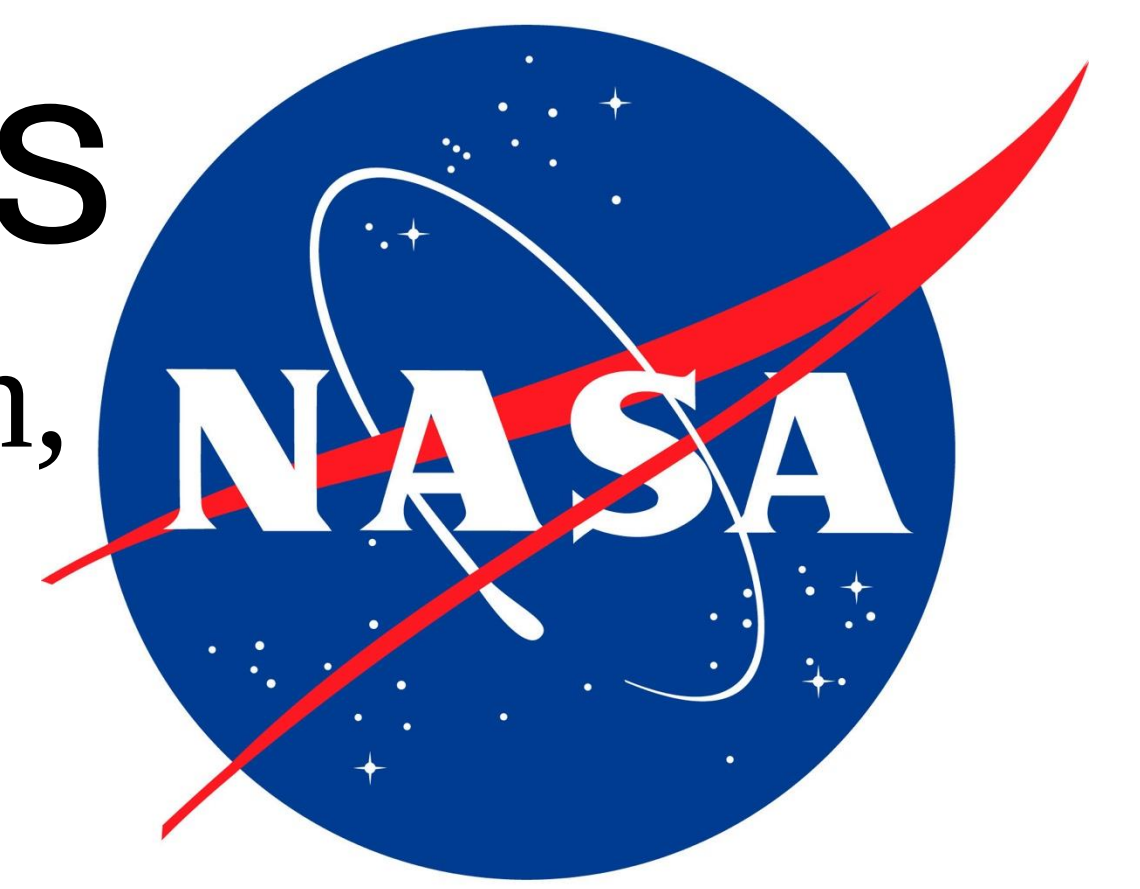




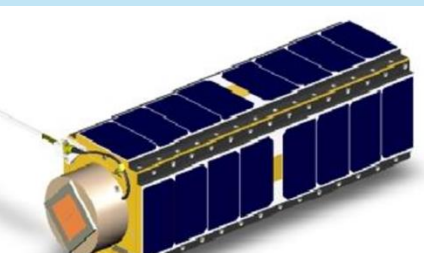
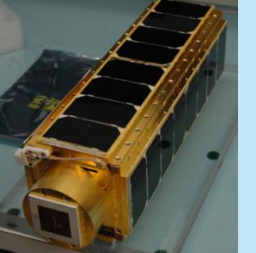
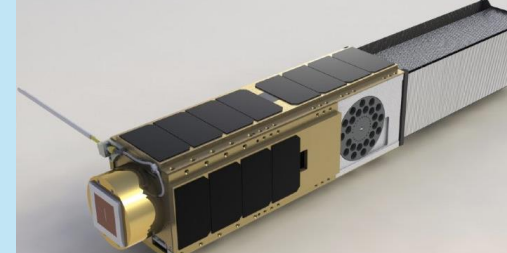
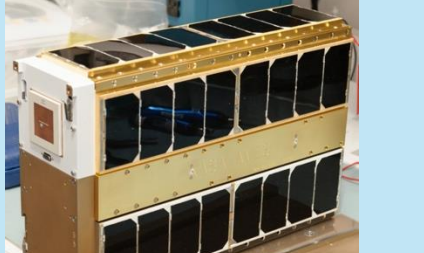
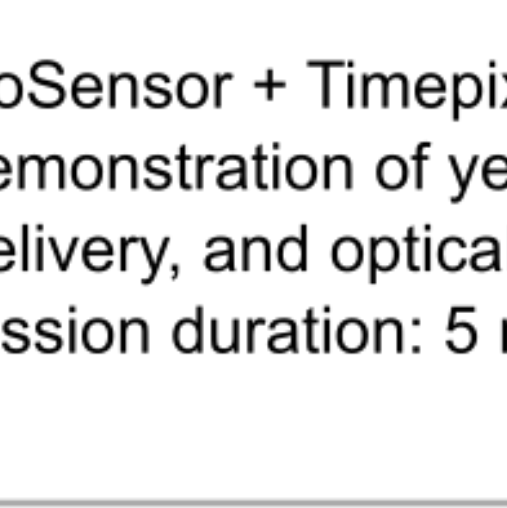
