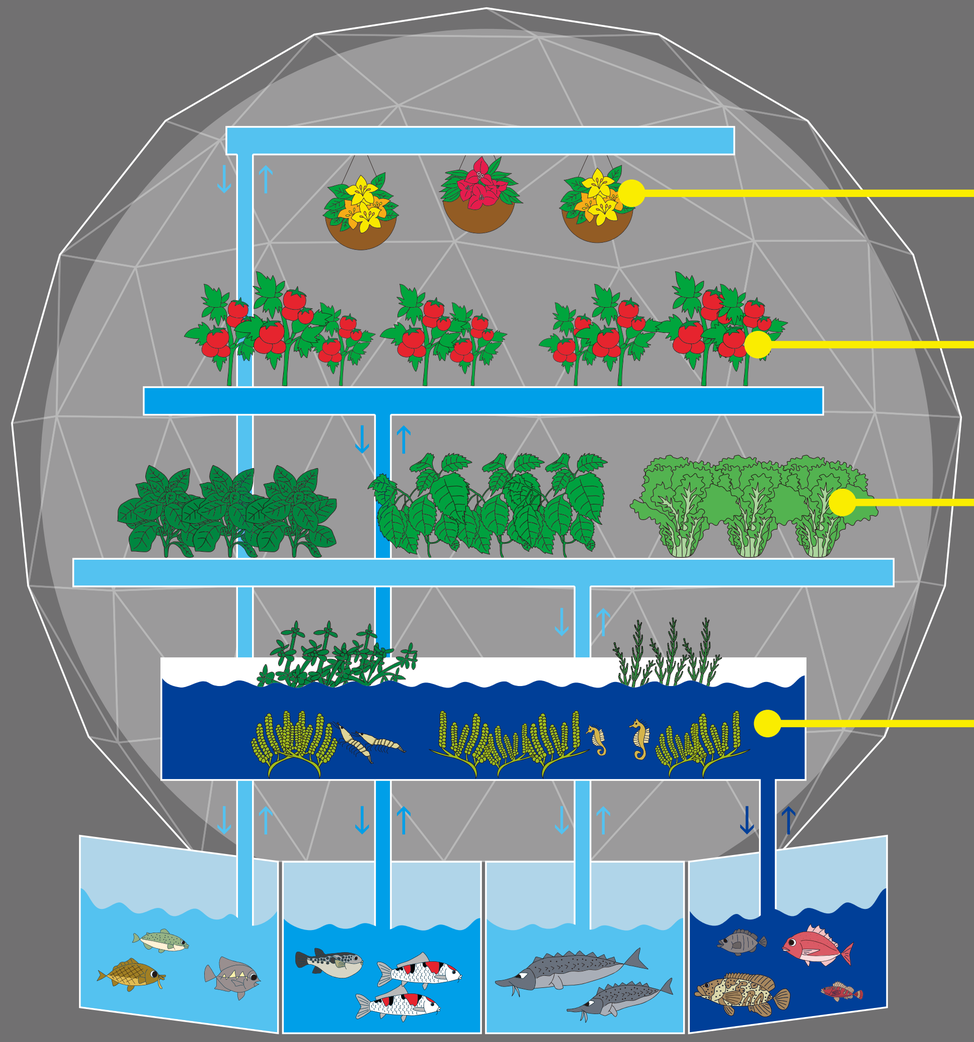
Osaka Kansai Expo Globe-shaped aquaponics “Cradle of Life”

The Globe-type Aquaponics, named “Cradle of Life”, is a showcase of a sustainable, next-generation, circular food production system that contributes to realizing a society that achieves the SDGs.

Courtesy of the EXPO 2025 Osaka Pavilion Association

Cradle of Life



4 Edible flowers

3 Semi-salt-tolerant vegetables

2 Functional vegetables

1 Salt-tolerant plants

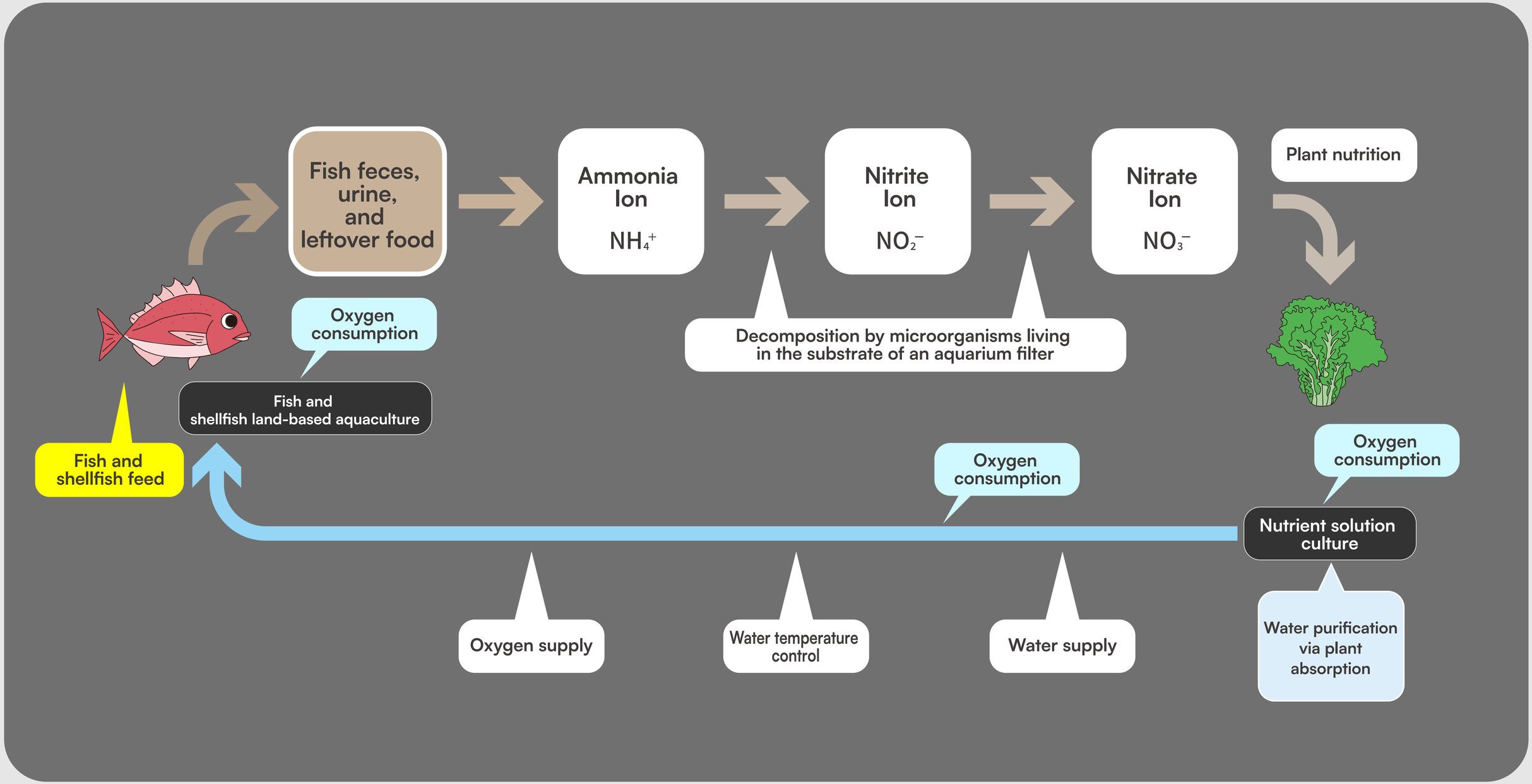
4 Fresh water

3 Brackish water

2 Fresh water

1 Seawater

Material circulation in aquaponics



Fish and shellfish feed production system

Residues from vegetables, fish, and shellfish, etc

Consumption of Vegetables, fish, and shellfish

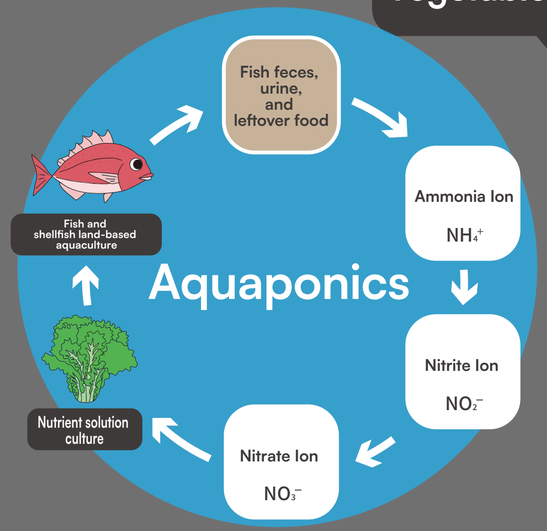
Supermarket
Processing plant

Vegetable shipping

Fish and shellfish feed

Soldier fly

Larvae pellet feed processing



Fish and shellfish shipping

Precedent case

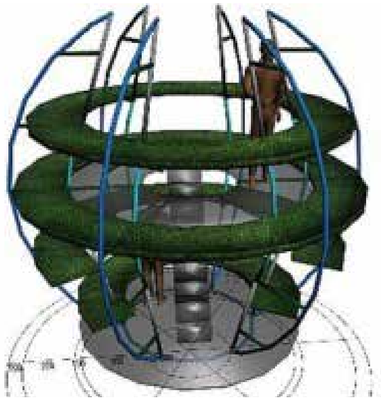
"Experimental Prototype Community of Tomorrow" (EPCOT), an experimental future city at Disney World in Florida, USA

In the futuristic agricultural area next to the giant dome, plant factories and aquaponics have been exhibited since it opened in 1982.

https://disneyworld.disney.go.com/destinations/epcot/

"JST Recycling-based Society Technology Research Report: Osaka Model for Recycling-based Regeneration of Existing Urban and Suburban Nature"

A prototype agricultural production device aimed at environmental conservation along the coast of Osaka Bay and the regeneration of a recycling-based city.

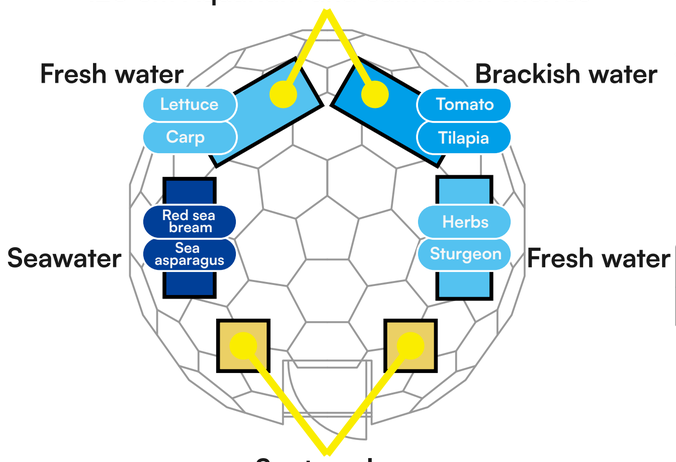


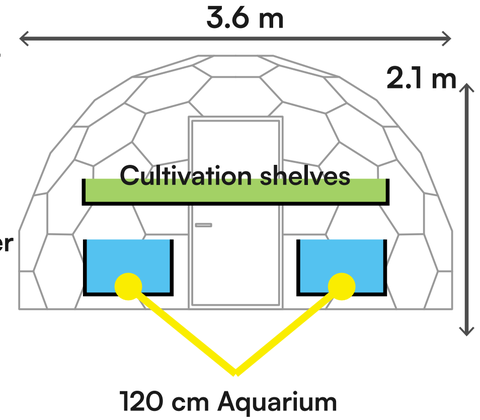
Precedent experiment

The exhibit of "Cradle of Life" was made possible through preliminary experiments at the R&D Center for the Plant Factory, Osaka Metropolitan University, based on the research results and knowledge gained from the Endo Laboratory at Tokyo University of Marine Science and Technology and the Osaka Prefectural Research Institute for Environment, Agriculture, and Fisheries in the selection of fish and feed.

