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FOR YOUR EXPERIMENT

ICECUBES
SPACE APPLICATIONS SERVICES

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INTERNATIONAL COMMERCIAL EXPERIMENT SERVICE

Making access for space research fast, simple and affordable

Our expertise for your experiment

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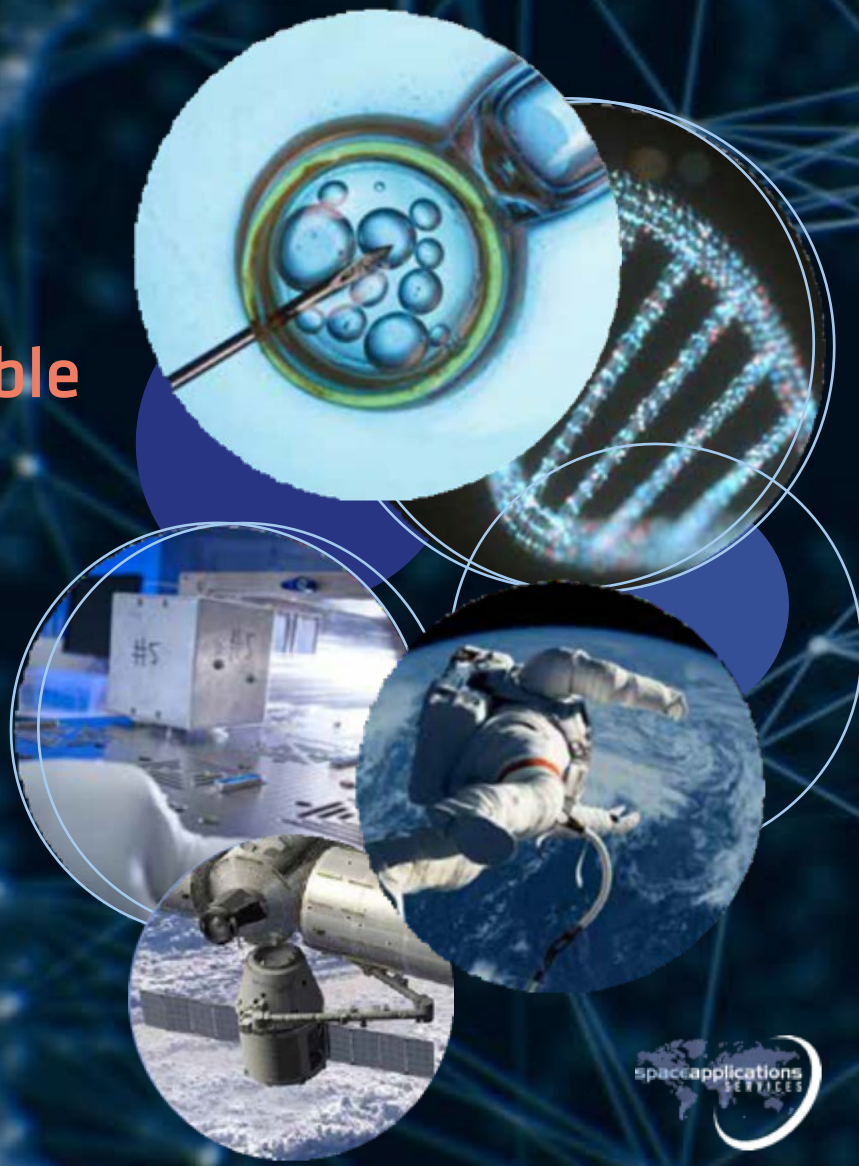
What is ICE Cubes?

International Commercial Experiment Cubes service

Provides fast, simple and affordable access to space

For your practical space project in
research,
technology,
STEAM,
capacity building.

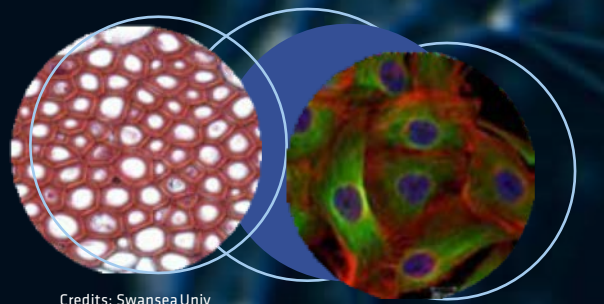


Why ICE Cubes in ISS? Why Microgravity?

