

EFFECT OF LOW GRAVITY ON CALCIUM METABOLISM  
AND BONE FORMATION

L-7

Tatsuo Suda  
Showa University, Tokyo  
Japan

Outline and Expectation of the Experiment

Recently, attention has been focused on the disorders of bone and calcium metabolism during space flight. The skeletal system has evolved on the Earth under 1-g. Space flights under low gravity appear to cause substantial changes in bone and calcium homeostasis of the animals adapted to 1-g. We have proposed a space experiment for FMPT to examine the effects of low gravity on calcium metabolism and bone formation using chick embryos loaded in a space shuttle. We proposed this space experiment based on the following two experimental findings. First, it has been reported that bone density decreases significantly during prolonged space flight. The data obtained from the US Skylab and the U.S.S.R. Salyut-6 cosmonauts have also documented that the degree of bone loss is related to the duration of space flight. Second, the US-Soviet joint space experiment has demonstrated that the decrease in bone density under low gravity appears to be due to the decrease in bone formation rather than the increase in bone resorption (Science 201: 1138, 1978). The purpose of our space experiment is, therefore, to investigate further the mechanisms of bone growth under low gravity using fertilized chick embryos.

In our space experiment, 30 fertilized chicken eggs are preincubated for 7 to 11 days on Earth (Table 1). The preincubated eggs are further incubated for an additional 7 days during

space flight. Thus, 7-, 9-, and 11-day-old chick embryos will be 14, 16, and 18 days old, respectively, when the space shuttle returns to Kennedy Space Center (KSC) in Florida. In each group, half of the eggs (5 eggs each) are subjected to the following experiments immediately after the space shuttle returns to KSC. The rest of the eggs are further incubated until hatching at KSC. Another batch of 30 fertilized eggs is incubated at KSC as the controls under 1 g. After the eggs are recovered from the space shuttle at KSC, cartilage growth, bone formation and resorption, differentiation of chondroblasts, osteoblasts and osteoclasts, biosynthesis of actin and myosin, muscle fiber formation, collagen biosynthesis, and calcium and vitamin D metabolism are compared morphologically as well as biochemically between the chick embryos recovered from the shuttle and the control embryos incubated on the Earth. It is expected that a counterplan for preventing bone loss due to prolonged space flight (for example, space station experiments) and immobilization (for example, disuse atrophy and bedridden, older people) may be obtained from this space experiment.

**Table 1. Flight Protocol of 30 Fertilized Chicken Eggs in our Space Experiment (L7)**

Stages of the Fertilized Chicken Eggs Loaded			
Taking off		Landing	Number of eggs
7 days old	7 days flight ----->	14 days old	10*
9 days old	7 days flight ----->	16 days old	10*
11 days old	7 days flight ----->	18 days old	10*

\*In each group, 5 of 10 eggs are further incubated on Earth until hatching after they are recovered at KSC.

**SEPARATION OF THE ANIMAL CELLULAR ORGANELLA  
BY MEANS OF FREE-FLOW ELECTROPHORESIS**

**L-8**

**Tokio Yamaguchi  
Tokyo Medical and Dental University  
Tokyo, Japan**

**Purpose of Experiment**

To demonstrate the effectiveness of a weightless environment to separate cells and cellular organelle by FFE.

**Experiment Status**

1. Sample is a mixture of microbial cells of lipopolysaccharide defective mutants derived from a gram-negative bacterium.
2. The bacterial cells show different mobilities in electrolyte.
3. The bacterial cells are stable and viable in electrolyte for mission period.
4. The bacterial cells are quite sensitive to antibiotics and disinfectants (alcohols, detergents, etc.).

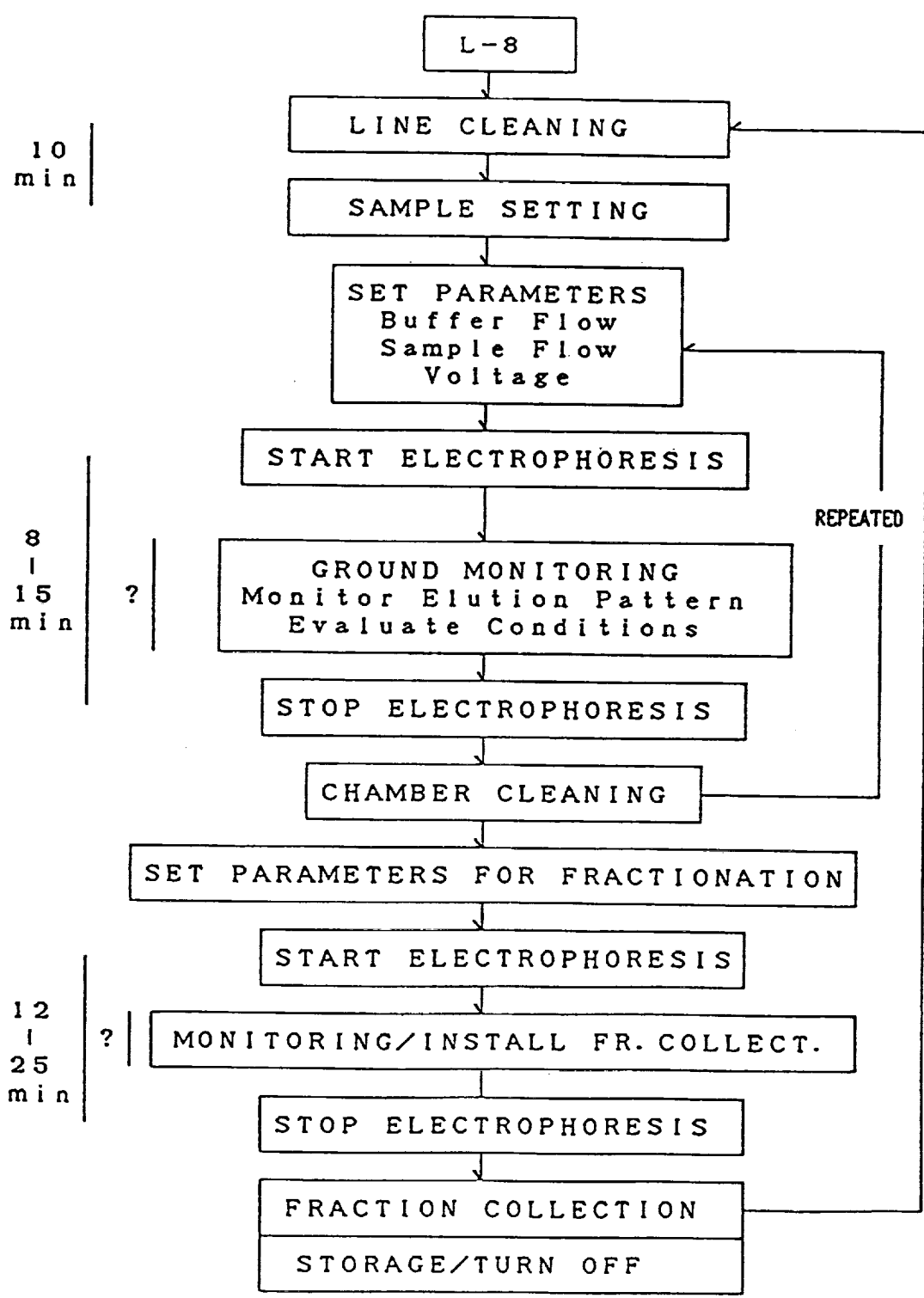


Figure 1. Experiment and operations.