

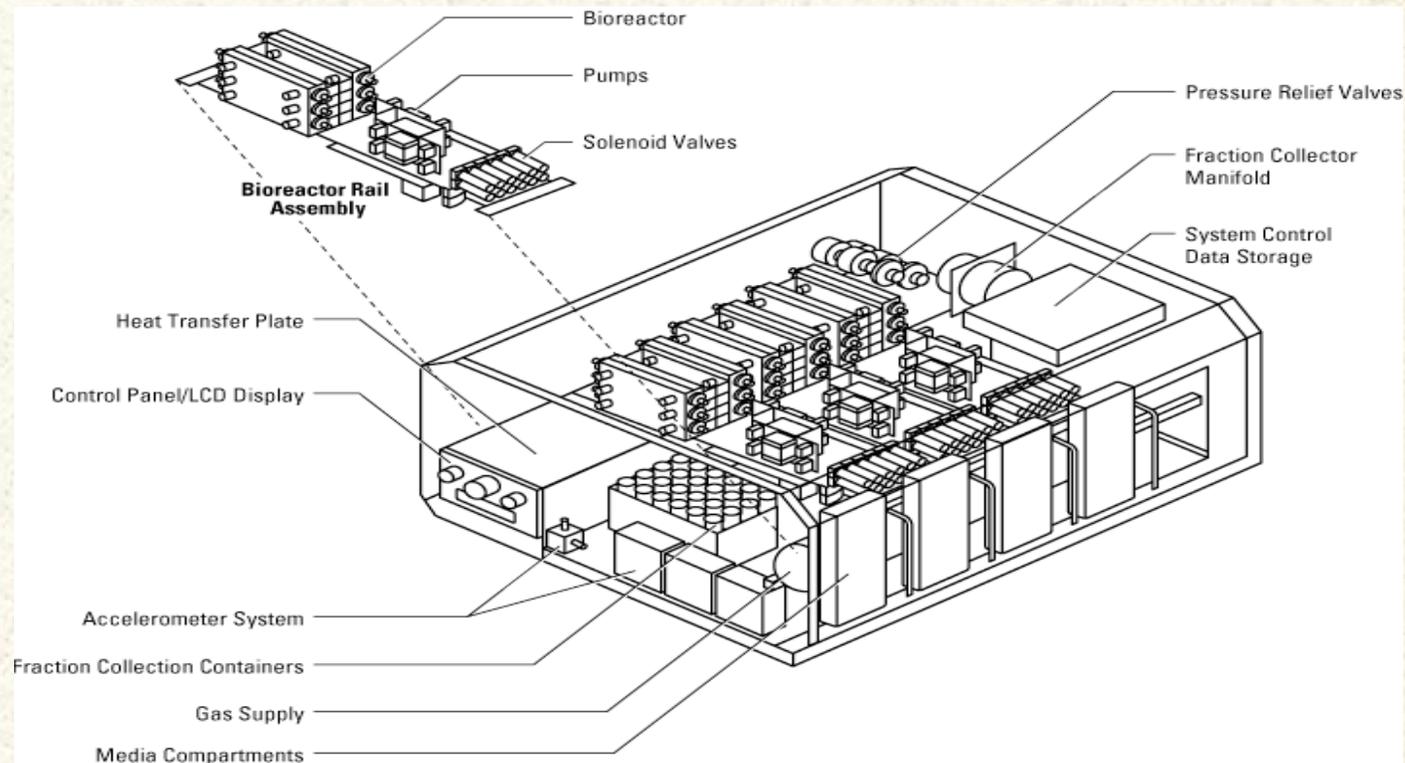
# Cell Culture Module: Effect of Microgravity on Wound Repair

In Vitro Model of New Blood Vessel



Presentation by Katherine and Lauren

# What is the Cell Culture Module?



The Cell Culture Module (CCM) is a completely automatic cell culture system designed to study the effects of microgravity at the cellular and embryonic levels. It has been in operation since 1996.

