Conducting Biological Experiments In Space Using CubeSat Technology

VECTOR SPACE BIOSCIENCES

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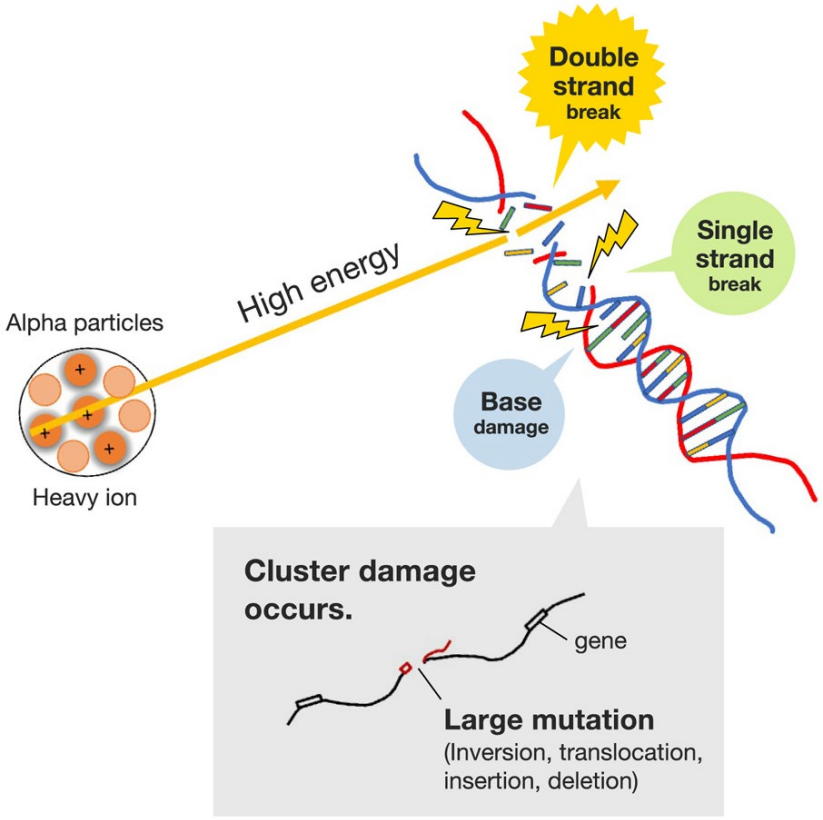
The Need For Space Biosciences

- Humans will not be able to build lunar bases or perform long duration missions on Mars without a proper understanding of how to protect humans from the stressors of the space environment
- As long duration manned-missions are developed, it is imperative to characterize the effects of microgravity and radiation on living organisms, and develop countermeasures to prevent and minimize adverse effects on astronauts
- In addition, biological experiments conducted in the space environment can yield results that lead to discoveries capable of benefitting everyone on Earth



Space Biosciences' Impact On Earth

- Space biosciences has already resulted in benefits that affect ordinary people on Earth
- An example is Merck's crystallization experiment conducted on the ISS to improve the formulation and delivery of the drug Keytruda®
- Proteins crystalize more uniformly in microgravity than they do on Earth, resulting in more consistent drug formulation
- This experiment also demonstrated reduced viscosity in the drug, allowing for subcutaneous injection
- Merck is currently using rotational mixers and temperature gradients to re-create this formulation on Earth.
- By utilizing a CubeSat platform, similar studies, amongst other diverse biological experiments, can be conducted in the space environment without adding to the ISS' backlog

