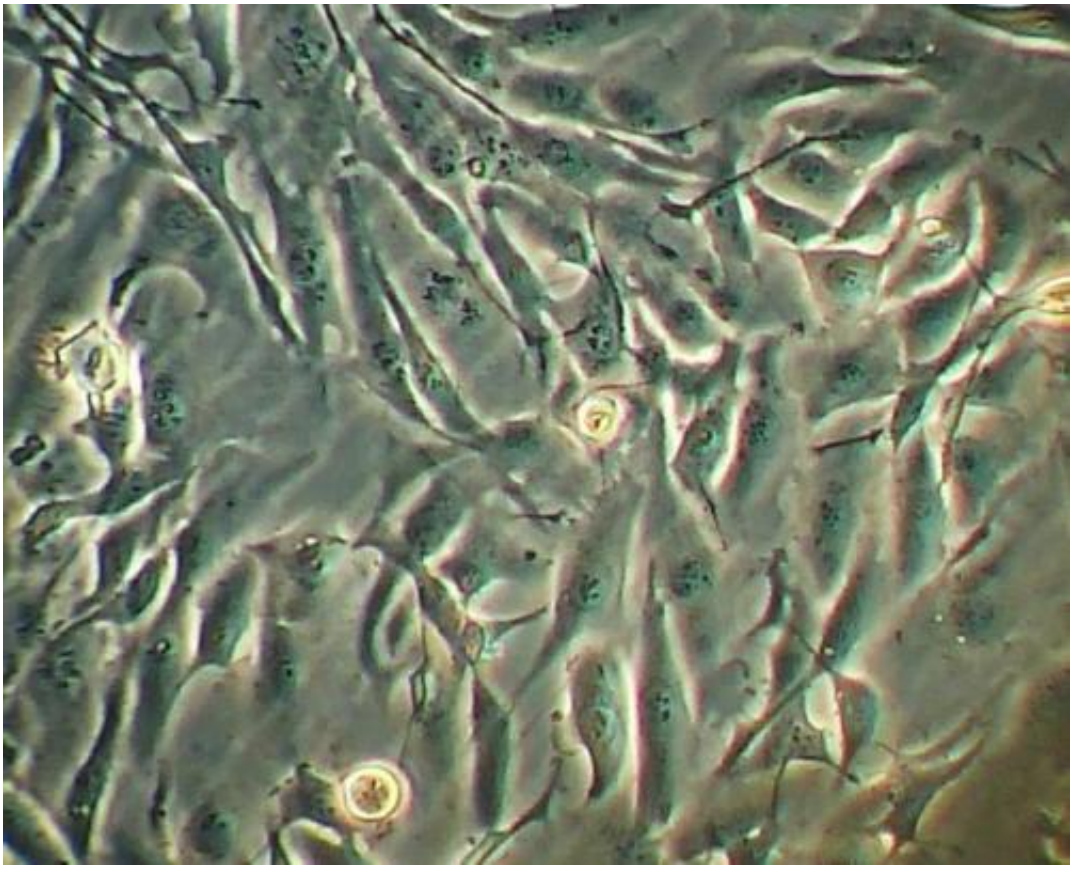
Scientists seek answers with space station thyroid cancer study

May 20 2014, by Jessica Nimon



This shows poorly differentiated follicular thyroid cells shortly before launch. The cells were then exposed to microgravity aboard the International Space Station for the Cellbox-Thyroid investigation. Credit: Daniela Grimm

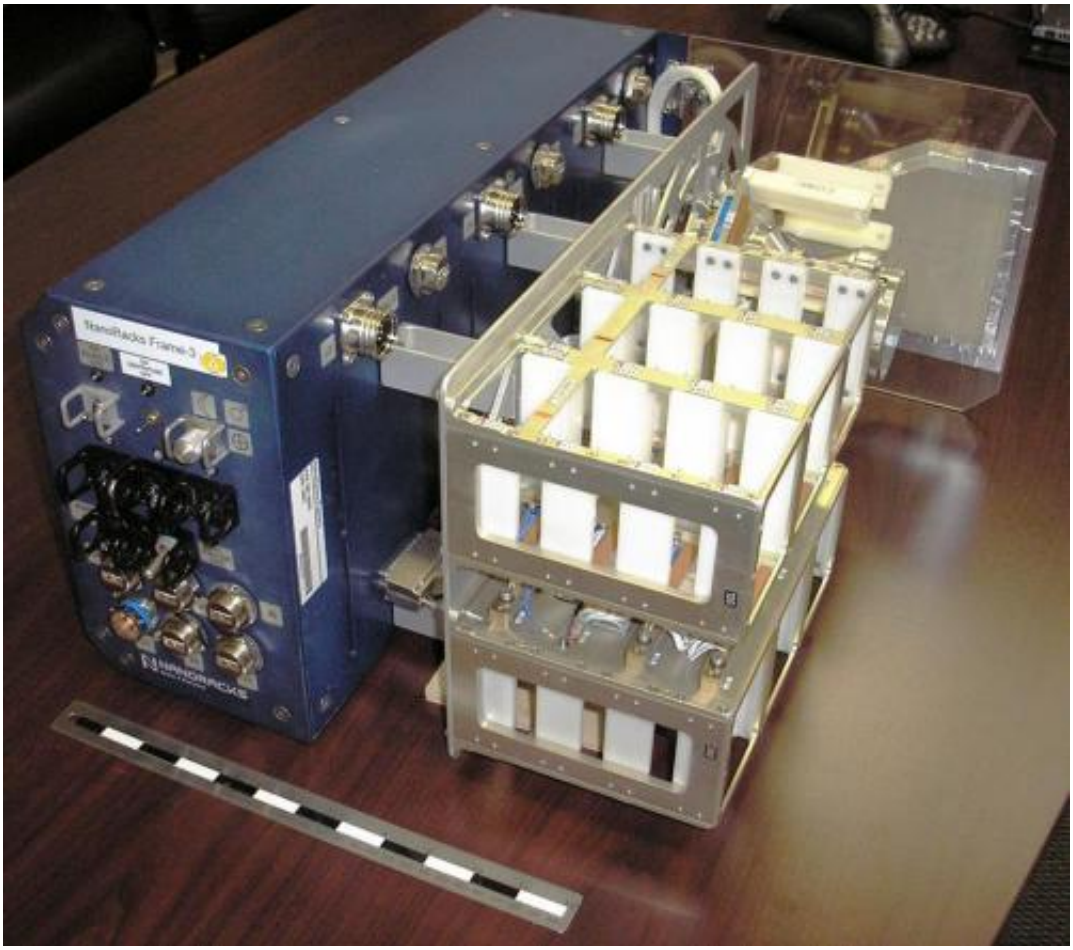
The multi-national efforts that go into research aboard the International Space Station show that working together can yield results with universal