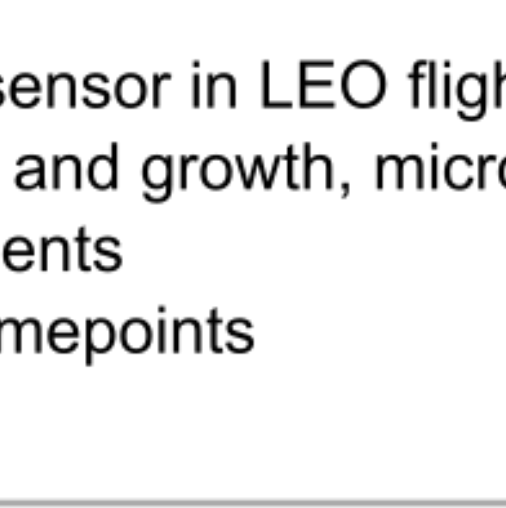
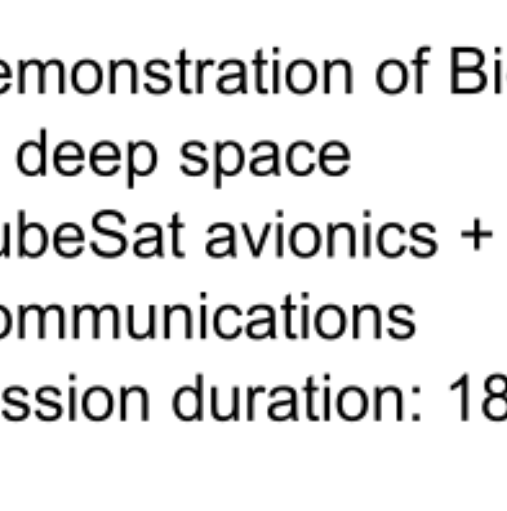
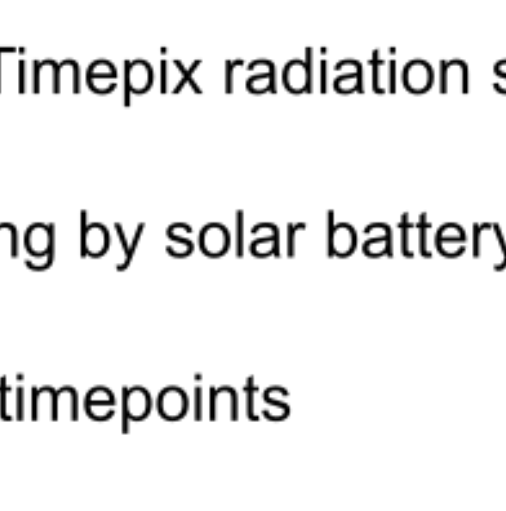
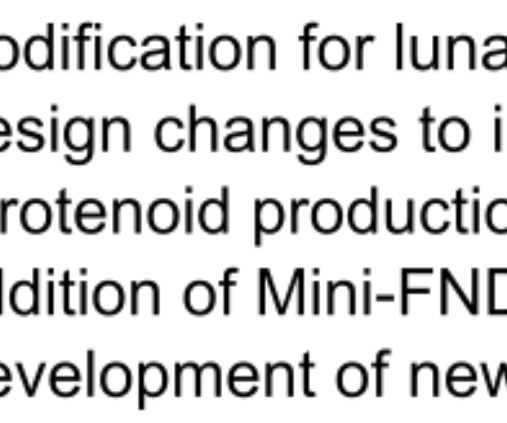
A Heritage BioSensor for Lunar Biology Experiments

