STS–107: Space Research and You

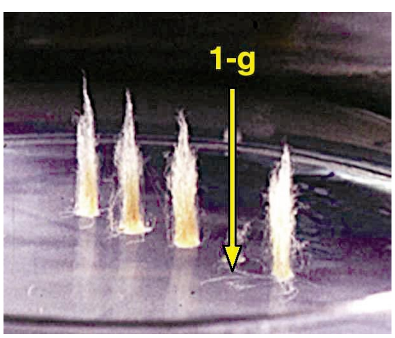
Seeking the Light

Development of Gravity Sensitive Plant Cells in Microgravity

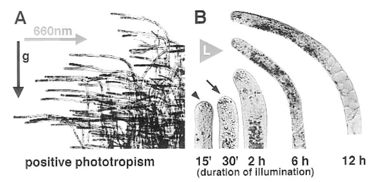
All living things sense gravity like humans might sense light or sound. The Biological Research In Canisters (BRIC–14) experiment, explores how moss cells sense and respond to gravity and light.

This experiment studies how gravity influences the internal structure of moss cells and seeks to understand the influences of the spaceflight environment on cell growth. This knowledge will help researchers understand the role of gravity in the evolution of cells and life on earth.

Plants respond to gravity (gravitropism) and light (phototropism). Typically, plant shoots will grow away from the direction of gravity and grow towards a light source. Some plants are primarily gravitropic while others are primarily phototropic. The moss, *Ceratodon*, is comprised of long chains of cells that grow from the filament tips. On earth, heavy particles in these tip cells fall toward gravity, causing the moss to grow away from the direction of gravity. When exposed to the microgravity environment of space, gravitropic forces no longer affect the moss. Due to decreased gravity, heavy particles don't fall out in the same manner. The resulting random particle distribution will cause changes in growth characteristics. Light direction is not altered in microgravity so the plant will still grow phototropically (towards light) just like on earth.



Moss Sample in Petri Dish.



Effects of Phototropism

The scientist's original hypothesis was that both random cell structure and cell growth would occur in space. The objectives for BRIC–14 experiment were developed from the knowledge gained during a previous shuttle flight, STS–87. Unexpectedly, moss specimens grown on STS–87 showed non-random subcellular component distribution and spiral growth.

Moss from STS–87, showing spiral growth patterns developed in the dark in microgravity.

For STS–107, the BRIC–14 experiment expands on the previous results with three major objectives.

1. Determine the age or developmental stage at which moss grows in a non-random pattern when exposed to microgravity conditions;
2. Determine the minimum illumination level required to impose a phototropic response on the growth pattern of the moss in the absence of gravity; and
3. Understand how microgravity affects the distribution of cell substructures.

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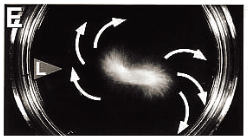
Background Information

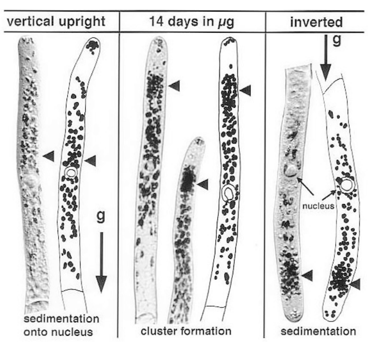
To address the first objective of this flight experiment, selected moss colonies will be grown while exposed to a directional light for six days before launch. Once in space, the lights will be turned off and the moss will continue to grow in darkness. This moss will be compared to moss that is grown without any exposure to light but has had similar exposure time to microgravity. This part of the experiment will help determine the age and developmental growth stage of the moss at which non-random spiral growth is exhibited.



Non-random spiral growth after phototropically-induced directional growth (from STS–87).

The second objective of the experiment is to determine the illumination intensity required to induce a phototropic response in the absence of gravity. This part of the experiment will expose moss to three different levels of light and observe at which light intensity samples respond. The moss will grow in the dark for seven days in space prior to the lights turning on. This will allow the moss time to establish a random growth pattern prior to exposure to a directional light source.

The third objective is to understand how the non-random distribution of cell substructure takes place in space. Scientists have known for quite some time that fibers inside cells are responsible for the organization of subcellular components called organelles. An unexpected finding from STS–87 is that these heavy organelles, which are affected by gravity on earth, form non-random groups within the cells. The investigators hypothesize that this grouping is organized by these same fibers, although normally, the fibers don't cause grouping on earth. To test this theory, chemicals will be applied that breakdown the fibers. If the fibers play a role, then the organelles should become randomly distributed inside the cells during spaceflight. This experiment will provide information about how the positions of heavy organelles are controlled and organized inside cells on earth.



Cellular substructure distribution (from the STS–87 experiment).

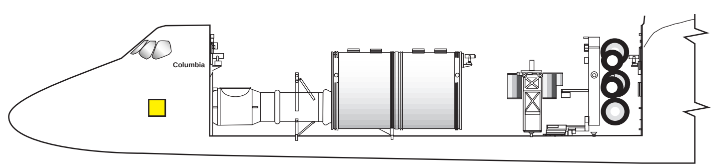
The astronauts will check the temperature and verify that the flight hardware is functioning each day. They will also switch the growth lights on and off at various locations in the flight hardware and will use a specialized tool to apply chemicals to the moss. These chemicals, called fixatives, will stop the growth process of the moss and preserve the specimens for analysis after the mission has ended.

Science Discipline Supported

This research primarily addresses Fundamental Space Biology, but can also be related to other disciplines.

Future Similar Experiments on *International Space Station*

Similar flight experiments can be conducted on the *International Space Station* to increase knowledge of how natural processes react to space and enrich life on Earth through people living and working in space.



Approximate location of this payload aboard STS–107.