

# Case Study on Extremophilic Organisms: Microbial Survivability in Lower Stratosphere

Bryan Gunawan, Jamie Lehnen, John Prince, Dr. Edgar A. Bering III,  
University of Houston, Houston, TX, USA



## BACKGROUND

- Around  $10^{21}$  to  $10^{24}$  biological cells are lifted up to the atmosphere annually and contribute to 25% of particulate matter (PM) in air
- Recovered samples from stratosphere contain prokaryotes with endospore forming ability.
  - Greater resistance to UV irradiation
  - Adaptation to mutagenic upper atmosphere
  - Possible extraterrestrial origin
- Presence would be detrimental for planetary protection protocol.
- Further collection required to assess validity of samples
  - Recurring issues with contamination and sterilization.
- Exposure test also needed to evaluate survivability of terrestrial bacteria under close-to-martian condition.

## EXPECTATIONS

### Collection:

- Corroborate estimated population density of microbes
- Capture discovered and undiscovered microbes and perform genomic analyses on their adaptive traits.
- Identify captured and cultivated microbes
- Prove or disprove panspermia theory from findings

### Exposure:

- Understand survivability mechanism of on-spore forming organisms on hardware under radiation exposure
- Determine probability of contamination during interplanetary travel.

## POTENTIAL USE

### Microbial findings

- Microbial Fuel Cells
- Bio mining of metals
- Antibiotics from antimicrobial properties
- Wastewater Treatment using formed biofilms
- Improve planetary protection protocol

### Instrument:

- Health and Air quality studies and management
- Air sampling to obtain in situ atmospheric composition
- For professional studies by other researchers and NASA investigators

## ACKNOWLEDGEMENTS

### University of Houston

- Dr. Deborah Rodrigues - Associate Professor of Civil and Environmental Engineering,
- Dr. Edgar Bering III - Professor of Physics and Electrical and Computer Engineering
  - Dr. Ralph Metcalfe - Professor of Mechanical Engineering

### University of Alaska - Fairbanks

- Dr. Mary Beth Leigh – Associate Professor of Microbiology

## SUMMARY

- Obtain cross-sectional data of microorganisms collected in the lower stratosphere using an efficiently designed, lightweight, balloon-borne suctioning mechanism.
- Expose terrestrial bacteria to stratospheric condition to assess survivability mechanisms.
- Data useful for further studies in field of microbiology and atmospheric science
- Payload will be flown using latex weather balloon