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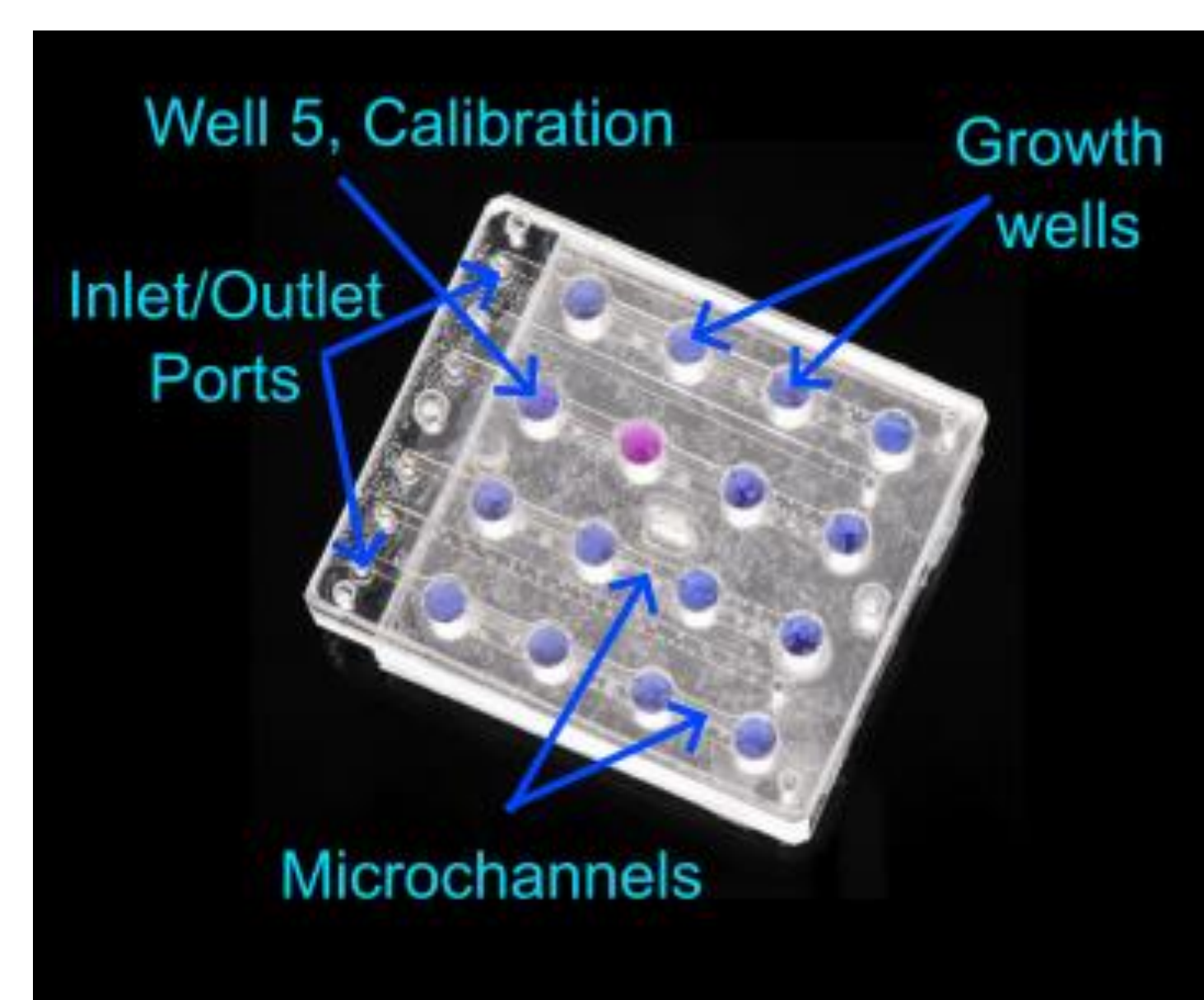
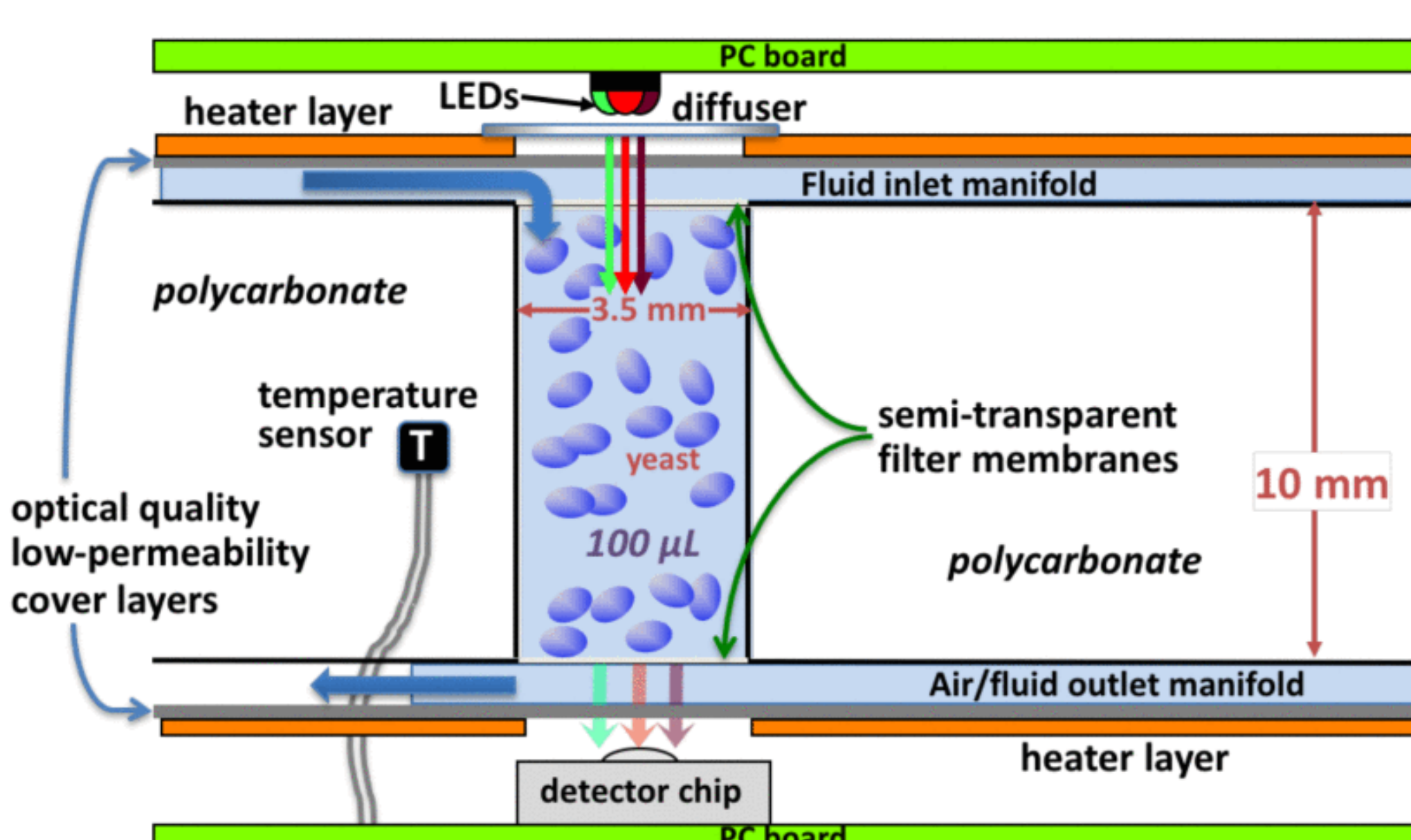
