SB
Sustainable Bioproduction

Through improving the productivity and functions of plants and microorganisms, and creating a biomanufacturing system, we contribute to stabilizing the food supply and building a society that does not depend on fossil resources.

MC
Material Circulation and Catalysts

Through the development of high-performance catalysts and innovative polymers, we contribute to reducing resource consumption and waste, and to realizing a 'resource-circulating' society.

SE
Symbiosis and Environment

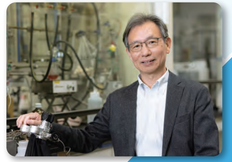
Through understanding the symbiotic relationships between plants and microorganisms and utilizing these insights, we contribute to the production of crops and materials that reduce environmental impact.

TP
Advanced Research and Technology Platforms

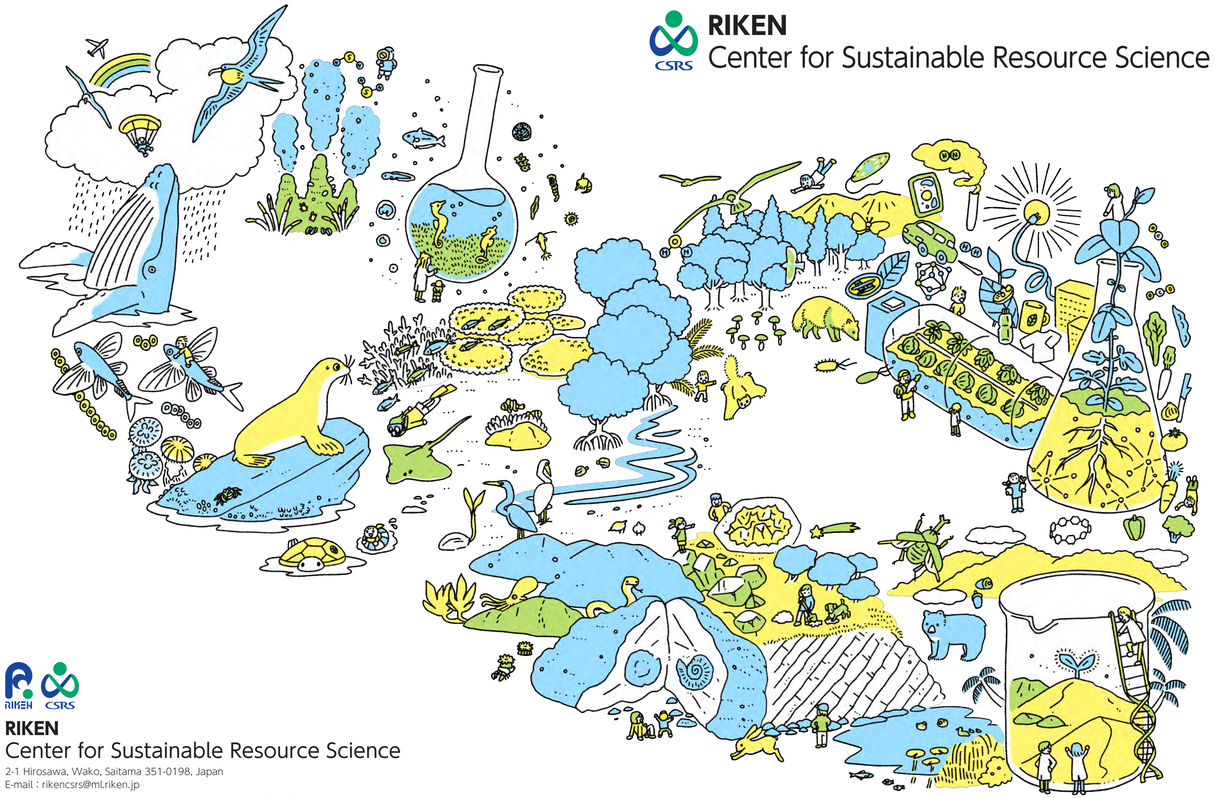
Through the state-of-the-art analytical infrastructure, compound library, and information infrastructure, we support three strategic programs and promote data science.

Deputy Director

Ken Shirasu



Zhaomin Hou



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Center for Sustainable Resource Science

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Through the power of science, CSRS opens our future where both the Earth and humanity can live healthily together

Message

The Earth we live on is a "system" where the air, oceans, land, and living things all affect each other. The Earth system has 'resilience' to heal itself and return to its original state. However, our activities to make life more comfortable have caused problems like climate change, loss of biodiversity, and pollution. Because of this, the Earth's resilience is reaching its limit. To solve the problems, people around the world have been working to achieve the Sustainable Development Goals (SDGs), but the crisis is not over yet. The Earth system is shared by all people, and it is called 'Global Commons'. To protect and nurture it, we must join forces to transition from a mass consumption society to a sustainable circular society that safeguards the Earth system.

