1. Experiment Title

Regulation of bone metabolism in space: Analysis by an *in vitro* assay system using goldfish scale as a model of bone

2. Principal Investigator

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3. Outline of Experiment

The purpose of our experiment is to elucidate the mechanism of the decrease of bone mineral density in the human body during space flight.

In mammals, including human, bone is formed and maintained by continuous remodeling through bone resorption by resorptive cells, i.e., osteoclasts, and subsequent new bone formation by formative cells, i.e., osteoblasts. To the best of our knowledge, no space experiments can be performed using mammalian osteoclasts because it is quite difficult to maintain mammalian osteoclasts under the limiting conditions in space flight. There has been no suitable *in vitro* model system to examine the effect of microgravity on osteoblasts and osteoclasts simultaneously.

The teleost scale is calcified tissue that contains osteoblasts and osteoclasts, the bone matrix, including type I collagen, bone γ-carboxyglutamic acid protein, osteonectin, and hydroxyapatite, similarly to mammalian bone. The scales are a better internal calcium reservoir than vertebral bone during periods of acute calcium demand, such as sexual maturation, as shown by ^{45}Ca-prelabeled experiments using goldfish and killifish. A morphological study has also shown many similarities between the structures of teleost scale and mammalian membrane bone (Figure 1). Considering these findings, we recently developed a new *in vitro* assay system with goldfish scale. Using this system, therefore, the effect of microgravity on the bone metabolism will be examined.

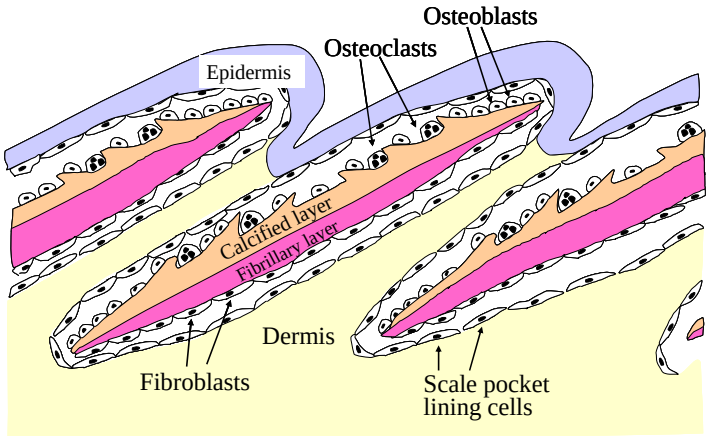

Figure 1 Schema of teleost scale in the integument.
The teleost scale is a calcified tissue that contains osteoblasts, osteoclasts, and bone matrix and is similar to that found in mammalian membrane bone.

Our planning space experiment is as follows. Scales collected from goldfish under anesthesia are incubated for 7 days under microgravity using a cell biology experiment facility (CEBF) and compared with a 1G control in space. After the experiments, the specimens are frozen at -80°C or fixed with formalin at 4°C. By analyzing the cell activity, mRNA expression, calcemic hormone, and morphology, we will clarify the bone metabolism under microgravity and elucidate the mechanism of the bone loss, such as those experienced in space flight.

4. Experiment Facility

Cell Biology Experiment Facility (CEBF)
Measurement Unit (MEU)