Sunlight-based plant factories

120 cm Aquarium and cultivation shelves

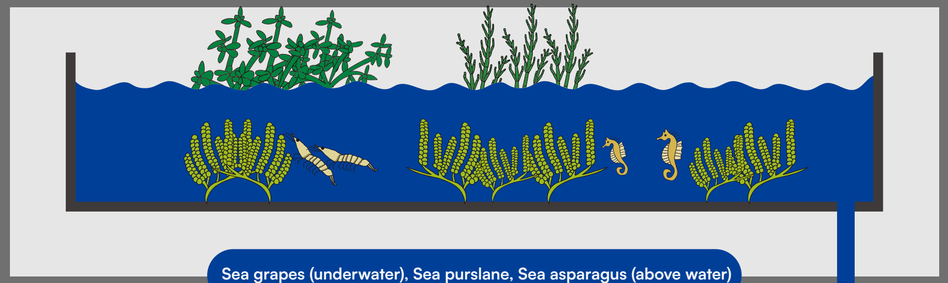




Artificial-light-based plant factories

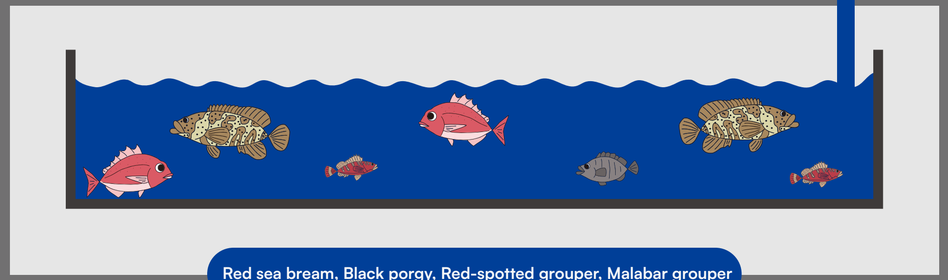
1st shelf　Seawater and salt-tolerant plants

❶Salt-tolerant plants



Sea grapes (underwater), Sea purslane, Sea asparagus (above water)

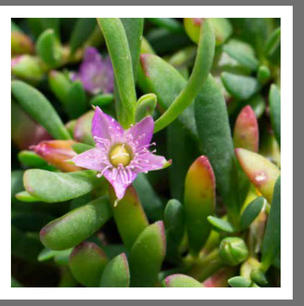
❶Seawater



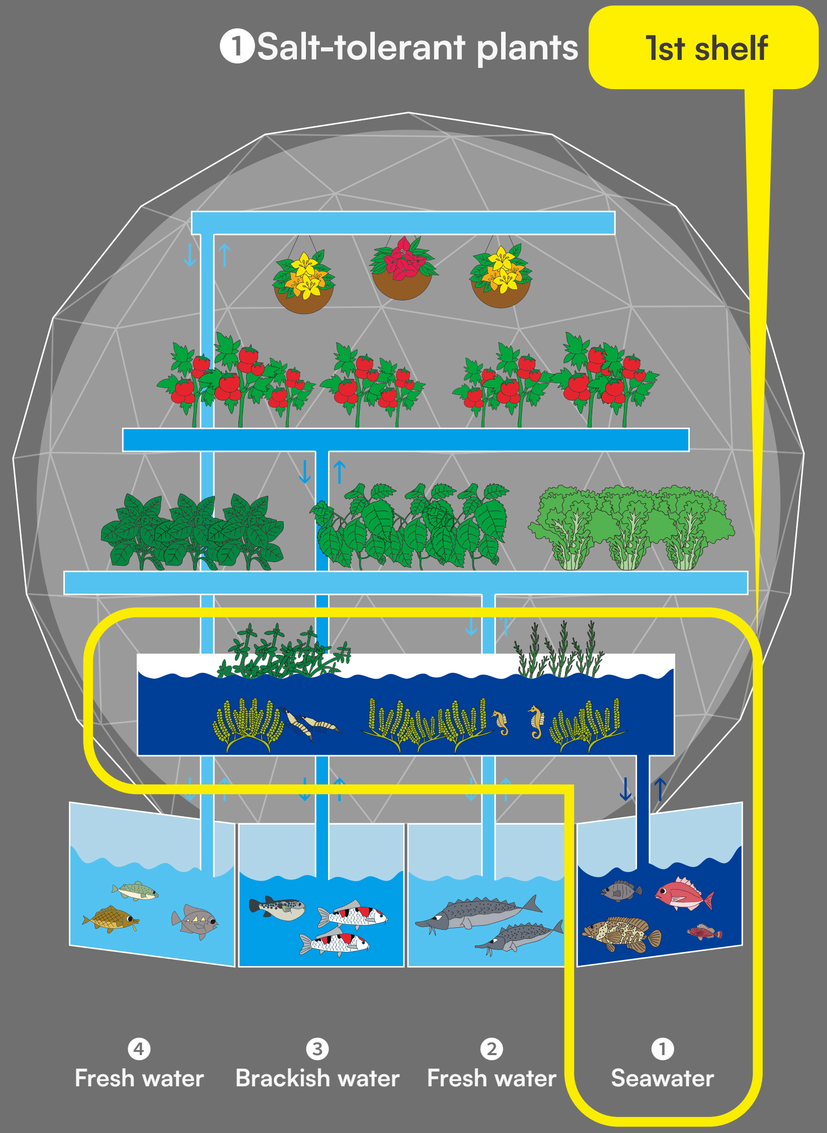
Red sea bream, Black porgy, Red-spotted grouper, Malabar grouper

Sea grapes

Sea purslane

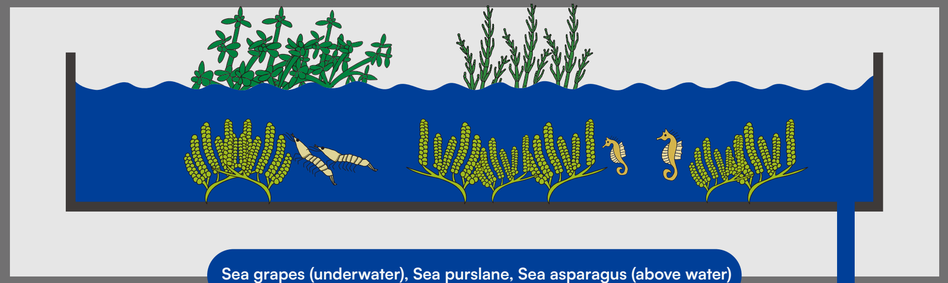


Sea asparagus



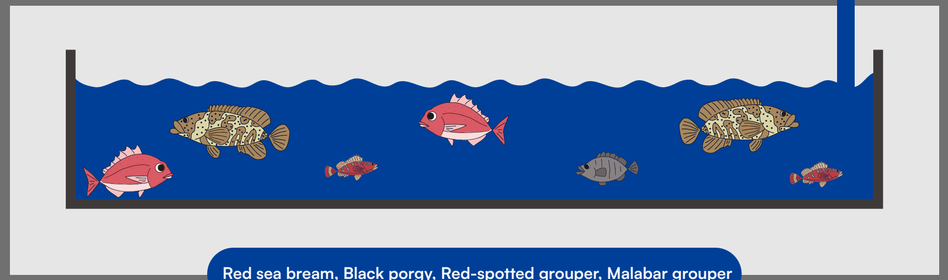
1st shelf　Seawater and salt-tolerant plants

❶Salt-tolerant plants



Sea grapes (underwater), Sea purslane, Sea asparagus (above water)

