ISS National Laboratory Pathfinder Mission

Progress in Vaccine Development

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**Industry:**
- SpaceHab / BioSpace Technologies
- Space Florida
Why space?

**Effect:** Growth within the space environment induces changes in microbial cells.

**Result:** These changes may be associated with:

- Growth
- Antibiotic resistance
- Pathogenicity
- Virulence

**Strategy:** Take advantage of new knowledge uncovered by exposure to microgravity to treat infectious disease.
Why now?

- ISS National Laboratory completion and utilization plans are being formulated.
- ISS National Lab is a resource for academic, government and commercial interests.
- RDT&E in ISS National Lab must be validated.
- ISS NL Pathfinder – Vaccine Mission paves the way for product development in ISS National Lab.
- GAO has recently identified key “Urgent Issues” as priorities for national security and well-being.
  - Caring for Service Members
  - Food Safety
An experiment conducted on the space shuttle demonstrated that *Salmonella* grown in space becomes more virulent, as compared to the same bacteria grown here on earth.
If the cause of the increased virulence could be determined, can this knowledge be used to create a vaccine?

A good vaccine must be:

- Strong enough to induce an adequate immune response
- Strong enough to provide protection from future *Salmonella* exposure
- Weak enough to allow administration with little or no risk of illness
Reverse Engineering

Take apart the microbial response to microgravity [virulence], define the components and determine the effect of those components on the response.
Scientific Approach

- Genomic scanning of genes has identified candidate virulence factors
- Ground-based assays conducted examining host-microbe interactions
- Microgravity exposure enhances *Salmonella* virulence
- Develop a way to test virulence and host-pathogen interaction
  - in-microgravity virulence assay
Model organism used is *Caenorhabditis elegans*, a small (1 mm long) soil nematode

- Eats bacteria, such as *Salmonella*

- Reports bacterial virulence (ability to cause disease)
Created strains of genetically altered bacteria

- Bacteria and worms launched
  - STS-123
  - STS-124
- Brought together in space
- Effect on *C. elegans* tested
Utilization of Microgravity

- Taking advantage of alterations in biological processes occurring in microgravity to facilitate product development
  - Enhanced bacterial virulence
  - Define targets for vaccine development
  - ISS National Lab Pathfinder – Vaccine Mission
  - Paves way for utilization of ISS National Laboratory for commercial enterprise
Using Space to Develop Products for Earth

Gene Deletion + Flight testing = Virulence

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Commercial Vaccine
ISS National Lab

Platform for New Discovery