Space Microbial Ecology

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Introduction

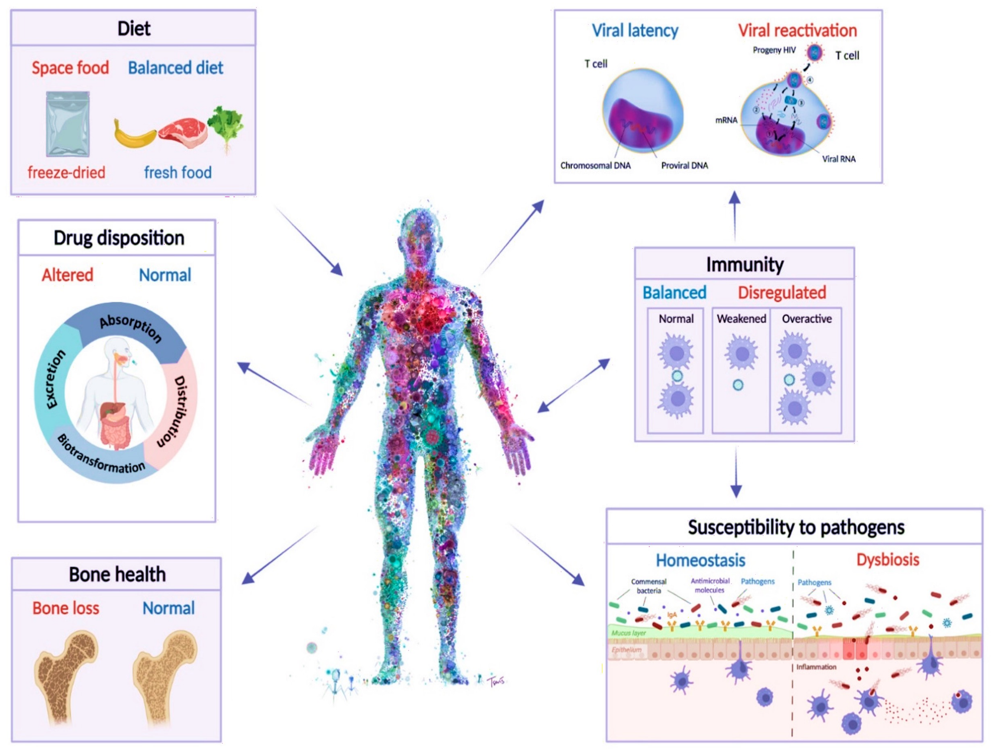
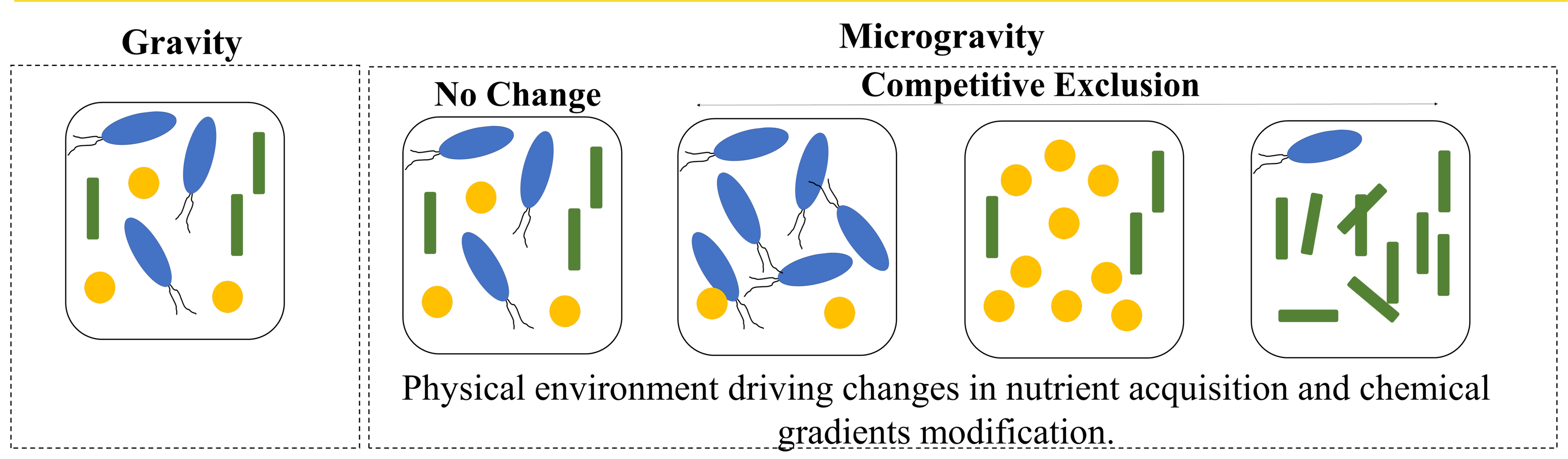