❶Seawater



Red sea bream, Black porgy, Red-spotted grouper, Malabar grouper

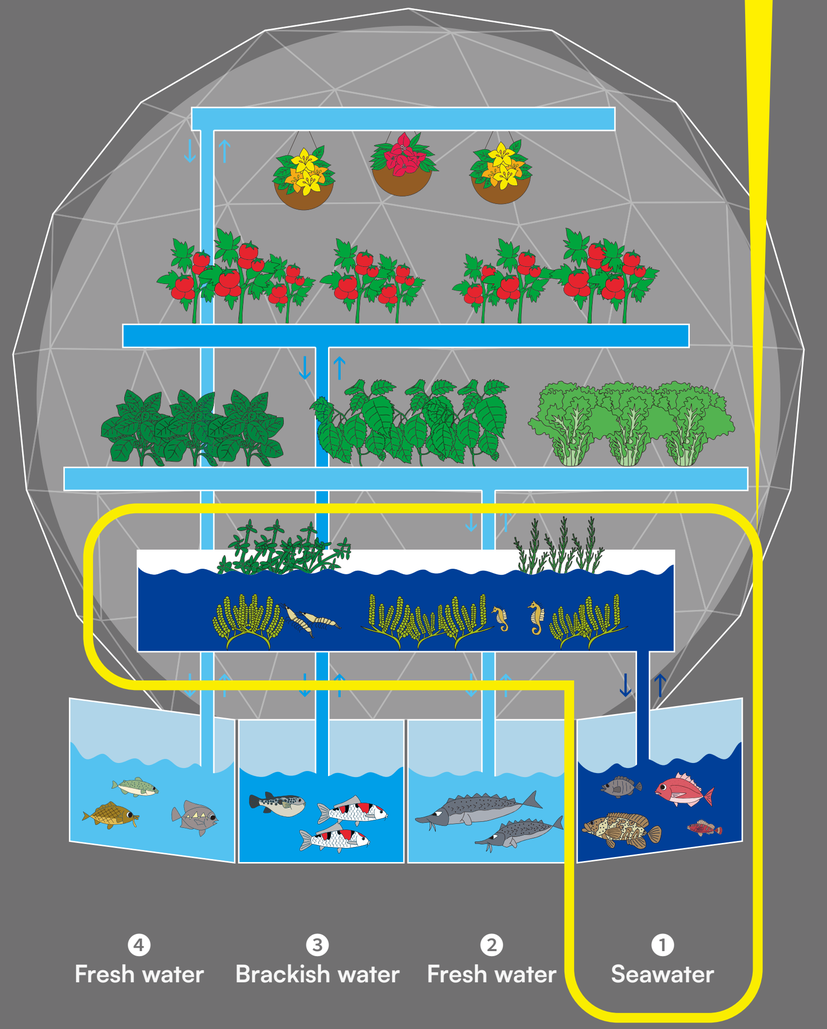
Red sea bream

Black porgy

Red-spotted grouper

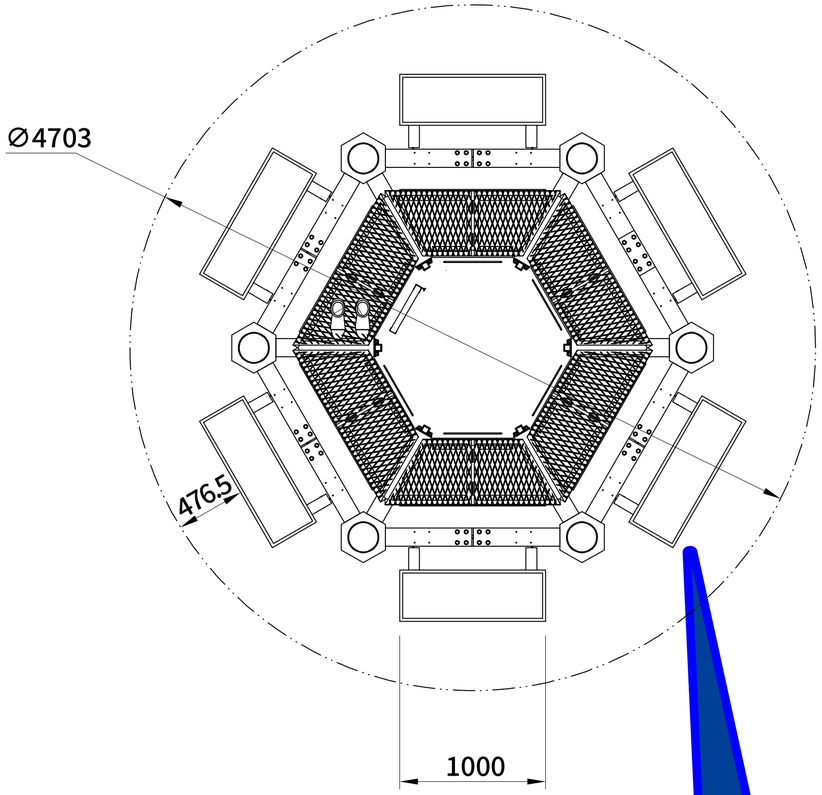
Malabar grouper

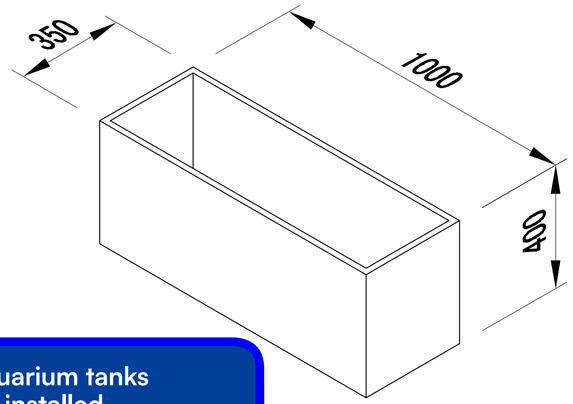
❶Salt-tolerant plants　1st shelf



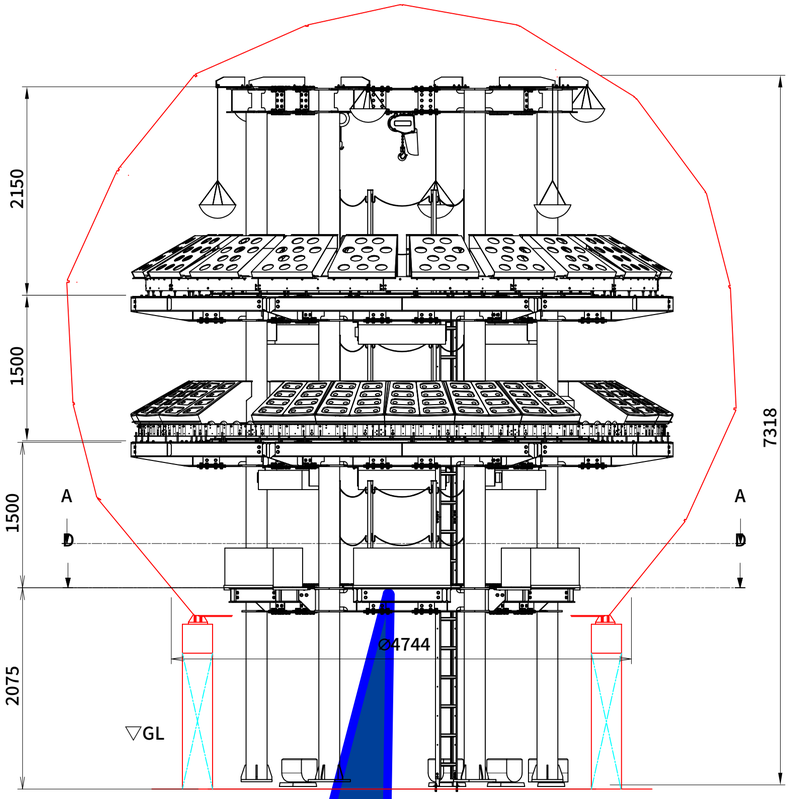
1st shelf　Seawater and salt-tolerant plants

The 1st shelf shows a combination of seawater and salt-tolerant plants.



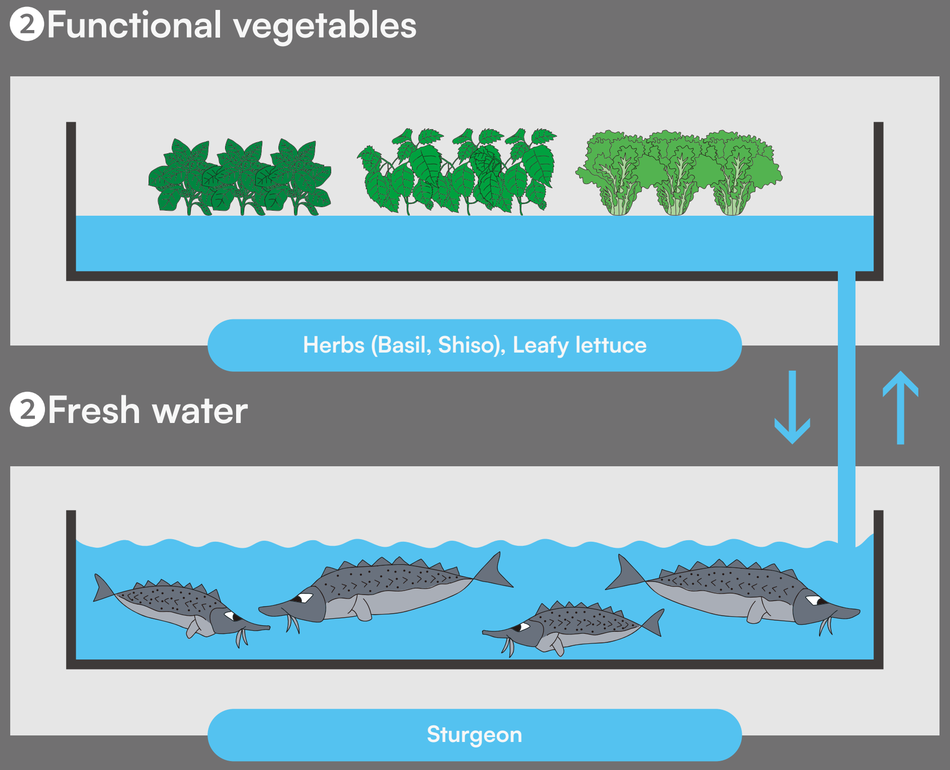


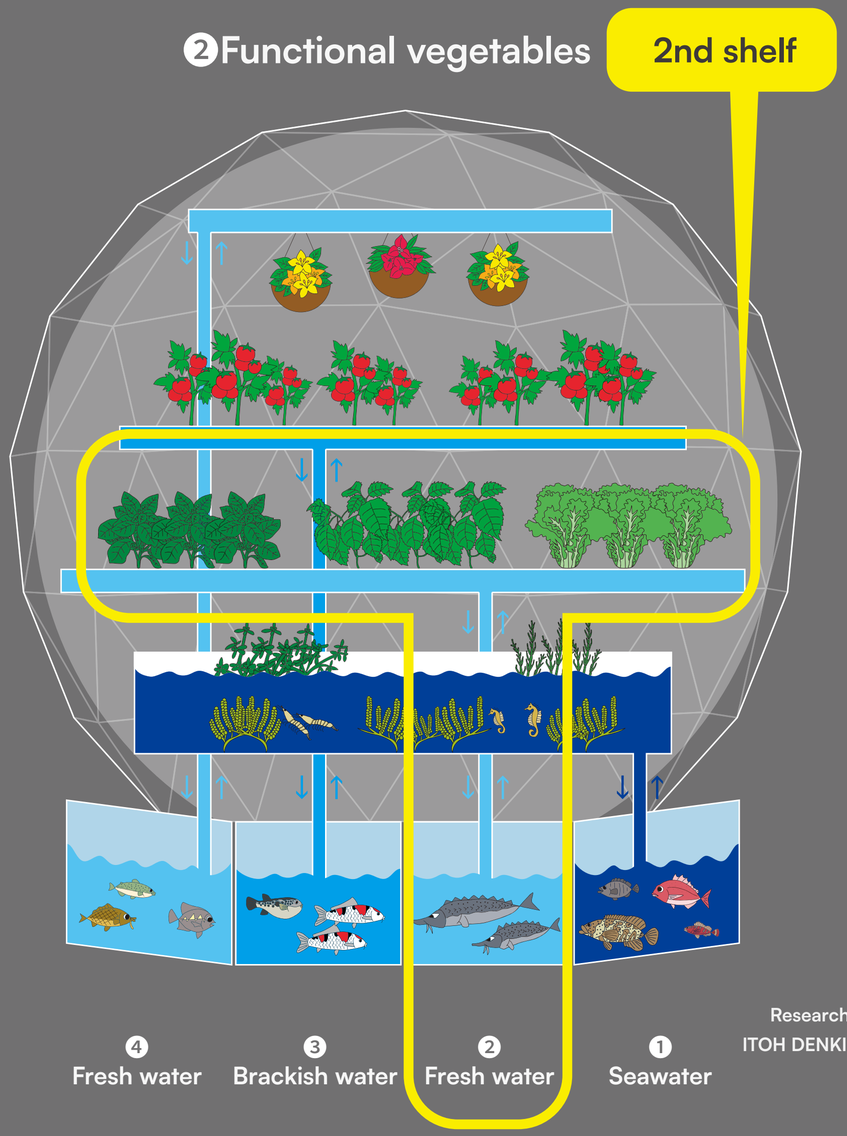
The aquarium tanks are installed.



The aquarium tanks are installed.

2nd shelf　Functional vegetables grown in fresh water





Basil

Shiso

Leafy lettuce

Sturgeon

Research Institutes
ITOH DENKI CO., LTD.

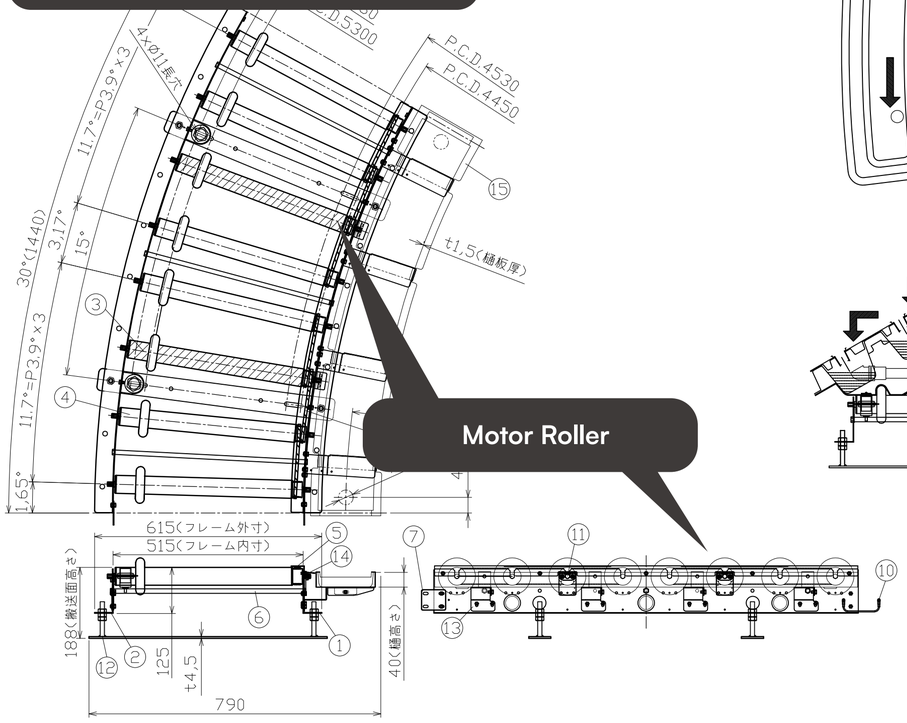
2nd shelf　Functional vegetables grown in fresh water

Specially designed cultivation trays are installed to make it easier for visitors to observe the plants.

