EDEN ISS – Frequently Asked Questions (FAQ)

What is the EDEN ISS project trying to achieve?

The goal of the project, is to bring technologies closer to flight-readiness for building sustainable bases on the Moon and on Mars. A greenhouse is foreseen, for use by astronauts, to cultivate their own fresh fruits and vegetables beyond terrestrial grounds.

The cultivation system being built in EDEN ISS, is unlike systems used today in greenhouse horticulture. The main reason is based on the 'closed' aspect of the system, meaning that all resources needed to grow the plants are coming from within the facility itself, including air, nutrients, water and energy.

Why is the EDEN ISS Mobile Test Facility going to Antarctica? How will it serve the Neumayer III Station?

Antarctica is an extreme harsh environment and is hostile to human beings. It is cold, far from civilization and isolated. The EDEN ISS project can be compared to the ISS and other space missions because the equipment and scientific payloads are similar in which to face harsh environments and limited resources.

When the two container EDEN ISS system can function properly in the extreme Antarctic climate, it will provide researchers with knowledge supporting sustainable farming practices that are not necessarily dependent on 'arable land,' as is largely the case today. When the EDEN ISS greenhouse supports the growth of safe and quality food in Antarctica, it will be a pointer towards what is also possible in the future. Not only, does the human race come closer to living on a planetary body other than Earth, but also, the increasing population of the world can be fed right here on Earth.

The EDEN ISS greenhouse will serve crew members of the Neumayer III Station, providing them with fresh vegetables and greens. Because missions of this type normally do not support the provision of fresh food, the EDEN ISS team expects that this improvement in diet and food variety will also positively support their psychological well-being.

What kinds of plants will be cultivated in EDEN ISS?

EDEN ISS focuses on the cultivation of fresh vegetables with high water content, which cannot be stored for a long period without compromising the quality. More than 15 different crop species are selected for the experiment campaign in Antarctica. There are three tall growing plants (tomato, pepper and cucumber), three different types of lettuce (two green, one red leaf), radish, spinach, a variety of herbs (basil, chives, parsley, mint, coriander) and strawberry. Seeds from a number of add-on crops, crops that are not part of the current production plan, will be taken to Antarctica as well. Among those are cabbage, cauliflower and red beet.

What do plants need to grow well in a semi-closed loop greenhouse?

Optimal light and temperature are essential for plant growth in a semi-closed loop greenhouse, as is the control of nutrients and humidity.

Light is the primary requirement of plants and is essential for the photosynthesis process, in which plants use light energy and CO2 to make sugar, the building material for plant growth and fruit production. Light must be uniformly distributed over the plants, so that all plants grow equally.

A temperature between 20-25°C is ideal for supporting plant physiological processes like photosynthesis, enzymatic processes, water transport and transpiration. Heat in a semi-closed loop system is generated mostly by the light source.

In a semi-closed greenhouse, it is important to monitor and control humidity. Plants transpire large amounts of water, as they absorb light and heat from the atmosphere. When possible, reclaimed water should be recycled to conserve the (often) limited amount of water within the system.

A nutrient solution is of utmost importance. Its distribution must be finely balanced to minimize recycling of excessive applications.

How will the plants be cared for?

Plants are grown in trays, fixed in a covering on the surface of the trays. The root systems of the plants are exposed under the tray.
An aeroponic system is used to supply plants with essential nutrients, using a spray system of application directly at the roots. Excessive nutrient solution is drained for re-use.

Grow trays are stored as shelves in the semi-closed greenhouse, under a light source of LEDs. The LEDs provide a mixture of light colors essential for plant growth. Temperature is controlled and based on a day/night regime, with a slightly higher day temperature.

In Antarctica, the plants will be cared for by a crew member. For extraterrestrial applications however, a big component of operations, is the control of scientific payloads in space, directly from Earth. When processes are well-designed, when all tasks are defined and assigned to a responsible party, when procedures are in place, and the right tools are available, many missions can be carried out from a great distance. Plant samples generated by the EDEN ISS project in Antarctica will be shipped to partner institutions in the European Union for research and analysis purposes.

Is the food that is grown in semi-closed loop systems safe to eat?

Partners within the EDEN-ISS consortium, CNR and Limerick Institute of Technology, work to ensure that the food produced in the EDEN ISS project is of high organoleptic and nutritional quality and is safe to consume.

The microbial load (including E. Coli and Salmonella) of different plants and surfaces within the greenhouse will be monitored. Using an *electronic Nose* (E-Nose), based on Metal-Oxide-Semiconductor(MOS) Sensor-Technology, measurements will be made accessing the health of the system. If contamination is discovered, a decontamination agent will be applied to the greenhouse as a countermeasure, by a process of micro-fogging (droplet size approx. 2-5 µm).

What are the applications for EDEN ISS, here on Earth?

The technologies that EDEN ISS develops for space missions, can also be used on Earth. Knowledge generated by the project will help Earth-based greenhouse systems to optimize plant-environment interactions, the level and cost of production and quality of food that is being produced. Solutions developed within the project could also support a reduction in pesticide use in closed environment agriculture. Positive changes to food growth on Earth can have a global impact and help in fighting against malnutrition and environmentally damaging farming practices.

How will EDEN ISS be integrated for use on the International Space Station (ISS)?

The Future Exploration Greenhouse (FEG) is the main plant growth area of the EDEN ISS project and has a cultivation area of around 12.5 m^2.

To prove that the EDEN ISS system can be implemented in space, we target experimentation on the ISS with a single International Standard Payload Rack (ISPR) subsystem.

The ISPR, located separately from the main plant growth area, in the service section of the Mobile Test Facility, is intended as a demonstrator of safe food complement production in a confined environment operating in microgravity conditions. This experiment is envisioned either as a complete higher plants cultivation system or as a demonstrator of key subsystems, depending on launch opportunities. A large difference in growing food on earth, as compared to inside a space-bound closed environment greenhouse, is the amount of space that is available to cultivate crops. The available space in the ISPR is 0.5-2.0m^2, whereas equivalent research on earth would use areas of 100-200 m^2.