Micogravity as a scientific tool

> Fluids, Foams
> Materials
> Proteins
> Nano particles

> Micro biology
> Medicine
> 3D Tissue engineering



Credits: Swansea Univ

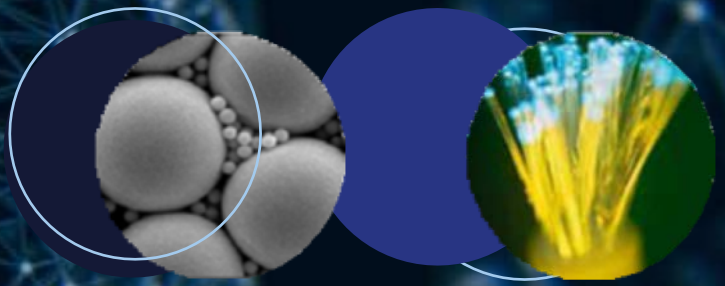
Credits: NASA

Micogravity for technology demonstration

> Future technologies
> Commercial products

Micogravity as a strategic business tool and research advantage

> Biotech
> Agriculture
> Food
> Pharmaceutical
> Petroleum
> Cosmetics

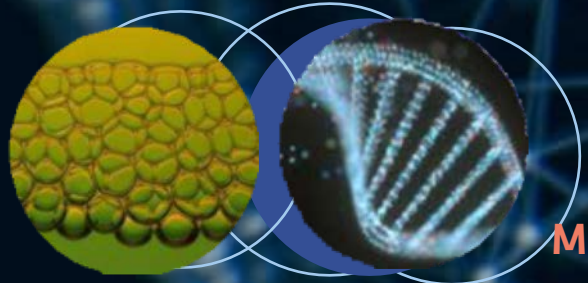


Credits: ESA

User

Micogravity as a manufacturing resource

> Medicines
> Optical fibre
> Organs



Credits: GRASP, ULG

Microgravity as STEAM resource

How ICE Cubes?

How ICE Cubes?

=> Allows any organization to directly develop and conduct their innovation project in space

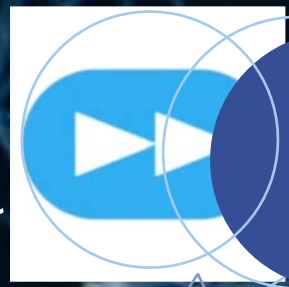
=> Fast: 9 to 12 months to launch for new setups and faster for recurring setups.

⇒ Simple & direct: processes streamlined and unique point of contact. Service takes care of: certification, safety, manifesting, interface testing, interface with agency & launcher,...

=> Regular launches: 3 times per year, every ~4 months. The ICE Cubes service can provide for return from space

⇒ Real-time interaction with space experiments. Users are provided with the tools to create their own control center. High data rate (downlink up to 4Mbps).

⇒ Catalogue of space-qualified H/W. Commercial-of-the-shelf H/W & adaptations



How ICE Cubes?

Standard Service includes:

> Basic Experiment Cube development guidance,

> Interface testing

> Arranging experiment certification,

> Launch

> On-orbit installation

> Standard type operations support

Additional Service can include:

> Engineering support for mission success

> Hands-on training possibility

> Conditioned stowage

> Return of the hardware

> Late access to launch vehicle

> Early access to return vehicle

> Dedicated crew activities

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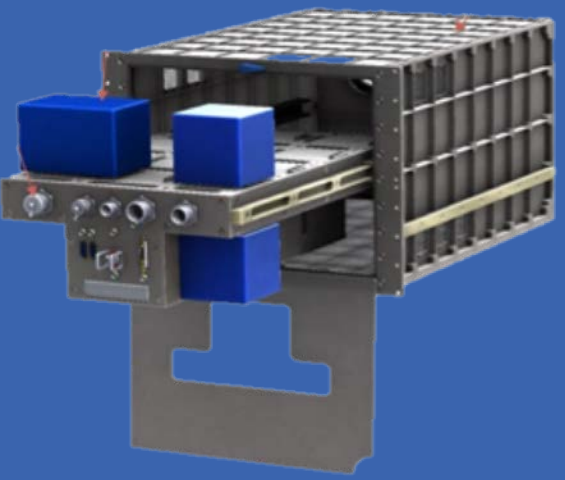
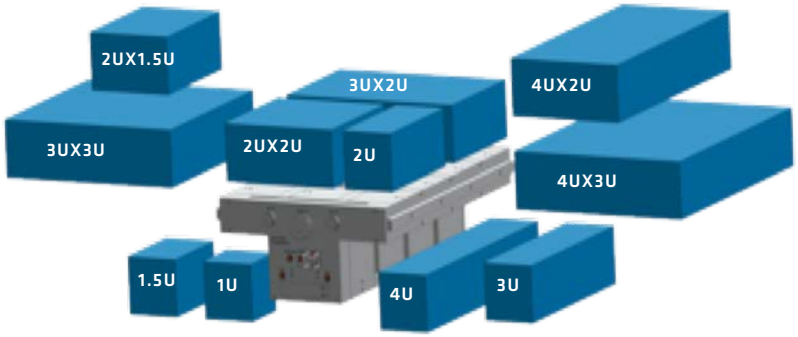
How ICE Cubes on ISS?

