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NASA Fungal Pathogenesis, Tumorigenesis and Effects of Host Immunity in Space (FIT)

As astronauts begin to leave the orbit of Earth to explore the moon, Mars, and beyond, they will leave the protective environment of the Earth system. Also, their travel will take them far away from Earth, which will result in a longer time to return to Earth in the event of a medical emergency or illness. Therefore, it is critical that a sound understanding of how the space flight environment affects humans be developed so that the biomedical risks can be reduced or eliminated. The NASA Fungal Pathogenesis, Tumorigenesis and Effects of Host Immunity in Space (FIT) experiment is designed to use a simple, well studied model organism to gain preliminary data that is statistically meaningful and focuses on three important issues to astronaut health in space: 1) immune system function, 2) infection due to bacteria or fungus, and 3) pathogen virulence.

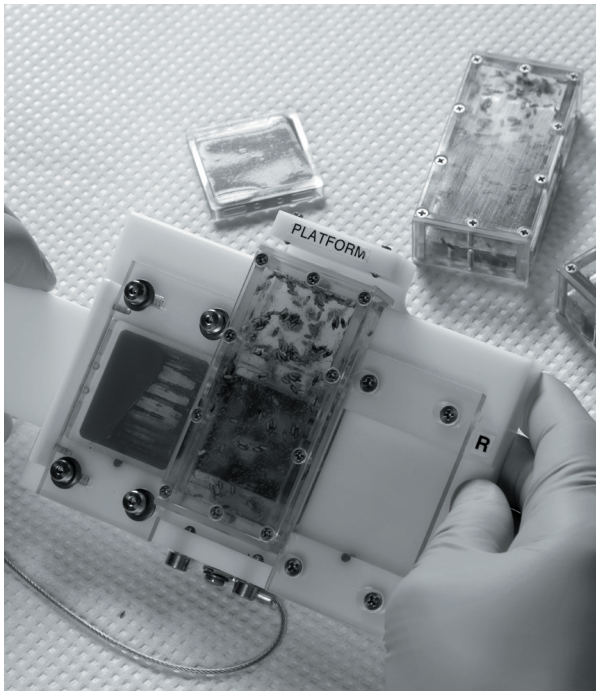
The FIT experiment is a life science research study that will be conducted on the space shuttle. This experiment will address important issues concerning changes in immune system function during space flight. This experiment will use a model organism, Drosophila, that is easy to grow in large numbers in a relatively small space and requires very few shuttle resources. The immune system cellular and molecular functions are highly conserved and similar to those in humans.

Also, FIT will examine the seeming link between the space flight environment and changes in the pathogenic behavior of a microorganism. Data from past space flight experiments of microbiological specimens suggest that these organisms become more virulent in the space environment. FIT will expose a common fungus used in agricultural insect control to the space flight environment. After the fungus is returned to Earth, infection studies will be conducted to investigate if there are changes in the virulence of the organism and whether there are any changes in how the organism interacts with the host. Overall, this fungal study will address how hosts respond to pathogens that might have altered virulence from the space environment.

Max Sanchez, research scientist at NASA Ames Research Center, assembling fly containers scheduled to launch on STS 121.

Earth Benefits

The FIT experiment will have two key components: 1) space flight study and 2) ground controls. These controls will be exposed to everything except the spaceflight environment. The comparative analysis between flight and ground samples will give scientists the ability to identify changes that are specific to the space flight environment. If alterations in immune system function or fungal



Replenishing the flies with new food to generate the next generation of flies in space.

virulence are observed, the scientists will be able to assess whether these changes are analogous to any immune or microbial diseases seen on Earth. The comprehensive analyses of the flight specimens may be tractable to human terrestrial disease and aid in identifying their causes and possible therapeutics.

FIT Experiment Goals and Objectives

The FIT flight experiment will use the well-defined biological model system, D. melanogaster to study how space flight affects immune system function. Also, this experiment will combine the immune system study with an investigation of how the pathogenic behavior of an insect fungal pathogen, B. bassiana, is affected by exposure to the space flight environment. These experiments include a comparative analysis between space-flown organisms and ground control organisms.

The overall goal of the FIT experiment is to gain further insight into immune system function after exposure to the space flight environment. The critical goal of the FIT experiment is to gain seminal data on the cellular and molecular biological affects of the space flight environment on immune system response to bacterial and fungal infections. Furthermore, this study will characterize fungal virulence in response to exposure to the space flight environment.

The FIT flight experiment objectives are as follows:

1. Characterize the effects that the space flight environment has on the immune system by conducting a comparative analysis between flight and ground control specimens
   - Determine if the space flight environment affects the blood cell count and cell types
   - Assess changes in morphology and function of fat body, which is tissue analogous to the mammalian liver
   - After post-flight infection with bacteria or fungus, assess phagocytosis and identify immune response gene expression patterns.
2. Determine if the space flight environment alters the pathogenicity of an insect-specific fungal pathogen
   - Compare infection of non-flight flies with space flown versus ground control fungus
     - Assess fly survival
     - Identify immune response gene expression patterns of infected flies

Fruit flies.

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