The cultivation trays can move horizontally using motorized rollers.

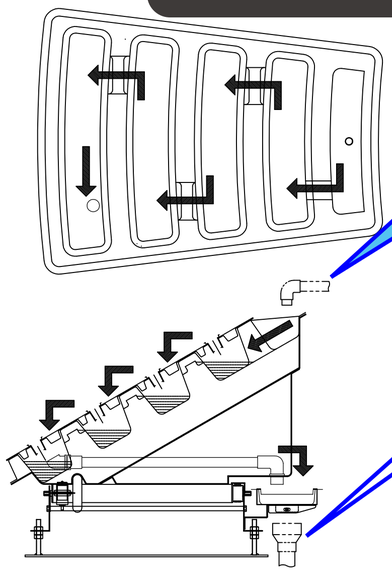
When moving, the water supply and drainage are automatically shut off.

The motor roller drive unit



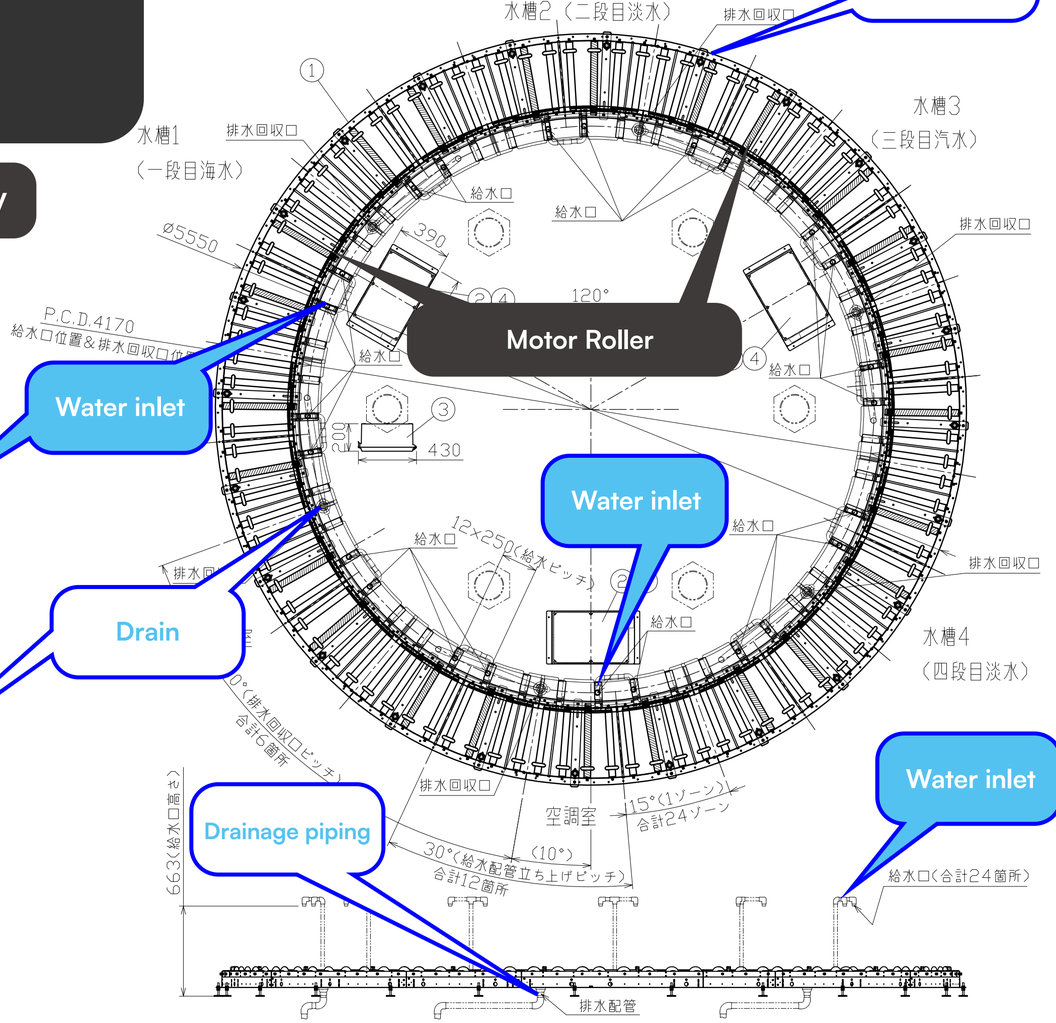
Motor Roller

Cultivation tray



Water inlet

Drain



Motor Roller

Water inlet

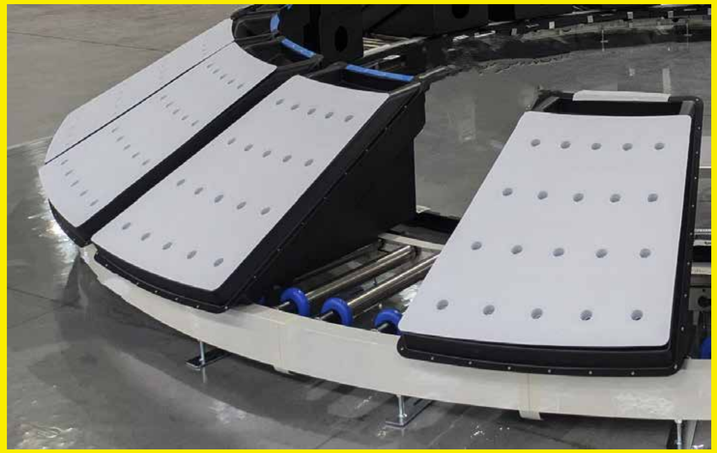
Drain

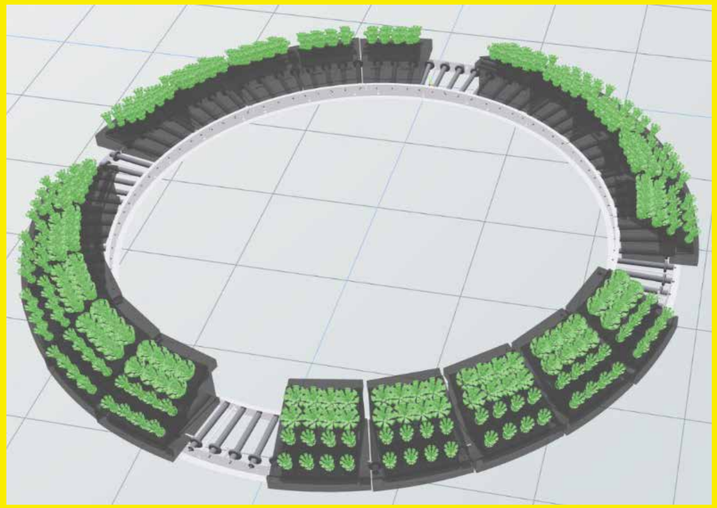
Drainage piping

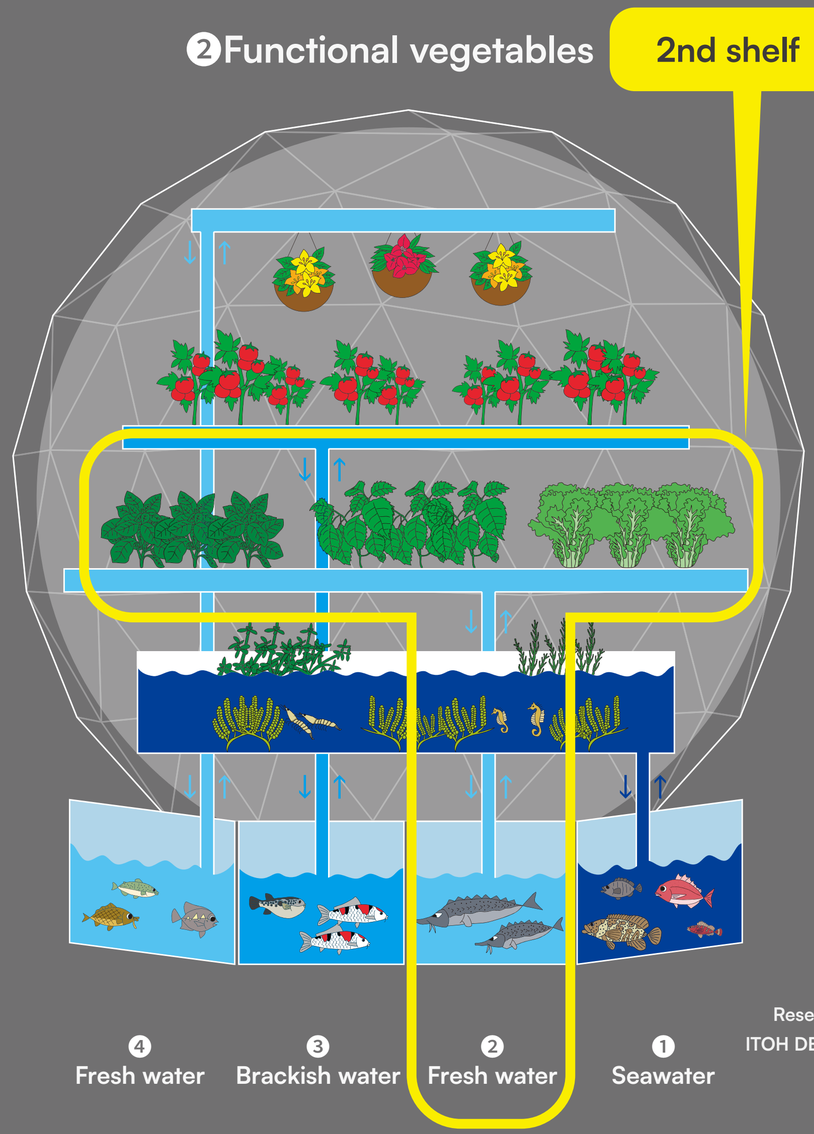
Water inlet

2nd shelf　Functional vegetables grown in fresh water

Automatic transport system







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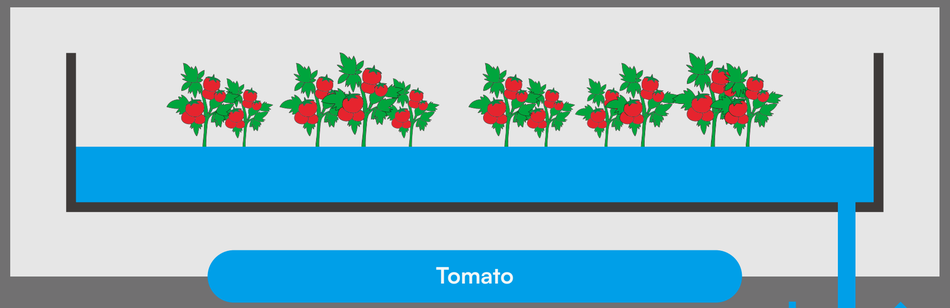
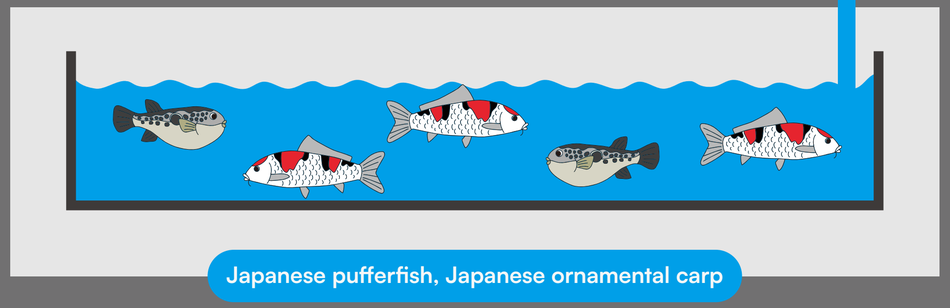
3rd shelf　Brackish water and semi-salt-tolerant plants