### • Advantage:

- Economical
- Reproducible

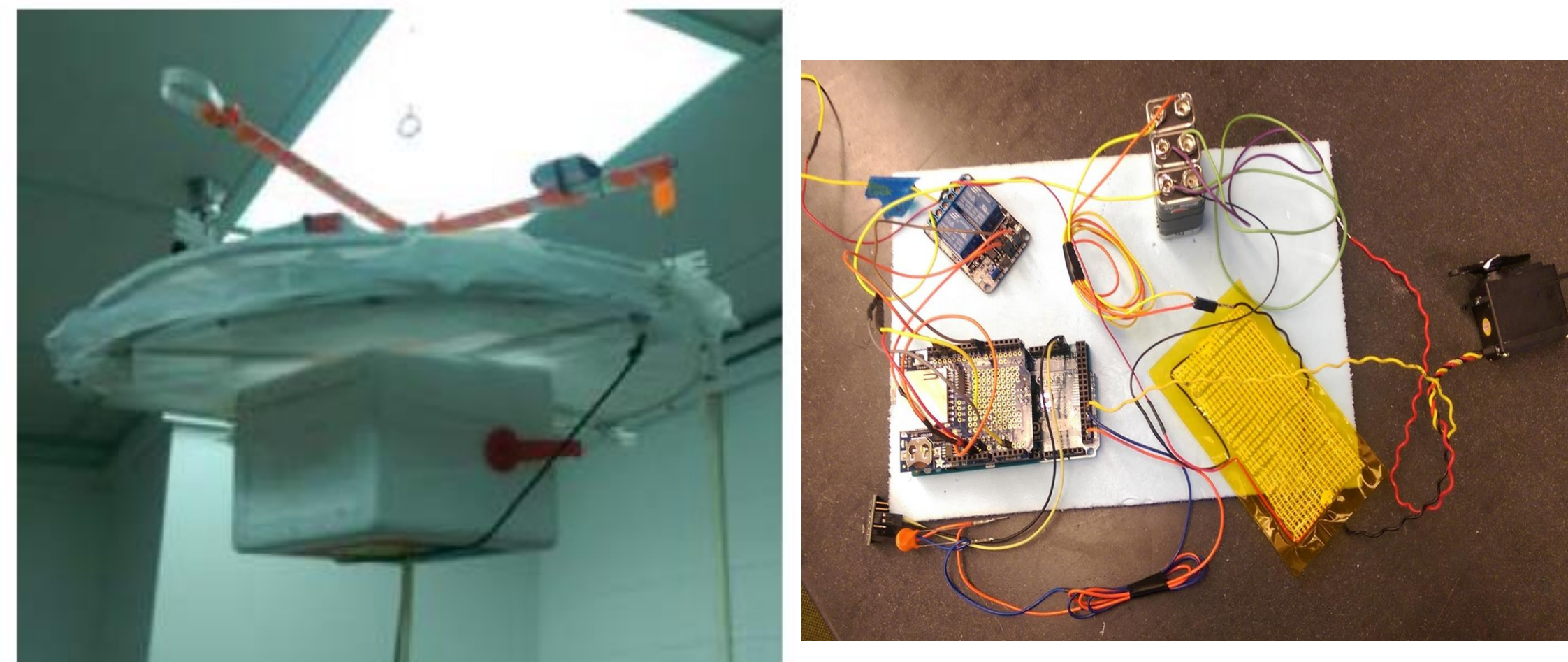
### Disadvantages/Risks:

