ISS EXPERIMENT: FUNCTIONAL TASK TEST: PHYSIOLOGICAL FACTORS CONTRIBUTING TO CHANGES IN POSTFLIGHT FUNCTIONAL PERFORMANCE

By Solana (10th grade, Princeton High School, NJ, Princeton)
Melody (12th grade, Princeton High School, NJ, Princeton)

INFORMATION ABOUT THE FLIGHT

Mission: Began operations on ISS Expedition 21 and is ongoing

Duration: Oct 2011 – Sep 2012

Payload: Johnson Space Center

Principal Investigator: Jacob Bloomberg, Ph.D., Johnson Space Center, Houston, TX

Co-Investigators: Brian T. Peters, Stuart M.C. Lee, Steven H. Platts, Ajitkumar Mulavara, Alan H. Feiveson, Lori Ploutz-Snyder, Scott J. Wood, Michael B. Stenger, Barry Spiering, Ryder, Millard F. Reschke

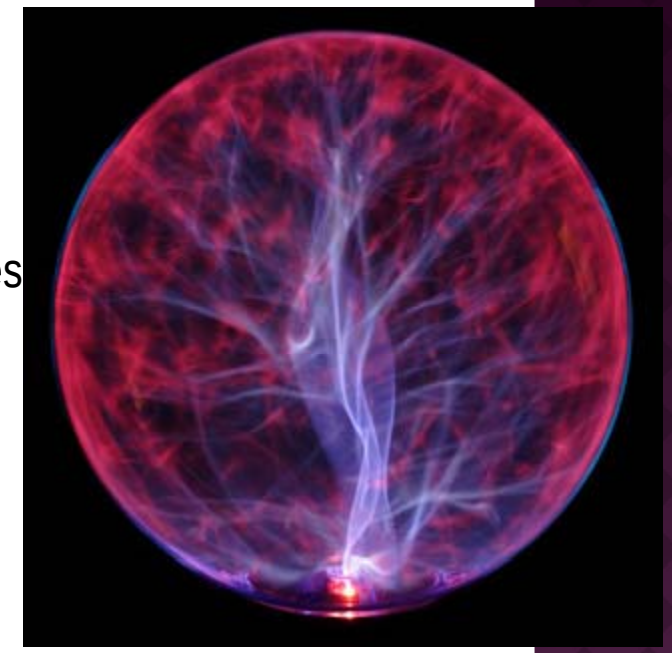
PURPOSE

- Due to exposure to microgravity conditions in space, crewmembers experience alterations in many physiological systems
  - sensorimotor disturbance
  - cardiovascular deconditioning
  - loss of muscle mass
- This reduces the astronaut's ability to perform "functional tasks".

PURPOSE (CON'T)

- The purpose of this study was to test crewmembers for physiological alterations after short and long space flights.
- This information would be used for countermeasures to prevent bodily harm in future flights.

WHAT'S THE EXPERIMENT?



- Exposure to Microgravity physiologically changes the human body. Ex:
  - Loss of muscle mass /strength
  - Cardiovascular deconditioning
- When people return to an environment with gravity these changes can impair them. But how does it impair their functional tasks?

The experiment:

- 1) Test physiological systems that have been impacted by microgravity. Identify which systems are impacted.
- 2) Functional Task Tests are tasks that are impacted when microgravity changes the human body. By doing these tests, scientists can map the specific physiological changes and help design countermeasures that target the specific physiological system that's being impacted.

13 Subjects were tested with the Functional Task Tests: Preflight and Postflight.

PROCEDURE

- 7 functional tests and physiological measures were developed to target the sensorimotor, cardiovascular, and muscle changes in microgravity
- Physiological measures:
  - assessment of dynamic visual acuity
  - fine motor control
  - vestibular function
  - postural and locomotor stability
  - plasma volume
  - orthostatic intolerance
  - upper and lower body muscle strength
  - power
  - fatigue
  - control
  - neuromuscular drive.