*Image Credit Tessei, D., et al., Life, (2022)

- NASA is establishing a lunar base to prepare for increased human space exploration
- Extended human space operations
- Increased exposure to space stressors such as microgravity (µG) can result in significant cellular and physiological changes
- Space travel has transient and long-term impacts on astronaut microbiome that alters immune system function
- Research studies that evaluate microbial ecology under µG are limited

Hypothesis



- H_1: Microbial communities develop atypical phenotypical characteristics and growth patterns under simulated μG environment compared to nominal gravity
- H_0: Microbial communities demonstrate typical gravity phenotypical characteristics and nominal growth curve characteristics under sim μG environment
  - Viable Colony Formation Units (CFUs) comparison
  - Phenotypical evaluation
  - Differential gene expression

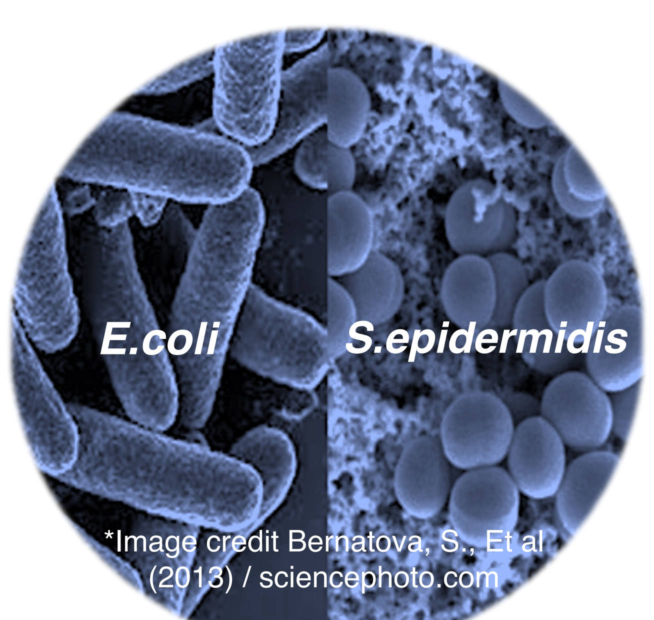
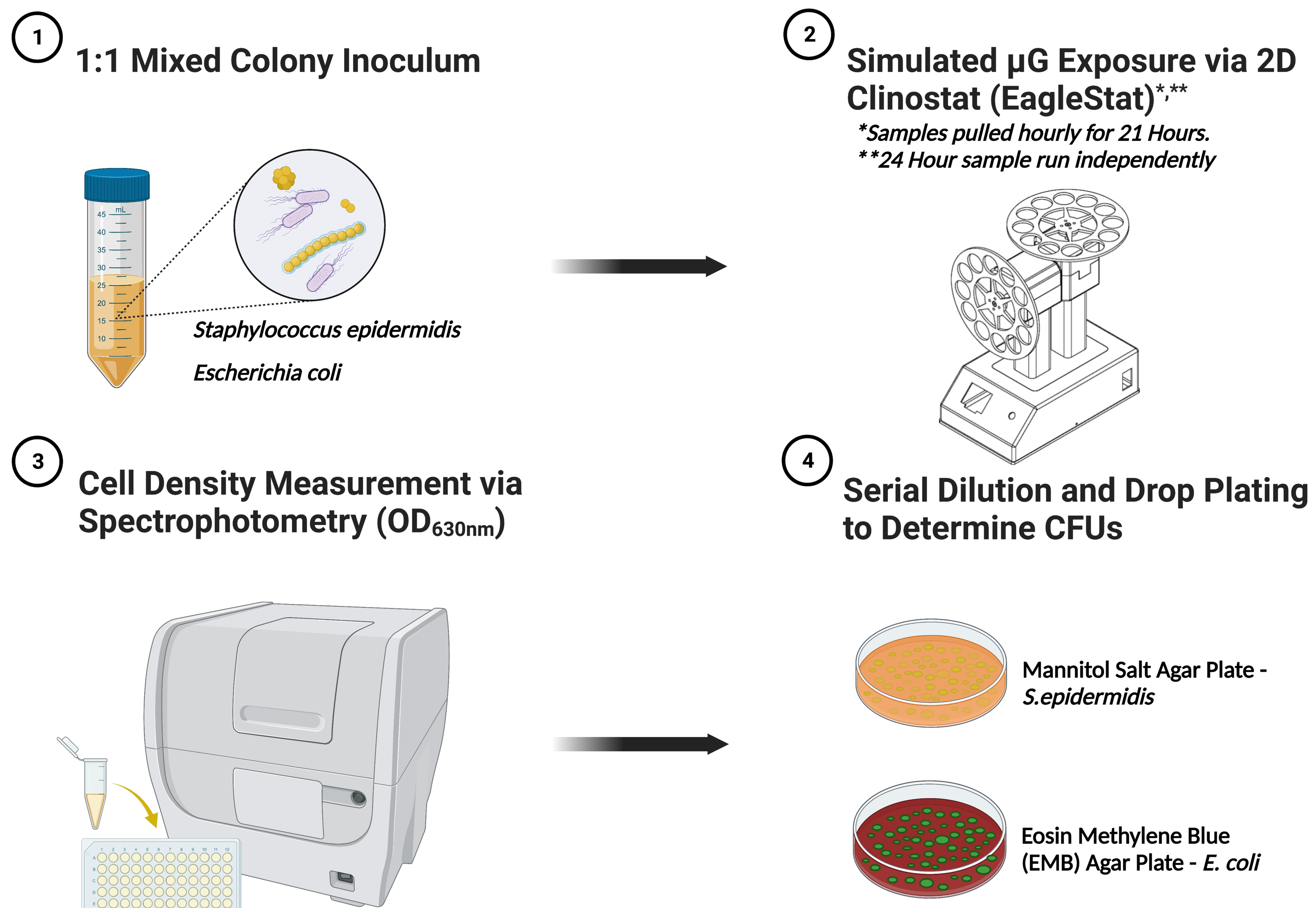


*Image credit Bernatova, S., Et al. (2013) / sciencephoto.com

Experimental Design

- *Escherichia coli* (Intestinal Microflora) – Gram Negative & Rod Shaped
- *Staphylococcus epidermidis* (Epithelial Microflora) - Gram Positive & Cocci Shaped
- Eosin Methylene Blue (EMB) media – Gram Negative
- Mannitol Salt Media – Gram Positive