❸Semi-salt-tolerant vegetables



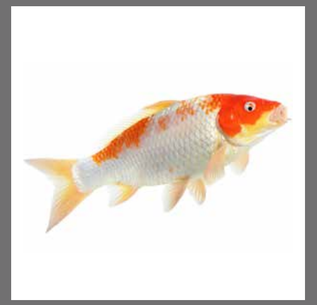
❸Brackish water

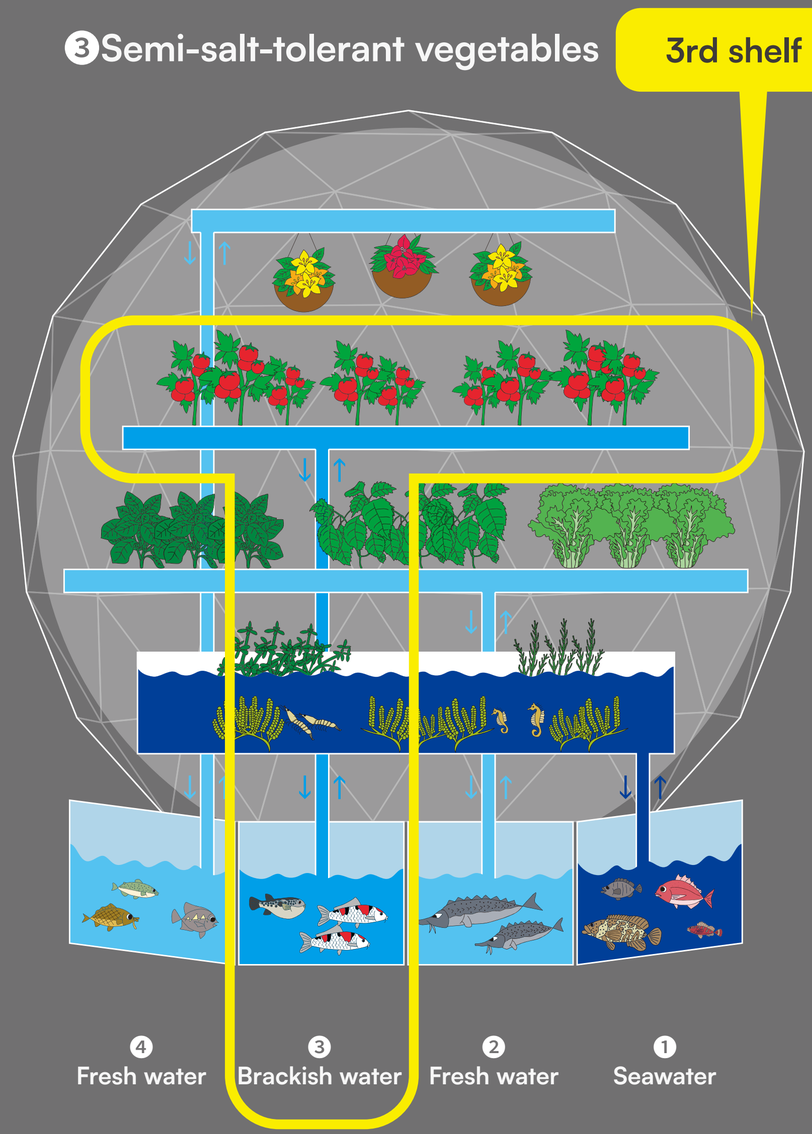


Tomato

Japanese pufferfish

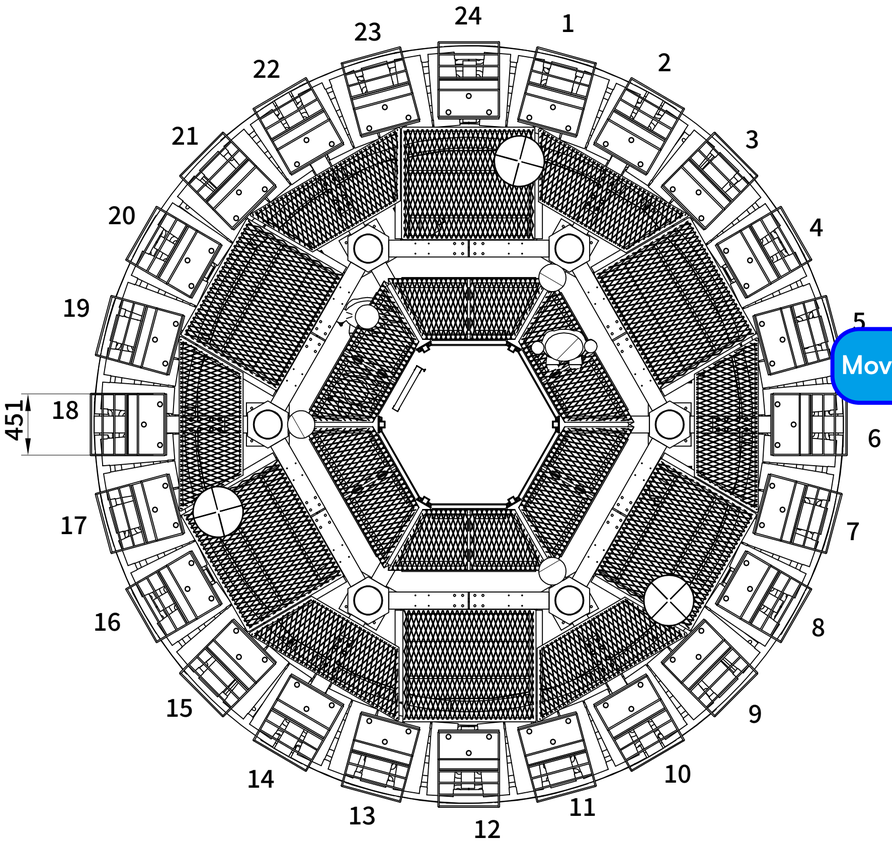
Japanese ornamental carp

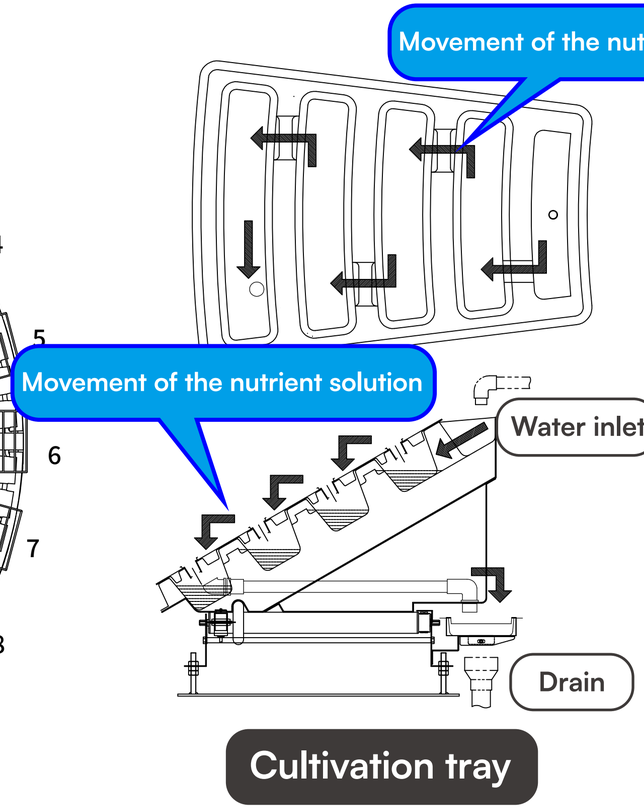




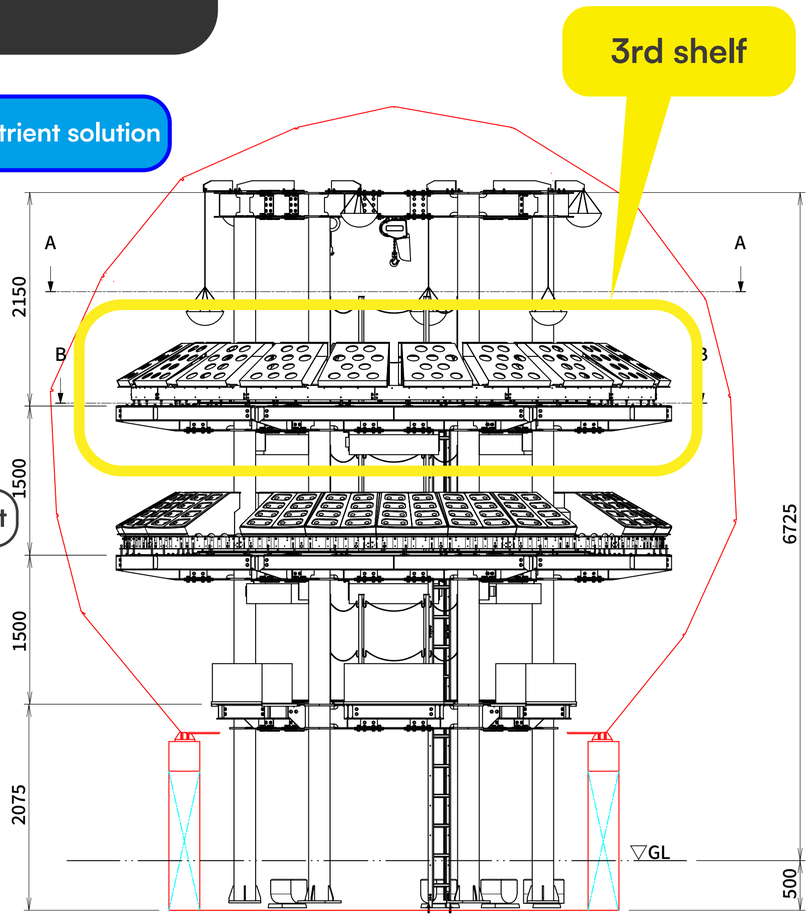
3rd shelf　Brackish water and semi-salt-tolerant plants

Specially designed cultivation trays are installed to make it easier for visitors to observe the plants.
The sugar content of tomato fruits can be increased by exposing to salt stress.



