How would you explain the main findings of your paper in lay terms?

Eukaryotic cells contain organelles. Each organelle plays an essential role for survival, and how organisms maintain their organelles is an important research subject. How organelles are divided and inherited in sync with the cell cycle is also an interesting question, as they must be properly inherited to the daughter cells during cell division. *Cyanidioschyzon merolae*, commonly called ‘CZON’, is a unicellular red alga with a simple cell structure, which makes it easy to study its organelles. The genome of *C. merolae* has already been determined to have one of the lowest gene numbers among eukaryotes. However, even in *C. merolae*, there are still many genes whose functions are not yet known. In order to analyze such genes efficiently and clarify the molecular mechanisms that regulate the division of organelles, we have established a system called CZON-cutter, which simultaneously performs genome editing using the CRISPR/Cas9 system and visualization of cell organelles. CZON-cutter can validate the function of any gene, even if it is essential, in living cells. I hope that CZON-cutter will be used as a basic tool to accelerate research on various topics, including the molecular mechanisms of cellular and organellar division.

Were there any specific challenges associated with this project? If so, how did you overcome them?

I started working on this research project in the second semester of my fourth year of undergraduate school. I devoted myself to this for those six months, and since I belonged to a different laboratory for my master’s program, I continued my research in parallel. In my free time, I joined the Yoshida research team to conduct research on CZON-cutter, but it turned out to be very challenging. I am very grateful for the support and understanding of the members of the Yoshida research team and the laboratory of Tetsuji Kakutani, which helped me to establish my research.

When doing the research, did you have a particular result or ‘eureka’ moment that has stuck with you?

I had been testing the CRISPR/Cas9 system since I was an undergraduate student, but it ended up being a failure. It wasn’t until my master’s program that I succeeded in genome editing. It took a long time, so I was very excited, and it was the ‘eureka’ moment.

Have you had any significant mentors who have helped you beyond supervision in the lab? How was their guidance special?

As mentioned above, I was able to develop CZON-cutter because of the support and understanding of the members of the

Fluorescence image of ACTIN-knockout cells made with CZON-cutter. During genome editing, the nucleus (green), mitochondria (yellow), peroxisomes (blue), and chloroplasts (red) are visualized at different wavelengths to enable phenotypic analysis.

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Yoshida research team and the laboratory of Tetsuji Kakutani. Among them, I am especially indebted to Associate Professor Yamato Yoshida and Dr Yuko Mogi. They frequently discussed and helped me with my experiments when I had difficulties. They were also kind enough to teach me how to write a paper, which was my first opportunity to do so. I am very grateful to them for the experience, which will be helpful for my future research activities.

What motivated you to pursue a career in science, and what have been the most interesting moments on the path that led you to where you are now?

When I was in high school, I learned a little about genes and genomes in biology class, and I thought I understood everything. However, as a university student, I learned about epigenetics and was impressed by a concept that I had never come across before. It was this experience that led me to the laboratory of Tetsuji Kakutani, where I am currently studying epigenetics. I often feel intrigued when I encounter new disciplines or concepts (this may be the most interesting moment so far), and I have been motivated to make discoveries that will enlighten others. I’m still a ‘work in progress’ as a researcher, so I will continue to study and search for other great discoveries.

What’s next for you?

In my current laboratory, we are studying epigenetics in Arabidopsis thaliana, and if possible, I would like to study epigenetics in the primitive red alga C. merolae as well. By comparing findings of C. merolae with those of A. thaliana, a land plant, I believe that interesting phenomena might be revealed from an evolutionary perspective.

I am also curious about a particular gene I found in C. merolae when I was an undergraduate student. The gene is highly conserved in photosynthetic eukaryotes, and when imaged by fusion to a fluorescent protein, it showed the interesting localization pattern. If I have time, I would like to use ‘CZON-cutter’ to investigate the function of this gene.

Reference