OHB System AG, *Life Sciences*
Dr. Klaus Slenzka, Sandra Podhajsky,

MELISSA Workshop 2016

SPACE SYSTEMS

ModuLES-PBR – lessons learned through parabolic flight tests

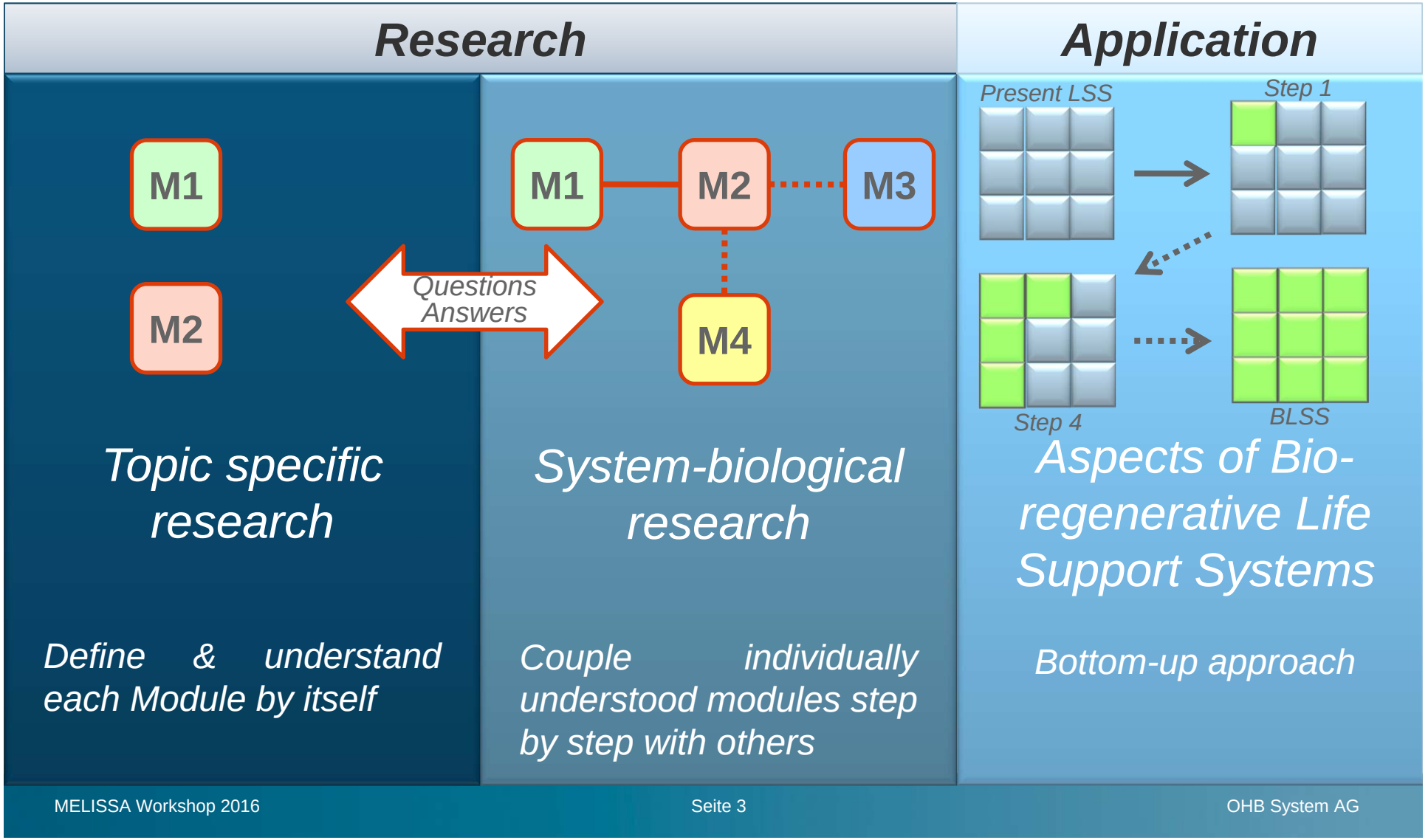
We. Create. Space.

