Biology

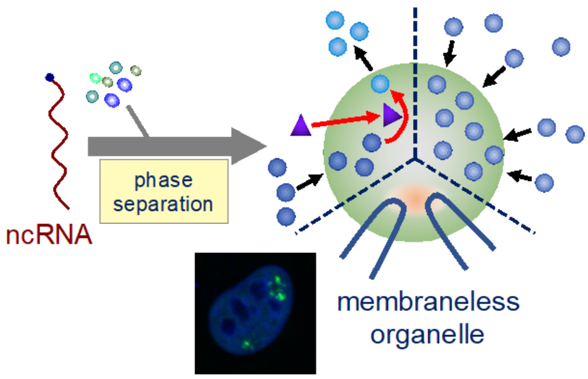
Date: July 6, 2:00-3:00 pm (JST)

Intracellular architecture by noncoding RNAs

Tetsuro Hirose

Graduate School of Frontier Biosciences and Institute for Open and Transdisciplinary Research Initiatives, Osaka University

RNA plays diverse molecular functions in various biological processes. At the beginning of the 21st century, people unexpectedly realized that numerous noncoding RNAs (ncRNAs) are transcribed from the large genomic regions which used to be considered meaningless or junk regions. The numerous ncRNAs likely play various regulatory roles related to physiology and diseases. Among various roles of ncRNAs, this lecture particularly focuses on a unique function of ncRNAs in the intracellular architecture. The architectural ncRNAs act as structural scaffolds of membraneless organelles by promoting phase separation in the cells and regulate gene expression.



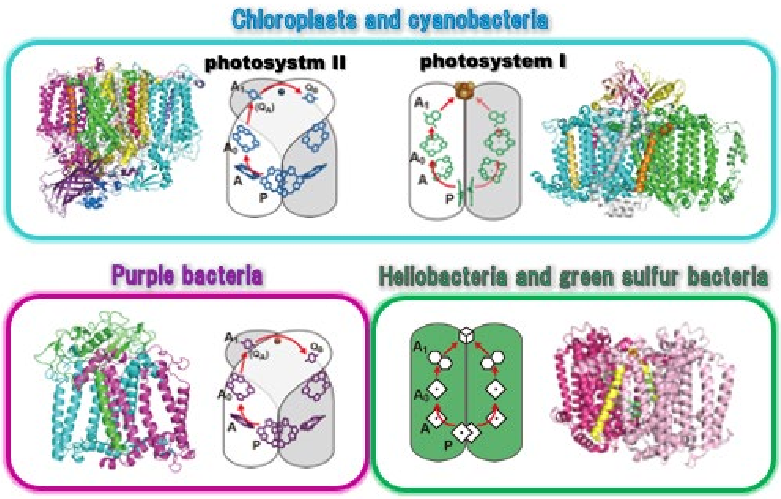
Biology

Date: July 5, 5:00-6:00 pm (JST)

Molecular mechanisms of light-energy conversion systems in photosynthesis

Hirozo Oh-oka
Department of Biological Sciences, Graduate School of Science, Osaka University

In photosynthesis, sun-light energy is efficiently converted into chemical energy that can be used by living organisms. This is carried out by pigment-associated protein complexes, reaction centers (RCs). RCs are classified into 2 groups, type 1 and type 2, based on their terminal electron acceptors. Photosystems I and II in oxygenic phototrophs belong to the type 1 and 2, respectively, and form a linear electron transport chain from water to NADPH. A single type of RC functions in anoxygenic phototrophs, that is, the type-1 RC in heliobacteria and green sulfur bacteria (hRC and gRC, respectively) and the type-2 RC in purple bacteria. I will describe the molecular mechanisms of these RCs and introduce our recent research on the hRC and gRC.



Structural comparisons of reaction center complexes

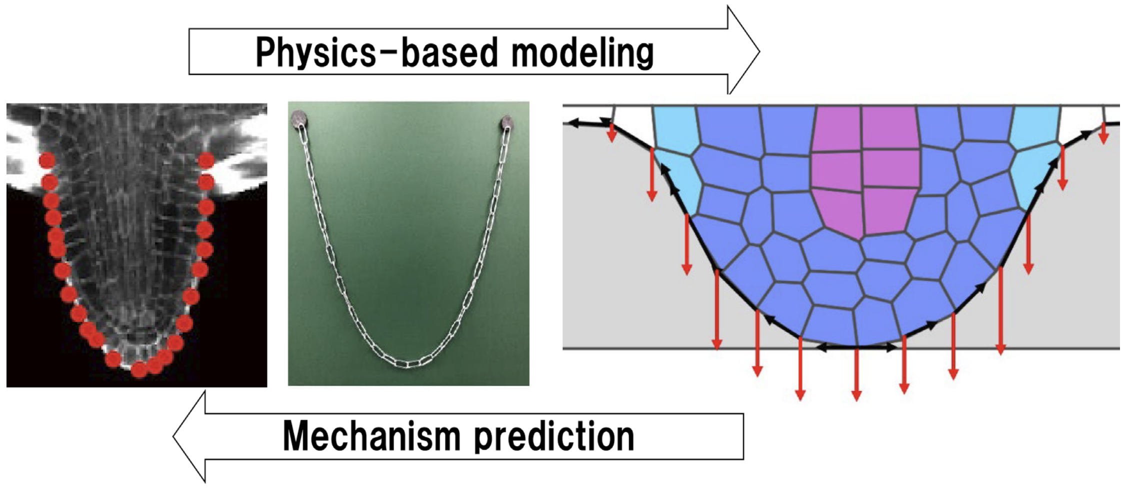
Biology (Mathematical biology 1)

Date: July 6, 2:00-3:00 pm (JST)

Quantitative modeling of multicellular mechanics shaping organs.

