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Japan Prize News
No. 59 Jan. 2018

JAPAN PRIZE

2018 Japan Prize Laureates Announced

This year's Japan Prize will be awarded to Dr. Akira Yoshino for his significant contributions to the development of lithium ion batteries, and jointly to Dr. Max D. Cooper and Dr. Jacques Miller for the establishment of the basic concepts underlying modern immunology

"Resources, Energy, Environment and Social Infrastructure" field

Dr. Akira Yoshino
Honorary Fellow,
Asahi Kasei Corporation

Japan

"Medical Science and Medicinal Science" field

Dr. Max D. Cooper
Professor,
Emory University School of Medicine

United States

Dr. Jacques Miller
Professor Emeritus,
Walter and Eliza Hall Institute of Medical Research

Australia

The Japan Prize Foundation has decided to award the 2018 (34th) Japan Prize to Dr. Akira Yoshino of Japan, Dr. Max D. Cooper of the United States and Dr. Jacques Miller of Australia.

In the field of "Resources, Energy, Environment and Social Infrastructure", Dr. Akira Yoshino is being honored for the "development of lithium ion batteries". Dr. Yoshino realized a practically viable lithium ion battery system by combining his original elemental technologies with existing technologies. Digitization, the IT revolution, and the mobile revolution that arose in the early 90s would not have been possible without the advent of lithium ion batteries. More recently, their importance to society continues to grow as lithium ion batteries are utilized to resolve the unstable supply of natural energy as a countermeasure to global warming. Dr. Yoshino's original and breakthrough accomplishments are highly significant, for they have formed the foundation of lithium ion battery technology and industry, thereby contributing to their widespread adoption.

Dr. Max D. Cooper and Dr. Jacques Miller are being honored in the field of "Medical Science and Medicinal Science" for the "discovery of B and T lymphocyte lineages and its impact on understanding disease pathology and therapeutic development", an accomplishment that has created major ripple effects socially and economically. The establishment of the basic concepts underlying modern immunology by Dr. Cooper and Dr. Miller fueled rapid advancements in basic and applied research. Recent developments in new anti-cancer drugs and anti-cytokine antibodies for the treatment of autoimmune diseases, such as rheumatoid arthritis and inflammatory bowel disease, are receiving great attention. Such advances are the fruits of ceaseless efforts in basic and translational immunology research that unfolded in the wake of the pioneering discoveries of Dr. Cooper and Dr. Miller.

As described, the achievements of the three laureates 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 April 18th of this year at the National Theatre in Tokyo.

JAPAN PRIZE

The Japan Prize came into being 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 for each prize category.

"Resources, Energy, Environment and Social Infrastructure" field

Achievement : Development of lithium ion batteries

Dr. Akira Yoshino (Japan)
Born: January 30, 1948 (Age: 70)
Honorary Fellow, Asahi Kasei Corporation

Summary

The lithium ion battery is a type of secondary battery capable of charge/discharge that has become the backbone of today's mobile society by powering smartphones and laptop PCs. It is also being adopted in electric vehicles that are becoming increasingly widespread, serving to reduce emissions of environment-impacting substances. In the early 1980s, Dr. Yoshino put forth the concept of the lithium ion battery and demonstrated its charge/discharge capability. At the time, research on batteries using lithium metal anodes was more predominant, with a strong focus on cathode materials and non-aqueous electrolyte solutions. Dr. Yoshino proposed and demonstrated a viable secondary battery using lithium cobalt oxide for the cathode and a carbon-based material for the anode, which he combined with his original separator and current collector technology. The resulting battery attained high voltage, high energy density and a long-life. Lithium ion batteries have since continued to improve through constant refinements in materials and manufacturing methods, and their application is anticipated to grow into the future.

Lithium ion battery: the key player in the mobile revolution

There are two types of batteries: primary and secondary. A primary battery is only capable of a single discharge, whereupon its life is finished. Notable examples include the zinc carbon battery and the alkaline battery often found in remote-controllers and flash lights. A secondary battery, in contrast, can be recharged for repeated use.

The lithium ion battery, developed by Dr. Yoshino in the 1980s, is a type of secondary battery. The secondary batteries in use at the time were the lead acid battery and the nickel cadmium battery, with the nickel metal hydride battery still under development. The lithium ion battery had an advantage over such batteries, in that it was smaller, lighter, had higher capacity and a longer life. Once it was adopted for practical use in 1991 as a battery for compact video cameras, it rapidly saw widespread use in laptop PCs and smartphones, becoming the driving force in today's mobile revolution.

