THE JAPAN PRIZE FOUNDATION

ARK Mori Building, East Wing 35th Floor, 1-12-32
Akasaka, Minato-ku, Tokyo, 107-6035, JAPAN
Tel: +81-3-5545-0551 Fax: +81-3-5545-0554
www.japanprize.jp
Twitter @JapanPrizeAward Instagram @JapanPrize

Japan Prize News

No. 61 Jan. 2019

JAPAN PRIZE

2019 Japan Prize Laureates Announced

This year's Japan Prize will be awarded to Prof. Yoshio Okamoto who established the concept of asymmetric polymerization for the creation of helical polymers, and developed the results into a practical separation method for optically active drugs, and to Prof. Rattan Lal who proposed and practiced the sustainable soil management method that contributes to both the stability of food security and environment conservation for climate change mitigation

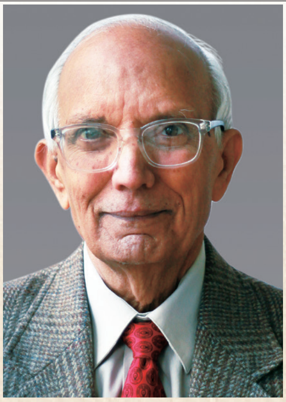
"Materials and Production" field

Prof. Yoshio Okamoto

Distinguished Invited University Professor, Nagoya University
Chair Professor, Harbin Engineering University

Japan

"Biological Production, Ecology" field



Prof. Rattan Lal

Distinguished University Professor of Soil Science
Director, Carbon Management and Sequestration Center
The Ohio State University

United States of America

The Japan Prize Foundation has decided to award the 2019 (35th) Japan Prize to Prof. Yoshio Okamoto of Japan and Prof. Rattan Lal of the United States of America.

In the prize field of "Materials and Production", Prof. Yoshio Okamoto is being honored for his "leading contributions to precision synthesis of helical polymers and development of practical chiral materials for separating chiral drugs".

Prof. Okamoto has contributed enormously to the development of basic science and industry by establishing the groundbreaking concept of asymmetric polymerization for the creation of helical polymers and developed the results into a practical separation method for optically active drugs.

His research has made it possible to efficiently separate the numerous enantiomers which had been deemed very difficult in the past, achieved its practical application and even led to the development of the most used chiral filler in the world. In order to produce drugs with high efficacy and no side effects, it is essential to obtain a single enantiomer (chiral drug). By using the chiral filler material developed by Prof. Okamoto, it is possible to separate chiral drugs by the tons. The chiral separation business based on this technology is now benefiting researchers from all over the world. In this way, the technology that originated from Prof. Okamoto's basic research, which was then adapted for practical application through applied research, has since contributed enormously to the creation of pharmaceuticals and other chiral substances.

In the prize field of "Biological Production, Ecology", Prof. Rattan Lal is being honored for the establishment of "sustainable soil management for global food security and mitigation of climate change".

Prof. Lal has been successful in establishing technological options adapted to various ecosystems through his deep academic exploration to prevent soil degradation caused by inappropriate biological production, as well as to propose the best soil management that reduces the effects on climate change and improves the environmental quality to cope with the issue of feeding the earth's population, which is expected to reach 9.8 billion by 2050.

Prof. Lal proposed the no-tillage cultivation method that ensures stable biological production and prevents soil erosion and practiced the concept widely around the world. Furthermore, the technique he proposed to sequestrate atmospheric CO_2 into the soil using crops can also provide numerous secondary effects, such as enhanced food security, reduced water pollution and biodiversity conservation at a low cost.

In this manner, Prof. Lal has not only pursued the principle of natural science and the adoptions of its technological applications in society, but has also demonstrated to society the importance of soil, which sustains biological production and affects the global environment. While enlightening the general public on this issue, he has also brought together international efforts to promote soil conservation with policy makers.

As described, the achievements of Prof. Yoshio Okamoto and Prof. Rattan Lal are deemed most eminently deserving of the Japan Prize, which honors contributions to the advancement of science and technology that further the cause of peace and prosperity for all mankind.

The award presentation ceremony to honor the laureates will be held on the 8th of April this year at the National Theatre in Tokyo.