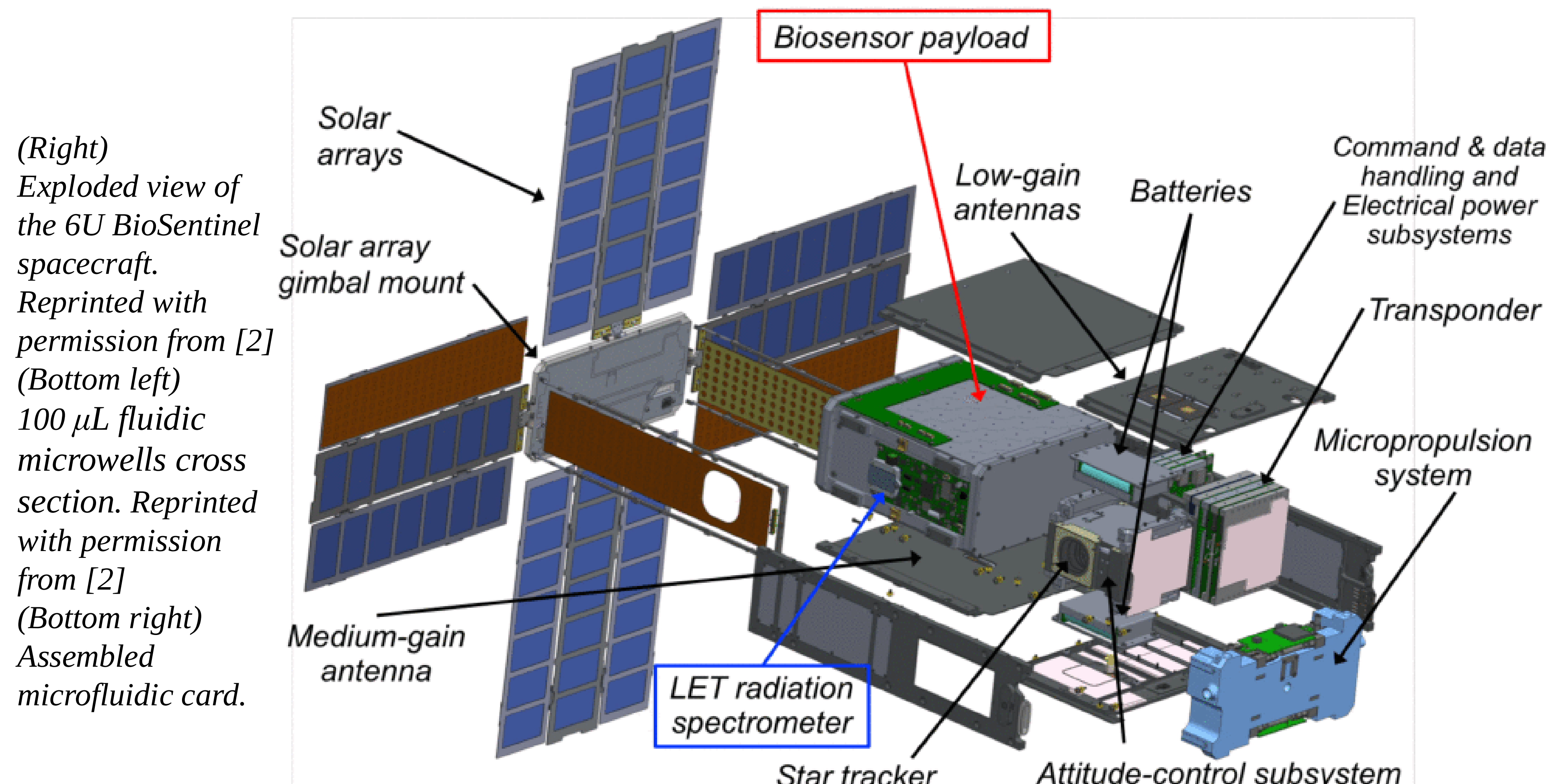
Background

