Spaceflight Physiological Issues

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Life Science Issues

Special conditions of spaceflight:

- **microgravity**
- **radiation**
- **vacuum**
- **temperature variations**
- **isolation**
- **confinement**

Produce various physiological and psychological effects:

- space adaptation syndrome (SAS)
- reduced stimulation of taste and olfactory receptors
- body mass loss
- body fluid upward shift and loss
- cardiovascular deconditioning
- muscular atrophy
- bone demineralization
- electrolyte imbalance
- nasal congestion
- cellular damage
- psychosocial manifestations

Space Flight Physiological Issues

- Phases of Flight (launch, transit, return)
- Environmental Considerations:
  - Atmospheric Conditions
    - Near Vacuum (no measurable pressure)
    - Extreme temperatures (-100 to +120 degrees C)
  - Radiation

    (LEO shuttle ~250 times average terrestrial exposure!)
    - High velocity charged particles
    - High frequency electromagnetic waves
  - Reduced gravity
    - Micro (on-orbit) or Partial (moon or Mars)
- Launch and Re-entry
  - acceleration, vibration, noise

Body Mass Loss

- Many of the physiological effects previously mentioned contribute to mass loss:

  - **Space Adaptation Syndrome (SAS)**
  - **Body Fluid Shift and Resultant Loss**
  - **Bone Loss**
  - **Muscular Deconditioning**
  - **Reduced Sensitivity of Taste and Olfactory Senses**

Mechanics & Components of Body Mass Loss

- Loss of both fat and lean mass; more than half the loss comes from fat-free mass such as muscle, organs, blood, and bone.
- Protein and bone catabolism increases; protein and bone mineral synthesis decreases.
- Headward fluid shift triggers baroreceptors to initiate diuresis; fluid intake decreases; thirst mechanism altered.
- In-flight energy expenditure is similar; food consumption decreases.

Bone Demineralization

PROBLEM:

- Human exposure to weightlessness causes progressive loss of bone mass similar to that observed in disuse osteoporosis, particularly in the bones of the lower limbs.

IMPORTANCE:

- For long-duration space travelers (and osteoporosis patients), bone losses may reach detrimental levels, possibly resulting in irreversible damage and/or future recurrences of osteoporosis.

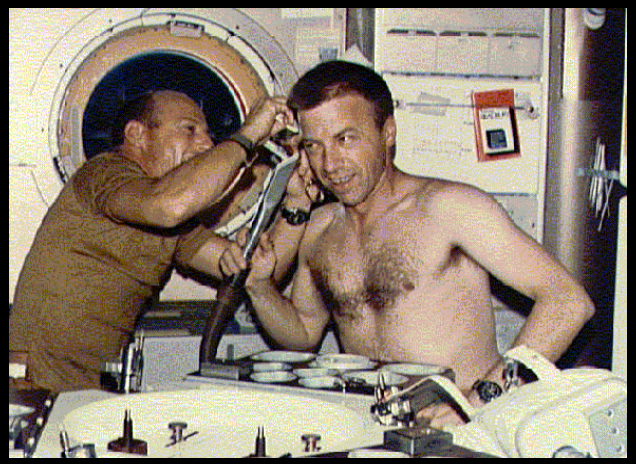
Countermeasures

Numerous countermeasures have been tried,
with varying degrees of success.

- Exercise
- Body-loading devices
- Hormonal and pharmaceutical agents
- Artificial gravity

Some exercises are more effective than others...

Personal Health and Fitness



- Full body showers
  - (Skylab, ISS)
- Sponge baths
  - (Shuttle)
- Private lockers for personal items and clothing
- Toiletry/cosmetic care
- Waste management

- Medical Care
  - diagnostics
  - first aid kit
  - respirator
  - defibrillator
- Regular Exercise
  - treadmill, exercycles, resistance training

SOURCES:

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