JAPAN PRIZE

The Japan Prize came into being in 1982 after the late Mr. Konosuke Matsushita, the founder of Matsushita Electric Industrial Co., Ltd. (now known as Panasonic Corporation), made a personal donation in response to the then government's wish to create a prestigious international prize for scientists from around the world as a token of gratitude to the international community. With cabinet endorsement, the prize was first awarded in 1985. The Japan Prize honors those whose original and outstanding achievements are not only scientifically significant, but have also served to promote peace and prosperity for all mankind. Each year, the foundation designates two fields for award presentation in consideration of developments in science and technology. Each Japan Prize laureate receives a certificate of merit and a prize medal. A cash prize of 50 million yen is also presented to each prize category.

"Materials and Production" Field

Achievement : Leading contributions to precision synthesis of helical polymers and development of practical chiral materials for separating chiral drugs

Prof. Yoshio Okamoto (Japan)
Born: January 10, 1941 (Age: 78)
Distinguished Invited University Professor, Nagoya University
Chair Professor, Harbin Engineering University

Summary

Even among two molecules of the same chemical composition, some have a three-dimensional structure with a mirror image that cannot be superimposed on to the other, as it is the case with our left and right hand. Such molecules are said to be in an enantiomeric relationship. Among enantiomers, physical properties such as the melting point and boiling point are the same, but their physiological effects on the human body can differ. This can cause major problems for the production of pharmaceuticals.

Despite the above being the case, ordinary chemical synthesis can only produce enantiomer mixtures. Along with the advancement of the technique for synthesizing only one hand of the molecule with a catalyst, the convenient method for separating the generated mixture has also come to be widely used. This was made possible by helical polymers. When one-handed helical polymer is coated onto silica gel, packed in a column and enantiomer mixture is injected through, the enantiomer that is more prone to being captured by the helical polymer remains in the column for a long period of time, and the other enantiomer that is less prone to being captured flows out first.

Prof. Yoshio Okamoto was the first in the world to achieve the synthesis of a one-handed helical polymer, and even demonstrated its utility in the separation of enantiomers. Today, products that have been derived from the application of these discoveries are being widely used throughout the world for the research & development and the manufacturing of pharmaceuticals, aroma chemicals and functional materials. Prof. Okamoto's achievements that span the advancement of basic polymer synthesis science to its practical application are highly regarded by the international community.

The different physiological effects among enantiomers

Enantiomers with different three-dimensional structures, like our left and right hand, often have different physiological effects on the body (Figure 1).

With menthol, for example, one of the enantiomers has the aroma of mint, but the other has very little aroma. With monosodium glutamate, the umami seasoning is derived only from one of the enantiomers, as red blood cells can only carry just one of the enantiomers when transporting glucose. The ability of organisms to distinguish enantiomers is related to the fact that the proteins that make up the living body are composed of amino acids from just one of the enantiomers.

One of the reasons that enantiomers have attracted public attention was the Thalidomide drug disaster that occurred during the early 1960s. Thalidomide has two types of enantiomers. Although one has the effect of a sleep-inducing drug, the other can sometimes cause malformation of the fetus when taken by a pregnant woman. At that time, the difference in the pharmacological effects of enantiomers was not well understood, which led to a series of serious drug poisoning incidents. It was much later that the technique to selectively synthesize different enantiomers (asymmetric synthesis) and the technique to separate different enantiomers (chiral resolution) were developed, hence enabling us to examine the various effects on body. Today, we also know that both enantiomers are partially inverted in the body.

Ordinary chemical synthesis can only produce mixtures of enantiomers with equal proportions. In the development and manufacturing of many chemical products, there was a major demand for the technique to selectively obtain just the useful enantiomers with a high degree of precision and efficiency. This was particularly an important aspect in the development of pharmaceutical drugs where efficacy and safety are crucial.

Column for high-precision separation of enantiomers

Amid these circumstances, there was a growing need for asymmetric synthesis, the technique to selectively obtain just one of the enantiomers, and chiral resolution, the technique to separate enantiomers.

From the 1980s onward, there was substantial progress in the research & development of asymmetric synthesis for selectively synthesizing the desired enantiomers using a catalyst. However, synthesis with high precision is not easy even with today's technology.

Meanwhile, the chiral resolution technique, which is highly convenient for separating target substances from synthesized mixtures, saw major advances and widespread adoption. Among them, chiral resolution by way of High-Performance Liquid Chromatography (HPLC) has especially seen high adoption in research & development and the production field for being a versatile technique capable of high precision separation. In HPLC, the mixture of enantiomers is injected into the column with the solvent, then separated by utilizing the time difference with which the substances flow out. By infusing the column's filler with a substance that captures one of the enantiomers, the other enantiomer can flow out faster, thereby enabling the separation of the two with high precision and efficiency.

