

[Grant - in - Aid for Scientific Research on Innovative Areas(Research in a proposed research area)]
Interdisciplinary Area



Title of Project : Integrated analysis and regulation of cellular diversity

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Research Project Number : 17H06324

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【Purpose of the Research Project】

A human body is estimated to be composed of 3.7×10^{13} cells. The cell population is not homogenous but is composed of diversity-rich heterogeneous cells differentiated from tissue stem cells. Such cellular diversity is important for the construction and maintenance of robust organs and tissues enduring environmental changes. So, it is speculated the collapse of the cellular diversity causes the onset and development of various diseases including cancer.

Since the inter-cellular interactions among diversity-rich cells are very complicated, the integrated analysis of the interaction has not been done so far. Recent developments of the technologies and analyzers decrease the cost to acquire omics data at the single cell levels and make it possible to analyze numerous amounts of data as big data. Taking this opportunity, we need to make 3D cell atlas and to create mathematical model to analyze the inter-cellular interactions within the organs and tissues.

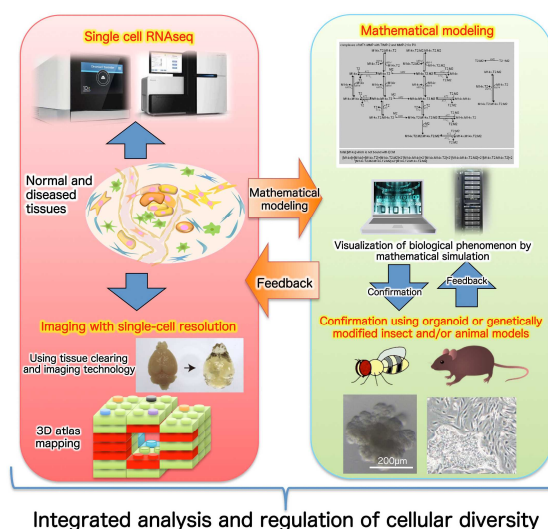
In this research project, we will clarify the basic principles of cellular diversity that are essential for the construction and maintenance of robust organs and tissues and their dysfunction in human disease through interdisciplinary collaborations among researchers who specialize in biology, mathematics, engineering, informatics and genomics. We will also develop novel mathematical models of cellular diversity and to identify therapeutic targets for treating diseases.

【Content of the Research Project】

Our research project consists of three research units: A01 “Analysis of basic principles of cellular diversity”, A02 “Mathematical analysis and modeling of cellular diversity” and A03 “Confirmation of mathematical model of cellular diversity”. In the A01 unit, we will perform molecular analysis of stem cells, cell differentiation and adaptation to environmental changes that are associated with construction and maintenance of robust organs and tissues. In the A02 unit, we will build mathematical models of cellular diversity using actual measurement data and will identify the key molecules and pathways by mathematical simulation. In the A03 unit, we will evaluate the accuracy of the key molecules and pathways identified in A02 unit by making genetically modified animals and insects.

Through interdisciplinary collaborations of the members in this research project, we are expecting to put forward the cycle of biological

studies, mathematical modeling and confirmation studies using animal or organoid models, to elucidate the novel key molecules and pathways involved in the onset and progression of disease.



【Expected Research Achievements and Scientific Significance】

Performing this interdisciplinary research project would enable us to achieve the comprehensive understanding of the fundamental principle of robust organ construction through cellular diversity. In addition, integrations of the research outcomes will lead to the identification of clues that are associated with disease onset, to the discovery of key therapeutic targets and to the innovation of therapeutic drug development and medical technologies.

【Key Words】

Omics: A research field focusing on the integrated analysis of biological molecules and metabolites.

【Term of Project】 FY2017-2021

【Budget Allocation】 1,189,600 Thousand Yen

【Homepage Address and Other Contact Information】

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