SPACE SYSTEMS

Basic Concept of ModuLES

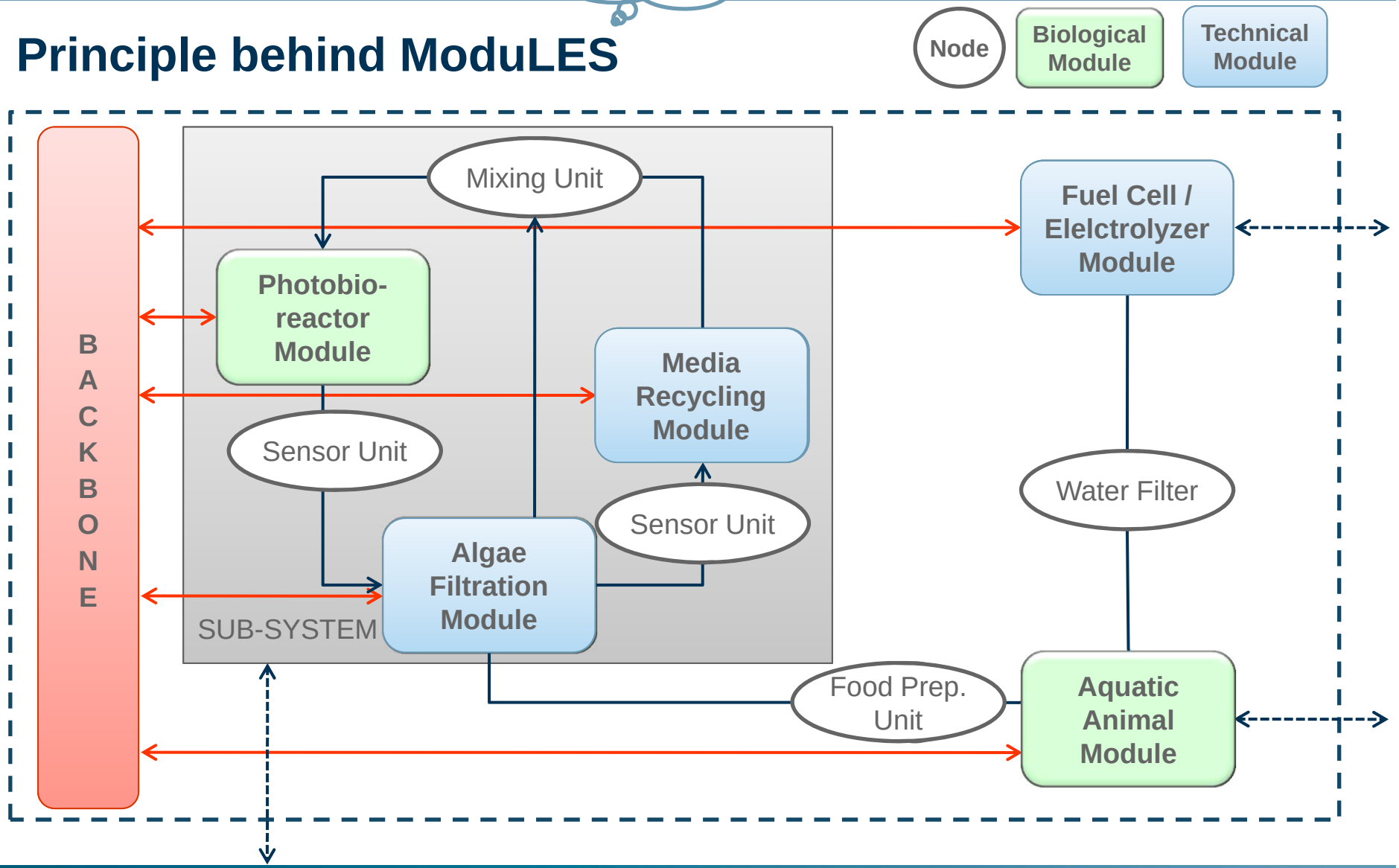
We. Create. Space.

General Aspects



EXAMPLE

Principle behind ModuLES



Engineering starting point and ModuLES application goal

- Designed for facilities supporting µ-g-experiment-duration varying between minutes and weeks (e.g. parabolic flight, sounding rockets, Bion-Satellites, Space Stations)
- Same H/W on ground and in orbit
- Suitable for unmanned operation
- Non-Return missions acceptable without the loss of scientific data (→ Automatic sample taking & analysis)