The revolutionary substance that led to the realization of chiral resolution by HPLC was the helical polymer that Prof. Okamoto succeeded in synthesizing in 1979. The one-handed helical polymer can recognize and capture just one of the enantiomers. As it is easy for two right hands to be shaken, and is difficult for the left and right hand to be shaken, precision separation was achieved by the mechanism in which one of the enantiomers stays in the column (easy to handshake) and the other flows out faster (difficult to handshake) (Figure 2). Based on this breakthrough, Prof. Okamoto embarked on a joint research with a domestic chemical manufacturer, and in 1982, commercialized the world's first practical chiral resolution column for polymeric HPLC.

The chemical synthesis of one-handed helical polymers

Early during his polymer research, Prof. Okamoto worked on “asymmetric selective polymerization”, a chemical reaction to polymerize just one of the enantiomers in an enantiomer mixture. Although many researchers had worked on this matter, none were able to produce good results. However, Prof. Okamoto in 1977 realized the asymmetric selective polymerization with high selectivity by using a catalyst derived from natural substances. Following this breakthrough, he used the same catalyst to achieve the world's first "helix-selective polymerization" which is the selective polymerization of one-handed helical polymers.

A left-handed helix and a right-handed helix have a symmetrical three-dimensional structure when reflected onto a mirror, and are in an enantiomeric relationship with each other (Figure 1). Prof. Okamoto confirmed that if a molecule he had been experimenting with was polymerized, a bulky structure would generate on one side of the polymer chain which consequently generated a stable one-handed helix even in solutions. Until then, the conditions under which helical polymers could retain its stable structure in solutions had

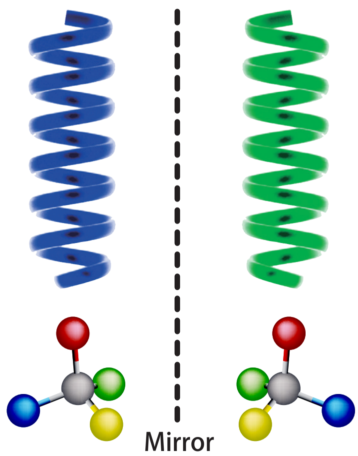


Figure1: Molecules in an enantiomeric relationship and left and right-handed helical polymers

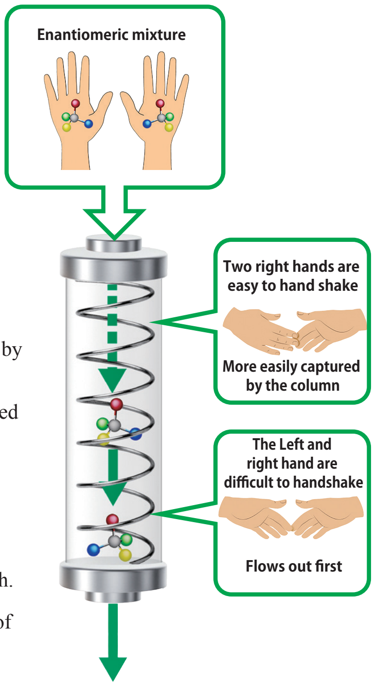


Figure2:
Separation of enantiomers by a helical polymer column

When the mixture is injected into the column of High-Performance Liquid Chromatography, the charged helical polymer captures one of the enantiomers. The other enantiomer flows out first because it is harder to catch. This mechanism enables high-precision separation of enantiomers.

been unknown. Furthermore, no one had predicted that a stable one-handed helical polymer could be formed by polymerizing such a molecule.

This breakthrough greatly stirred up the field of organic synthetic chemistry and the synthesis of helical polymers have since been actively pursued by researchers all over the world. Helix is the fundamental structure of biopolymers responsible for biological phenomena such as proteins, DNA and polysaccharides, and is the primary factor that gives rise to the advanced and diverse functions of life forms.

With so much potential, helical polymers are substances of great appeal. As research on the synthesis and dynamics of helical polymers move forward, a new field of helical polymer science has also been expanding.

Today, there is high anticipation surrounding its applications toward catalysts and nanomaterials.

