【Grant-in-Aid for Scientific Research (S)】

Integrated Disciplines (Complex Systems)

Title of Project : Dissection of molecules and neural circuits underlying a behavioral switch

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Research Project Number : 17H06113 Researcher Number : 40192471
Research Area : Brain Sciences
Keyword : The nematode *C. elegans*, Learning and memory, Synaptic transmission, Neural circuit

【Purpose and Background of the Research】

The nervous system is the most sophisticated information processing system that evolution of life has ever created. Unfortunately, much still remains unknown about its functions, due to the general difficultly of obtaining precise knowledge of the structure of neural circuits. However, in the small model organism *C. elegans*, all 302 neurons have been named and the structure of the entire neural circuit is known. In this study, by using *C. elegans* and extending the results of our previous study, we will elucidate how sensory inputs are processed to generate behavior and how molecular interplay reshapes the neural circuits to cause learning.

【Research Methods】

1) *C. elegans* are attracted to salt concentrations they have experienced in the presence of food, while they learn to avoid salt concentrations experienced while being starved. Our studies so far have revealed that a specific isoform of insulin receptor acts for the behavioral switch. We have also identified several other signaling molecules on which we will perform functional analyses, and we will clarify the relationship between the molecules, neurons and behavior.
2) We found that the sign of synaptic transmission between a specific pair of neurons changes via learning. We will clarify the mechanism by identifying the neurotransmitter, the receptor, the cells in which they act, and their change through learning.
3) We have developed a 4D imaging system in which all neurons in the head are observed at the same time. By using this method, we will identify the motor circuits and quantify the circuit dynamics and the change of these dynamics through mathematical modeling.
4) We will also generate a 4D optical system equipped with a tracking system that can observe the whole brain's activity in freely moving animals

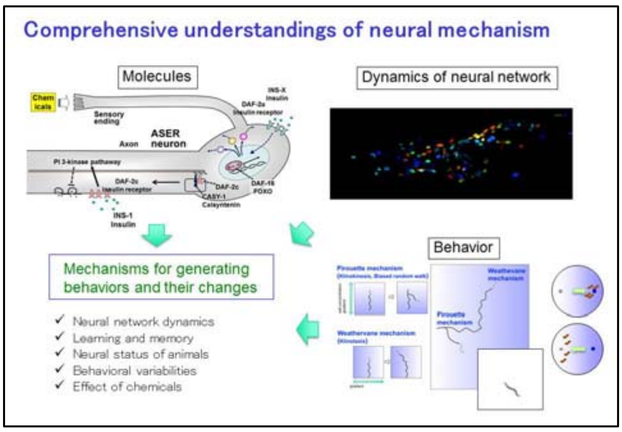

Figure 1 Outline of the study

【Expected Research Achievements and Scientific Significance】

Our analyses will cover the molecular, synaptic and neural circuit levels, and look at the whole brain's activity as well as behavioral patterns. Through these analyses, operational mechanisms of the neural circuit that have been previously unknown will be revealed.

【Publications Relevant to the Project】

Kunitomo, H. et al. "Concentration memory-dependent synaptic plasticity of a taste circuit regulates salt concentration chemotaxis in *Caenorhabditis elegans*." Nat. Commun. 4, 2210 (2013).
Ohno, H. et al. "Role of synaptic phosphatidylinositol 3-kinase in a behavioral learning response in *C. elegans*." Science 345, 313-317 (2014).

【Term of Project】 FY2017-2021

【Budget Allocation】 156,800 Thousand Yen

【Homepage Address and Other Contact Information】

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