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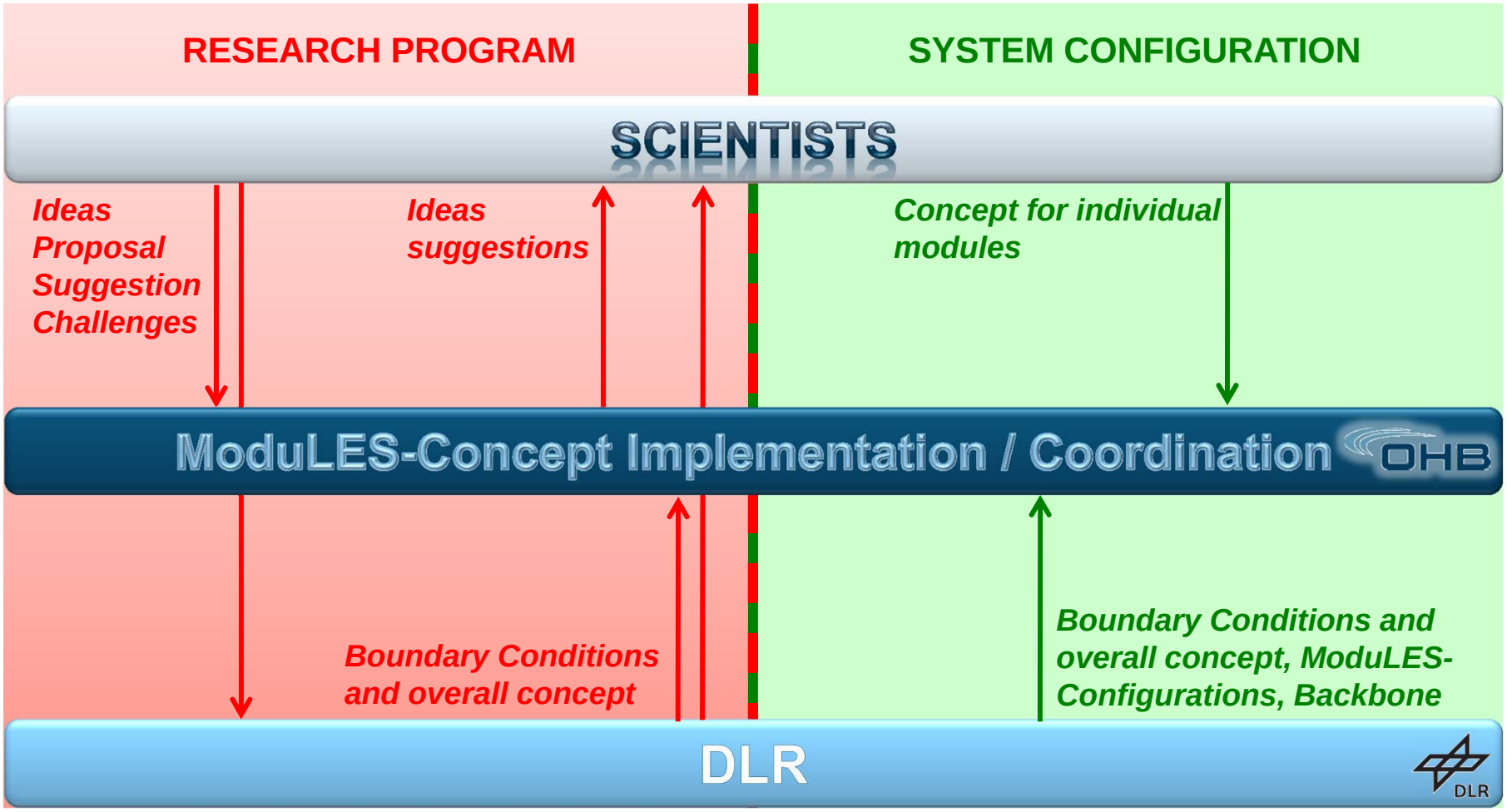
Scientific Community & Research

We. Create. Space.

Task distribution in ModuLES-Team

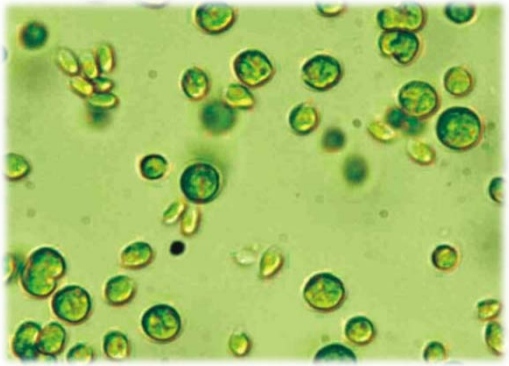


The photosynthetic workhorse

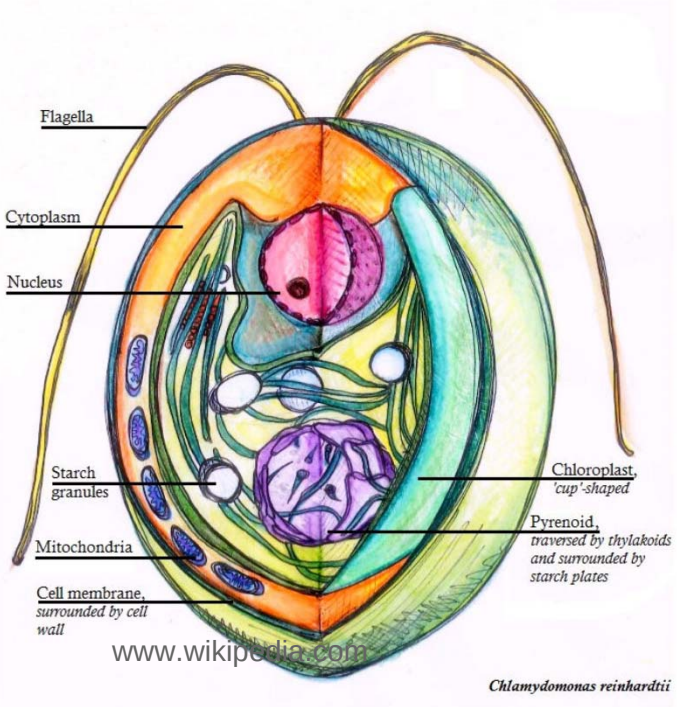
- ***Chlamydomonas reinhardtii***
- Unicellular green microalgae
- Well understood

