"Going to Places Where Humans Cannot" Sending the Dream of Science on a Space Probe

JAXA's successful space probe Hayabusa was built to perform the first sample-return mission from an asteroid in human history. The probe experienced many problems after arriving at its target, Itokawa, and the resulting drama and anticipation of Hayabusa's return made it one of the most well-known space missions in Japanese history. The Space Robotics Lab at Tohoku University, led by Professor Kazuya Yoshida, contributed to the design and analysis of Hayabusa's sampling apparatus. The Space Robotics Lab focuses on technology, like Hayabusa, which allows exploration of environments where humans cannot survive. Hayabusa was designed for asteroid exploration, but robots for lunar and planetary exploration, satellites in orbit around Earth, and even rescue robots for use on Earth are being investigated in Professor Yoshida's lab.

For planetary exploration, such as on the Moon and Mars, rovers which travel on and carry scientific equipment across the surface of the planet are incredibly useful. The Space Robotics Lab has worked to improve various traveling methods which prevent wheels from spinning out of control in soft soil. They then conduct experiments by traveling to deserts and volcanoes where conditions are similar to barren planets.

The Space Robotics Lab is also developing a series of university-made microsatellites for Earth observing missions, known as "RISING". The first model is already in orbit around Earth and the RISING-2 is launching soon. In partnership with Hokkaido University, the satellites are being used to investigate the "sprites" upper atmosphere lightning phenomena. As projects like this lower the barrier to entry for space, hundreds of satellites can be placed in orbit for innumerable uses, such as rapid monitoring of natural disasters.

Space is not the only place where humans cannot go – disasters here on Earth of often complicated by environments too dangerous for human access. The Space Robotics Lab is involved in the "Quince" Project and worked on developing a model to be used in the nuclear accident in Fukushima. Radiation damage to electronic components of conventional robots was a significant concern, but they were able to find solutions by leveraging their experience with space systems.

[Photo 1] A computer graphic model of the Hayabusa asteroid probe. Professor Yoshida contributed to the technological development for sampling of the asteroid surface. [Photo 2] The earth observation microsatellite RISING. This satellite, created by students, is now flying in space. [Photo 3] The model rocket was launched in Nevada, U.S.A. Emphasis is placed on the educational aspects, such as practical training using robots.

[Photo 4] An exploration rover which has been repeatedly tested in the laboratory sand pit. It is important that the robot can traverse sandy slopes. [Photo 5] Rescue Robot "Quince," which can climb even steep stairs. Also used after the nuclear accident in Fukushima due to our know-how in the radiation field.

Department of Aerospace Engineering
Graduate School of Engineering
Professor **Kazuya Yoshida**

Born in 1960 in Tokyo. Awarded his doctoral degree in Mechanical Engineering Science from Tokyo Institute of Technology. After the experience as an assistant professor in Tokyo Institute of Technology, a visiting researcher at Massachusetts Institute of Technology, and an associate professor of the School of Engineering, Tohoku University, Dr. Yoshida has served at his current position since 2003. Since 1998 Dr. Yoshida has also engaged in international educational activities as an adjunct professor of the International Space University.

http://www.astro.mech.tohoku.ac.jp/e/index.html

Discovery of Novel Type of Pluripotent Stem Cell, "Muse Cells" Opening a New Stage of Regenerative Medicine

While medical treatment is evolving, diseases which are completely curable are the exception. Among treatment types, "regenerative medicine" aims to regenerate tissues by the replenishment of lost cells due to degeneration of demages.

Pluripotent cells, such as ES cells and iPS cells, are considered to be cell source for regenerative medicine. However, much attention has been given to problems such as tumorigenic property.

In response to the question, "Are there any safe and effective cells?" Professor Mari Dezawa began considering mesenchymal cells. "When culturing human bone marrow mesenchymal cells, cell masses similar to ES cells are formed at a low frequency. We could understand to a point that these cells consisted of tridermic elements."

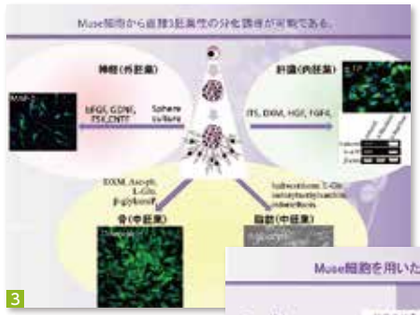
How to identify and isolate pluripotent cells then became the focal point of research. In 2007, clues to identify such cells were obtained at last. "During the experiment, mesenchymal cells were mistakenly incubated in a digestive enzyme for a prolonged period. It was a radical move, but, we were shocked to find an extremely small number of cells still remaining. With nothing to lose, we tried to culture them. And lo and behold, pluripotent stem cells we were searching for appeared!"

The discovered cells were named "Muse cells," and reported in April 2010. At the time, they were introduced by mass media as "The third type of pluripotent stem cells," and became very popular. Since then, direct separation from fresh bone marrow aspirate or the skin dermis using human embryonic stem cell marker SSEA-3 could be recognized.

"Since these cells already exist in vivo, no special procedures, such as gene transfer, are necessary. The danger of tumorigenic transformation is extremely low." When administered to a living body, Muse cells nome to damaged tissues, and differentiate into cells corresponding to the tissues. The possibility of autologous cell transplantation treatment is expected in the future.

"Progress in the research of Muse cells can be seen around the world. I think as efficacy increases, one path after another will be opened in regenerative medicine."

[Photo 1] Many young researchers, including foreign students, gather in the laboratory and actively carry out research. [Photo 2] A "Muse cell", the third type of pluripotent stem cell discovered by Professor Dezawa.



[Photo 3] Using a unique marker from Muse cells can directly lead to differentiation and induction to triderm without passing through iPS cells.

[Photo 4] A greater range of possibilities in regenerative medicine is expected by Muse cells allograft.

Department of Stem Cell Biology and Histology/Anatomy and Anthropology, Graduate School of Medicine
Professor **Mari Dezawa**

Born in Fukuoka Prefecture in 1963. She graduated from Chiba University Graduate School of Medicine and Pharmaceutical Sciences, specializing in regenerative medicine and stem cell biology. After serving as an assistant at Chiba University School of Medicine, lecturer of Yokohama City University School of Medicine, and Associate professor of Kyoto University Graduate School of Medicine and Faculty of Medicine, Dr. Dezawa has been at her present post since 2008.

http://www.stemcells.med.tohoku.ac.jp/english/index.html