Achievements that span from basic research all the way through to practical applications

Prof. Okamoto studied the functions of helical polymers he had synthesized and confirmed its ability to distinguish enantiomers. As a result, the aforementioned column filler was born. In search of filler material with better separation capacity, he next focused on cellulose and amylose, which are polymers of natural polysaccharides. To examine their functions, he made various chemical modifications to these macromolecules and succeeded in obtaining a filler with higher capacity.

Today, the HPLC column with filler material made of polysaccharide-infused silica gel is used by the overwhelming majority of research institutions and companies around the world. This column, which can separate enantiomers at a very high success rate, has not only contributed to the research & development of pharmaceuticals, aroma chemicals and functional materials but has also been widely adopted in the production field, thereby enabling the separation of enantiomers in tons.

Currently, many pharmaceutical drugs such as antidepressants, antiepileptics and hyperlipidemia drugs are manufactured using chiral resolution column with polysaccharide fillers.

It has also played an important role in the production and development of esomeprazole, a gastric acid secretion inhibitor, of which the global annual sales (up to June 2014) amounted to 894 billion Yen ($8.83 billion USD).

With the advancement of chiral resolution technology, it has been recommended in Japan since the mid-1980s that the manufacturing of pharmaceutical drugs take enantiomers into account and only use the more effective enantiomer.

In this manner, Prof. Okamoto's achievements, which include the development of asymmetric selective polymerization, helix selective polymerization, and chiral materials utilizing helical polymers, and span from basic research all the way through to practical applications, are highly regarded for its immense contributions to society.

"Biological Production, Ecology" field

Achievement : Sustainable soil management for global food security and mitigation of climate change

Prof. Rattan Lal (United States of America)
Born: September 5, 1944 (Age: 74)
Distinguished University Professor of Soil Science
Director, Carbon Management and Sequestration Center
The Ohio State University

Summary

Soil is important not only for food production but also for a wide range of functions in environmental conservation, such as carbon sequestration, environmental cleanup, material circulation and preservation of biodiversity. Prof. Rattan Lal demonstrated in Africa's sub-Saharan region that the "no-tillage cultivation method" can ensure stable biological production while preventing soil erosion, and has undertaken great efforts to spread this technique and promote the idea that a healthy soil is the basis of sustainable agriculture and good environment.

While the soil is usually plowed in agriculture, the no-tillage cultivation method which does away with plowing was adapted and tested by Prof. Lal who had noticed the outflow mechanism of soil organic matter. Based on this finding, Prof. Lal began studying the relationship between soil and global environmental issues.

As a result of the analysis of the global carbon cycle, he found out that with appropriate management, soil not only isolates carbon and reduces CO_2 in the atmosphere but also becomes fertile, thereby improving food production.

And as a result of his continuous appeal to the international community of the importance of appropriate soil management, Prof. Lal's ideas were formulated into the policy of international effort for soil preservation called the "4 per 1000 Initiative", and is closely tied to the promotion of the UN's Sustainable Development Goals (SDGs).

The degradation of soil by humankind

Soil is made over a very long time span. For example, immediately after a landslide, the ground is covered with rocks. The rocks then weather and gradually become finer, turning into sand and eventually to clay. Meanwhile, as the growth of plants gradually increase, microorganisms decompose the dead plants over a long period of time. This results in the formation of organic matter called "humus". It takes hundreds of years for clay, microorganisms and humus to form aggregates and become stable soil.

Ever since mankind began agriculture, soil has been exposed to human-induced changes. The plowing of soil increases the supply of oxygen and fuels the activities of microorganisms, thereby driving the decomposition of organic matter. The decomposed organic matter then becomes the nutrients that help agricultural crops grow. In other words, agriculture is originally a process of extracting organic matter accumulated in the soil over a very long span and turning it into crops. As mankind gained experience in agriculture, productivity has increased through the use of fertilizers, but this also meant the faster depletion of organic matter in soil.

In fact, when averaged out, the soil thickness for the whole earth is only about 30 to 40 cm. Despite there being very little soil, it produces food for the world's population that now exceeds 7 billion people. If we keep using the organic matter in soil at the current pace, we will be in danger of not being able to produce enough food for the growing world population. Furthermore, the organic matter in the soil will eventually become CO_2 and escape into the atmosphere.

Between 1750 (immediately prior to the industrial revolution) and 2017, the amount of CO_2 emitted into the atmosphere (in carbon equivalent) was 235±95 gigatons (1 billion tons) due to human-induced changes to land such as deforestation. This is almost half the amount that was emitted by the burning of fossil fuel and cement production, which stands at 430±20 gigatons.*

As described, soil has a major impact on food production and global environment. From this perspective, Prof. Lal addressed these issues by focusing on the importance of soil physical management and has made two major achievements.