- Model organism for photosynthesis research
- Fully analyzed genome
- Standard lab application for analytical tools

- Low viscosity of culture media
- **Carbon free culture media**
- Broad range of environmental condition



www.biotechnologie.de



www.wikipedia.com

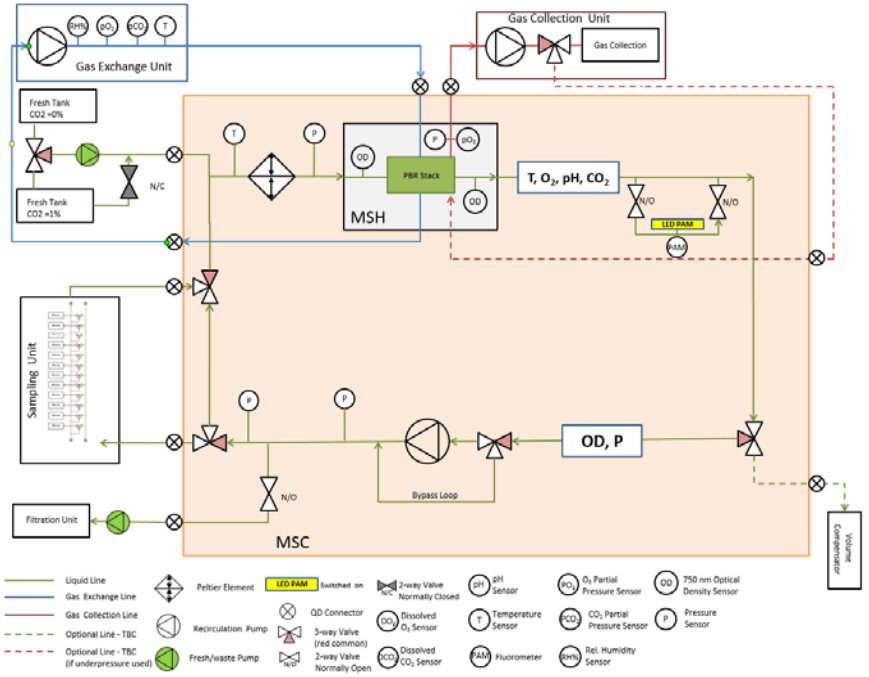
SPACE SYSTEMS

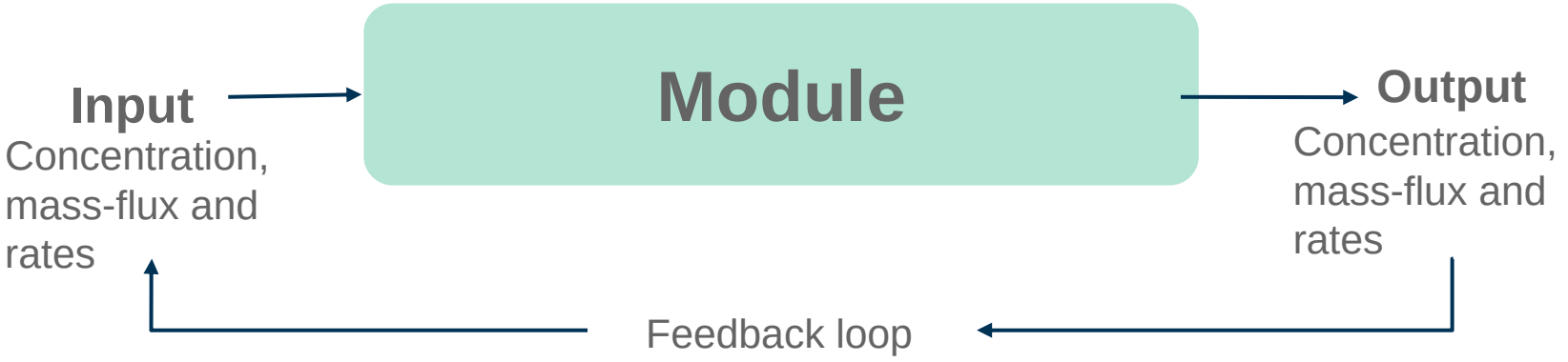
1st module & bread boarding

We. Create. Space.

