T-cell Activation in Aging

Hughes-Fulford Laboratory

NCIRE The Veterans Health Research Institute

UCSF

National Institutes of Health

Goals

Immunosuppression in space was first observed in astronauts of the Apollo and Skylab missions. More than half of the Apollo astronauts experienced infections during, immediately after, or within one week following spaceflight. The nearly total loss of T-cell activation in microgravity (µg) has since been confirmed by several experiments in space.

In aging, the elderly often experience changes in their immune systems: decreases in IL-2, IL-2Rα, and T-cell activation and proliferation. These are the same key immune changes found in returning astronauts with altered immune function and increased vulnerability to infection during spaceflights.

Microgravity (µg) gives us a way to look at the mechanisms of immunosuppression, particularly in early T-cell activation. The results of our analysis can then be applied to studies of reduced immune response in the elderly.

We will be examining how T-cell activation responds to normal gravity (1g) and true µg by looking at the gene expression and production of microRNAs.

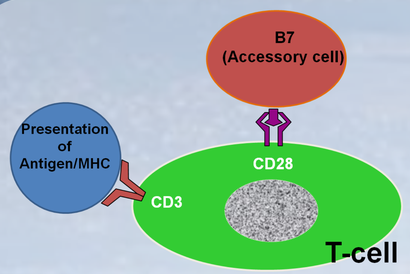


Figure 1
In the event of an infection, physiological T-cell activation occurs via the binding of an antigen/MHC and accessory cell to the CD3 and CD28 T-cell receptors.

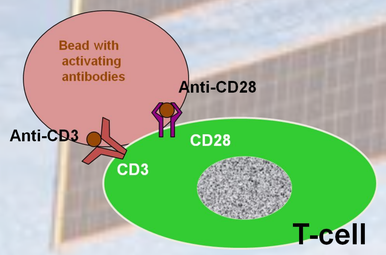
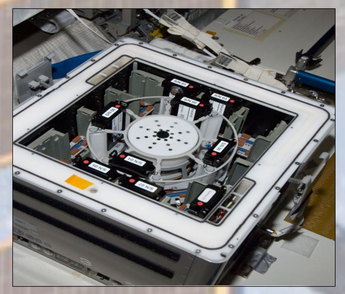


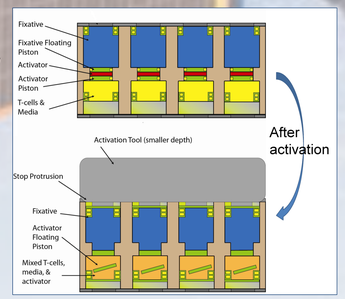
Figure 2
Activation beads are able to mimic the normal immune response by binding to the CD3 and CD28 receptors, thus allowing us to stimulate T-cell activation.

Hardware

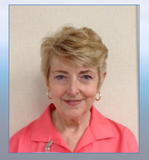
KUBIK is the incubator that will be used for the microgravity experiments onboard the International Space Station (ISS). The incubator resides inside the ISS Columbus module; it is also a centrifuge that is capable of delivering 1g and µg. The Experiment Units (EUs) containing the T-cells will be held inside the Kubik.



EXPERIMENT UNITS will hold the T-cells and activation beads in separate compartments. At set timepoints, the ISS crew will activate the T-cells by combining the two compartments with a plunger. The "iButton" on the face of the EU will record the temperature over a 7-day period.



Scientific Team



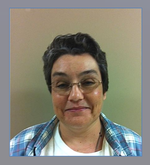
Millie Hughes-Fulford, Ph.D.
Principal Investigator

Tara Candelario, B.S.
Research Associate

Emily Martinez, M.S.
Research Scholar

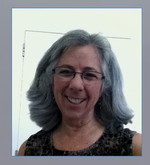
Miya Yoshida, B.S.
Research Associate

BJ Navarro
Project Lead
NASA Ames



Karin Perkins
Payload Logistics Lead
Lockheed Martin, NASA Ames

Francis Laxamana
Payload Logistics Coordinator
Lockheed Martin, NASA Ames

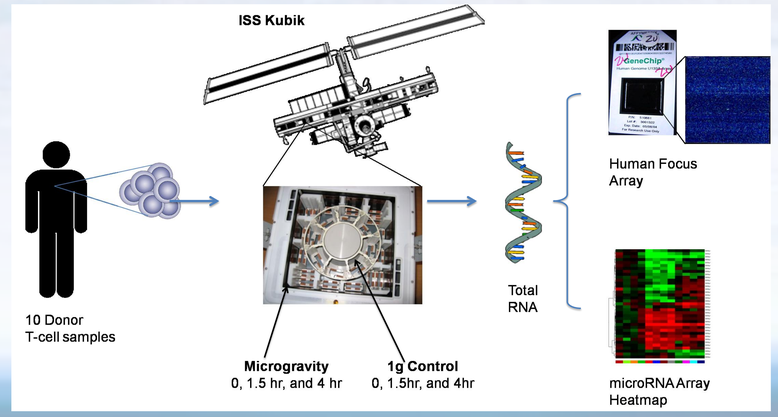


Susan Suffel
Payload Safety Lead
NASA Ames

Launch Date:
December 9, 2013

Launch Vehicle: SpaceX Falcon 9
Launch Site: Cape Canaveral, FL

Hughes-Fulford Lab at the dress rehearsal at the European Space Agency in April



Overview

Our lab will first isolate the T-cells from 10 donors and load the cells into 10 Experimental Units. The EUs will then be carried to the International Space Station by the Falcon 9 and placed inside the Kubik. Once the samples have been activated and fixed by the ISS crew, they will be frozen and sent back to Earth, where we will then process and analyze them.

Links to More Information

http://www.nasa.gov/mission_pages/station/research/experiments/TCell_Act_in_Aging.html
http://esa.int/Our_Activities/Space_Engineering/Against-the-clock_rehearsal_for_Station_immunology_test
Lab of Cell Growth: http://www.labofcellgrowth.com/

International Space Station, 2006
Photo courtesy of NASA