Koichi Fujimoto (Department of Biological Sciences, Graduate School of Science, Osaka University)

Organ shapes such as animal skulls or plant leaves are highly diverse but similar in their outline across species. Can we mathematically represent the similarity of biological shapes? If yes, how does the mathematical nature contribute to identifying the underlying mechanism during the morphogenesis? Here I show that the physics of a mathematical formula representing the organ shape can identify a developmental mechanism ensuring the similarity. We recently found that root tip outlines of multiple plant species commonly fitted to a catenary curve, a mechanically stable structure found in a free-hanging chain. The physical process of catenary curve formation predicts that the tissue growth rules force to form catenary-curved root tip. The rules were successfully verified *in vivo* using mutants of genes. The physics-inspired research strategy provides new insights into the shared constraints on the shape similarity across species.



Biology

Date: July 5, 5:00-6:00 pm (JST)

Cellular thermogenesis studied by light

Madoka Suzuki

Institute for Protein Research, Osaka University

Thermogenesis in our bodies originates from biochemical reactions in cells. Uncontrolled thermogenesis can result in a death of the organism. However, quantitative understanding is limited at the cellular scale; e.g., where, when and how much the thermogenesis occurs in the cell? How are the biochemical reactions influenced by the thermogenesis? Conventional thermometers and heaters are too large to be applied for individual cells. Therefore, we are developing "small" heaters and thermometers based on optical microscopy. Recent advances and applications to cells will be introduced.

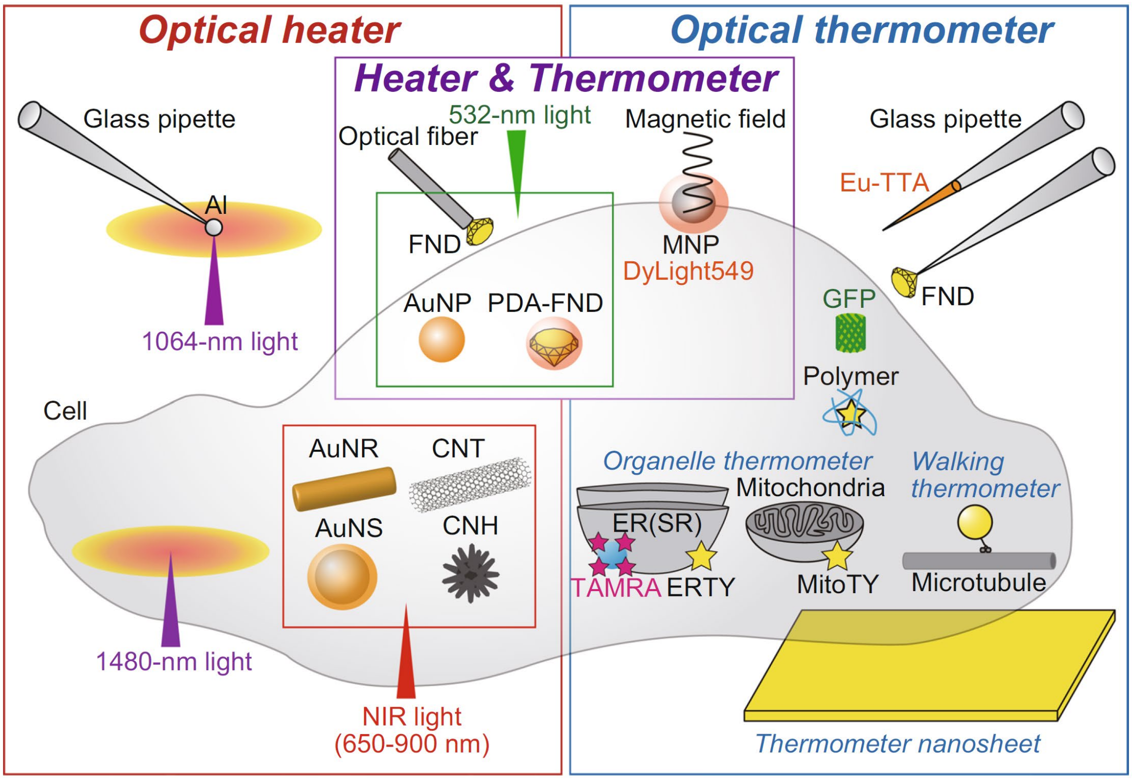


Figure. Optical microheaters and thermometers developed by us and others for cells. Adapted from Oyama *et al.*, *Biophys. Rev.* (2022) 14:41-54.