During the discharge of a secondary battery, reduction occurs at the cathode and oxidation at the anode, thereby causing electric current to flow from the cathode to the anode. Similarly, during a recharge, electric current is externally applied in the opposite direction, causing a reverse reaction. The battery contains an electrolyte solution, which conducts electricity between the cathode and the anode. The lithium ion battery is a secondary battery that uses lithium ion metallic oxide, such as lithium cobalt oxide ($LiCoO_2$) for the cathode, carbon-based materials for the anode, and an organic solvent for its electrolyte solution. Operating on the principle that lithium ions traverse the cathode-anode gap during the charge/discharge cycle, the battery is able to produce a high voltage of approximately 3.9V.

Secondary batteries prior to the lithium ion battery used a water-based solvent for their electrolyte solution, and could therefore only generate an electromotive force below 1-2V, the threshold for the electrolysis of water. A Lithium ion battery, in contrast, can generate a higher electromotive force due to its use of an organic solvent with high-voltage electrolytes. This offers the advantage of being able to power devices that require high voltage with a single battery. Furthermore, the amount of energy that can be stored in a battery (charging capacity) is dependent on the discharge voltage and the discharge amount (current x time), so that a stronger electromotive force translates into greater battery capacity.

It all began with Dr. Shirakawa's discovery of polyacetylene

Upon graduating from Kyoto University in 1972 with a Master's degree in Engineering, Dr. Yoshino joined Asahi Chemical Industry Co. (now known as Asahi Kasei Corporation). In 1981, he began researching polyacetylene at the company's laboratory. Polyacetylene is a substance discovered in 1967 by Dr. Hideki Shirakawa (currently Professor Emeritus, University of Tsukuba), who at the time was an assistant researcher at the Tokyo Institute of Technology. Polyacetylene has the ability to conduct electricity despite being an organic substance.

Primary batteries that used lithium for the anode were already in use in the 1970s, and by the 1980s, many researchers were pursuing developmental research on a secondary battery with a lithium anode. At the time, there was a strong momentum in the development of what we now call mobile devices, which created a need for a small, lightweight and high-capacity secondary battery. The fact that lithium is the most oxidizable of the elements made it ideal as an anode material, and it also has the highest electric quantity per unit weight among the metallic elements. For these reasons, it was anticipated that if a secondary battery with a lithium anode capable of high voltage and high energy density could be realized, it could meet the needs of the times. Lithium, however, was not without its problems, for it is a highly flammable metal, and is prone to short-circuit with the cathode when dendrites form on the lithium anode over multiple charge/discharge cycles.

Dr. Yoshino, who was researching polyacetylene, considered using it as an anode material instead of lithium, but soon reached a deadlock because he could not find a suitable cathode material. At the time, the phenomenon of lithium ions traversing layered materials, such as titanium disulfide (TiS_2), was already common knowledge. Such layered materials were thus being considered for use as a cathode material to be paired with a lithium anode. But using polyacetylene as the anode was not enough for the battery to function, because there would be no supply of lithium ions, which was the most essential component.

Just around that time, Dr. Yoshino came across a paper reporting on a new cathode material called $LiCoO_2$,. This material could supply the much-needed lithium ions, making it the ideal counterpart to a polyacetylene anode. Without hesitation, Dr. Yoshino conducted experiments using this combination and confirmed that it successfully functioned as a secondary battery. This took place in 1983. "I feel that this was a moment of discovery", says Dr. Yoshino recalling that moment.

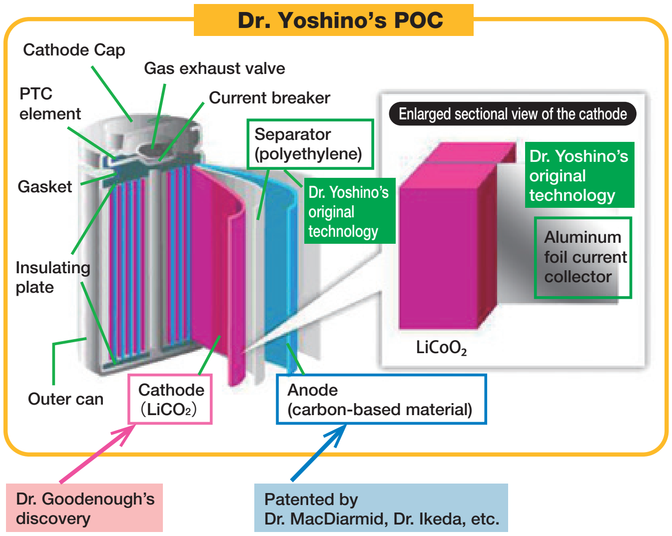
After this breakthrough, Dr. Yoshino led a research team to refine the battery. The team sought carbon-based materials better suited for the anode, and in 1985, filed a patent on the design of the lithium ion battery as we know it today, composed of a $LiCoO_2$ cathode and a carbon-based anode. The patent was granted in 1995.

