Policy

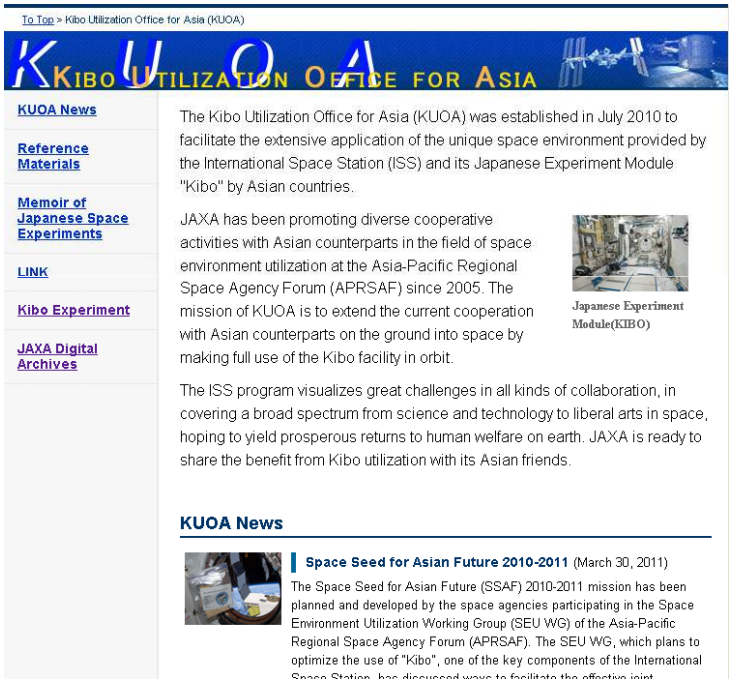
....as the only participant in the International Space Station Program in Asia, the Government will promote international cooperation with Asian countries by providing them with the opportunities to use “Kibo” for experiments.

by the Strategic Headquarters for Space Policy
“Basic Plan for Space Policy – Wisdom of Japan Moves Space –” June 2, 2009