PROCEDURE (CON'T)

Functional Task Tests

- Seat Egress and Walk – tests the ability to rise from a sitting position and walk while avoiding obstacles

PROCEDURE (CON'T)

- Recovery from Fall/Stand:
  - Fall Test – the subject lies face down on a foam mat then stands up as quickly as they can when they hear a sound
  - Stand Test – the subject steps on a solid floor and stands quietly for 3 minutes

PROCEDURE (CON'T)

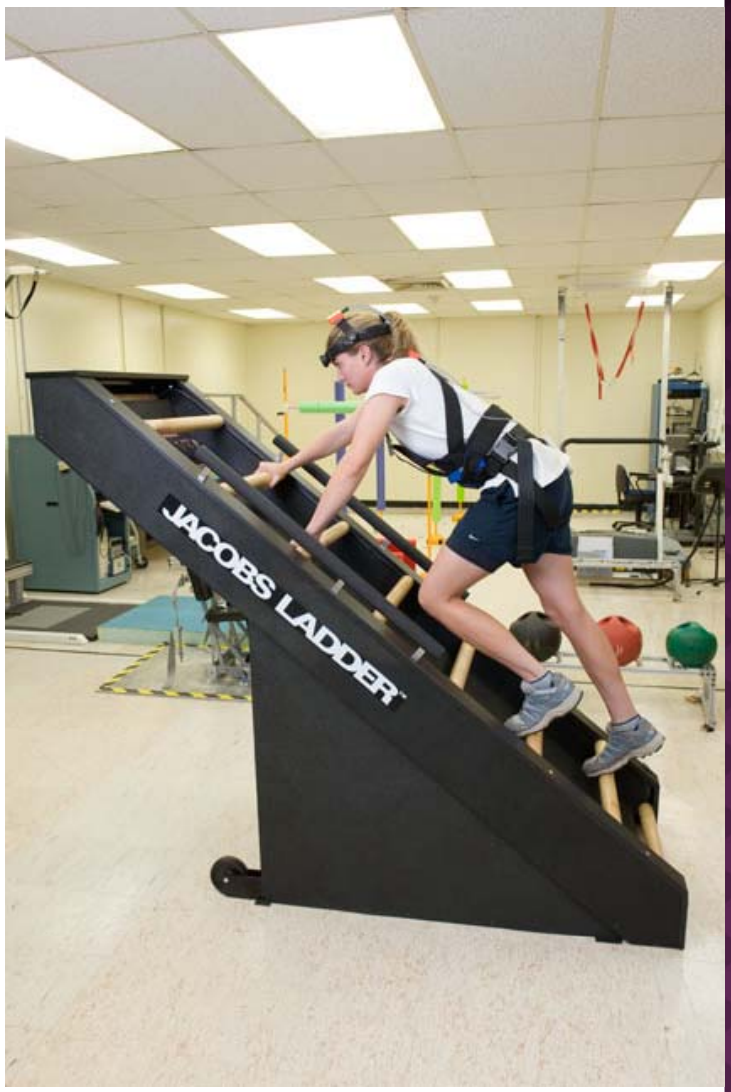
- Rock Translation – the subject picks up 3 weights of 6, 10, and 20 lbs (individually) and carries them 8 feet away to a receptacle 20 inches off the floor.

PROCEDURE (CON'T)

- Torque Generation – A wheel is attached to a PrimusRS system, which is used to simulate opening a hatch. The subject stands on the floor and performs the task under isometric and isotonic conditions. They apply a torque to the wheel when the wheel is fixed and when the wheel is free.