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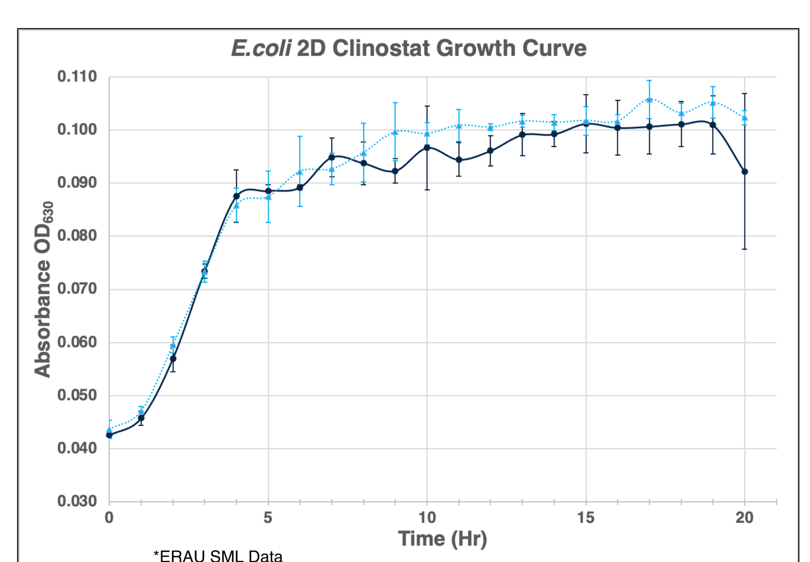
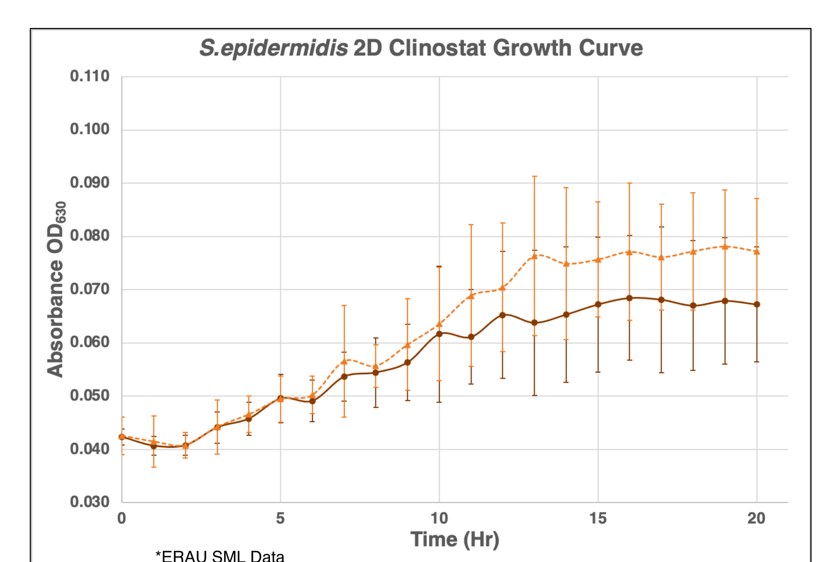
Growth Curve Results

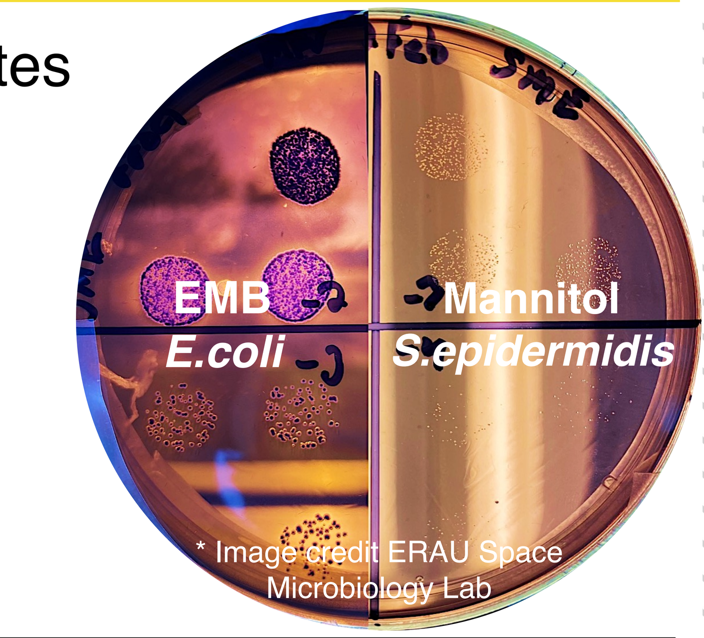
- 6 Clinostat Trials = 252 Samples (3 Biological Replicates)
- Spectrophotometry measurements completed in triplicate per sample at optical density of 630nm
- Slight increase of cells under simulated μG compared to gravity analog