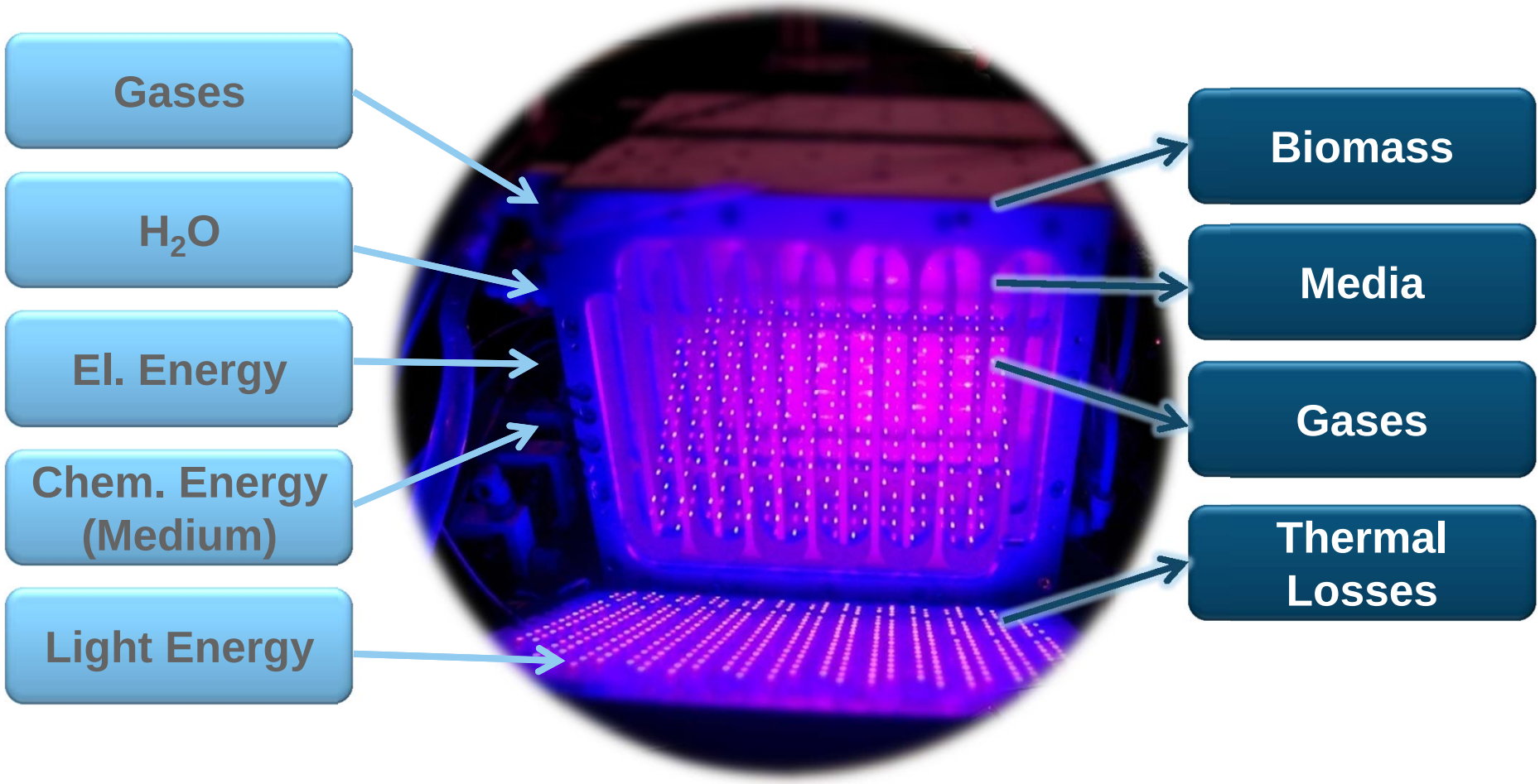
Goals of ModuLES-PBR

The **most efficient** Photobioreator with respect to **CO_2 uptake, O_2 production**, **energy conversion and consumption** with control over cultivation parameters and operation under chemostatic conditions.





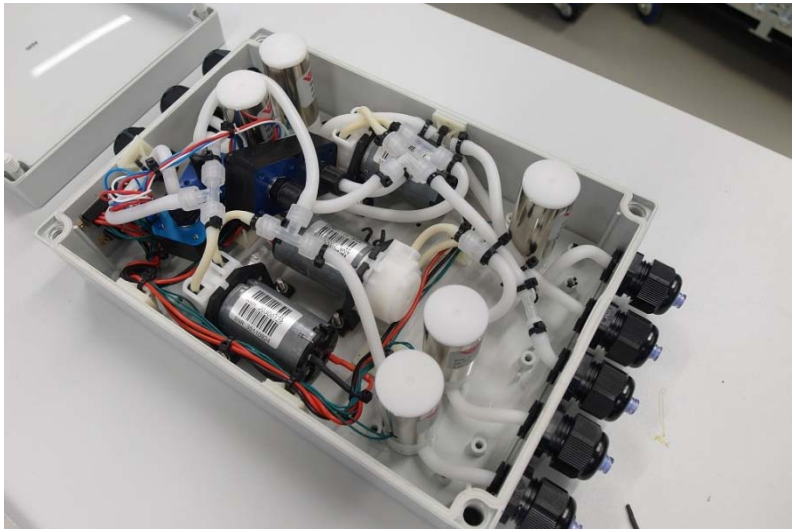
Important In- / Outflows for ModuLES-Concept

