Space Microbiology: Mitochondrial Transfer in Spaceflight Environments

Elucidating the impact of microgravity environments on chemical and biological systems

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MISSION OBJECTIVE

Our mission is investigating the influence of microgravity on mitochondrial biology as a potential driver of spaceflight anemia and bone marrow disruption. To do so, we will quantify mitochondrial transfer transfer and function within and between bone marrow (BMSC) and hematopoietic stem cells (HSC) in a stationary vs. microgravity environment, stimulated by a 3D clinostat. These functional studies will be complemented by high-throughput sequencing to elucidate transcriptome-level changes. Our team consists of four interdisciplinary groups; namely, bioinformatics, biology, clone & flow, and engineering, who aim to explore one potential mechanistic driver of spaceflight-associated anemia.

Significance: Nearly half of astronauts return from spaceflight demonstrate symptoms of spaceflight-associated anemia, due a lack of red blood cells.

Importance: Characterizing the influence of HSCs (Hematopoietic Stem Cell) mitochondria transfer to BMSCs (Bone Marrow-derived Mesenchymal Stem Cells) to counter spaceflight anemia and bone marrow disruption enables long-term human spaceflight.

2023-24 PROGRESS

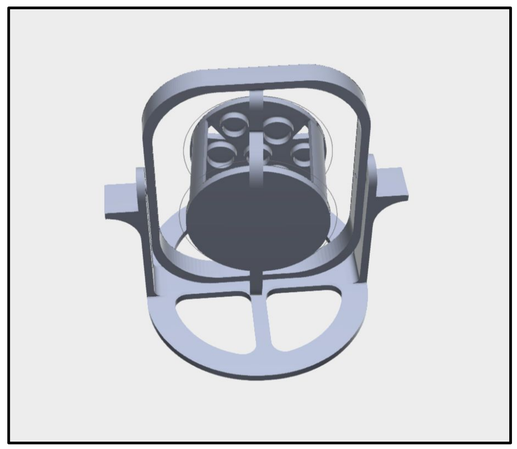
Engineering

BIOLOGY

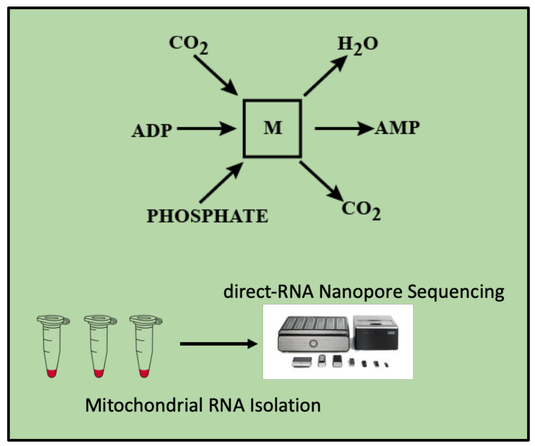
CLONE & FLOW

BIOINFORMATICS

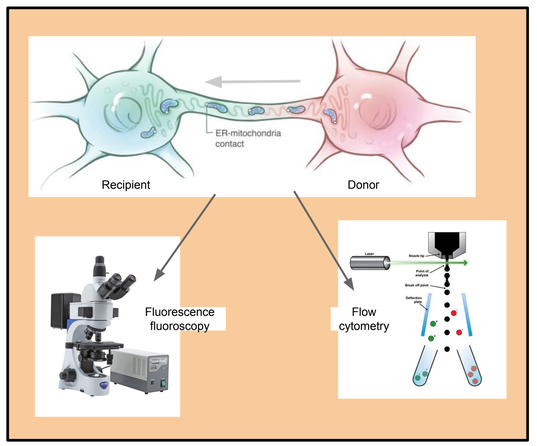
3D CLINOSTAT CAD DESIGN



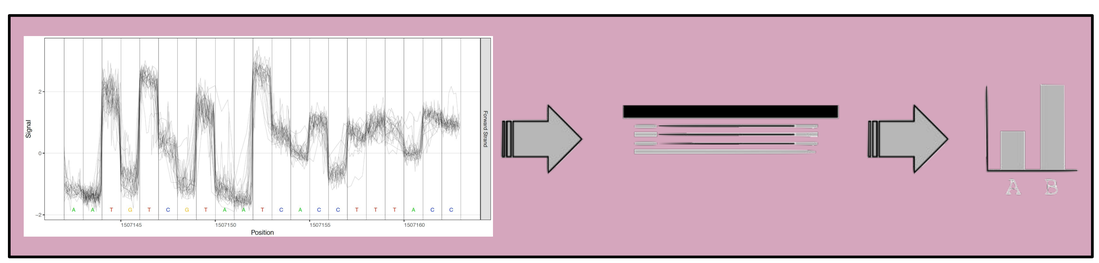
BIOLOGY



CLONE & FLOW



BIOINFORMATICS



RESULTS AND FUTURE PLANS

***Accomplishments*:** So far, we have completed a CAD design of the 3-D Clinostat. We have also formulated a hypothesis about the effects of microgravity on spaceflight anemia; namely, that HSC mito transfer to BMSCs is disrupted in spaceflight.

***Looking Forward*:** We plan to culture human Bone Marrow Stromal Cells (BMSCs) and Hematopoietic Stem Cells (HSCs) and subsequently isolate mitochondria using a magnetic bead technique to investigate mitochondrial transfer. With the obtained outcomes and data, we will conduct biological assays to comprehensively characterize mitochondrial function, including respiration and ROS production. Engineering plans to integrate sensors to measure parameters such as temperature and oxygen percentages, along with scaling the model of the 3D-Clinostat to the motor and writing the necessary code.

LEARN MORE

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