- Failure in Recovery
- Payload Damages can compromise samples

## DESIGN

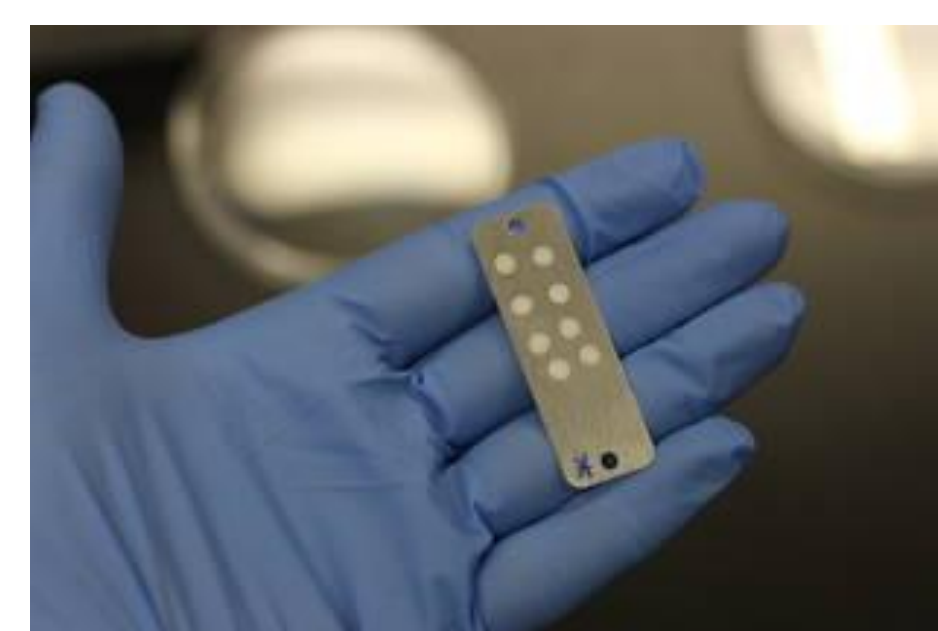
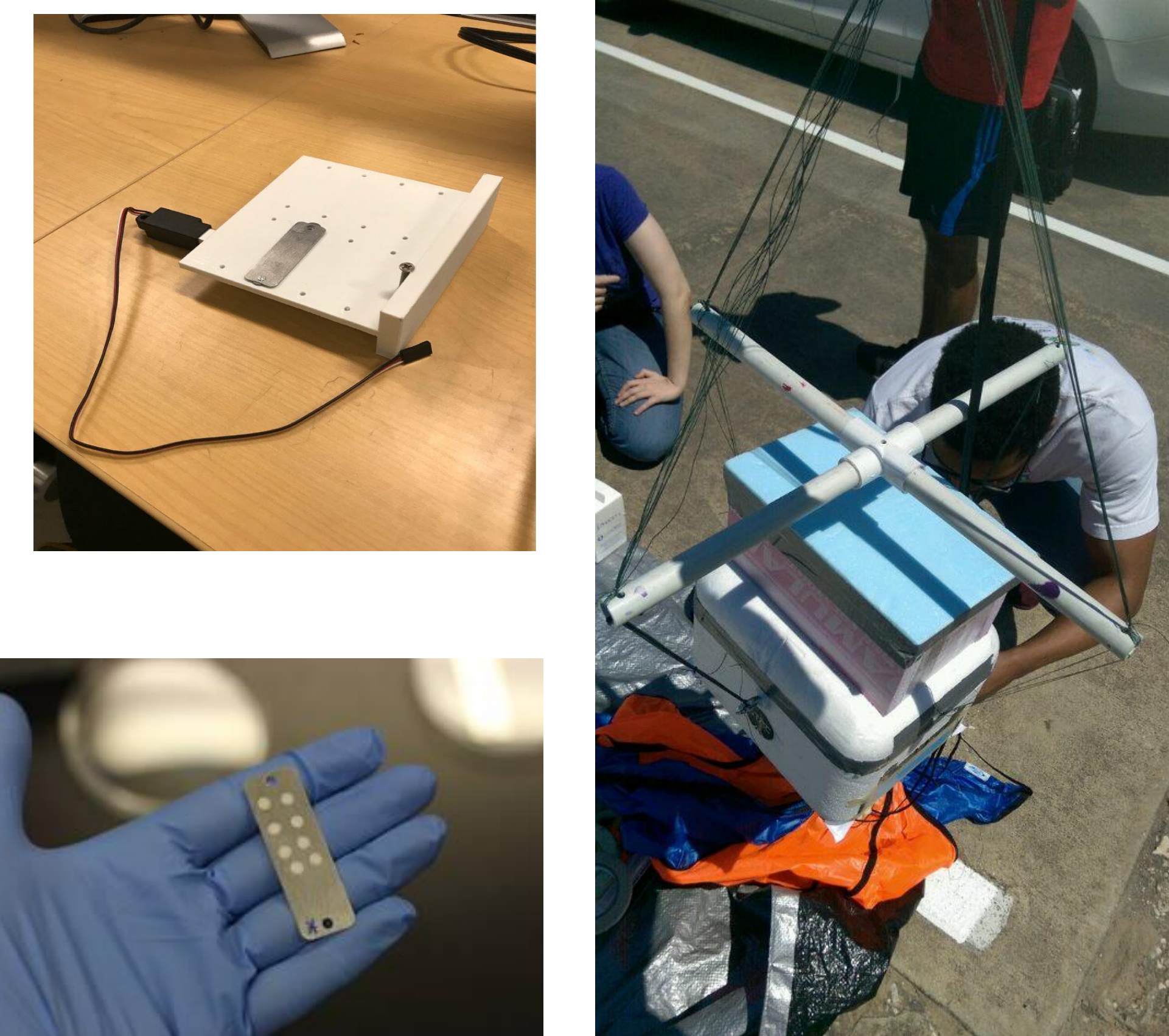
### Sampling