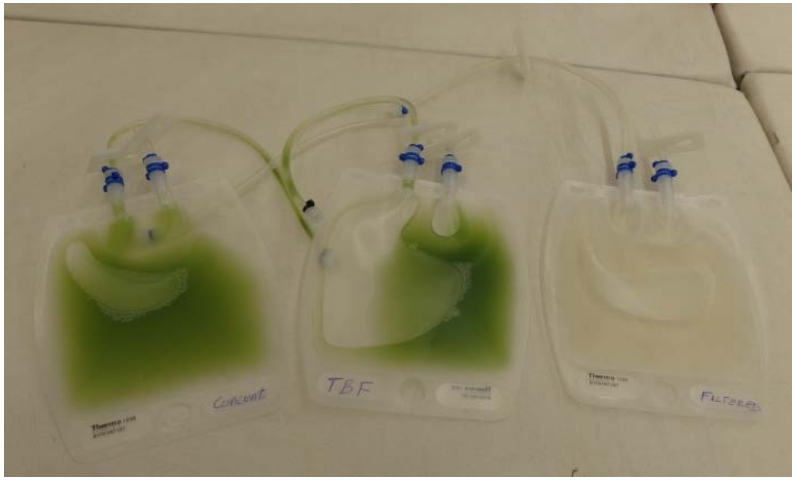


Sampling Unit

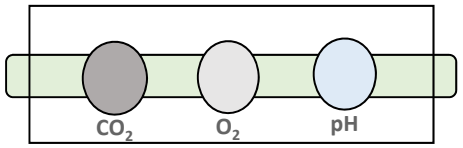
- 12 x sterile Syringe
- Pre-filled with a *RNA fixation* solution
- 5 ml sample volume
- Constant flow- through of cell culture
- Sample taking at desired timing
- Automatic suction mechanism

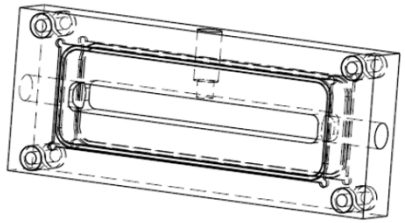
Filtration Unit





Optical Sensor System

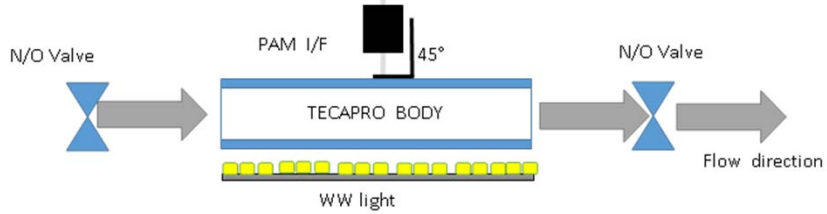


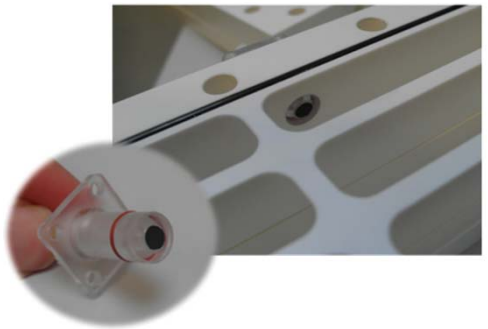


- **Dissolved O_2** of the culture media
- **Dissolved CO_2** of the culture media
- **pH Value** of the culture media

} fluorescence quenching

- **Optical density** of the culture media (at 750 nm wavelength)
- **Photosynthetic activity** (PAM)





- O_2 concentration inside the gas loops
- CO_2 concentration inside the gas loops