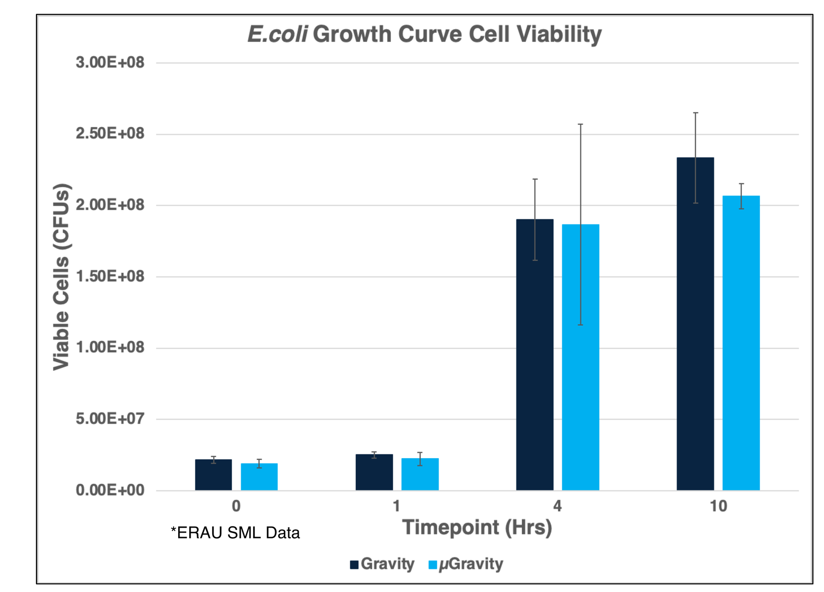


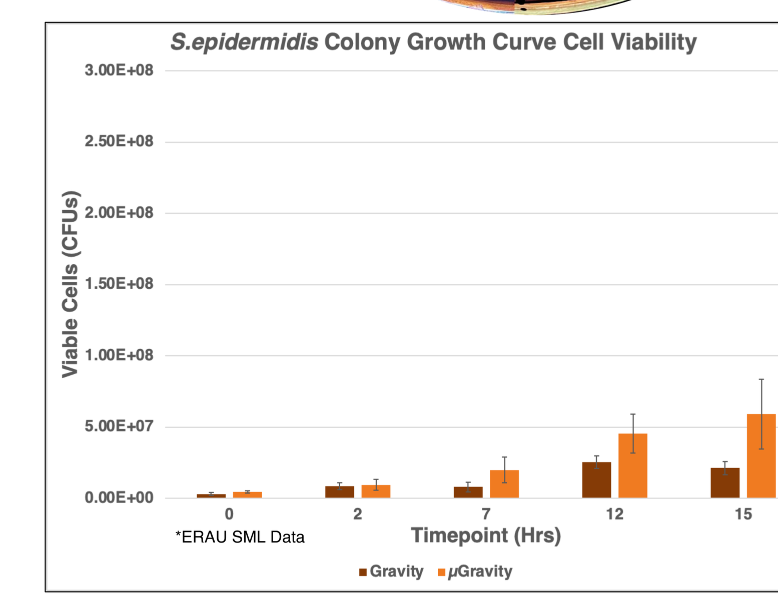


Growth Curve Viable Cells Results

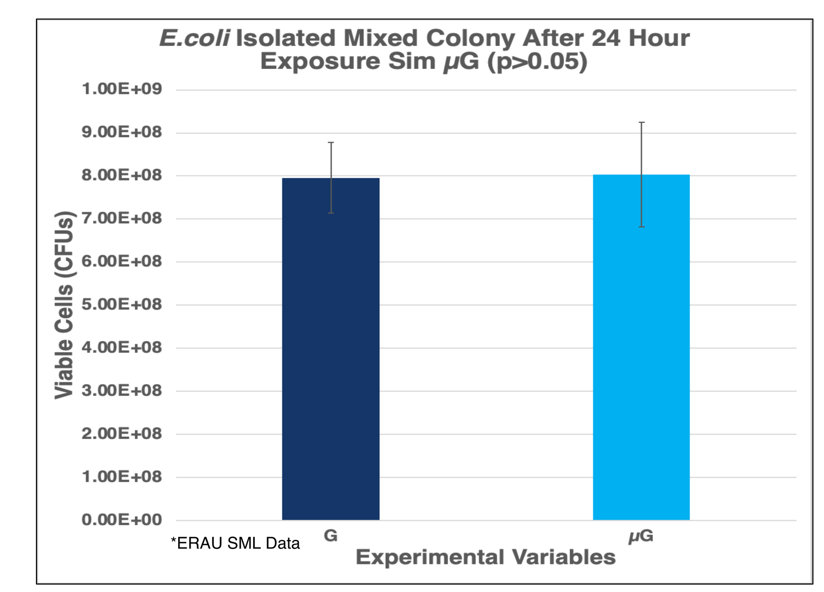
- 11 Timepoint Samples – 22 Plates (3 Biological Replicates per)
- Timepoint samples selected from growth curve phases
- S.epidermidis Hour 15 p>0.05

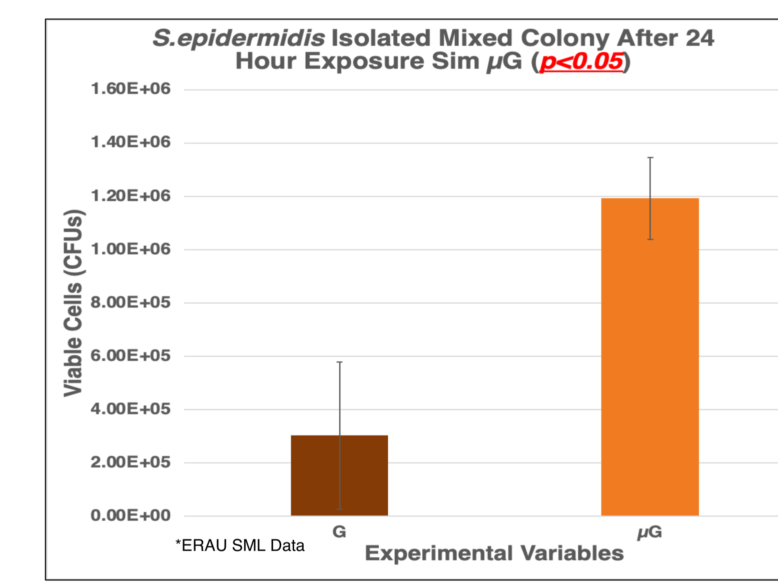






Mixed Culture Results

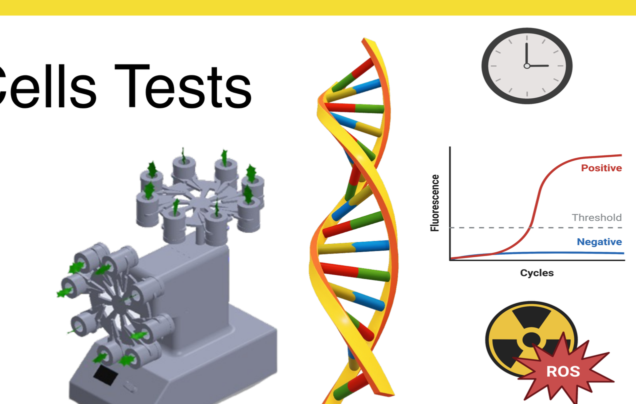




- Significant **($p<0.05$)** viable cell increase (~<u>1.5 fold increase</u>) with *S.epidermidis* under simulated μG conditions

Future Research

- ➢ Timepoint Mixed Culture Viable Cells Tests
- ➢ Differential Gene Expression
- ➢ Low Dose Ionizing Radiation
- ➢ Lunar Regolith Soil Communities



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