Evaluation of toxicity of lunar and Martian regolith on skin microbiome-relevant bacteria.

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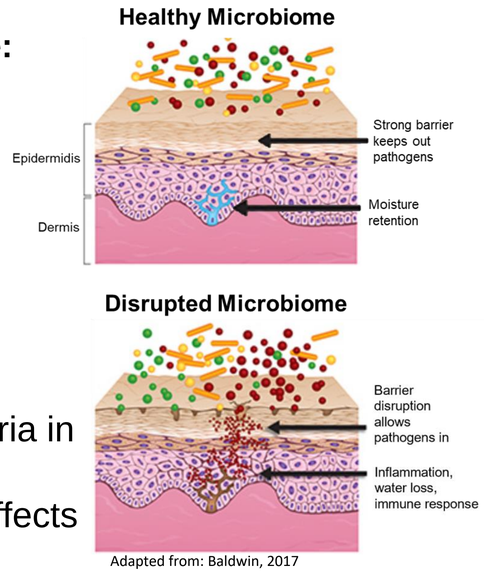
Introduction

Lunar regolith potential alterations of the skin microbiome:
- Physical irritation
- Chemical alteration
  - pH, moisture content, toxic elements
- Immune response modulation
- Secondary radiation species from galactic cosmic ray exposure

Hypotheses
- Growth rates will be inhibited when simulant is added to bacteria in nutrient broth.
- Death rates will increase when simulant is added to bacteria in buffer(no nutrients).
- Increasing the concentration of simulant will worsen the effects in both conditions.



Adapted from: Baldwin, 2017

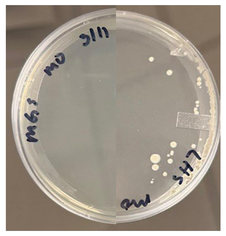
Lunar dust on human health

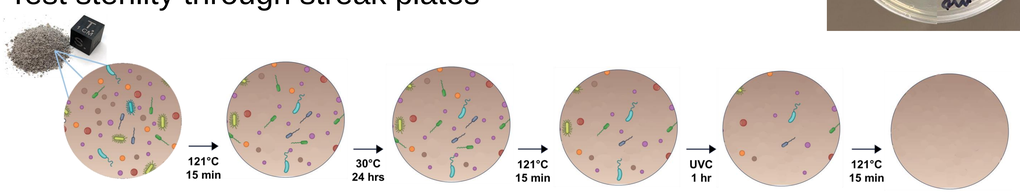
- Apollo astronaut, Harrison Schmitt, reported that all 12 men who stepped foot on the Moon struggled with short-term nasal congestion, sore throat, and watering eyes. This condition was later labeled “lunar hay fever”.
- Long-term studies are being conducted on respiratory and visual systems to analyze the long-term health risks of regolith exposure.
- Other research with regolith simulants have shown cell death and DNA damage in neuronal and lung cell lines. (Caston, 2018)


Spacesuit exposed to the lunar surface on the Apollo 12 mission (Christoffersen, 2009)

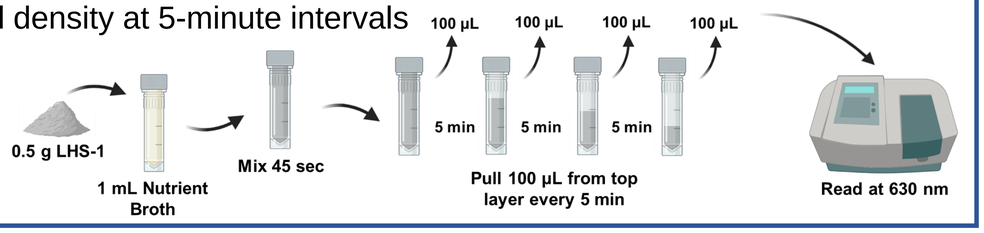
Substrate Preparation

Simulant Sterilization Method
- To maintain and allow for pure cultures to be analyzed.
- Optimize control over experimental conditions.
- Utilize autoclave and UV light sterilization techniques
- Test sterility through streak plates