KUOA

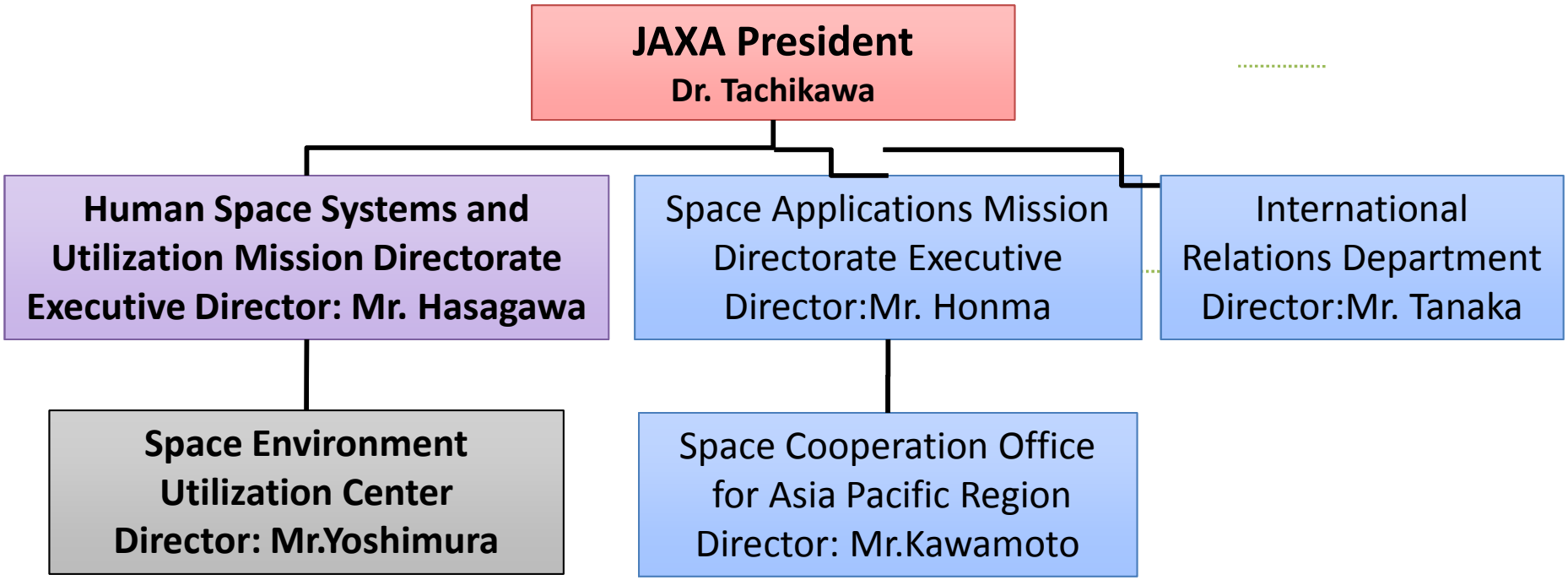
“Kibo” Utilization Office for Asia

KUOA was established under the Space Environment Utilization Center, Human Space Systems and Utilization Mission Directorate of JAXA in July 2010, to facilitate Kibo utilization by Asian countries.



http://iss.jaxa.jp/en/kuoa/

KUOA



- Kibo Utilization Planning
- Kibo Utilization Project Promotion
- Space Experiment Mission Group (Integration , Payload Dept. ,Ops)
- EF Payload Mission Group (Payload Dept)
- **Kibo Utilization Office for Asia**

What is Kibo Utilization?

- To obtain beneficial results from activities optimally utilizing the unique environment of the Kibo module.
- These activities include education, culture and life sciences as well as technological challenges and research in natural sciences.
- The unique environment of Kibo includes, microgravity, cosmic radiation and isolated closed conditions.
- The ability of ***mission integration***, namely making various components work together, is vital.

The Road to Joint KIBO Utilization

- Establishing a local system to conduct space utilization.
  - Promotion of the user community
  - A publicity campaign
  - Building capability on ***mission integration***
- Balanced and mutually beneficial cooperation
  - Shared opportunities and information
  - Implementation under a bilateral agreement

APRSAF

- The Asia-Pacific Regional Space Agency Forum (APRSAF) was established in 1993 to enhance space activities in the region.
- APRSAF currently organizes four working groups: Earth Observation, Communication Satellite Applications, Space Education and Awareness, and Space Environment Utilization

Kibo utilization cooperation is discussed at the Space Environment Utilization Working Group (SEU WG)

18th APRSAF is scheduled on December 6 through 9 in Sigapore.

17th APRSAF 23-26 November 2010 in Australia

SEU WG of APRSAF

- Introductory sessions on space environment utilization were held at the 8th and 9th APRSAF
- The Space Environment Utilization Working Group (then called ISS WG) meeting was held at the 12th APRSAF, in 2005
- JAXA announced the possibility to conduct joint utilizations of Kibo with Asian countries.
- Space agencies in Malaysia, Indonesia, Thailand and Vietnam expressed their interest, and JAXA dispatched its first delegation to these countries in 2006

Asian “Kibo” Mission Planning Task Force

- The task force was first established under the SEU WG of APRSAF, in 2008 to manage students’ parabolic experiment program, and obtained good results.
- The mission of the task force expanded to cover the planning of joint missions utilizing Kibo in education and outreach fields, as well as scientific and technological research.
- “Space Seed for Asian Future” is the first space mission planned by the task force.