Since its establishment in 2013, the Center for Sustainable Resource Science (CSRS) has pursued research under the concept of "Sustainable Resource Science," integrating research fields such as plant science, chemical biology, catalytic chemistry, and biomass engineering, and has been tackling the global challenge. The center is advancing the development of stress-resistant plants and environmentally friendly crop production technologies, and has also achieved results in 'manufacturing' utilizing the power of biology and catalysts. Furthermore, to ensure that the outcomes of our basic research benefit society, CSRS collaborates with researchers within and beyond RIKEN and experts from companies and the fields of humanities and social sciences.

It is humanity that has brought crisis to the Earth. However, we believe that humanity can also overcome this crisis by using its wisdom and actions. Through the power of science, CSRS contributes to solving global challenges toward the realization of a sustainable circular society and preserving the global commons, and opens our future where both the Earth and humanity can live healthily together.

Director
Mikiko Sodeoka

Mission

CSRS has built world-class achievements through the interdisciplinary research integrating plant science, chemical biology, catalytic chemistry, and biomass engineering. We promote four strategic programs leveraging the strengths of CSRS and tackle the urgent and global challenge of preserving the Global Commons.

Sustainable Bioproduction SB

Through improving the productivity and functions of plants and microorganisms, and creating a biomanufacturing system, we contribute to stabilizing the food supply and building a society that does not depend on fossil resources.

In the field of food production, climate change and population growth are urgent challenge that need to be addressed. This program focuses on enhancing the productivity and functions of plants and microorganisms, aiming to develop "resilient" species that have improved adaptability to environmental stress and increased material productivity. This program also promotes sustainable biomanufacturing using synthetic biology techniques.

Creation of Resilient Plants and Microorganisms

We aim to enhance the ability of plants and microorganisms to adapt to climate change and environmental stress, enhance material productivity, increase resource use efficiency, and contribute to carbon neutrality. To achieve these goals, we conduct single-cell omics analyses of plants and microorganisms to identify new genes and functional small molecules useful for trait improvement, and develop and validate technologies to enhance their functions. Additionally, we work on developing control technologies for cultivation and culture methods that are effective in improving the productivity and functions of plants and microorganisms.

Biomass and Biomanufacturing

We work on redesigning the metabolic networks of plants and microorganisms to enable biomanufacturing that produces useful substances sustainably and efficiently. Furthermore, we work on building a new production platform that is independent of fossil fuels.

Through research that exploits the full potential of plants and microorganisms, we aim to contribute to solving global challenges, such as the severe food crisis, and the creation of crops that can withstand climate change.

Program Leader
Motoaki Seki

Material Circulation and Catalysts MC

Through the development of high-performance catalysts and innovative polymers, we contribute to reducing resource consumption and waste, and to realizing a 'resource-circulating' society.

Modern society depends on materials produced through the consumption of large amounts of energy. To achieve a sustainable society, we must address the challenges related to these materials and their production processes. This program, based on catalytic chemistry, works on developing efficient chemical synthesis methods that use abundant resources, such as air, water, and Earth-abundant elements, while incorporating information technology, such as big data and theoretical analysis. We also create innovative polymers with self-healing and biodegradability properties, and develop chemical approaches that contribute to an environmentally sustainable and resource-recycling society.

Harnessing Earth's Common Resources

We work on developing highly functional transition metal catalysts and biocatalysts capable of synthesizing useful substances from the Earth's natural resources, including abundant atmospheric resources such as nitrogen and carbon dioxide, Earth-abundant elements and crustal resources. Additionally, we work on developing hydrogen production catalysts that utilize mineral resources and various water resources. These innovations will allow us to secure resources on a large scale and at low cost. Along with methods for reusing resources and catalysts, we are also exploring technologies for recycling chemical substances that contribute to environmental pollution.