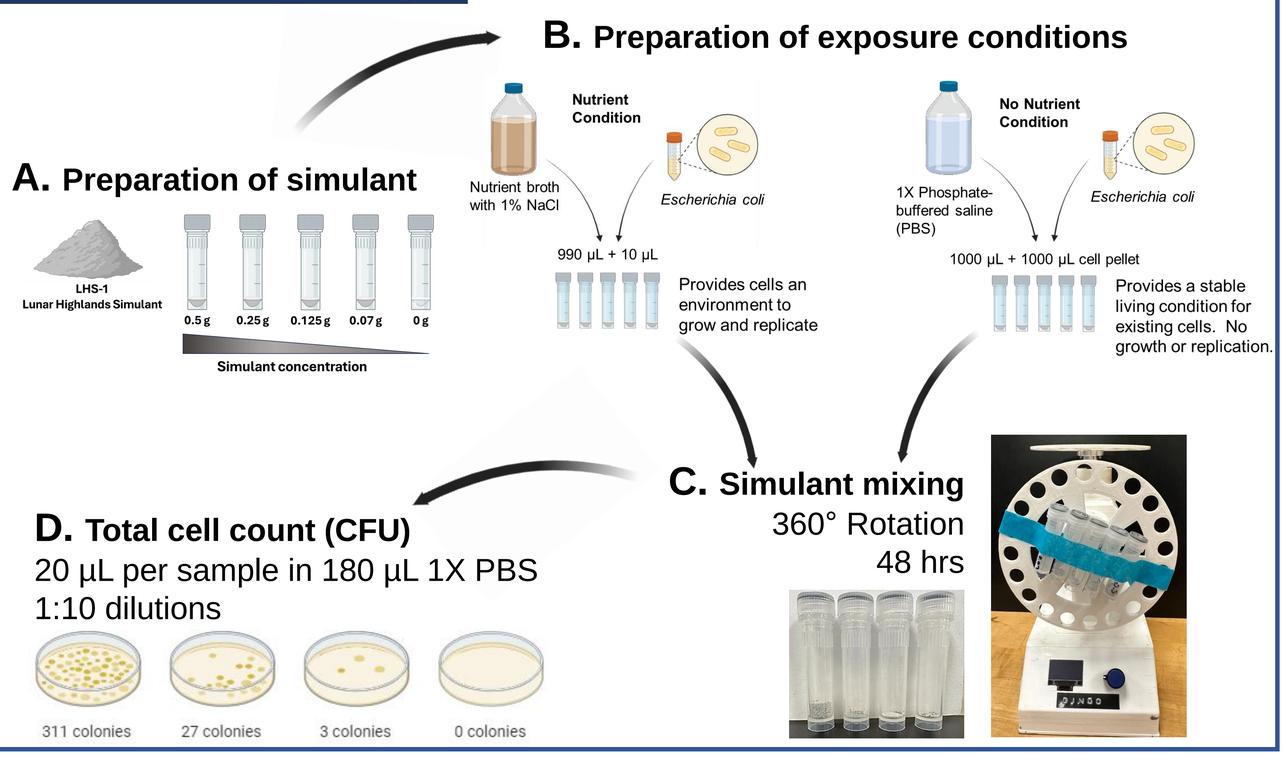




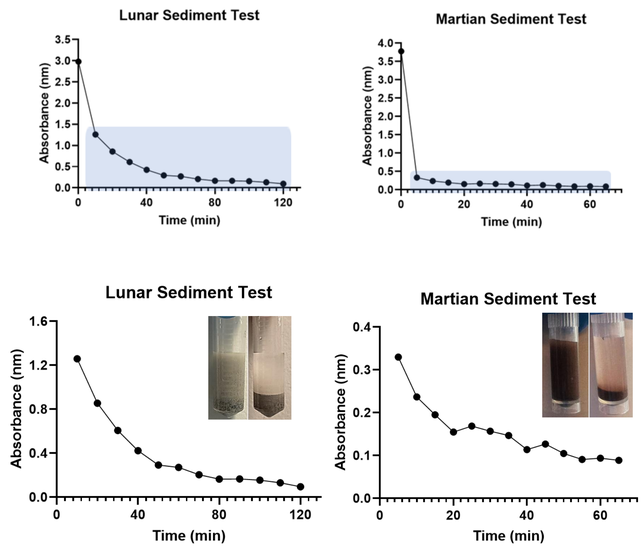
Particle Sediment Test
- Observe average time simulant settles from nutrient broth.
- Optical density at 5-minute intervals



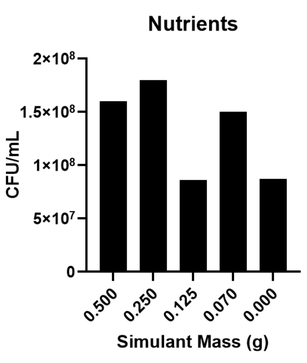
Experimental Design



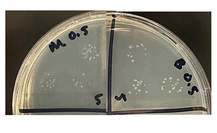
Preliminary Results

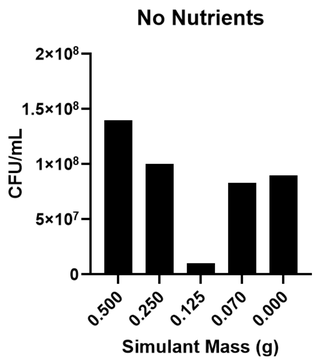


First trials show MGS-1 settles faster than LHS-1



Total cell count shows an **increase in *Escherichia coli* growth** after higher MGS exposure in nutrients.

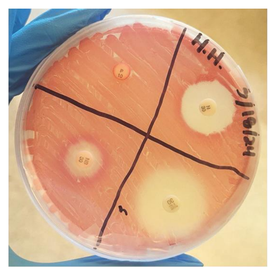




Total cell count shows an **increase in *Escherichia coli* death** after lower MGS exposure in no nutrients.

Future work

Antibiotic resistance of *Serratia marcescens* post microgravity (RCCS) and simulant exposure
- Grow *Serratia marcescens* under microgravity conditions using the RCCS
- Expose the cells to simulant
  - Observe changes in growth rates and biofilms
  - Observe the appearance of pigment
- Total cell counts on nonselective agar
- Kirby Bauer antibiotic assay


Kirby Bauer assay on *Serratia marcescens* prior to any stressors

References

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