Students' Parabolic Experiments

- Utilizes 20 second microgravity produced by parabolic maneuvers of aircraft.
- Students' proposals are examined by a task force attached to SEU WG of APRSAF
- Students are given advice to improve their experiments
- The task force identify eligible proposals as flight candidate experiments
- More than 20 students in 8 teams from Malaysia and Thailand have participated in the program since 2006

Students in Parabolic Experiments

Parabolic Experiment Outcome

- Students expressed their creative and innovative ideas.
- The experience had a beneficial effect on students' career development.
- Space agency officers gained space *mission integration* capability.
- Japanese students were also stimulated through the program with foreign students.

Space Seed for Asian Future

- Plant seeds from Indonesia, Malaysia, Thailand and Vietnam are sent to Kibo. The retrieved seeds were distributed for science, education and outreach purposes.
- The mission was proposed at the task force's web conference and developed into the first joint Asian Kibo utilization.
- Task force members selected their own plant species, the seeds of which are to be flown into space.
- A mission logo was designed by the task force members.

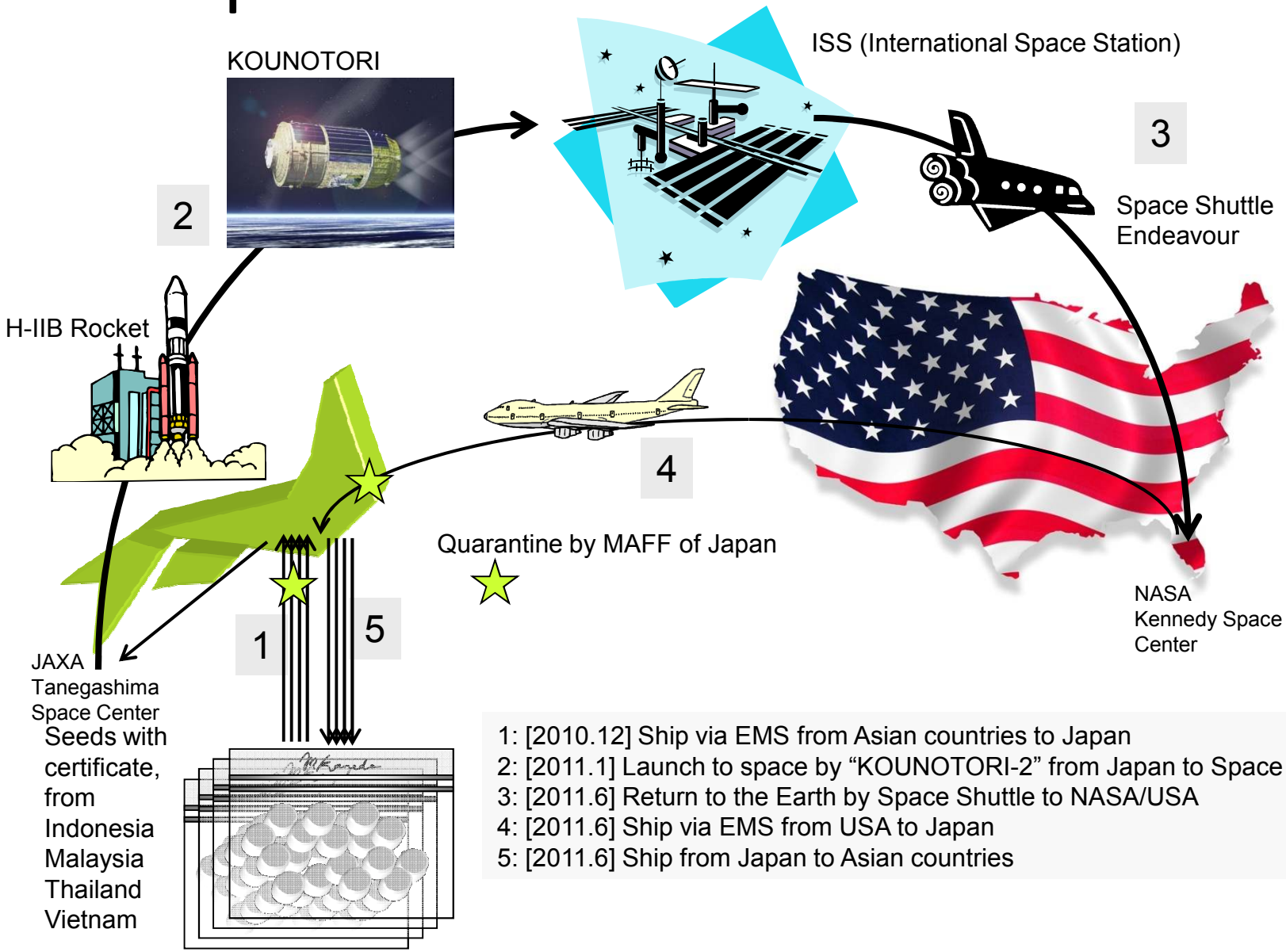
Space Seed Mission Logo

Asian Seeds in Kibo

ISS027E008229

JAXA/NASA

Transportation Route of Asian Seeds

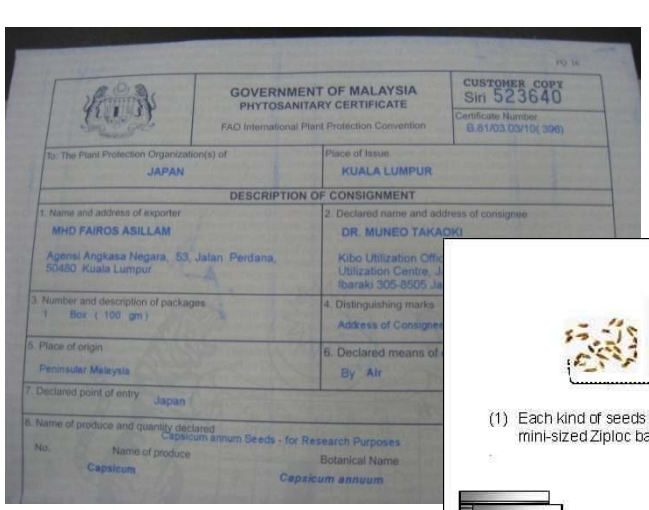


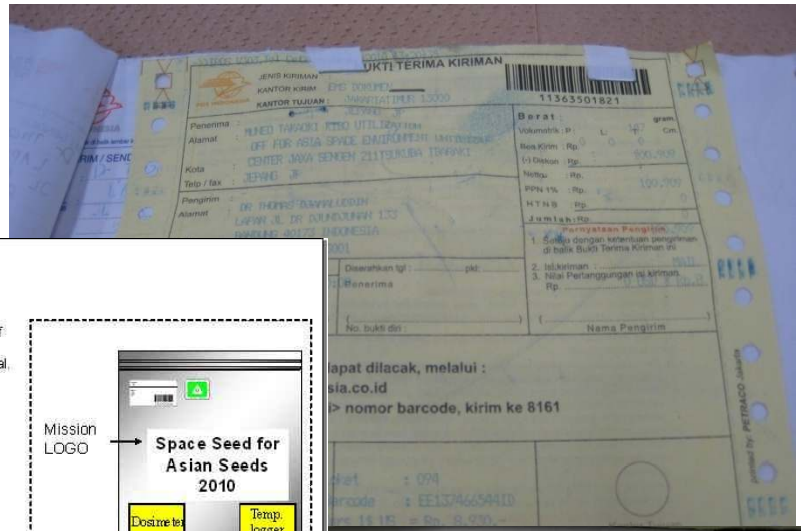
1: [2010.12] Ship via EMS from Asian countries to Japan
2: [2011.1] Launch to space by “KOUNOTORI-2” from Japan to Space
3: [2011.6] Return to the Earth by Space Shuttle to NASA/USA
4: [2011.6] Ship via EMS from USA to Japan
5: [2011.6] Ship from Japan to Asian countries

