

Research area in Strategic Objective;

• *Elucidation of the mechanisms relating to changes in biological robustness associated with aging and control of age-related diseases*

• *Integrated understanding of human multi-sensing networks and elucidation of their control mechanisms*

• *Design of plant-derived molecules building up the foundation for plant synthetic biology*

• *Functional dynamics in the cell*

• *Development of core technology platforms for understanding spatiotemporal multicellular interaction*

• *Establishing technologies for genome-scale DNA synthesis and functional expression, and creating technology seeds for material production and medical care*

• *Construction of revolutionary material development methods through fusion among experiments and theory/data science*

Life Phenomena and Materials

Research supervisor: Yoko Toyoshima (Professor Emeritus, University of Tokyo)

Overview

Biotechnology is an important, fundamental technical field that holds the key to Japan's future competitiveness. Further development is required to achieve a society of health and longevity and construct a sustainable social system. In addition, the spread of coronavirus disease (COVID-19) and its socioeconomic impact have heightened the necessity to develop measures required to reduce the threat of subsequent infectious diseases. For biotechnology to address these challenges, it is necessary to develop substances and materials with novel functions and develop technologies that measure and evaluate them to deepen our understanding of life phenomena and contribute to solving issues. From this perspective, it is indispensable to support and foster excellent young researchers who have original ideas and will lead the next generation.

This "Research Area", under the keywords of "Life Phenomena" and "Materials", promotes fundamental research and creates new values and challenges for young researchers in various fields. Specifically, the Research Area focuses on designing and creating new substances and materials related to "Life Phenomena" and research related to the elucidation, control, and application of these life phenomena, such as discovery, functional analysis, and utilization of biomolecules and microorganisms. Further, research on measurements and evaluations related to the interaction between substances/materials and living organisms is also included. In various fields, such as life sciences,

chemistry, engineering, and physics, challenging concepts based on novel ideas are sought, with “Materials” as the cornerstone for investigations that can contribute to the medical/health and environmental fields and for research on substances and materials that can contribute to improving our knowledge on life phenomena.

In promoting research and emphasizing on researcher development, fostering investigators who promote advanced studies that contribute to the future, and fostering networking that would facilitate future collaborations are planned by providing an avenue for young scholars from different fields to interact and inspire one another.

Research Supervisor’s Policy on Call for Application, Selection, and Management of the Research Area

1. Background

As stated in the “Integrated Innovation Strategy 2021” and the “Sixth Basic Plan for Science, Technology, and Innovation,” biotechnology is an important, fundamental technical field that holds the key to Japan’s future competitiveness. Further development is required for achieving a society with strongly desirable health and longevity, construction of a sustainable social system, and realization of measures to reduce the threat of infectious diseases such as coronavirus disease (COVID-19) that may occur in the future. For the development of biotechnology, it is necessary to design and create new substances and materials related to life phenomena or substances and materials that can contribute to further understanding of life phenomena and solving issues; it is also necessary to develop technologies to measure and evaluate these substances and materials. From this perspective, it is indispensable to support and foster excellent young researchers who have original ideas and will lead the next generation.

The Research Area of ACT-X is a program to establish the individuality of young researchers by advancing research based on their independent and challenging ideas. We support and foster young researchers who will expand studies based on their original and challenging ideas, and who have ideas to innovate and create new fields that lead to new values. under the keywords “Life Phenomena” and “Materials”

In this Research Area, a target “young researcher” should have obtained a doctoral degree within eight years. If the doctoral degree has not been obtained, the researcher should have obtained a bachelor’s degree (including graduate studies) within 13 years. Any prenatal/postnatal/childcare leave after obtaining the degree- should be excluded in each case.

2. Direction of the themes called for in this research area

This Research Area focuses on the investigations on substances and materials that can contribute to research on life phenomena, medical/health and SDGs, and supports the fundamental research in various academic disciplines where the two keywords “Life Phenomena” and “Materials” intersect (issues related only to “Life Phenomena” or “Materials” are out of the scope of the themes called for in this Research Area).

The targets of the Research Area are elucidation, control, and application of life phenomena, and research subjects are on the design and creation of new substances and materials related to “Life Phenomena,” and on the discovery, functional analysis, and utilization of biomolecules and microorganisms. Research on measurements and evaluations related to the interaction between substances/materials and living organisms is also included. Examples include receptor, membrane transport, signal transmission molecule, transcription factor, development, differentiation, stress response, enzymatic function, drug design, drug delivery, and oligonucleotide therapeutics, but eligibility for application is not limited to these examples. In a wide range of fields, such as life science, chemistry, engineering, and physics, novel challenging concepts based on new ideas are sought. Research techniques include the so-called “Dry Lab” as well as “Wet Lab,” which utilizes the techniques of information science.

The new substances/materials mentioned above include hard materials (such as metals and ceramics) and soft materials (such as polymers, liquid crystals, colloids, biological membranes, and biopolymers). In addition to new substances/materials, discovery, functional analysis, and future utilization of biomolecules and microorganisms with unknown functions are also included.

3. Research area management policy

This research area supports and promotes exchange between young researchers in order to form connections between researchers, which will become important in the future.

ACT-X expects that young researchers will boldly carry out their research, and makes allowances for the risk of failure that comes with the outcome of a challenge. On the other hand, the budget scale for individual research projects is limited, you should make use of shared facilities in each research institution.

At the study of a life science, for study beginners having little experience especially in “Wet Lab”, it is difficult to make a study plan and executing it originally. But we believe to be able to promote a new study with original viewpoint and idea while even a graduate student is adding to his experience. We support such graduate student.

As ACT-X is a program that aims to establish individual young researchers, we encourage people to apply for PRESTO if there is a research area for which they can make a proposal, even if they are

in the middle of carrying out ACT-X research (if they are selected, they can switch programs via early graduation). In addition, should a researcher gain beneficial outcomes, we will freely give advice so that these can be developed through joint research with a company.

4. Research period and research funds

The call for applications for the 2024 academic year offers a research period of two years and six months. Standard research costs are 1.5–2 million yen per year, and total research costs are 4.5–6 million yen (excluding indirect costs) for a single project. It is not necessary to use the amount of money equally in every year. If you need more than a total of 6 million yen for research costs, please state the reason clearly on your application (max. 10 million yen). Those selected will be evaluated on the progress towards their goal two years after their research begins; at this time, any research projects that are expected to lead to even greater results with support for continued research will be given additional aid (around several million yen) for one year as an acceleration phase. Approximately 20–30 projects will be selected. (It is possible that the number of selected projects will change according to budget status and the research budget of said projects, among other issues.)

When a graduate student is adopted, they may pay the cost of a “Research Assistant” as their own personnel expenses separately from the above research fund.

5. Points to note when applying

In this research area, an area advisor, a researcher who has been playing an important role at the front line of each field, will be assigned to each researcher; thus, we take a system in which the full selected applicants can ask for discussion and/or advice on their research when necessary. In addition, the research supervisor or the area advisor gives advice on the research plan at an early stage after the selection; we aim at the creation of an effective achievement by clarifying the concept of a research. Furthermore, we host a research area meeting where the research supervisors, area advisors, and researchers whose proposal has been adopted gather at the same time to promote communication among the researchers, and we also expect development to crossing group studies from a human network by various researchers of the young people.

In this research area, we do not care about short-term achievements or outreach; we will take management such that young researchers can focus on their research without any restriction. Moreover, we aim to take management of the research area such that the researchers at their various life stages can easily join us.