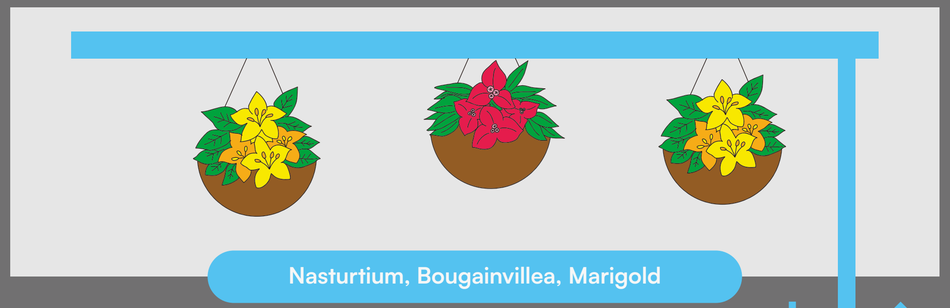


Cultivation tray

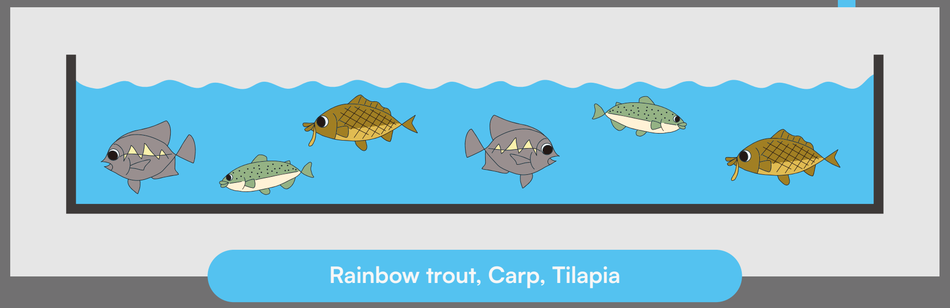


4th shelf　Edible flowers grown in fresh water

④Edible flowers



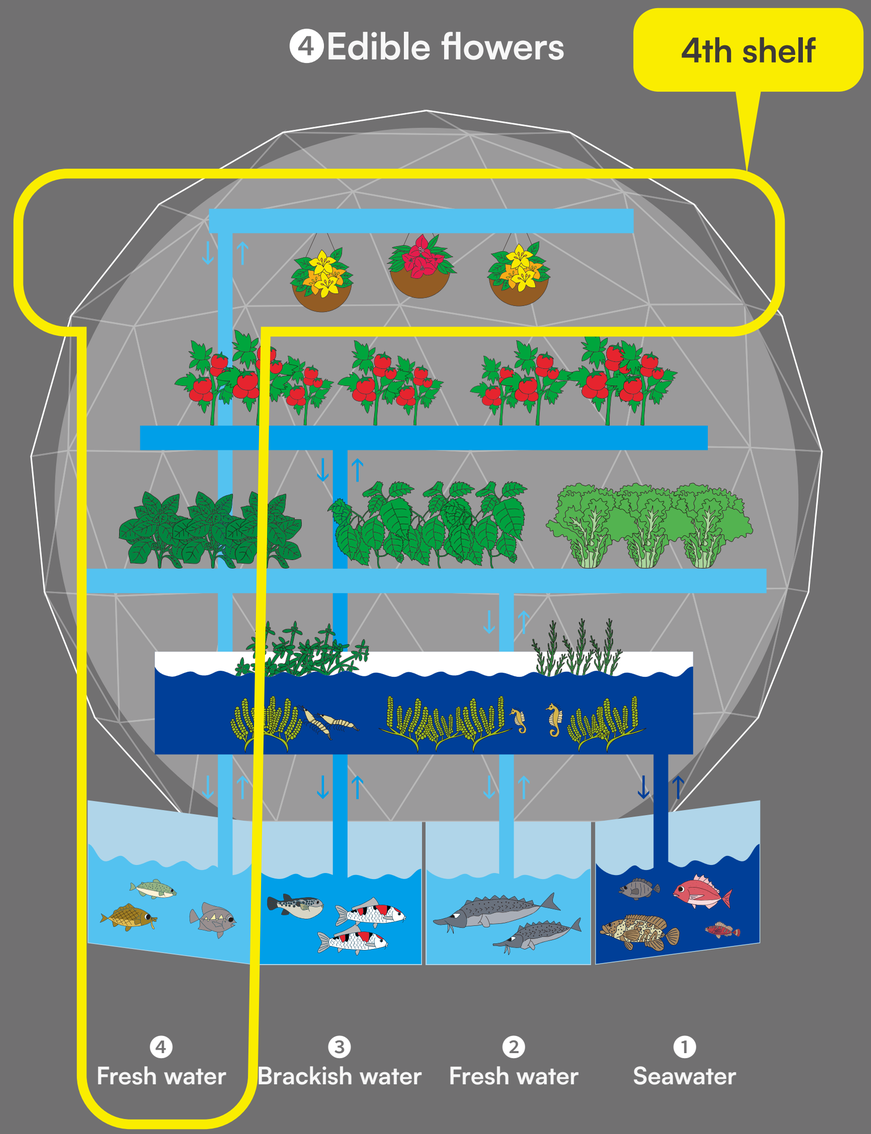
④Fresh water



Nasturtium

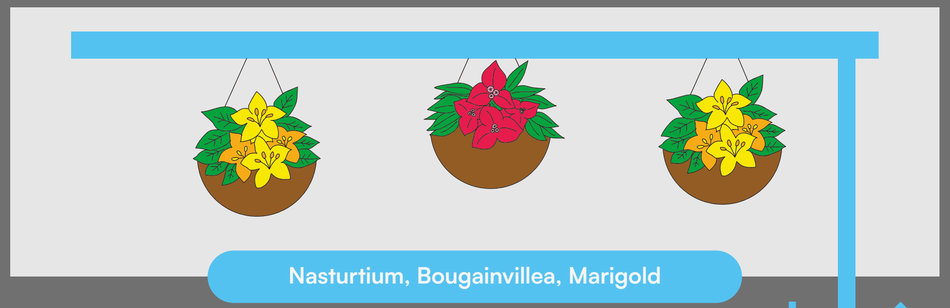
Bougainvillea

Marigold



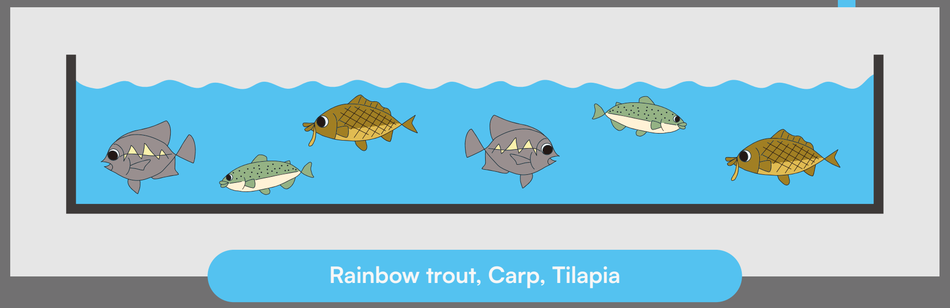
4th shelf　Edible flowers grown in fresh water