- Large sampling volume
- Reduced reliance on electronic movement i.e. pump

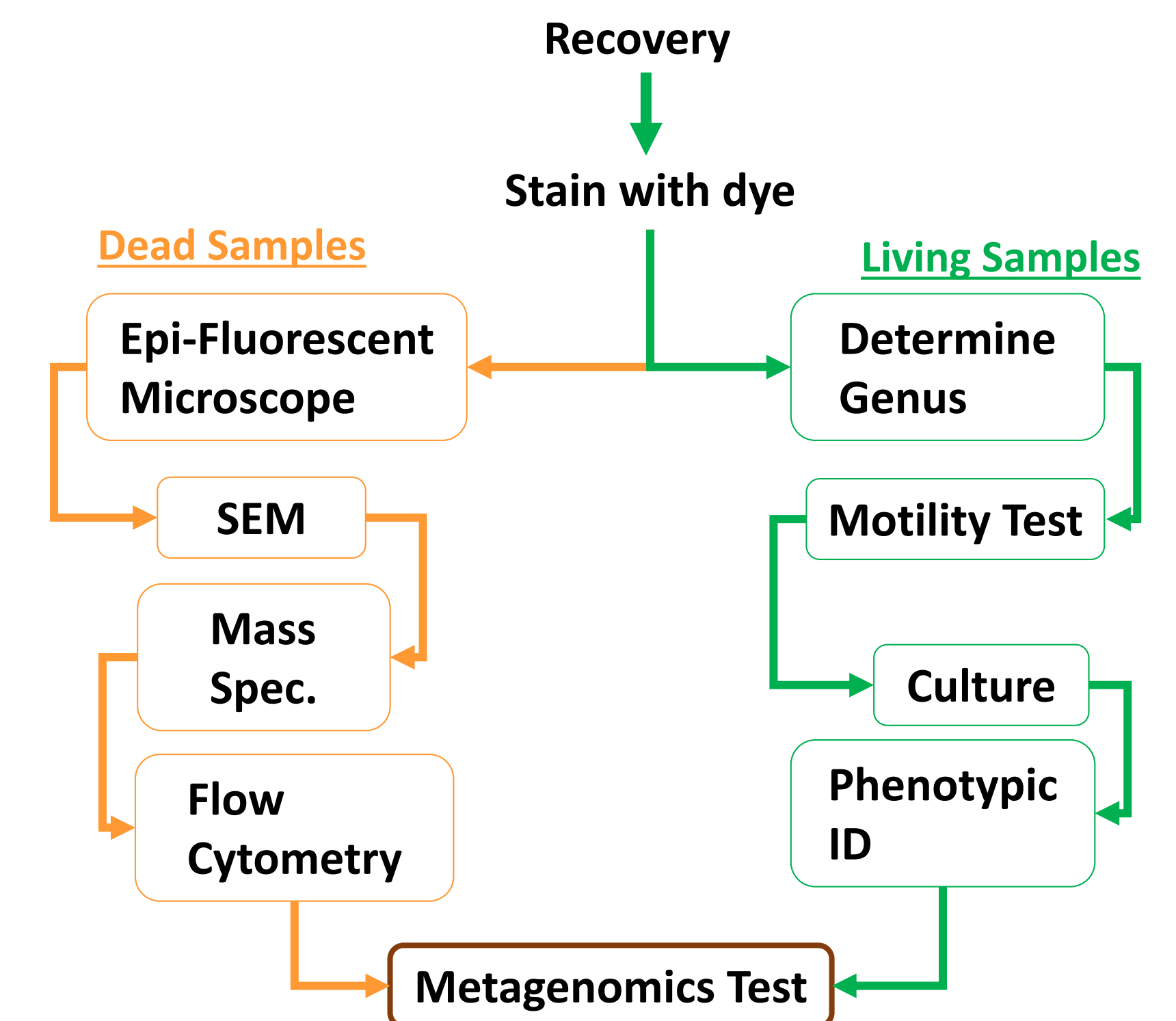


### Exposure

- Simplified design - two platforms and actuator
- 6 microscope slides (48 batch) per platform