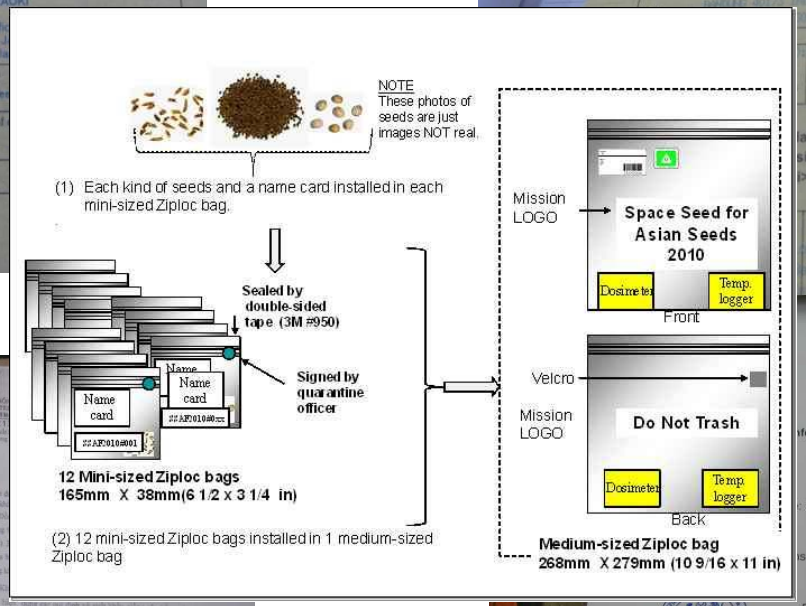
Lessons Learned from Space Seed

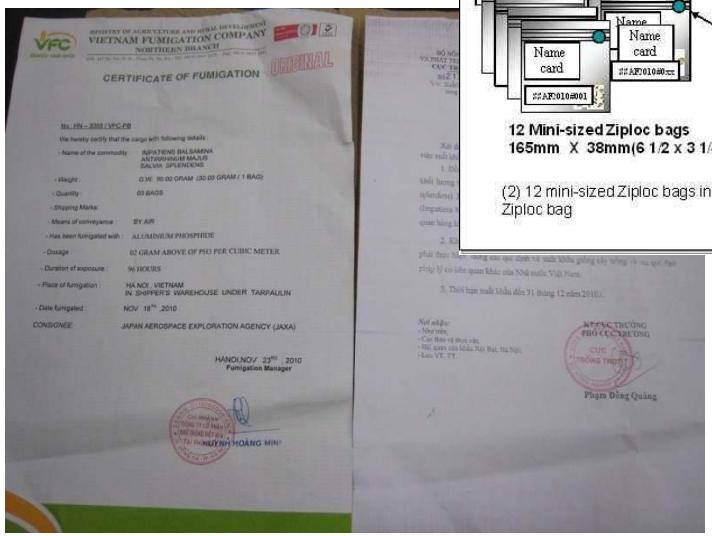
- Participants recognized the importance of *mission integration*, finding that sending plant seeds into space was neither simple nor easy.
- The mission contains components which require wide-ranging specialties, in addition to space technologies.
- The *mission integration* had to cover plant physiology, phytosanitary certification, CITES, import-export regulations, and many other specialties.

