National Aeronautics and Space Administration

Stem Cell Based Models for Investigating Effects of Space Radiation

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ABSTRACT

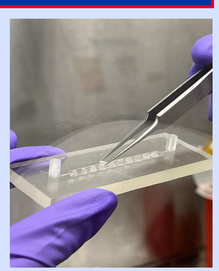
Space radiation creates numerous negative health effects, which are not well understood. While preparing for long term missions to Mars, it is important to understand these risks to protect astronaut health. The Radiation Biophysics laboratory is developing an automated microfluidics system that would enable long duration biology experiments on free flyers beyond low Earth orbit. In addition to fluidics control, this automation includes fluorescence based genetically encoded sensors that would report spaceflight-induced biological damage.

GOALS

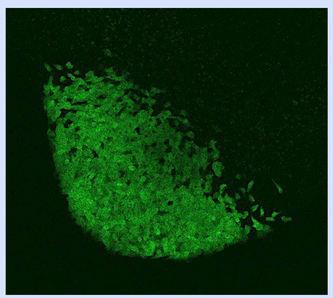
- Generate and mature directed forebrain organoids.
- Test and prepare microfluidics system for long term experiments.
- Purify the stem cell line carrying the genetically encoded sensor, HyPer7.
- Design plasmids for future encoded sensor experiments.

FLUIDICS SYSTEM

- Troubleshot pressure controller.
- Collaborated with Stanford Mechanical Engineering students.
- Leak testing
- Biocompatibility testing with organoids



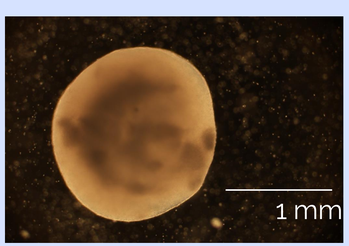
HYPER7

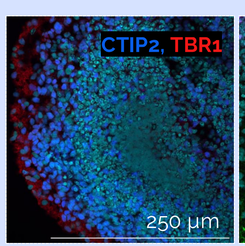


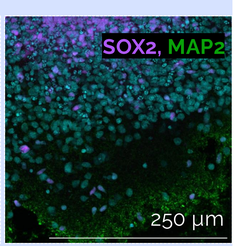
- Purified the stem cell line carrying the artificial HyPer7 reporter gene.
- HyPer7 fluoresces when in contact with hydrogen peroxide, a common radiation byproduct.

BRAIN ORGANOIDS

- Brain organoids are artificially grown tissue that resembles the human brain.
- Generated a forebrain organoid cohort.
- Maintained directed forebrain organoids (70 days old).
- Imaged via immunohistochemistry.

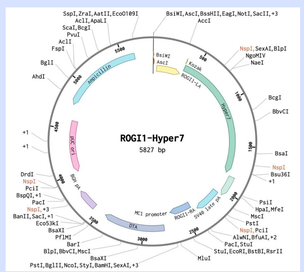






PLASMID DESIGN

- Progressed design for a luminescence as opposed to fluorescence reporter, which would have simpler imaging requirements.
- New ROGI1 integration site should improve gene expression and minimize disruption.



CONCLUSIONS

- Fluidics system is prepared for its first 6-month test
- Multiple cohorts of brain organoids were made and matured.
- HyPer7 purification progressed.
- Luminescence plasmid design progressed.

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