PROCEDURE (CON'T)

- Ladder Climb – subject climbs a passive treadmill ladder for 40 rungs to simulate crewmembers climbing ladders after landing



PROCEDURE (CON'T)

- Construction Activity Board – subjects perform a variety of construction and assembly tasks including connecting hoses and electrical connectors to receptacles and using a power tool to tighten bolts

PROCEDURE (CON'T)

- Jump Down – Subjects jump from a height of 30 cm with 2 feet and land on a force plate, measuring the peak vertical impact force and postural stability on landing. This simulates jumping from landing vehicles, habitats, and uneven terrain.

PROCEDURE (CON'T)

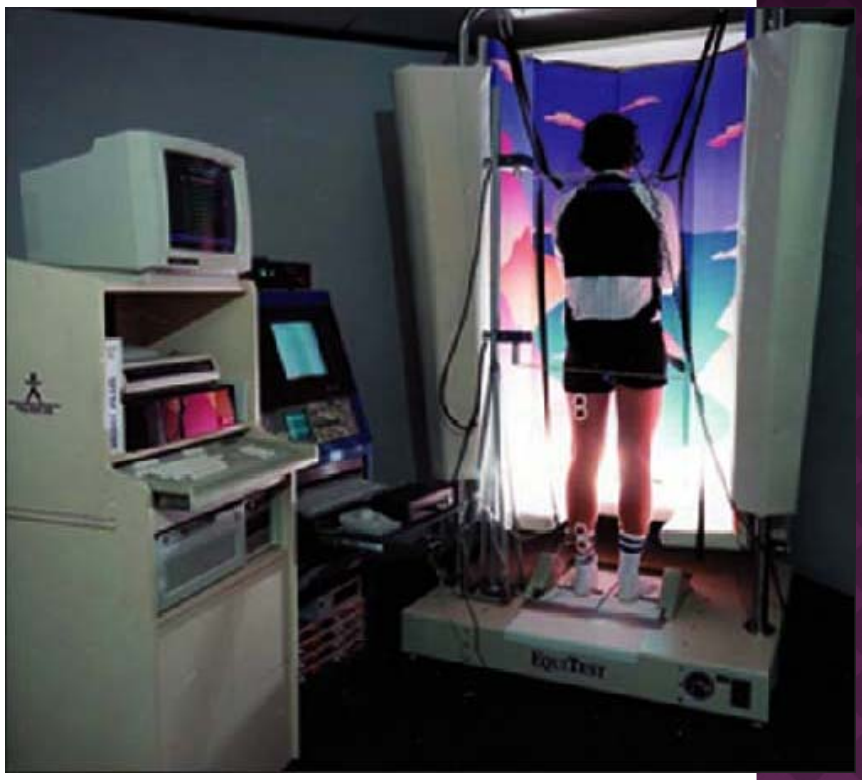
- Plasma Volume – measures plasma volume after a cycle of rest, breathing oxygen, and carbon monoxide rebreathing, in order to determine changes in volume caused by space flight

PROCEDURE (CON'T)

- Fine Motor Control – subjects try and complete the test as quickly and accurately as possible using a Grooved Pegboard Test to test for neurological and vocational assessment of fine motor control.

PROCEDURE (CON'T)

- Dynamic Posturography: To test balance control, subjects use a computerized system that tracks their movements on a swaying platform.



PROCEDURE (CON'T)

- Treadmill Locomotion: Subject walks 6.4 km/hr in 90 seconds while being evaluated on visual acuity, to test their motor control and visual acuity.

PROCEDURE (CON'T)

- Muscle Performance: Subjects use muscle-building machines to test upper and lower body strength to measure any changes in muscle performance.

RESULTS

- Data is still being collected to ensure stronger results. This will be important in mapping changes in task performance once people return from microgravity.
- The information will be used to design countermeasures that can target the deteriorated physiological systems. (see Future Applications)

FUTURE APPLICATIONS

- Earth Applications: Gives us a better understanding of microgravity and its effects on our body. Using this study, we can create rehabilitation programs for astronauts returning from space.
- Space Applications: Helps us to design countermeasures that diminish the changes that impact important daily functions.