# What is CCM-Wound Repair?

Effect of Microgravity on Wound Repair: In Vitro Model of New Blood Vessel (CCM-Wound Repair)

- was an experiment that utilized the CCM
- flew on International Space Station Expedition 15
- lasted from April to October 2007

CCM-Wound Repair's Principal Investigators were:



—and—



Dr. Stuart K. Williams

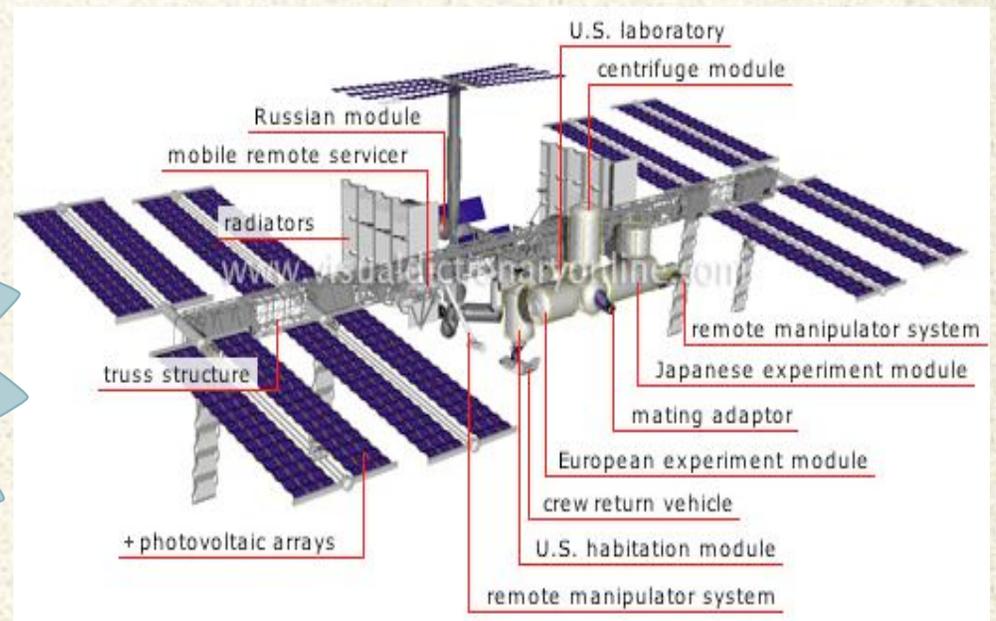
Dr. James B. Hoying

# What is the ISS?

The International Space Station is a satellite created collaboratively by 15 space agencies around the world (NASA included). It serves as a space laboratory, in which experiments like CCM-Wound Repair are performed.

Since its launch in November 2000, the ISS has seen...

- over **200** astronauts
- over **600** experiments
- and **29** expeditions!



Just how big is "big"? The ISS is the size of a football field! That's 120 yards across! It also has nearly an acre of solar panels.

# Research Objectives

## *The Problem*

Microgravity has been shown to be detrimental to wound repair. Astronauts injured in space have a harder time healing.

## *The Questions*

- How does microgravity affect angiogenesis (the development of new blood vessels)?
- How can these effects be mitigated?

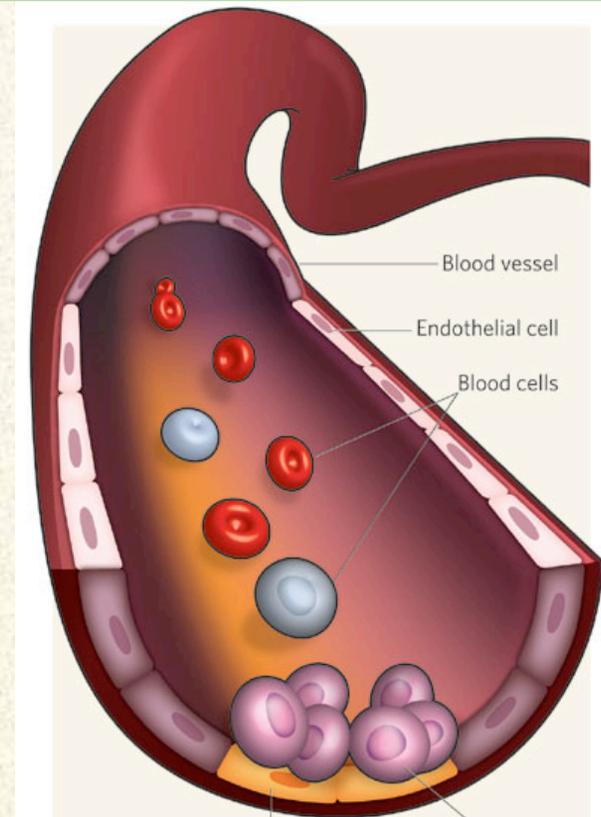
## *The Hypotheses*

- The cells cultured in microgravity and the cells cultured on earth will differ in gene expression.
- Blood vessel development will be impaired in cells cultured in microgravity.
- Cells injected with growth hormone will grow faster.