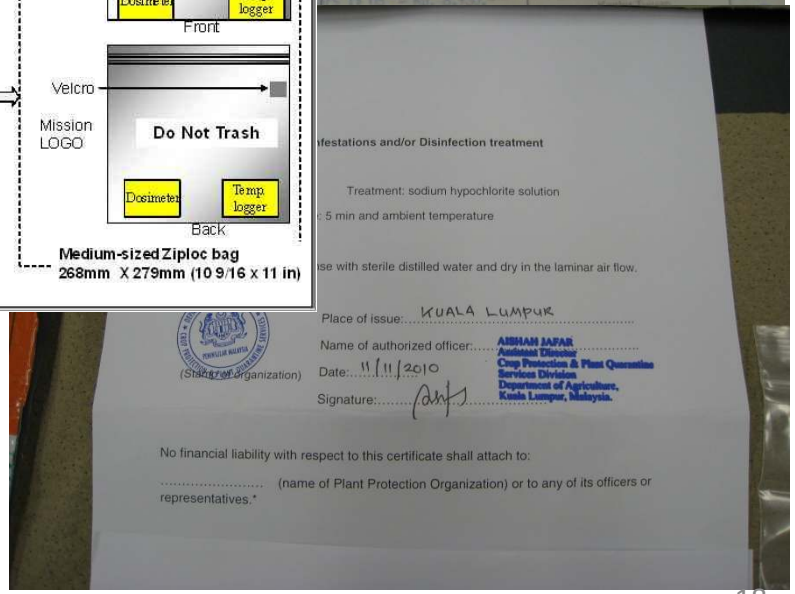
Documentation on Seeds











Malaysian Protein Crystal Experiments

General Objective

- To obtain high quality proteins crystals of industrially important enzymes under a microgravity environment for more precise protein 3D structure.

Specific Objective

- To study the crystal growth behavior of industrially important enzymes on earth.
- To study the effect of microgravity on the crystal growth behavior of industrially important enzymes.
- To solve the 3D structure of selected enzymes
- To integrate the 3D crystal structures obtained on earth and in space

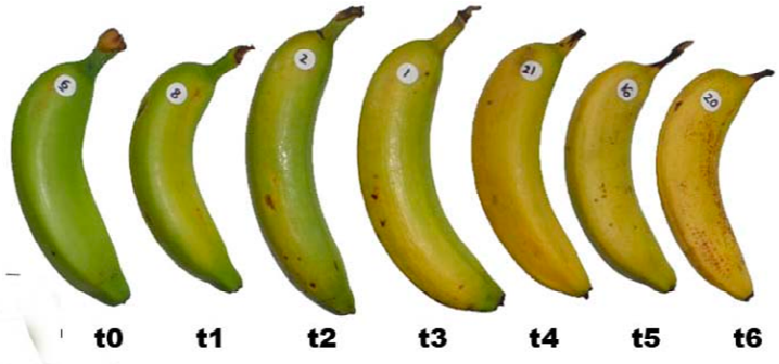
Joint Feasibility Studies

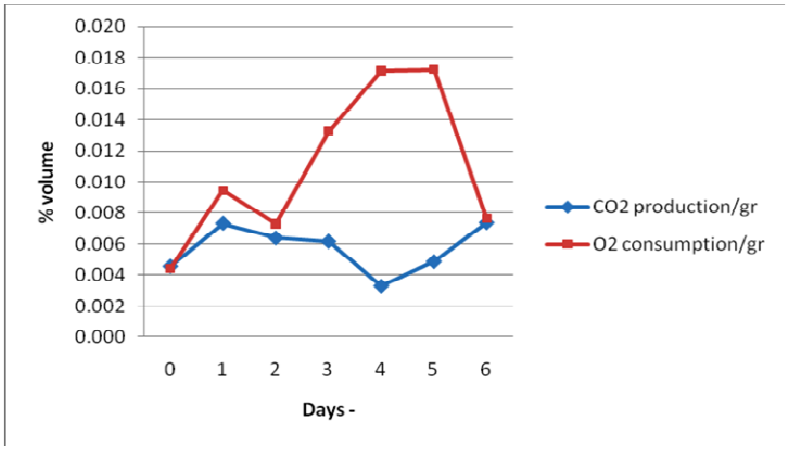
- The Korean space agency, KARI, invited space experiment proposals.
- JAXA and KARI are conducting a joint feasibility study to develop experiment hardware which will be utilized by researchers from both countries
- JAXA and LAPAN are conducting a joint study to develop an idea into a feasible space experiment proposal.

