Visiting Professors

Visiting Professor
KAMIYA, Yukiko *(from Kobe Pharmaceutical University)*

Expand the Artificial Nucleic Acid World Based on the Studies of Molecular Science

Nucleic acids (DNA and RNA) are essential biopolymers that carry genetic information in all living organisms. On the other hand, various artificial nucleic acids (XNAs) such as ribose-modified or non-ribose type nucleic acids having nucleic acid recognition ability have been developed. One of our motivation of XNA study is development of nucleic acid drugs. Another big motivation is addressing the fundamental question why nature selected ribose as backbone of genetic materials. Our group has focused on amino acid-type artificial nucleic acids and we are studying on characterization of their molecular recognition properties, design of unique structures, and development of molecular tools and drugs that target RNA as applications. In recent study we successfully established a preparation scheme for full-XNA oligonucleotides possessing artificial nucleobases. The artificial oligonucleotides are currently being applied in in vitro and in vivo study to test whether they function in the biological system.

Visiting Professor
SATO, Sota *(from The University of Tokyo)*

Integrated Molecular Structure Analysis Through Industry-Academia Collaboration

Elucidating molecular structures is crucial in various fields of molecular science, regardless of academia or industry. In addition to NMR and mass spectrometry, X-ray/electron diffraction is a powerful analytical technique that can directly determine atomic positions, enabling clear determination of three-dimensional structures. We are actively pursuing the “crystalline sponge method” as one of core technologies, which eliminates the need for the crystallization process and completes sample preparation by simply soaking the target molecules into crystalline sponge, allowing structural analysis even with minute sample amounts. Furthermore, we are extensively deriving technological advancements and building collaborative relationships with numerous companies and institutions to promote research aimed at creating new industries. Recently, we have been dedicated to fostering future talent who will support the scientific community in Japan and the world. We organized mock lectures and research experiences for high school students in collaboration with corporate researchers, aiming to nurture the next generation of scientists.

Visiting Professor
TOYABE, Shoichi *(from Tohoku University)*

Optimal Control of Biological Molecular Motors—What Is the Most Efficient Way to Control Motors?

ATP synthase plays a central role in cellular energetics by synthesizing most of the ATP molecules required by cells. ATP synthase consists of two coupled motors, F_1 and F_o. F_1 has the ATP-synthesizing activity and catalyzes ATP synthesis using the mechanical driving force rovided by F_o. We assume that nature has optimized F_o and F_1 to rotate F_1 efficiently. However, we do not know in detail how F_o rotates F_1. Instead, we should be able to know what is the most efficient way to rotate F_1 based on physical theory. We use optimal transport theory to find the optimal way to rotate F_1 with the least amount of work, and practice the obtained optimal protocol by single molecule experiments. We have not found the optimal protocol. However, we have at least found that rotation by trapping torque at constant speed requires less work than rotation by constant torque at the same speed.