} fluorescence quenching

SPACE SYSTEMS

lessons learned & next steps

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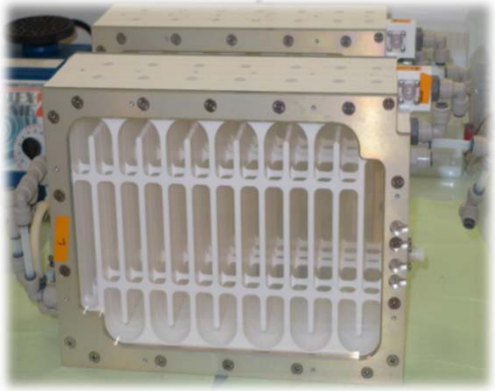
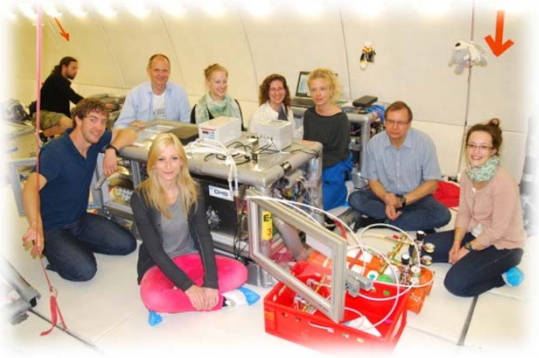
Parabolic flights (2x)





lessons learned to basic requirements and concerns

sources and sinks

efficiency vs. production rates and space feasibility

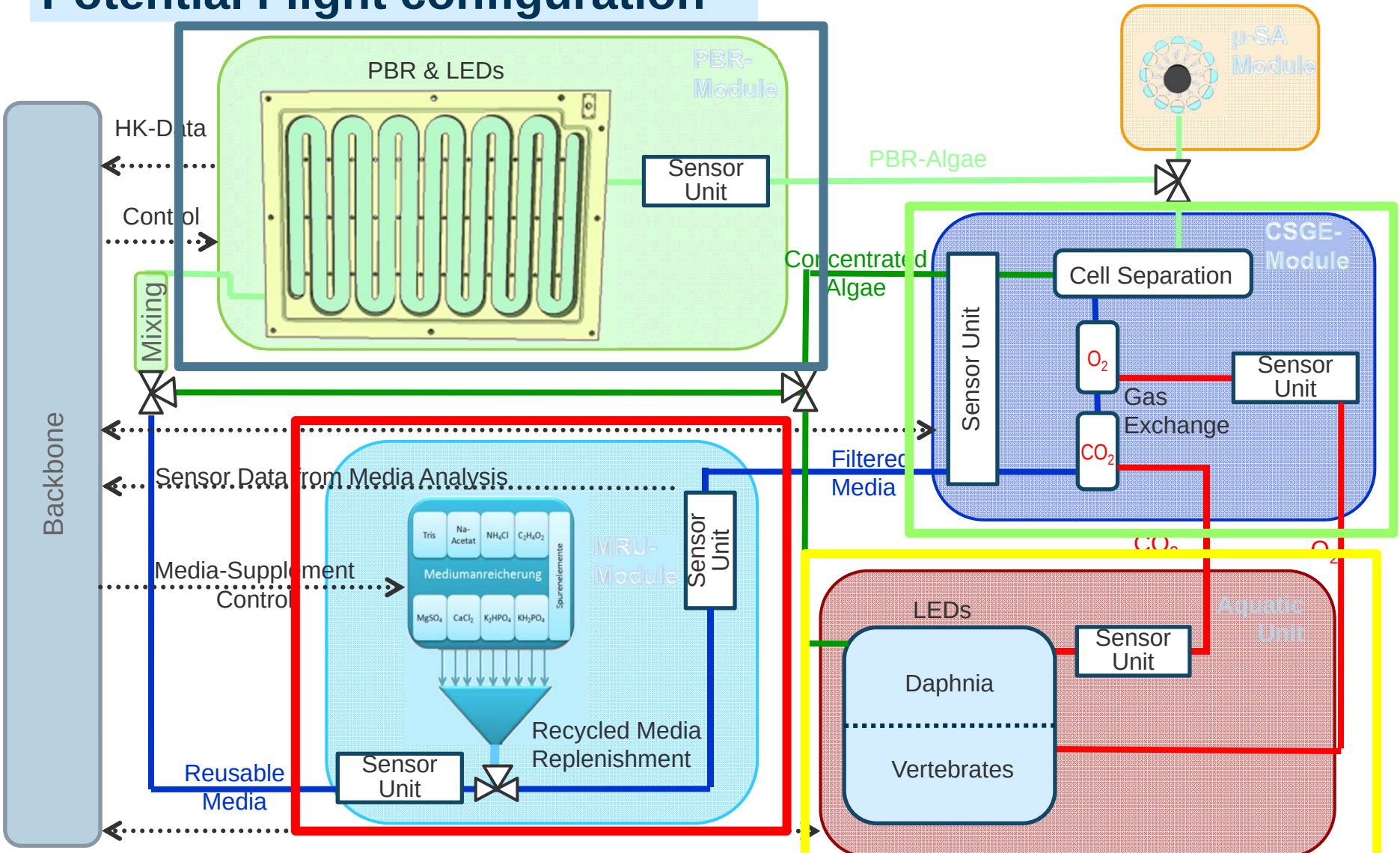
PBR Re-Design

Gas Exchange with Commercial Membranes in-efficient

Sterility is in BioRegLS not an Option!
Increase in tracegas contaminants acceptable

etc.