# Experimental Methods

Before the flight, endothelial cells (see picture and next slide) were seeded onto bioreactors, devices capable of supporting biological systems (the system in this case being the cells and new vessels resulting from angiogenesis). The cells were perused, or sustained and allowed to grow by submergence in fluid. Half the samples were also injected with VEG-F, a growth hormone.

During the flight, all samples were fixed, or treated to prevent decay.

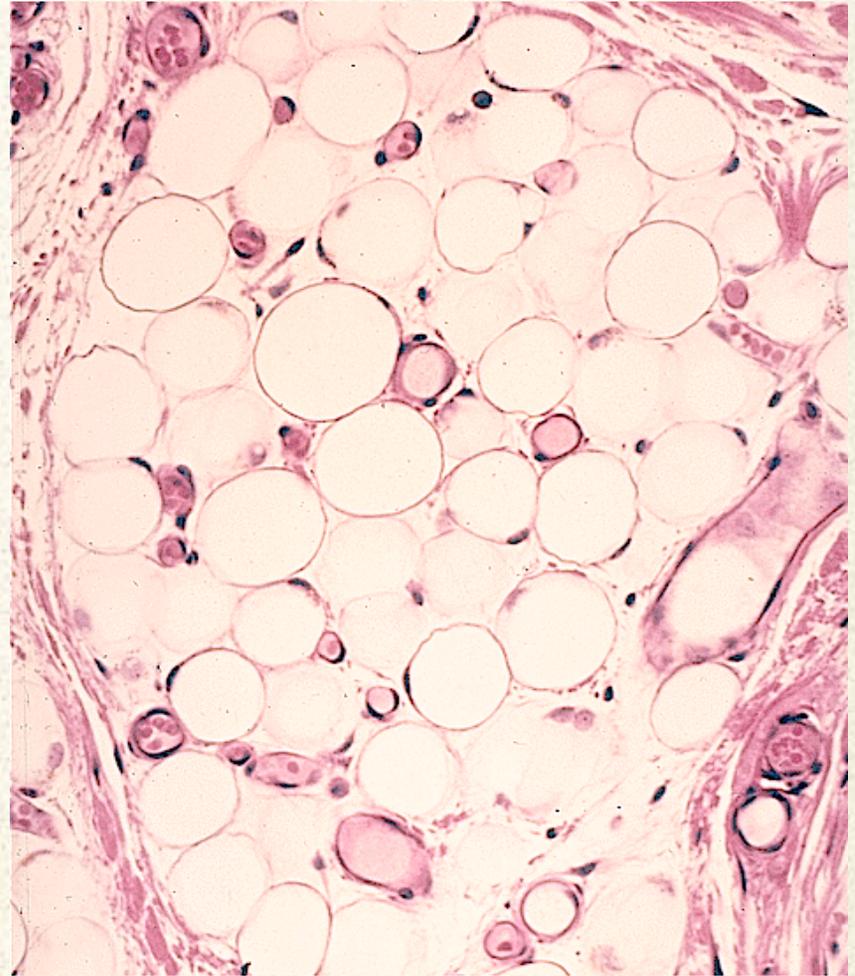


*a diagram of a blood vessel*

# Adipose-derived Stem Cells (ADSCs)

CCM-Wound Repair used ADSCs to generate endothelial cells for the experiment.

Adult Stem Cells can be thought of as "template" cells—they can differentiate, or transform, into other types of cells, a process involved in organ regeneration. ADSCs in particular come from fat tissue and can differentiate into bone, muscle, nerves, blood vessels, etc. ADSCs may also speed up angiogenesis.



*an adipose tissue sample*

# Experimental Results

After the flight, the samples were returned to Dr. Williams and Dr. Hoying for comparison with samples from earth.