No-tillage agriculture will save our soil

Prof. Lal's first achievement is the adaptation of the "no-tillage cultivation method" that increases crop production while preserving the stable state of soil organic matter in Africa's sub-Saharan region suffering from severe soil erosion, and the subsequent spreading of the technique throughout the tropics and elsewhere.

Prof. Lal, who was born in India, graduated from the Punjab Agricultural University, then earned a master's degree from the Indian Agricultural Research Institute. He then moved to the United States and earned a Ph.D. from the Ohio State University in 1968. In 1970, he began researching at the International Institute of Tropical Agriculture (IITA) in Nigeria and worked on addressing the issue of soil erosion and physical degradation.

The sub-Saharan region at the time was suffering from soil deterioration due to the use of heavy machinery for deforestation and cultivation. The problem was made worse by the prevalence of erosion due to rain and wind, making it difficult for the crops to grow sufficiently.

Prof. Lal, who specializes in soil physics, conducted a detailed investigation of the size distribution and kinetic energy of raindrops and clarified the conditions under which soil erosion occurs. He also quantified the effect of mulch (the covering of soil surface) for the prevention of soil erosion. Plowing not only makes soil erosion more likely to happen but also makes it easier for aggregates in the soil to break due to temperature rise on soil surface and raindrops. By elucidating this mechanism, he discovered how soil organic matter is lost. Based on these analyses, Prof. Lal promoted the "no-tillage cultivation method" as a way of preventing soil erosion and stabilizing biological production. He gradually increased the scale of his cultivation experiments, repeating and refining it until the method could yield production increase that would be adequate for farmers to consider adoption.

The method he devised was:

1) Leave the surface soil protected with roots and stumps when cutting forests,
2) Plant and grow cover crops (such as plants of Leguminosae family) immediately after cutting,
3) Plant the seeds of target crops where the cover crops have died without plowing.

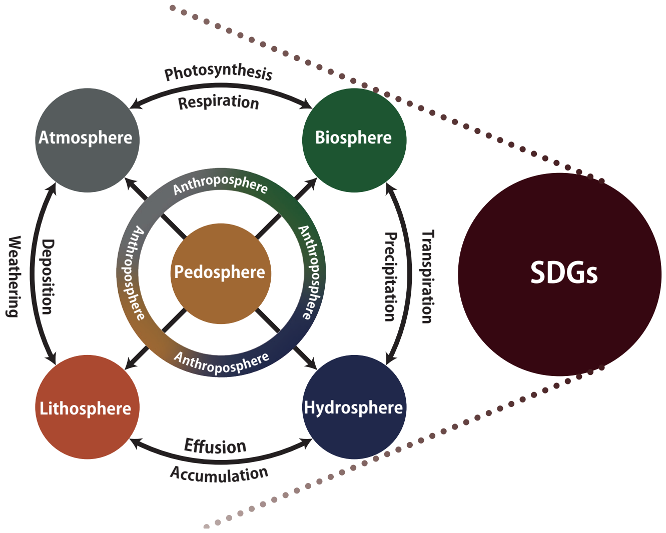
The dead cover crops will not only prevent soil erosion but also serve as mulch and compost for the target crops while conserving water and moderating soil temperature.

Following this discovery, Prof. Lal, who devised the method to prevent soil erosion and improve the growth of crops by the counterintuitive concept of "no-tillage", worked in Asia including his home country India as well as Brazil and Australia to spread the no-tillage cultivation method. Prof. Lal has also taught the "non-tillage cultivation method" to researchers worldwide who came to IITA, leading to its adoption throughout the tropics and globally. Translation of his academic findings in soil physics into a sustainable method of farming with real-life applications is Prof. Lal's biggest achievement.

Isolating carbon into the soil

In 1987, Prof. Lal became a professor at the Ohio State University. With nearly 20 years of experience accumulated while researching at IITA, Prof. Lal conducted research on the relationship between soil and global environmental issues. He revealed that the proper management of soil is crucial if we are to solve the major issues of food production and conservation of the global environment. In addition, he continued to promote the proper management of soil so that the real-life application of his academic findings would become established in society. His efforts eventually led to the realization of international efforts. This is Prof. Lal's second achievement.