Joint Feasibility Studies

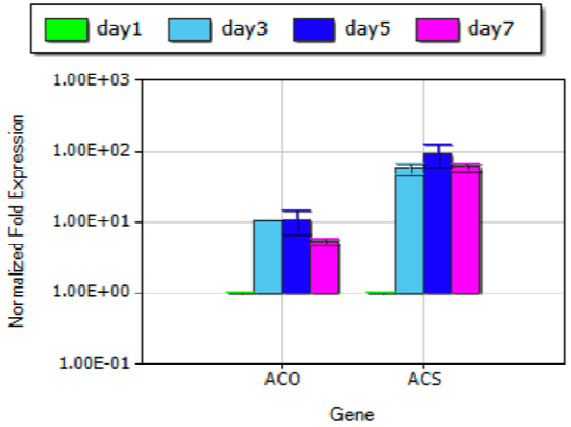
- Refinement of the experiment plan to demonstrate:
  - Justification for the experiment purpose
  - Necessity for implementation in space
  - Hypothesis and validation methodology
  - Requirements for experimental equipment in orbit
- Selection of a candidate experiment based on the results of the feasibility study..
- Establishment of the framework, implementation plans, roles and responsibilities.

Do Fruits Ripe Differently in Space?





CO_2 production and O_2 consumption during fruit ripening



Normalized MaACS and MaACO genes fold expression during fruit ripening using qPCR

by Dr. Fenny M. Divan, ITB

by Prof. Khairurrijal, ITB

3D Clinostat by LAPAN/ITB

2-meter/0.6-second drop test tower constructed by JAXA

ISS will contribute the earth observation as well.

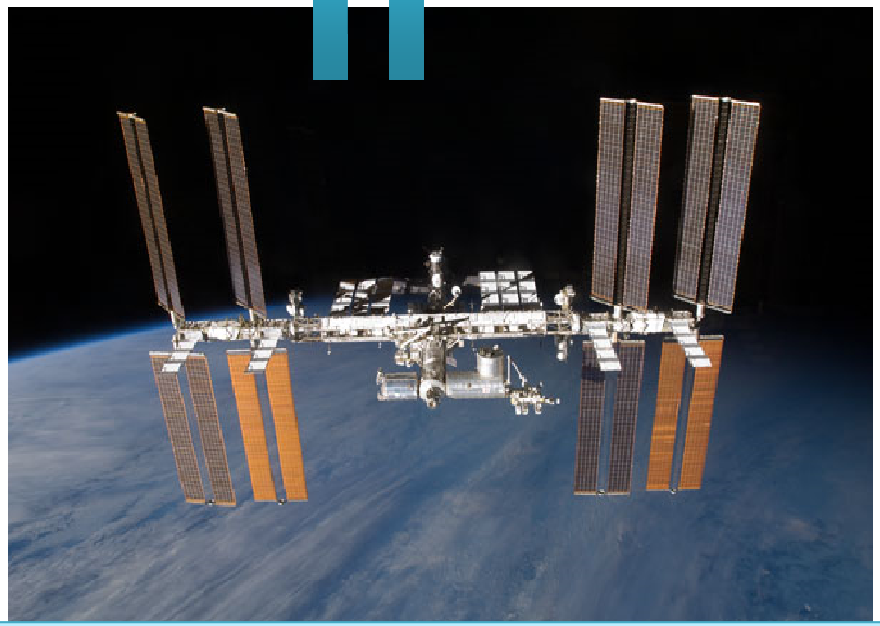
Earth observation missions aiming to resolve global environmental and climate change issues using external sites of ISS such as Kibo Exposed Facility.