Development of Innovative, Environmentally Friendly Polymers

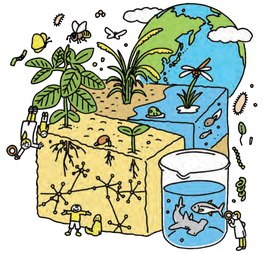
In addition to developing self-healing materials using proprietary catalysts, we work on creating marine biodegradable polymers and other materials derived from biomass (resources from living organisms, excluding fossil resources) that can serve as substitutes for plastics made from fossil resources. Moreover, by incorporating material and catalyst informatics using big data, artificial intelligence, and mathematics, we are developing novel biopolymers.

The role of chemistry is becoming increasingly important in sustainable human development. We are committed to working toward a circular society that promotes resource recycling.

Program Leader
Zhaomin Hou

Symbiosis and Environment SE

Through understanding the symbiotic relationships between plants and microorganisms and utilizing these insights, we contribute to the production of crops and materials that reduce environmental impact.



Although symbiosis with microorganisms in the environment is essential for plants to survive, the mechanism is not yet entirely understood. This program aims to realize agriculture with less environmental impact by comprehensively analyzing the complex symbiotic relationships between plants and microorganisms as well as among different microorganisms as a single system. It also strives to use new, useful substances produced by microorganisms.

Research on Useful Symbiotic Bacteria

To elucidate the mechanism of symbiosis between plants and mycorrhizal fungi and nitrogen-fixing bacteria, we work on isolating and identifying useful genes involved in the infection process in the plants as well as the microbes. While working to understand the complex interrelationships among the environment, plants, and microorganisms, we are exploring new symbiotic microorganisms and collecting chemical communication molecules that mediate these symbiotic relationships.

Sustainable Agriculture with Disease-Resistant Crops

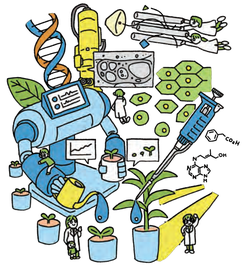
By isolating immunoreceptor genes critical for the plant immune system and designing synthetic biology to enhance plant immune functions, we aim to establish disease-resistant crops and cultivation techniques. We are also developing low-fertilizer and low-pesticide crop production methods that use symbiotic microorganisms. Furthermore, we work on developing digital twin prototypes for agricultural and aquatic environments based on field multiomics analysis.

The symbiotic relationship between plants and microorganisms remains largely a mystery. With a more advanced understanding of the symbiotic mechanisms, we may see a future where food is produced without the need for chemical fertilizers and pesticides.

Program Leader
Ken Shirasu

Advanced Research and Technology Platforms TP

Through the state-of-the-art analytical infrastructure, compound library, and information infrastructure, we support three strategic programs and promote data science.



Technologies for measuring and observing molecules and cells, a library of chemical compounds useful for understanding biological phenomena, and an information infrastructure that maximizes the use of obtained research data are essential for advancing sustainable resource science and addressing global-scale problems. This program supports the Center's three strategic programs by developing and advancing cutting-edge technologies. In addition to playing a key role in the research infrastructure of the RIKEN TRIP project, we also lead advanced science through joint research with domestic and international institutes and universities.

Establishment and Advancement of Analytical Technology Infrastructure and Information Infrastructure

We are advancing biomolecular analyses using mass spectrometry, structural analyses using nuclear magnetic resonance, imaging technologies with optical and electron microscopes, plant phenotype analyses, a compound library, and chemical genomics analysis platforms, while establishing new technological foundations. We are developing a data platform suited for storing and sharing vast amounts of data, contributing to the research promotion utilizing data science.

Analytical Support for the Research Community

Highly skilled staff members perform research support using analytical platforms and provide compounds, tools, and technical advice to researchers working collaboratively to solve scientific problems.

We aim to enhance research sustainability by further advancing our cutting-edge research infrastructure and data science efforts. We are also prioritizing the training of highly skilled personnel.

We aim to develop technologies that will lead to scientific breakthroughs and support cutting-edge research within the research community.

Program Leader
Naoshi Dohmae

Program Leader
Masami Hirai

Collaborations

Leveraging the strengths of CSRS to vigorously promote cross-cutting collaboration with researchers and companies inside and outside RIKEN.

Drug Discovery Platforms Cooperation Division

DDP

Academic drug discovery has become a world-wide movement at universities and research institutions. RIKEN facilitates academic drug discovery by conducting the Drug Discovery and Medical Technology Platforms (DMP). To achieve this goal, it is necessary to develop novel assay systems based on recent advances in genome and iPS cell research. Capitalizing on RIKEN's vast library of bioactive natural products, optimized assay systems, and state of the art equipment for high throughput screening (HTS), our division aims at making innovative contributions to the academic drug discovery effort.