benefits. This is especially the case when talking about human health concerns such as cancer. Researchers make use of the microgravity environment aboard the space station to seek answers to questions about the nature of cancer cells. With the Microgravity on Human Thyroid Carcinoma Cells (Cellbox-Thyroid) study, recently conducted in orbit, the hope is to reveal answers that will help in the fight against thyroid cancer.

The American Cancer Society estimates about 62,980 cases of thyroid cancer in the U.S. for 2014. The thyroid is a gland in the neck that secretes hormones that help the body to regulate growth and development, metabolism, and body temperature. The Cellbox-Thyroid study is enabled through a collaborative effort between NanoRacks, Airbus Defense and Space, the German Aerospace Center (DLR) and the Center for the Advancement of Science in Space (CASIS) to facilitate the microgravity investigation aboard the space station.

"NanoRacks is hosting this German research study aboard the U.S. National Laboratory," said Jeff Manber, CEO of NanoRacks. "It may well make critical advances in understanding and even delaying the onset of cancer in the thyroid."

The overall aim of the Cellbox-Thyroid study is to identify new biomarkers and target proteins for use in developing new cancer-fighting drugs. The investigation has roots in research performed in SIMBOX aboard the Sino-German Chinese Shenzhou-8 mission. During that 2011 study, Daniela-Gabriele Grimm, M.D., principal investigator and researcher with the Department of Biomedicine, Pharmacology at Aarhus University in Aarhus, Denmark, looked at cancer cells in microgravity and found that tumors behave less aggressively in that environment. Grimm's published findings appeared earlier this year in the Federation of the American Societies for Experimental Biology Journal.



This shows Nanoracks Frame-3 with the Airbus, Defense and Space Centrifuge for use to culture thyroid cancer cells aboard the International Space Station. Credit: Daniela Grimm

"A further important finding was that a tumor grows three-dimensionally in space. The mechanism for this finding will also be investigated in this Cellbox-Thyroid experiment," said Grimm. This result published in Elsevier *Biomaterials* 2013.

With the Cellbox-Thyroid study, Grimm seeks to build on her earlier conclusions by identifying the proteins that can be targeted to anti-

cancer therapies. Insights into what controls how tumors grow may lead to knowledge for enhancing treatments on Earth. The experiments took place aboard the space station soon after berthing of the SpaceX Dragon on April 20. The samples returned to Earth aboard the same vehicle on May 18 for further analysis by researchers on the ground.

Specifically, researchers are looking for the microgravity environment to reveal an altered gene expression pattern—how the gene's encoded information directs protein molecule assembly. They also seek to learn about the proteins expressed or secreted by the cells, called proteome and secretome. Isolating how the cell processes work could lead to new thyroid cancer drugs and provide a better understanding of the mechanism leading to cancer development for new strategies in thyroid cancer therapy.

"Spaceflight experiments are of great value for cell biology research in general and for cancer research in particular," said Grimm. "Our experiments indicate that microgravity induce[s] changes in the expression and secretion of genes and proteins involved in cancer cell proliferation, metastasis, and survival, shifting the cells toward a less aggressive phenotype."

Jessica Pietsch, Ph.D., and Stefan Riwaldt, medical student, work on the hardware assembly for the Cellbox-Thyroid study. Credit: Daniela Grimm

In microgravity, researchers anticipate the cancer cells will form three-dimensional multicellular tumor spheroids. This behavior was identified in the previous study, where cells floated without mixing with each other in the microgravity environment. This finding revealed that biochemical components on the cell surfaces were responsible for the initial cell-to-cell interactions required for spheroid formation.

For the Cellbox-Thyroid study, researchers used six experiment containers that fit into the NanoRacks platform and centrifuge for the test runs. After the experiments completed, the samples were stored for return to Earth. Once back on the ground, researchers will analyze the samples and compare them to data from ground controls using simulated microgravity via a random positioning machine and the results from the SIMBOX study.

The hope is that the continuance of this research from the original SIMBOX mission to the space station study will confirm findings and build the statistical data. Grimm plans an additional follow up study, called Spheroids, for 2015. Spheroids will operate for two weeks while in orbit, providing data that—together with its predecessors—may one day take a chunk out of those annual thyroid cancer statistics.

Provided by NASA