Live broadcasting from astronauts onboard ISS

Earth observation data broadcasted from ISS to the world

Eruption of a volcano in Russia
(taken by Astronaut Wakata)

Flood in Thailand



"Geosphere observation and diagnosis station"

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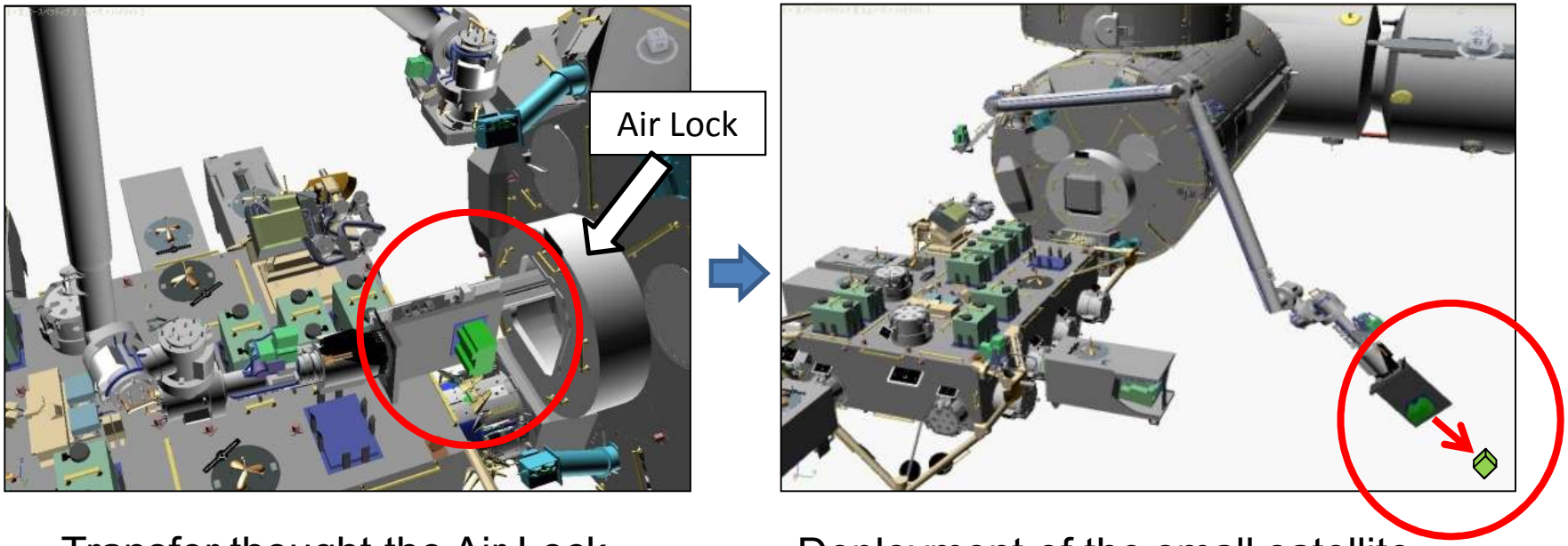
Small Satellite Deployment from Kibo

JAXA is now developing a new system to deploy some small satellites by KIBO Robotic Arm. This system will be demonstrated in 2012.

(1) The small satellite will be launched with pressurized payload contained in the soft bag. This will relieve the satellite launch condition.
(2) The small satellite will be checked by crew and transferred though the air lock to the outside.
(3) The Kibo Robotic Arm will take and deploy it to the planed trajectory to space.



Transfer thought the Air Lock

Deployment of the small satellite

Promotion of the User Community

- The first Japan-Korea Joint Seminar on Space Environment Utilization Research was held in 2004 at the Tsukuba Space Center.
- Annual meetings have since been held alternately in Japan and Korea.
- The Malaysian space agency has held microgravity science workshops.
- JAXA has sent experts to Indonesia, Malaysia, Thailand and Vietnam to deliver lectures

Toward Future Cooperation

- Space utilization is a synthetic project. Even a simple experiment requires extensive efforts, especially in *mission integration*.
- Experiencing space utilization promotes human capital development in the relevant field.
- The introduction of innovative concepts from an Asian cultural background is expected.
- JAXA anticipates friendly rivalry with its Asian counterparts to optimally exploit the Kibo potential.