Cradle of Aviation Museum and Education Center

Long Island's Air & Space Museum

THE EFFECT OF LONG DURATION SPACE FLIGHT ON BONE

Abstract:

Astronauts face many changes while in a microgravity environment. One of those changes is bone loss. The longer time an astronaut spends in space, the weaker her/his bones become. An astronaut who has been in space for more than 180 days may lose 20% of his or her bone mass. They then have a greater propensity towards osteoporosis. In this activity students use large Styrofoam cups to simulate human bone and demonstrate the weakening of bone due to time spent in microgravity.

Background:

Bones are living tissue. On Earth, we need bones for support and protection. Calcium keeps bones strong. Low levels of calcium pose a serious health risk, such as the increased chance of broken bones and fractures. At least 10 million people suffer from bone loss in the U.S. It's called *osteoporosis.* Astronauts experience bone loss while in space because they do not have to stand and support themselves to create loading forces on the bone. Because space is a microgravity environment the body does not have to do as much work and reacts by decreasing the mass and strength of bones and muscle. Scientists think reduced stress on bones may be responsible for the progressive bone loss seen in long-term residents of space. The calcium in the bones begins to break down. As a result, the astronauts' bones begin to weaken. Holes can form in bone, creating a danger to the astronaut even after she or he returns to Earth. When the astronauts return to Earth, they are at a higher risk of breaking bones because of the calcium loss.

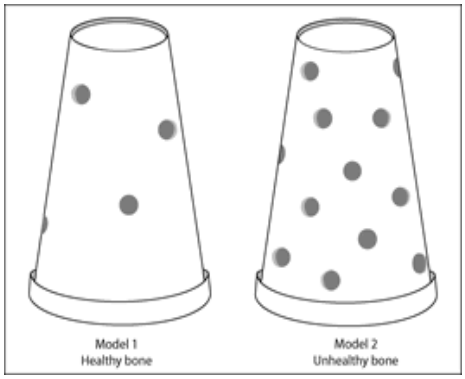
Objectives:

The students will be able to

- Explain why astronauts experience bone loss while in space.
- Explore and investigate how decreased bone density is related to increased risk of bone fracture
- Simulate the effect of long-term microgravity exposure on bone.

Procedure:

1. Balance several books on top of a large Styrofoam cup.
2. Remove the books and punch five (5) holes in the Styrofoam using a sharpened pencil.
3. After creating the holes, balance the same number of books on the cylinder.
4. Record your observations.
5. Repeat Steps 2 & 3 each time adding more holes until the cylinder can no longer support the books.



6. ASK:
    1) Why are you adding holes to the cup? (Adding holes simulates the weakening effect of microgravity on bone that happens the longer time an astronaut spends in space.)
    2) What do you think caused one bone to crumple more easily than the other?
    3) Now imagine that your Styrofoam cup bone is actually a real bone. If a real bone were built like your Styrofoam bone, what would happen if a sudden force (like a bump or fall) were applied to the bone?
    4) What do you think happens to bones on Earth that don't exercise enough or get enough calcium

Materials

- Large Styrofoam cups
- several text books
- sharpened pencil

From: "Muscles and Bones" Activity Guide for Teachers. National Space Biomedical Research Institute: Houston, TX