Automated biological experiments on small spacecraft missions have gained prominence over the past decade due to their simplicity, accessibility, and small mass, volume, and power needs.

	GeneSat-1	PharmaSat	O/OREOS	EcAMSat
BioSentinel				
BioSentinel -ISS				
BioSentinel -Deep Space				
LEIA				

The BioSensor payload has great adaptability to host a diverse range of biological experiments with single- and multi-celled organisms in both crewed and uncrewed missions, making it a compelling candidate for future space biology studies in a lunar surface environment.

BioSensor Instrumentation



Lunar Explorer Instrument for Space Biology Applications (LEIA)

BioSentinel

Storage for multiple culture medium types

Housing modifications for later biology load before launch

Additional LED color (465 nm) for new biological assay for antioxidant (carotenoid) production

Improved isolation between electronic and fluidic components

Improved humidity control for prolonged organism viability in case of post-load launch delay.



LEIA

Future Prospects

Consistent successful demonstration of complex fluidics platforms with reliable instrument operations in a space environment is poised to create strong momentum for BioSensor-based biological experiment payloads. Planned future developments with the BioSensor include extending compatibility to a broader range of organisms and assays. Preliminary work has already demonstrated successful growth of *Arabidopsis* seedlings in fluidic cards. With a few modifications to the optical assembly, the setup could easily measure photosynthetic traits in plants and cyanobacteria. The addition of fluorescence measurements and generation of novel luminescent assays will elevate BioSensor's functionality further.

Beyond the BioSensor's potential uses on free-flyer missions, ISS and Gateway, and CLPS landers, deploying the BioSensor to the lunar surface or in an artificial habitat on crewed missions could enable pioneering research on both how life responds to lunar conditions and future bioproduction capabilities making the BioSensor an indispensable tool for future space biology research.



BioSensor supports plant growth and quantifies it. (Top) *Arabidopsis* seeds glued to microfluidics card wells with hydroxypropyl methylcellulose. (Bottom) Etiolated seedlings 148 hrs post hydration. [3]

Acknowledgements

The BioSentinel project is supported by NASA's Exploration Systems Development Mission Directorate (ESDMD). LEIA is supported by NASA's Exploration Science Strategy and Integration Office (ESSIO).

References

[1] F. Karouia *et al.*, Biotechnol. doi: 10.1016/j.biotechadv.2017.04.003. [2] A. J. Ricco *et al.*, IEEE Aerospace and Electronic Systems Magazine, doi: 10.1109/MAES.2019.2953760. [3] A. M. Settles *et al.*, (in preparation).