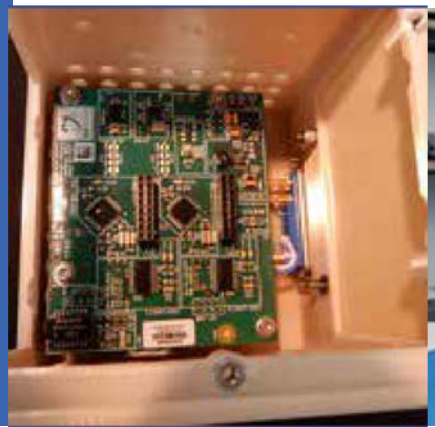
Experiment Cubes using one single connector for both power and data



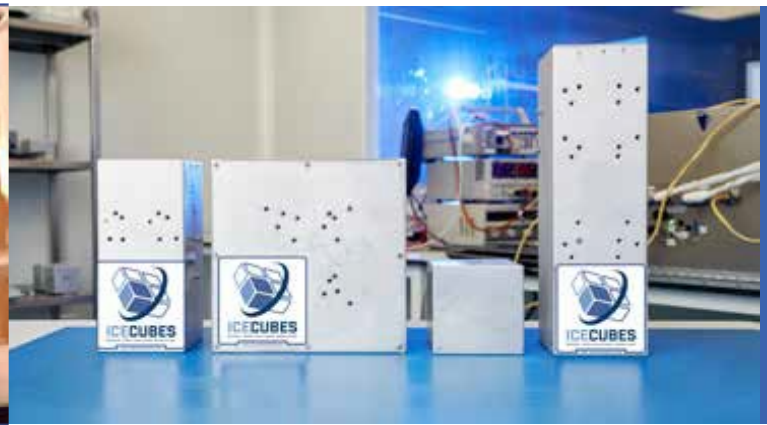
Size of the Experiment Cubes set to mimic **the CubeSat standard,** i.e. 10x10x10cm (1 litre) for a 1U Cube, 20x10x10cm for a 2U Cube, etc, with a **max of ~45 x ~35 x ~30cm**



Modularity
Flexibility
Standard interfaces



Cube 0 for testing



How ICE Cubes on ISS?

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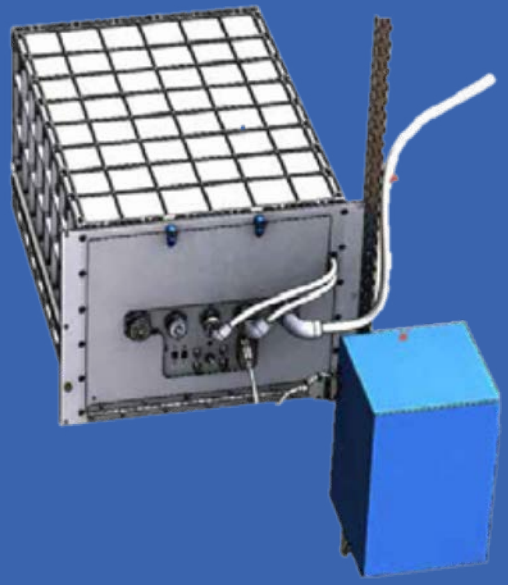
Credits: NASA Spheres



External Wired
Experiment Cubes

External Wireless
Experiment Cubes
(images courtesy ESA-NASA)

Credits: NASA Astrobee

Modularity
Flexibility
Standard interfaces

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ICE Cubes - Real-time interaction

> ICE Cubes Mission Control Centre powers on-off the various experiments and opens the communications lines

> Users directly interact with their experiments from their premises via Internet

To control their Experiments, users are provided with an out-of-the-box software suite composed of VPN client, FTP client, Web browser, Mission Control System client and User Manual