Analysis is not yet done. Researchers are currently working to characterize the microgravity-induced stresses on the samples.

## ***Expected Applications***

Microgravity provides unique conditions for understanding the tissue death (necrosis) that occurs following serious injuries.

- In space, the results of the CCM-Wound Repair will help researchers treat the damaging effects of microgravity on wound repair and angiogenesis.
- On Earth, the results will provide a model by which to learn more about angiogenesis and prevent tissue necrosis and limb loss.

# Reflections

We chose **CCM-Wound Repair** because we were interested in learning about a biology-based experiment and wound repair sounded like a fascinating topic. The results of this experiment don't seem to have been published yet, but it will be exciting to learn what became of this experiment. By doing this project, the enormity of the ISS was really put into perspective. We also learned about cell repair systems, bioreactors, adipose-derived stem cells, and gained a general awareness as to the experiments on the ISS.

# Bibliography

"Cell Culture Module - Effect of Microgravity on Wound Repair: In Vitro Model of New Blood Vessel Development (CCM-Wound\_Repair)." NASA. NASA, 10 Jun 11. Web. 30 Sep 2011. <[http://www.nasa.gov/mission\\_pages/station/research/experiments/CCM-Wound\\_Repair.html](http://www.nasa.gov/mission_pages/station/research/experiments/CCM-Wound_Repair.html)>.

"Cell Culture Module (CCM)." Life Into Space: Space Life Sciences Research. NASA, 2005. Web. 19 Oct 2011. <[http://lis.arc.nasa.gov/lis3/Hardware\\_Appendix/CCM.html](http://lis.arc.nasa.gov/lis3/Hardware_Appendix/CCM.html)>.

"Explore Your Future: Store Your Adult Stem Cells Today." *Advanced Minimally-Invasive Surgery*. Advanced Minimally Invasive Surgery, LLC, n.d. Web. 31 Oct 2011. <<http://www.advancedmisurgery.com/services/adipose-derived-adult-stem-cells.asp>>.

"International Space Station." NASA. NASA, n.d. Web. 31 Oct 2011. <[http://www.nasa.gov/mission\\_pages/station/main/index.html](http://www.nasa.gov/mission_pages/station/main/index.html)>.

"The International Space Station." *High-Tech Science*. High-Tech Productions, n.d. Web. 7 Nov 2011. <<http://www.hightechscience.org/iss.htm>>.

"White Adipose Tissue and Vasculature" Photograph. *University of Delaware Biology Department*. Web. 8 Nov 2011. <<http://www.udel.edu/biology/Wags/histopage/colorpage/ca/wav.GIF>>.

"Stem Cell 2." Photograph. Total Cosmetrix, Web. 8 Nov 2011. <<http://totalcosmetix.com/images-new/stem-cell-2.jpg>>.

"International Space Station." *Merriam-Webster Visual Dictionary Online*. QA International, 2011. Web. <<http://visual.merriam-webster.com/astronomy/astronautics/international-space-station.php>>.

"Research: Innovation in Science and New Materials." *Omega Genesis*. OmegaGenesis, 2009. Web. 8 Nov 2011. <<http://www.omegagenesis.com/html/Research.html>>.

Evans, Cynthia A., Julia A. Robinson, Judy Tate-Brown, Tracy Thumm, Jessica Crespo-Richey, David Baumann, and Jennifer Rhatigan, ed. and comp. *International Space Station Science Research Accomplishments During the Assembly Years: An Analysis of Results from 2000-2008*. Revision A. Houston: NASA, 2009. 125. Web. 11 Nov. 2011. <[http://www.nasa.gov/pdf/389388main\\_ISS\\_Science\\_Report\\_20090030907.pdf](http://www.nasa.gov/pdf/389388main_ISS_Science_Report_20090030907.pdf)>.

Momoko Yoshimoto, and Movin C. Yoder. *Relationship between endothelial cells and blood cells*. 2009. Graphic. Nature. Web. 13 Nov 2011. <[http://www.nature.com/nature/journal/v457/n7231/fig\\_tab/457801a\\_F1.html](http://www.nature.com/nature/journal/v457/n7231/fig_tab/457801a_F1.html)>.