Potential Flight configuration



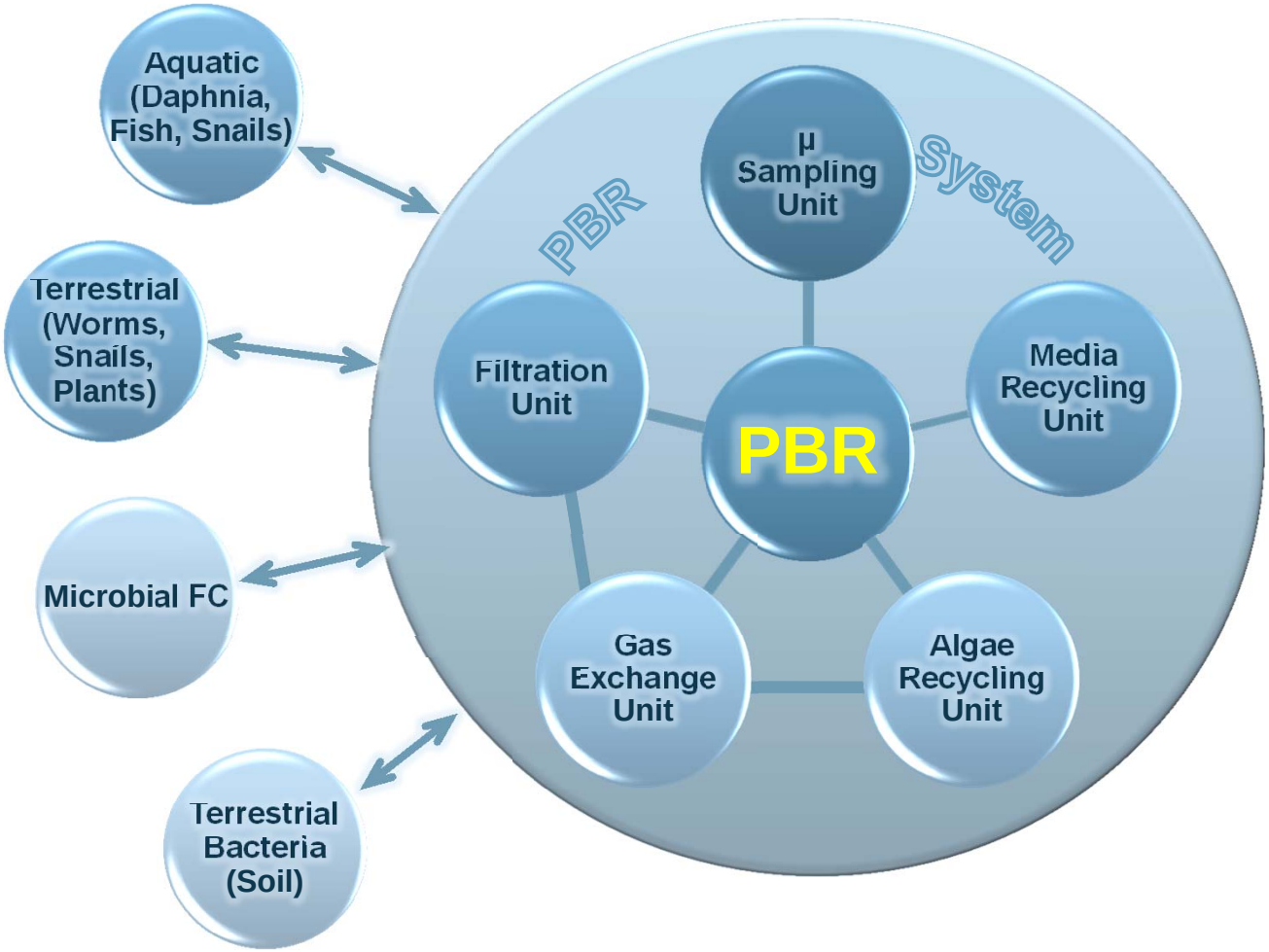
Potential timeline

2018/19 (2020)
Phase C/D – Preparation for Bion Flight

2017
Phase B2 - *Potential modules: Media Recycling Unit, µ-Sampling and Analyzing Module & Cell Separation and Gas Exchange Module & Aquatic Module*
Design, BB, Tests, Integration in PBR
PBR-Upgrade: antimicrobial coating, Adaption PFC-PT

2016
Additional modules:
Media Recycling Unit
New automated analyzer for Health status monitoring in the bioreactor
Gas Exchange Uni
Consumer Module

Combination options with potential next modules



Considered further Species/Options:

- **Chlorella**
- Scenedesmus
- **Nostoc**

THANK YOU FOR YOUR ATTENTION

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