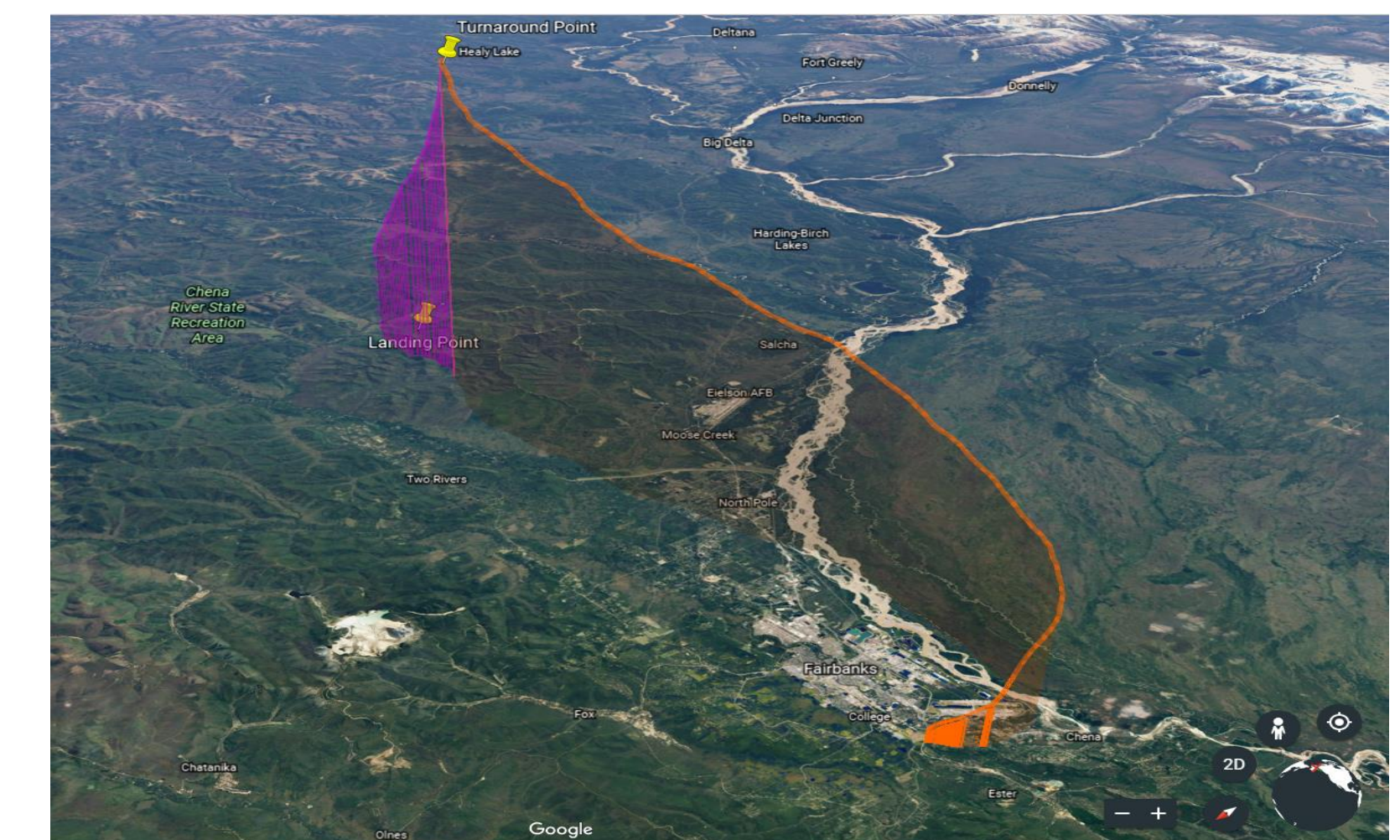


## POST-ANALYSIS PLAN

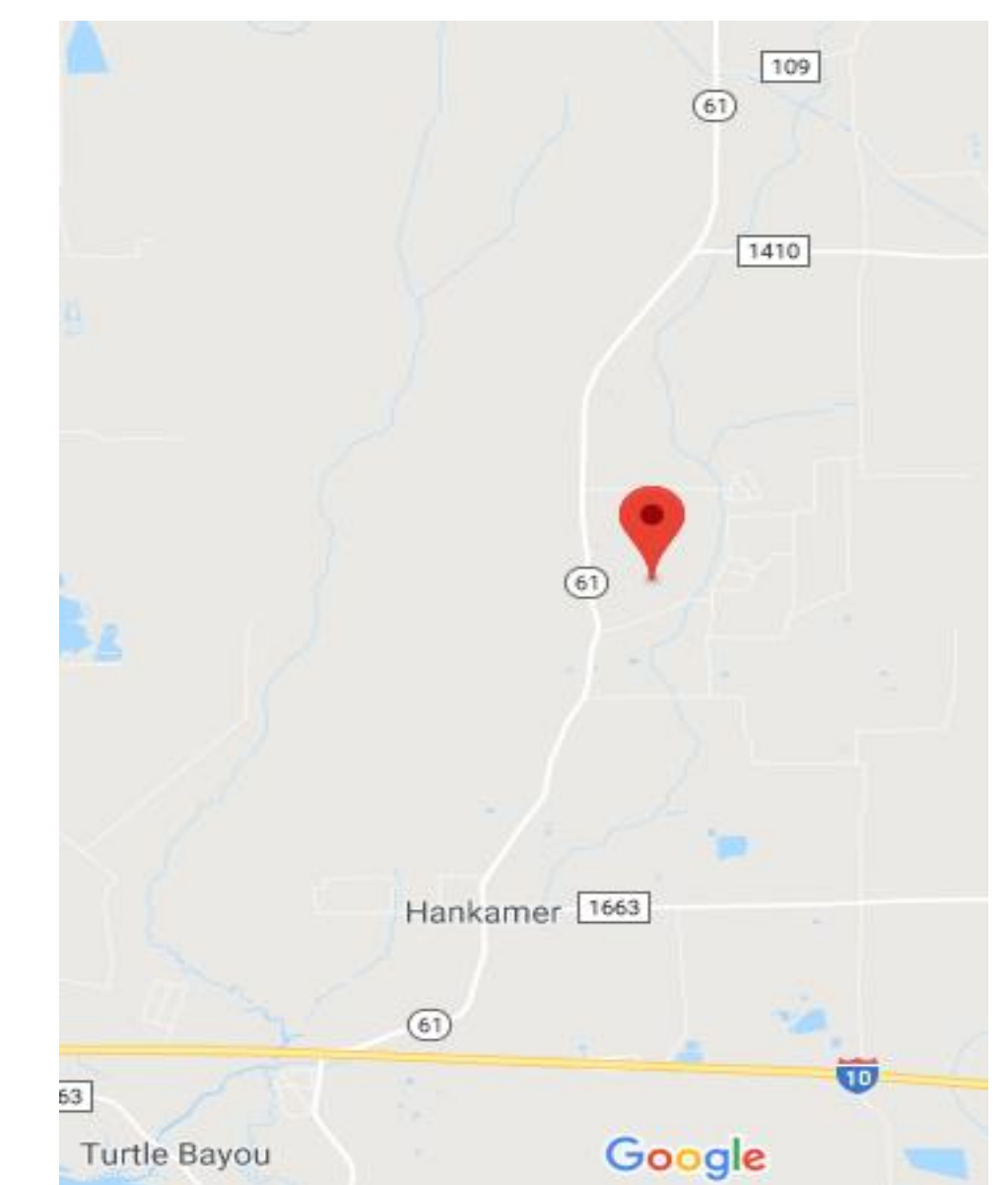


## INITIAL FLIGHT & RESULTS

- Sampling experiment – Fairbanks, AK.



- Exposure experiment – Houston, TX



- Moving Forward

- Re-design sampling payload with protective barrier and contingencies
- Recover exposure payload from Hankamer Field