④Edible flowers



Nasturtium, Bougainvillea, Marigold

④Fresh water

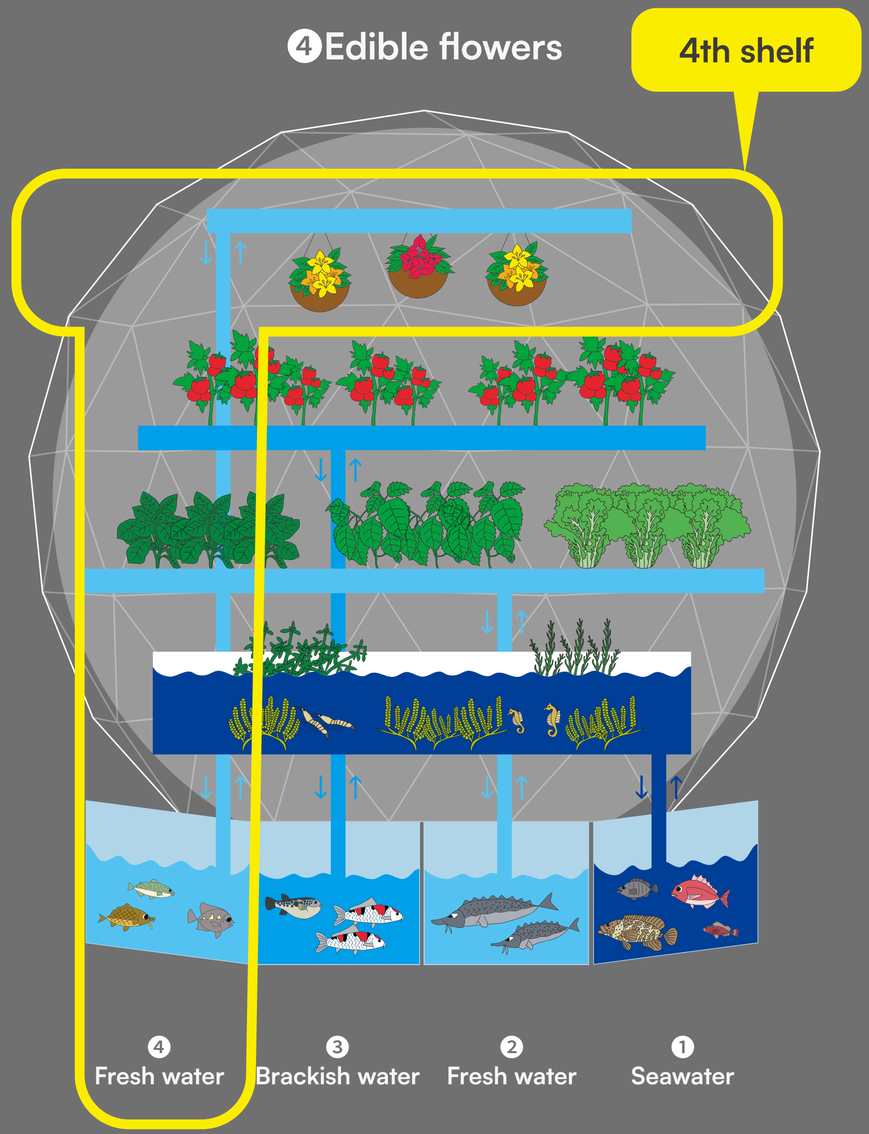


Rainbow trout, Carp, Tilapia

Rainbow trout

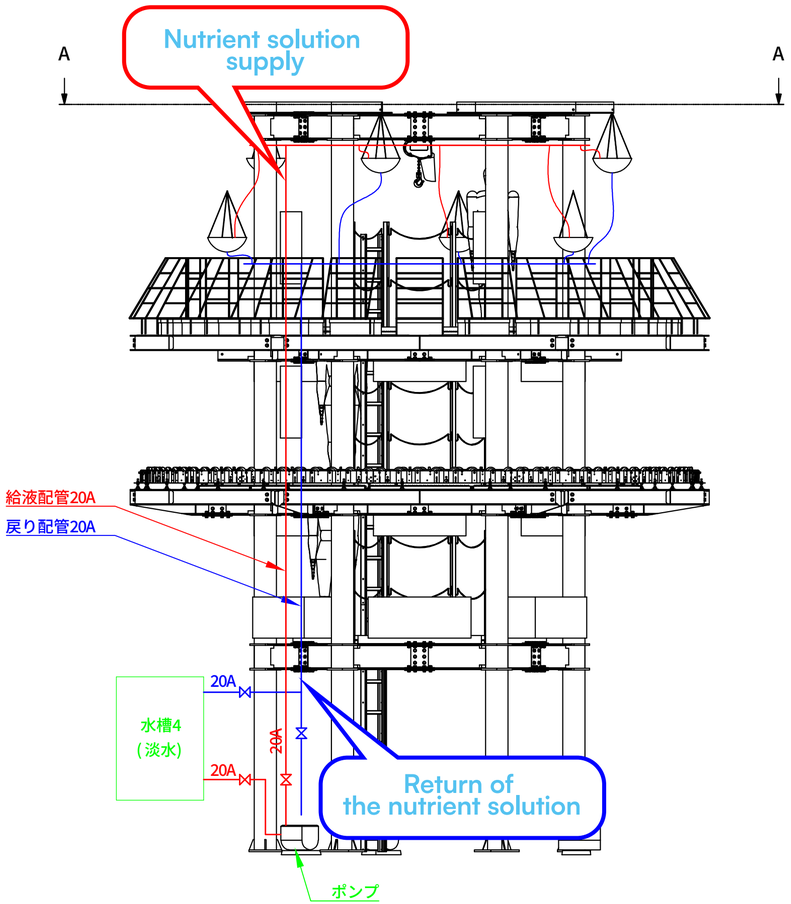
Carp

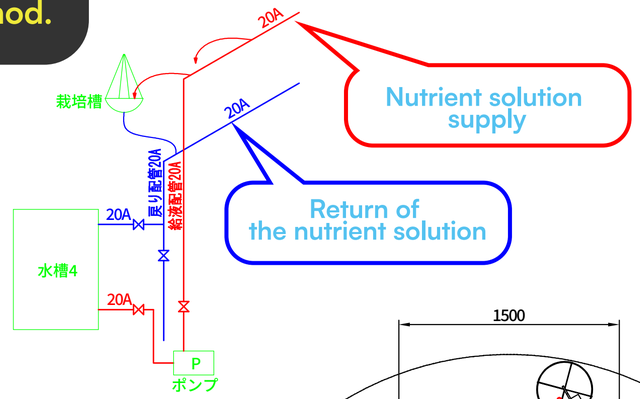
Tilapia

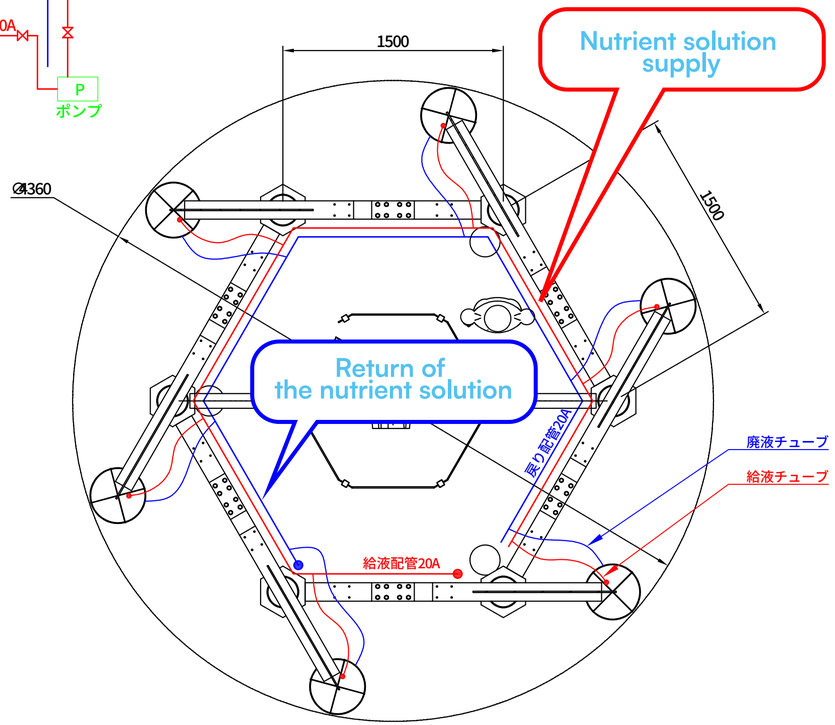


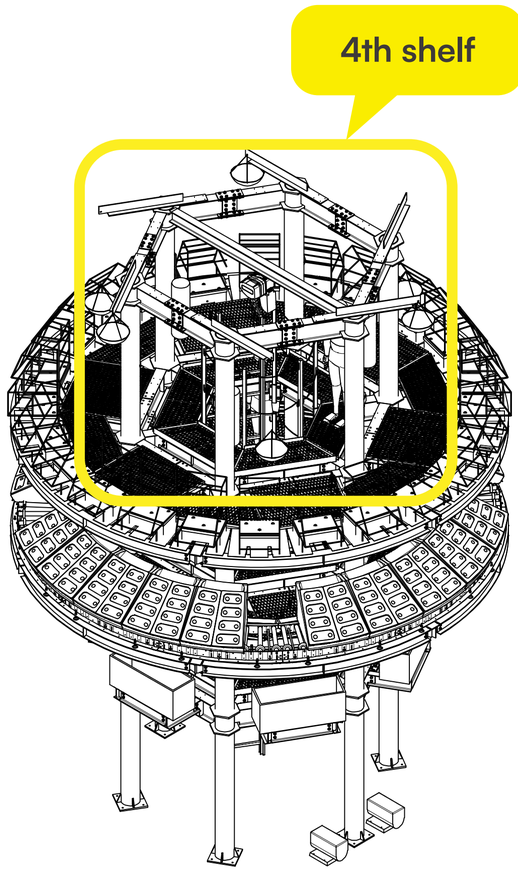
4th shelf　Edible flowers grown in fresh water

The 4th shelf displays edible flowers in hanging pots.
The nutrient solution is supplied by the drip method.





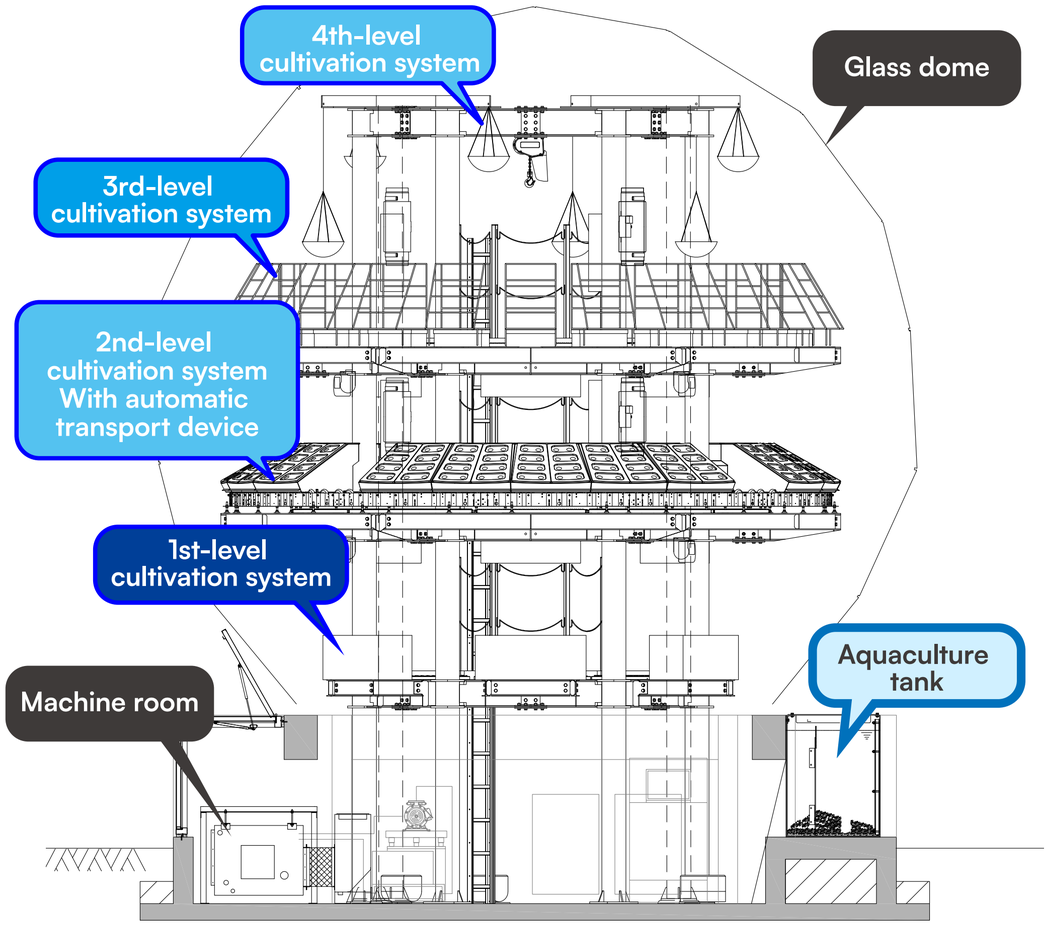




Overall view of the facility

Equipment features

Four fish farming tanks are placed at the bottom, and three shelves and a hanging cultivation device are installed above them.

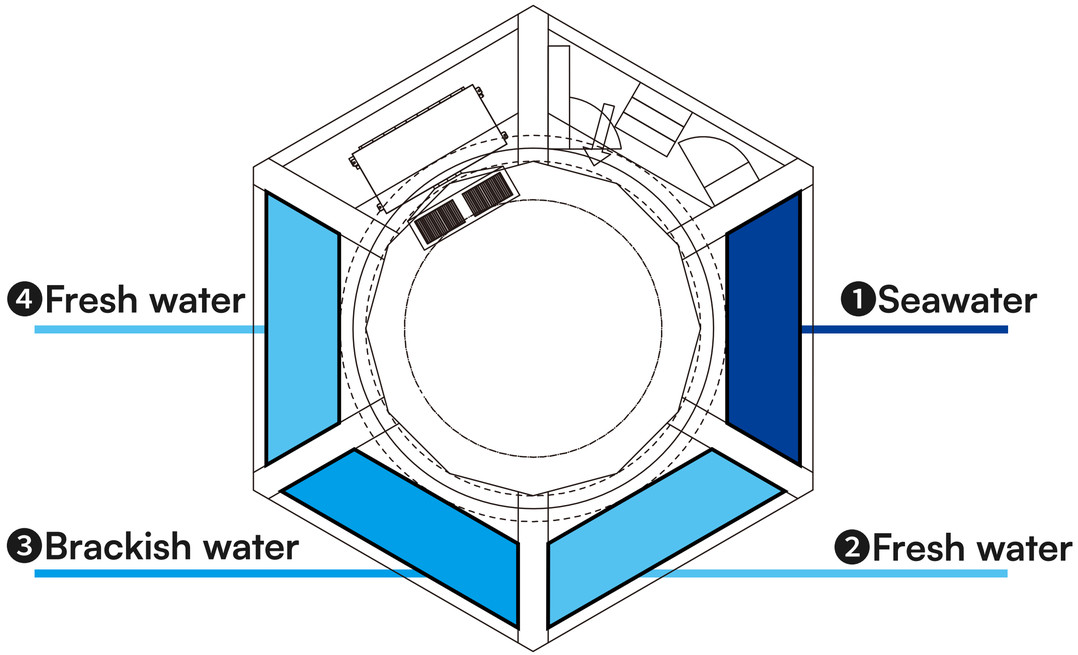


Research Institutes

Sanshin Metal Working Co., Ltd.

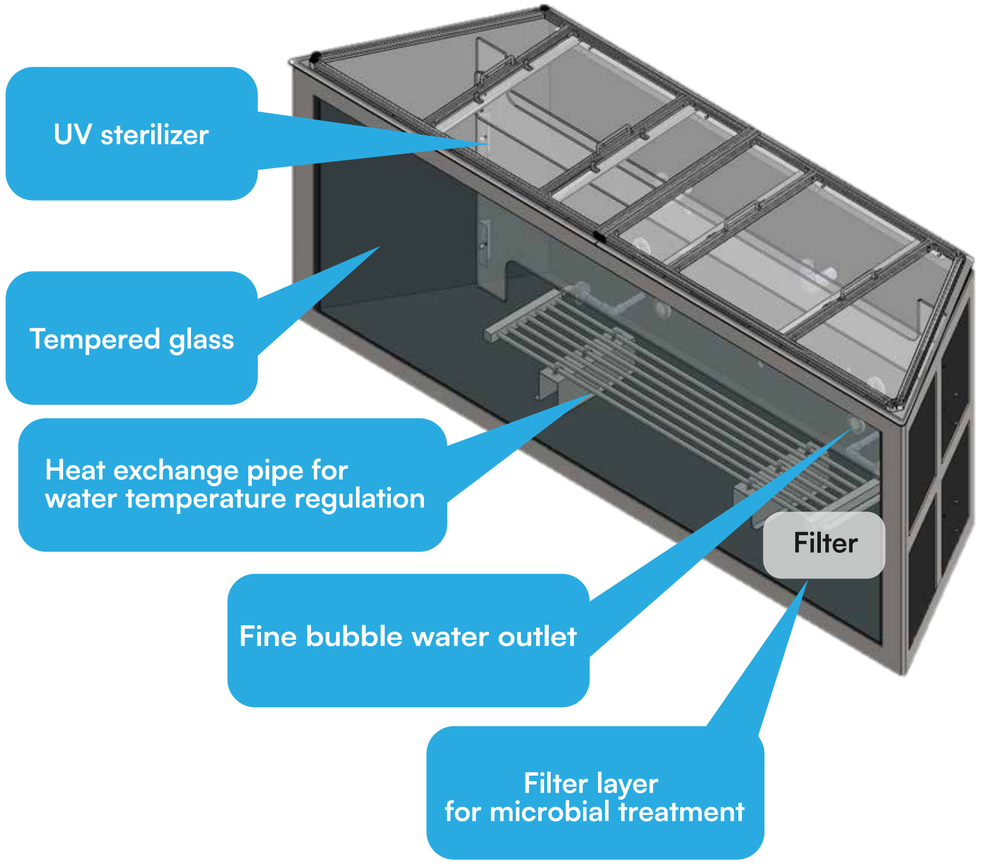
Fish farming system

Each tank has a volume of approximately 2.5 ㎥.
It has a filtration layer at the bottom, and microorganisms break down waste and leftover food.
The tank is equipped with a heat exchange pipe for controlling the water temperature and a fine bubble generator.