The Advantage Of CubeSats

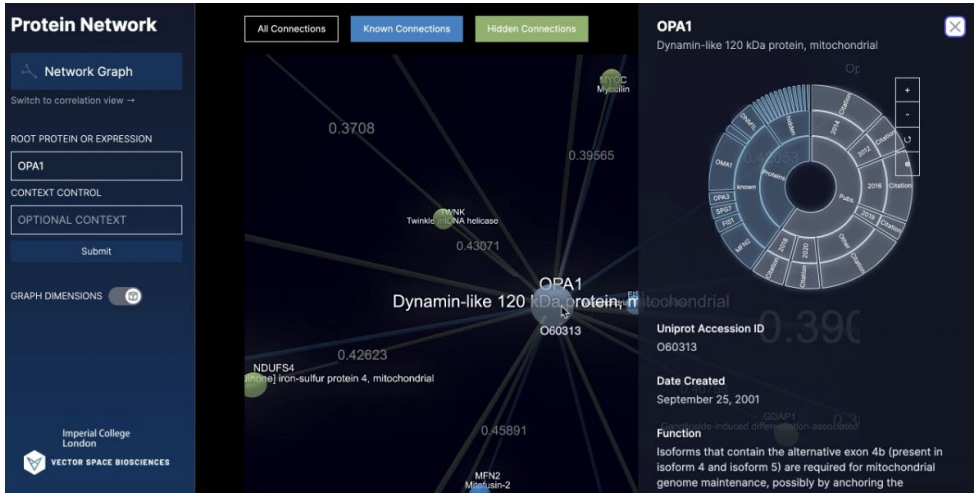
- Standardized sizes and shapes allows for mass production of components, drastically reducing hardware costs
- Mass produced components have led to the expanding market of Commercial Off-The-Shelf (COTS) components that we see today, resulting in shorter development and production times
- CubeSats can stack up for integration of increasingly sophisticated biological experiments
- CubeSats can function autonomously, removing the need to utilize ISS resources and ISS astronauts' limited time

Project Astrovex

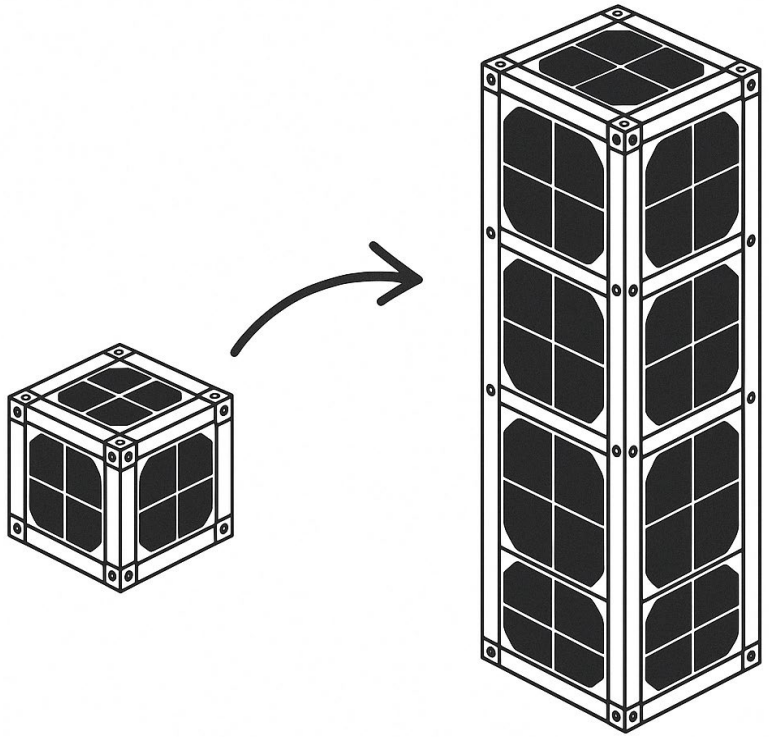
- 1U CubeSat
- ISS Orbit
- Dual-Payload:
  - Advacam MiniPIX Timepix2 – containing CERN's Timepix2 radiation detector
  - Radiation count, dose, and time of impact recorded
  - 50 tardigrades in hydrated and dehydrated form, to expose them in their non-tun state
  - Tardigrades' response to space-related stressors is recorded by camera
- Tardigrades chosen due to ability to repair DNA 200 times faster than humans
- Mission serves as a proof-of-concept
- Launch in 2025

Post - Mission

- Data will be analyzed using Vector Space Biosciences' proprietary Small/Large Language Modeling and visualization pipeline
- S/LLM has been proven to be able to find hidden relationships between genes and proteins
- Data analysis of in-space experiment data, for Project Astrovex and future projects will be used to compare results with findings in previously published papers
- Goal of S/LLM data analysis is to help accelerate discoveries by discovering hidden relationships



Scaling Up



- The same principles applied to Project Astrovex will be applied to larger CubeSats including 3U and 6U form factors
- CubeSats and experiments can be developed in under one year
- Variety of CubeSat platforms with scientific instruments for biological experiment integration in development
- Biotechnology , pharmaceutical, and materials companies, and academic institutions can utilize this platform for in-space biological experimentation
- Frequent launches assist in the tokenization of payloads

Thank You!

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