When viewed from a different perspective, it can be said that organic matter contained in the soil serves to isolate carbon. Whereas there are 1,550 gigatons of carbon that exists as soil organic matter and 950 gigatons as soil minerals, coming to a total of 2,500 gigatons. This is more than three times the carbon contained in the atmosphere (800 gigatons) and 4.5 times the carbon that exists as plants (560 gigatons).



The relationship between the pedosphere and the ecosphere of Earth seen in relation to the SDGs. The pedosphere at the center is related with everything else, and plays a major role in the achievement of SDGs. Diagram based on Fig.15-2 of "Soil and Sustainable Development Goals" (Catena soil sciences publications) edited by R. Lal et al.(2018).

If we can confine more carbon into soil which we now understand it to be a huge "warehouse", we can suppress the rising levels of CO_2 in the atmosphere and perhaps help to alleviate global warming. In addition, this can also stop the decline of soil organic matter caused by agriculture and improve food production, as well as bring about secondary effects such as the reduction of water pollution and the conservation of biodiversity. While many methods of carbon sequestration have problems such as technical difficulty, cost, adverse effects on the environment and so on, soil management is a relatively simple, safe and inexpensive method that is more superior.

With this goal, Prof. Lal analyzed the circulation of earth's carbon from data, examined the relationship between soil, the environment and agricultural production in detail, and studied how soil should be managed in order to increase the isolation of carbon. And in 2004, he published the results in "Science" magazine. His paper proposed not only the no-tillage cultivation method for areas with eroded soil but also various other types of soil management methods, and estimated that every year 0.4 to 1.2 gigatons of carbon could be isolated in cropland soils throughout the world.

Following the publication of his paper, Prof. Lal has served as a committee member at relevant academic conferences, government agencies and international organizations, and has even made presentations to appeal for the implementation of the countermeasures he put forth. His efforts eventually bore fruit at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change held in Paris in 2015, when the initiative to "increase soil carbon by 4/1000 per year" (4 per 1000 initiative) was launched.

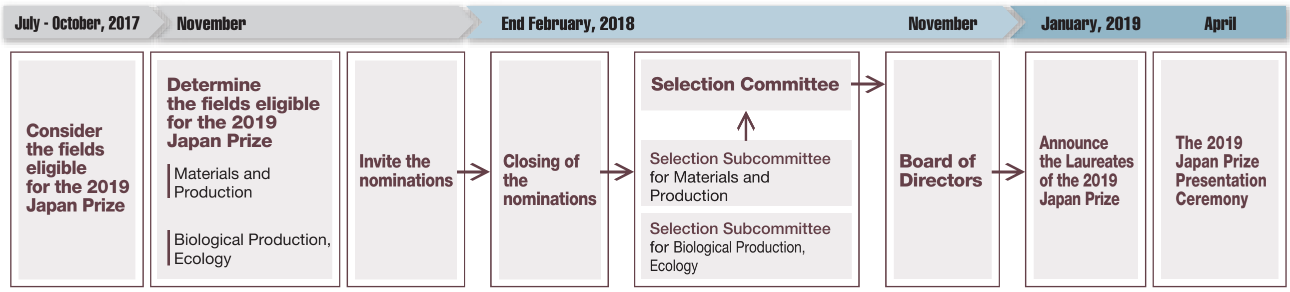
It is calculated that if this goal is achieved, the increase in carbon due to the burning of fossil fuels could be offset, thereby drastically reducing the annual increment of atmospheric CO_2. His ideas have also been reflected in the AAA Initiative (the initiative for the Adaptation of African Agriculture) adopted at the COP22 held in Marrakesh in 2016. Furthermore, Prof. Lal's ideas are expected to contribute towards the achieving of 4 of the 17 of sustainable development goals (SDGs) formulated by the United Nations in 2015, namely Goal 1 "No Poverty", Goal 2 "Zero Hunger", Goal 13 "Climate Action", and Goal 15 "Life On Land"and achieving land degradation neutrality.

Prof. Lal, who initially began his research to stop soil erosion in the sub-Saharan region, expanded his activities in order to help solve global food and environmental issues, and has consistently conveyed the importance of soil to the international community. With his unstoppable enthusiasm and spirit of inquiry, today, Prof. Lal is also conducting research on the relationship between urbanization and soil.