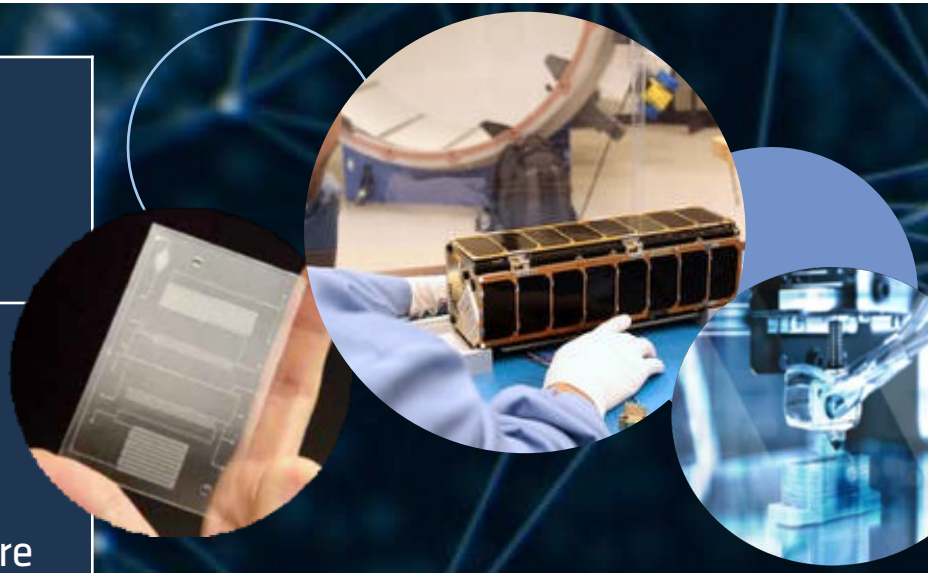
ICE Cubes – Use cases / areas

Needs of final user:

Demonstration and validation of technologies, processes and systems in relevant space environment

Examples:

- Heat exchangers / heat pipes
- Radiation hardened electronics
- High performance computer systems / miniature space computers
- Delay-and disruption-tolerant networks testing
- Autonomous navigation capabilities / autonomous rendezvous & docking / constellation flying
- Miniaturized space robotics and servicing



Needs of final user:

Validated space technologies for cubesats / satellites

Key features of solution:

Use space environment (with standardized form factor) to validate space technologies to raise TRL level

ICE Cubes – Use cases / areas

Needs of final user:

Reduction of pre-clinical testing time for drugs

Create infrastructure and operational flow allowing to test drugs in a relevant environment not possible on earth

Generation of value :

Faster drug testing

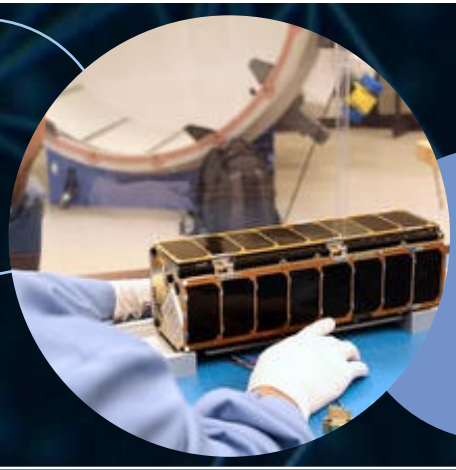
Needs of final user:

Produce plants with highest nutrient density / produce food with highest lifetime

Use space environment to iteratively select those plants / seeds with most optimal characteristics. Research on food stability

Generation of value :

Address food availability & lifetime



Needs of final user:

Manufacturing technologies and new materials

Key features of solution:

Use space environment for manufacturing and novel materials, e.g.:

- 3D printer validation in space

ICE Cubes - funding possibilities

- Space Agencies or institutional funding
- Collaborative setups
- Collaborations with companies
- Sponsors
- Crowdfunding
- Etc…

ICE Cubes - Future Evolution

Internal ISS Experiments

> Specialized sub-facility labs with diagnostic capabilities

> Crew interaction application
s

External ISS Experiments

> Facility for exposure and deployment of external payloads

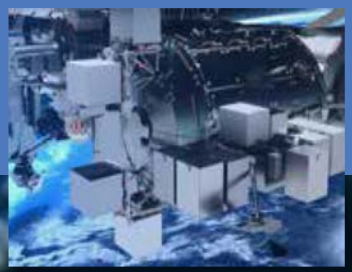


Image Courtesy of Airbus DGS

Free flying and sub-orbital Experiments

> Facility for pressurized payloads in e.g. Dream Chaser, Space Rider,...

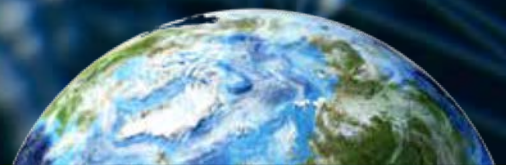
> Facility for utilization in balloons and/or Sounding Rockets

Image Courtesy of Siera NevadaCorporation

Post ISS and beyond LEO

> Possible collaborations with commercial platforms

> Possible commercial exploitation of the Cis-lunar Station



ICE Cubes Service - Summary

Enabling end-to-end service

Fast, simple, direct

Regular launches

Long-duration, high-quality microgravity

Flexible and modular accommodation

Real-time interaction capability

Return possibility

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