Aquaculture tank layout

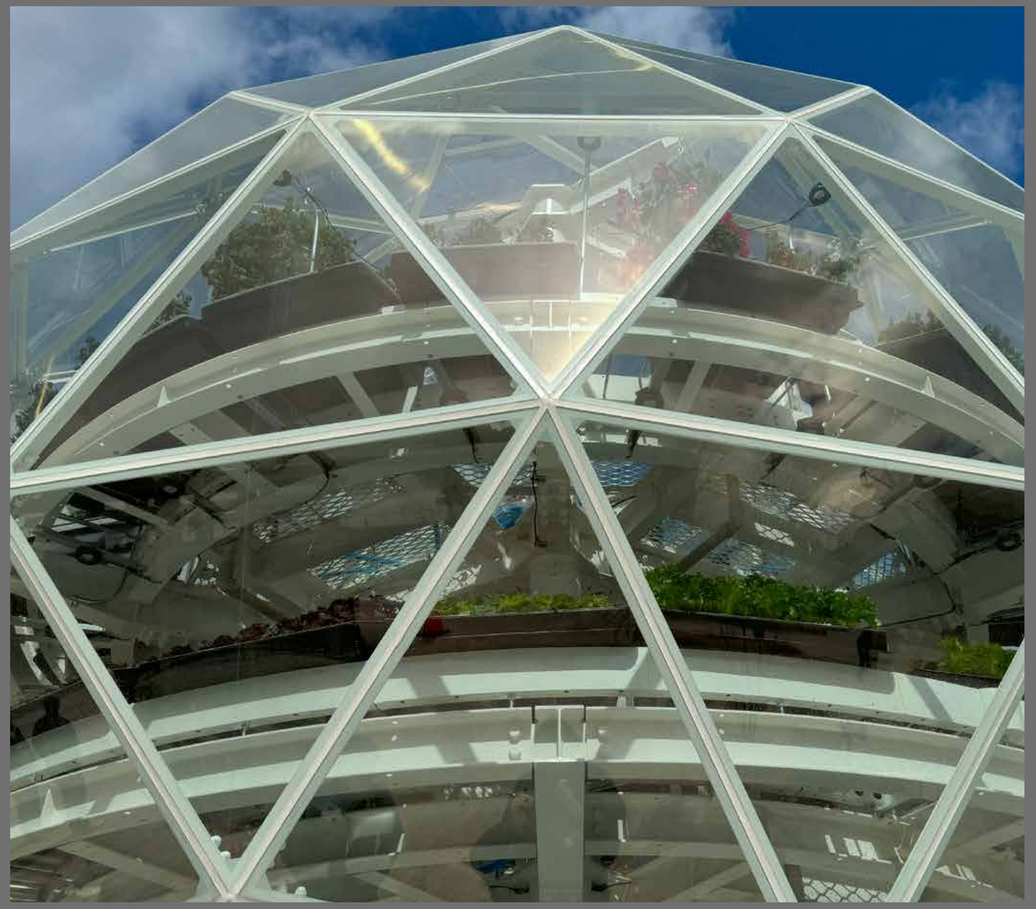
Aquaculture tank



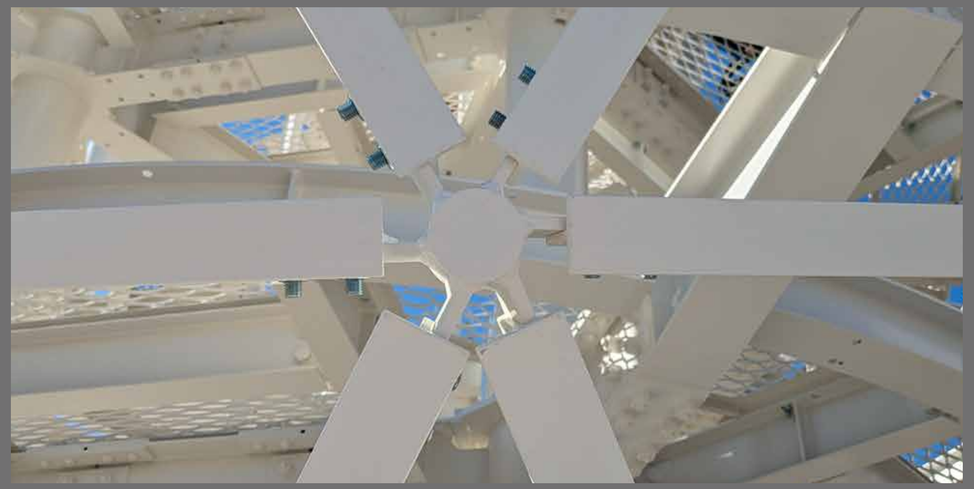
Research Institutes
SCIENCE CO., LTD.

Glass dome structure

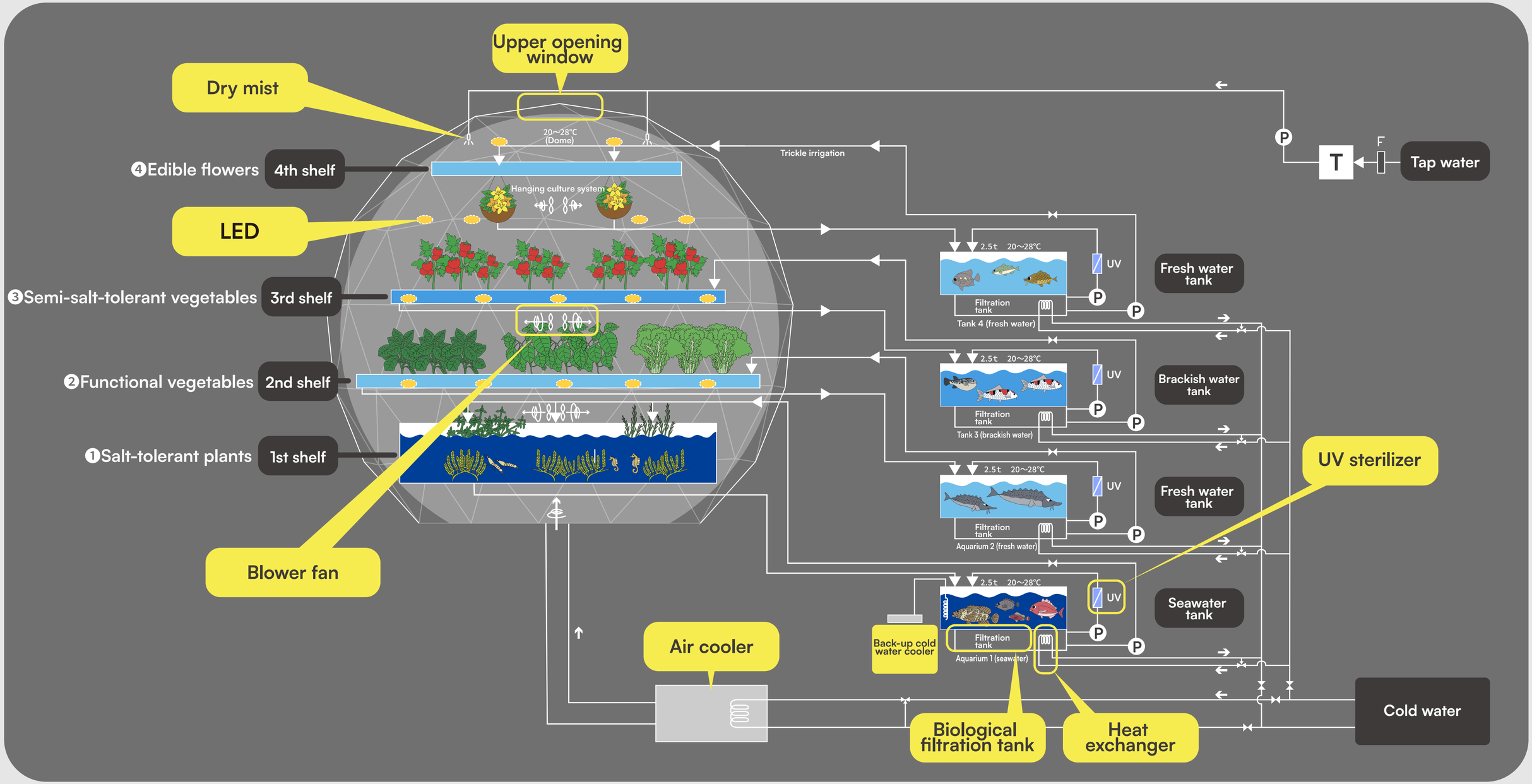
The glass dome uses a geotech frame structure as the truss.
The upper opening window provides natural ventilation for cooling.
The glass is made of Agrigrass (with an infrared cut filter) to prevent excessive heating during summer.



Geotech frame structure as the truss



Environmental control system



Environmental control system using IoT, etc.

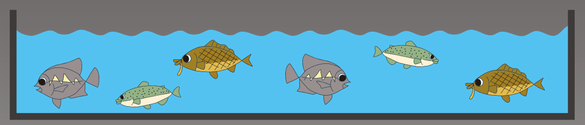
In a recycling-based food production system, the room temperature, humidity, illuminance, and carbon dioxide concentration of the "nutrient solution culture" and the water temperature, acidity, electrical conductivity, and dissolved oxygen concentration of the "land-based aquaculture" are monitored and managed by smartphones and PCs.

Hydroponic cultivation

- Room temperature
- Humidity
- Light intensity
- Carbon dioxide concentration

IoT

Land-based aquaculture



- Water temperature
- Acidity (pH)
- Electrical conductivity (EC)
- Dissolved oxygen concentration (DO), etc.

Research Institutes
ESPEC MIC Corp.


And now...
Currently, studies are underway
to introduce aquaponics for food production
at a lunar base
from the perspective of waste recycling.
JAXA 申開ID:0000039524

Controlled Ecological Life Support System for creating a living environment for humans in space

Animal farming (space farm subsystem)

Feed

CO_2

O_2

Gas treatment system

O_2

CO_2

Plant cultivation (space farm subsystem)

Water for rearing

Food

O_2

CO_2

Food

Wastewater

Inedible parts

Fertilizer and culture solution

Drinking water
Water for daily use

Human habitation system

Food	700	100	Solids
Water	3,000	3,400	Water
O_2	800	1,000	CO_2

Average metabolic rate (g/day/person)

Wastewater

Excrement

Water treatment system

Concentrated wastewater

Waste treatment system

Excrement Waste

Research and implementation structure

Ms. Yoko Maeda donated JPY 300 million to the Osaka Pavilion Fund for the 2025 Japan World Expo, run by Osaka City.

Research institutions that cooperated in the selection of vegetables and fish species, the implementation of preliminary experiments, and the provision of backyard and feed supply

R&D Center for the Plant Factory, Osaka Metropolitan University
Tokyo University of Marine Science and Technology(Masato Endo Laboratory)
Research Institute of Environment, Agriculture and Fisheries, Osaka Prefecture

Collaborating companies that contributed to the design, construction, and sponsorship

Sanshin Metal Working Co., Ltd.
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