*According to the Global Carbon Budget (2018) by Le Quere et al. published in Earth System Science Data 10:2141-2194

Nomination and Selection Process

- Every November, the Field Selection Committee of The Japan Prize Foundation designates and announces two fields in which the Japan Prize will be awarded two years hence. At the same time, the Foundation calls for over 15,000 nominators, strictly comprised of prominent scientists and researchers from around the world invited by the Foundation, to nominate the candidates through the web by JPNS (Japan Prize Nomination System). The deadline for nominations is the end of February of the following year.
- For each field, a Selection Subcommittee conducts a rigorous evaluation of the candidates' academic achievements. The conclusions are then forwarded to the Selection Committee, which conducts evaluations of candidates' achievements from a wider perspective, including contributions to the progress of science and technology, and significant advancement towards the cause of world peace and prosperity, and finally the selected candidates are recommended for the Prize.
- The recommendations are then sent to the Foundation's Board of Directors, which makes the final decision on the winners.
- The nomination and selection process takes almost two years from the time that the fields are decided. Every January, the winners of that year's Japan Prize are announced. The Presentation Ceremony is held in April in Tokyo.



Members of the 2019 Japan Prize Selection Committee

Chairman
Makoto Asashima
Research Professor
Academic Advisor, Teikyo University
Academic Advisor, Japan Society for the Promotion of Science
Professor Emeritus
The University of Tokyo

Vice Chairman
Yoshinao Mishima
Former President
Tokyo Institute of Technology
Professor Emeritus
Tokyo Institute of Technology

Member

Yoshinori Fujiyoshi
Guest Professor
Cellular and Structural Physiology Institute, Nagoya University

Yoshihiro Hayashi
President/Director General
National Museum of Nature and Science

Yoshio Karita
Former Grand Master of the Ceremonies
Imperial Household Agency

Kazunori Kataoka
Professor Emeritus, Project Professor, The University of Tokyo
Director General of Innovation Center of NanoMedicine

Yoichiro Matsumoto
President
Tokyo University of Science

Masayuki Matsushita
Director
The Japan Prize Foundation

Shojiro Nishio
President
Osaka University

Tadatsugu Taniguchi
Professor Emeritus, Advisor to the Office of President
The University of Tokyo

Selection Subcommittee for the "Materials and Production" field

Chairman
Kazunori Kataoka
Professor Emeritus
Project Professor
The University of Tokyo
Director General of Innovation Center of NanoMedicine

Deputy Chairman
Toru Okabe
Professor
Institute of Industrial Science
The University of Tokyo

Member

Katsuhiko Ariga
Principal Investigator
WPI Center for Materials Nanoarchitectonics
National Institute for Materials Science

Kazunari Domen
Professor, School of Engineering, The University of Tokyo
Professor, Center for Energy & Environmental Science
Shinshu University

Koji Ishibashi
Chief Scientist
Advanced Device Laboratory, RIKEN

Yasuhiro Koike
Professor
Faculty of Science and Technology, Keio University

Toshihiko Koseki
Professor
School of Engineering, The University of Tokyo

Kazue Kurihara
Professor
New Industry Creation Hatchery Center, Tohoku University

Kazuyuki Kuroda
Professor
Faculty of Science and Engineering, Waseda University

Atsushi Maruyama
Professor
School of Life Science and Technology
Tokyo Institute of Technology

Kyoko Nozaki
Professor
School of Engineering, The University of Tokyo

Tamio Oguchi
Professor
The Institute of Scientific and Industrial Research
Osaka University

Selection Subcommittee for the "Biological Production, Ecology" field

Chairman
Yoshihiro Hayashi
President/Director General
National Museum of Nature and Science

Deputy Chairman
Hiromichi Nagasawa
Professor Emeritus
The University of Tokyo

Member

Kazuyuki Inubushi
Professor
Graduate School of Horticulture, Chiba University

Futoshi Nakamura
Professor
Research Faculty of Agriculture, Hokkaido University

Taikan Oki
Professor, Integrated Research System for Sustainability Science (IR3S)
The University of Tokyo Institutes for Advanced Study (UTIAS)
The University of Tokyo

Masakazu Shimada
Professor
Graduate School of Arts and Sciences, The University of Tokyo

Tatsuya Sugawara
Professor
Graduate School of Agriculture, Kyoto University

Katsumi Tsukamoto
Professor Emeritus, The University of Tokyo
Specially Appointed Professor
Graduate School of Agricultural and Life Sciences, The University of Tokyo

Tetsukazu Yahara
Professor
Department of Biology, Kyushu University

Keitaro Yamanouchi
Associate Professor
Graduate School of Agricultural and Life Sciences
The University of Tokyo

(alphabetical order, titles as of January, 2019)

Fields Eligible for the 2020 Japan Prize

Area of Physics, Chemistry, Informatics, Engineering

Electronics, Information and Communication

Background and rationale:

The successive birth of various technologies in fields of electronics, information and communication has greatly contributed to human society. Its progress has been remarkably fast, and in recent years, we are seeing innovative developments in basic technologies, such as artificial intelligence, big data, IoT, robotics, semiconductor devices, optical/wireless network and information security. As a result, for example, the accumulation of enormous amount of information and its sophisticated analysis, made possible by the convergence of the physical and cyber space, are beginning to revolutionize the industrial structure and human lifestyle.

It is highly anticipated that such technological advancements will not only facilitate economic development but also resolve societal issues, thereby contributing to the realization of a safe, secure and sustainable society that enables innovative lifestyles.

Achievement eligible:

The 2020 Japan Prize in the field of "Electronics, Information and Communication" is awarded to an individual(s) who has achieved scientific and technological breakthroughs, such as the development of essential technologies or systems that have contributed significantly to the creation of new industries, innovations in production technology, the realization of a safe and secure society, and improvements in amenity of life, as well as advances in basic science and technology that are highly likely to promote the further development of society.

Area of Life Science, Agriculture and Medicine

Life Science

Background and rationale:

In recent years, major advances in life science driven by innovative analysis technology have led to the elucidation of many complex yet subtle mechanisms of life.

Today, analysis technologies such as DNA sequencing technology capable of rapidly determining the entire genome information and its gene expression state, genome editing technology that can modify genetic information in a targeted manner, and imaging technology capable of visualizing various layers of anatomy from intracellular organelle to complex brain tissues, have especially become well established and widely accessible, thereby opening up a whole new dimension in the realm of life science.

It is anticipated that progress in the understanding of the foundation of life phenomena while upholding bioethics will contribute toward the welfare of mankind by creating new medical care and bringing about wisdom for sustainable human development.

Achievement eligible:

The 2020 Japan Prize in the field of "Life Science" is awarded to individual(s) who has made significant contributions to society by achieving scientific and technological breakthroughs, such as the discovery of new life phenomena, proposal of paradigm shifts, and technological innovations that deepen the understanding of biological functions.

Fields Selection Committee for the 2020 Japan Prize

Chairman
Michiharu Nakamura
Counselor to the President
Japan Science and Technology Agency
Director
The Japan Prize Foundation

Vice Chairman
Kazuhito Hashimoto
President
National Institute for Materials Science

Vice Chairman
Kohei Miyazono
Professor
Department of Molecular Pathology
Graduate School of Medicine
The University of Tokyo

Member

Yozo Fujino
Distinguished Professor
Institute of Advanced Sciences
Yokohama National University

Ken Furuya
Professor, Graduate School of Engineering
Soka University
Professor Emeritus, The University of Tokyo

Mariko Hasegawa
President
SOKENDAI
(The Graduate University for Advanced Studies)

Masaru Kitsuregawa
Director General, National Institute of Informatics
Professor, Institute of Industrial Science
The University of Tokyo

Kazuo Kyuma
President
National Agriculture and Food Research Organization

Eiichi Nakamura
Endowed Professor
Office of the President and Department of Chemistry
The University of Tokyo

Yuichi Sugiyama
Head, Sugiyama Laboratory
RIKEN Baton Zone Program

Mariko Takahashi
Science Coordinator
The Asahi Shimbun

Masayuki Yamamoto
Director General
National Institute for Basic Biology

(alphabetical order, titles as of November, 2018)

Schedule (2020-2022)

The fields eligible for the Japan Prize (2020 to 2022) have been decided for the two research areas, respectively.
These fields rotate every year in a three year cycle.
Every year the Fields Selection Committee announces the eligible field for the next three years.

Area of Physics, Chemistry and Engineering

Year	Eligible Fields
2020	Electronics, Information, Communication
2021	Resources, Energy, Environment, Social Infrastructure
2022	Materials, Production

Area of Life Science, Agriculture and Medicine

Year	Eligible Fields
2020	Life Science
2021	Medical Science, Medicinal Science
2022	Biological Production, Ecology/ Environment