The importance of proving the concept behind a system

The realization of the lithium ion battery by Dr. Yoshino would not have been possible without the research and development efforts of many researchers and engineers who came before him.

$LiCoO_2$, the substance Dr. Yoshino used for the cathode, was discovered in 1979 by Dr. John B. Goodenough of the University of Texas and Dr. Koichi Mizushima of the University of Tokyo, who was visiting Dr. Goodenough's laboratory on an exchange program. Dr. Goodenough not only discovered this substance but also made distinguished achievements in the basic field of solid-state chemistry, for which he was awarded the 2001 Japan Prize.

Meanwhile, Dr. Yoshino had initially used polyacetylene for the anode but later switched to carbon-based materials. Because lithium ions traverse the cathode-anode gap, the anode must be able to absorb and release lithium ions. There had also been preceding studies on this topic. Graphite's ability to absorb lithium ions was reported in 1975, and from



By combining existing technologies with his own, Dr. Yoshino proposed and demonstrated that the lithium ion battery system, in which "charge/discharge is achieved by the traversal of lithium ions through the cathode-anode gap," is capable of delivering the performance necessary for practical application.

1980 to 1981, patents were filed by Dr. Alan MacDiarmid of the University of Pennsylvania for the polyacetylene anode, and by Dr. Hironosuke Ikeda of Sanyo Electric Co. for the graphite anode. Furthermore, there was a proposal in 1980 of a battery with a lithium-inserted tungsten oxide ($LixWO_2$) anode and a TiS_2 cathode that permits the traversal of lithium ions.

A secondary battery is a complex system. Even if one develops cathode and anode materials of excellent quality, if the combination cannot achieve the performance and safety necessary for practical use and the capability to charge/discharge repeatedly, one cannot claim to have developed a secondary battery. Dr. Yoshino was able to realize the lithium ion battery system by discovering the right cathode-anode combination and developing an original elemental technology. One of his original technologies is the very thin polyethylene-based porous membrane which he used as a separator between the battery's cathode and anode. Lithium ions can normally traverse the membrane pores, but in case of abnormal overheating, the membrane melts and closes off the pores, thereby halting the function of the battery. Dr. Yoshino demonstrated through reliability tests that a polyethylene membrane of a specific structure and composition could indeed prevent an overheated battery from exploding. His other original technology is the use of aluminum foil as a current collector which draws electricity from the cathode. The various improvements he made on the current collector achieved a necessary level of performance including high voltage and high capacity.

Dr. Yoshino's greatest achievement is the establishment of the POC (proof of concept) for the lithium ion battery, in which he demonstrated that the traversal of lithium ions through the cathode-anode gap enables the battery to be charged/discharged (see diagram). The performance of lithium ion batteries has improved in the ensuing years through refinements in materials and manufacturing methods. Besides mobile devices, they are now being used in electric vehicles, serving to significantly reduce emissions of environment-impacting substances. Furthermore, it is anticipated that "downcycling", or the recycling of retired lithium ion batteries from electric vehicles into electricity storage for solar power and the like, will become increasingly prevalent. The lithium ion battery that Dr. Yoshino brought into the world has not only made our lives dramatically more convenient, but is also playing a crucial role in resolving the resource, energy and environmental issues we face.

"Medical Science and Medicinal Science" field

Achievement : Discovery of B and T lymphocyte lineages and its impact on understanding disease pathology and therapeutic development

Dr. Max D. Cooper (United States)
Born: August 31, 1933 (Age: 84)
Professor, Emory University School of Medicine

Dr. Jacques Miller (Australia)
Born: April 2, 1931 (Age: 86)
Professor Emeritus, Walter and Eliza Hall Institute of Medical Research

Summary

Dr. Max D. Cooper and Dr. Jacques Miller discovered the "B and T lymphocytes", the two primary cell lineages involved in adaptive immunity that are responsible for protecting our bodies from intrusion by foreign substances. The B lymphocytes are responsible for the production of antibodies that attack foreign substances such as invading pathogens. T lymphocytes, on the other hand, are responsible for attacking virus-infected cells and cancer cells, and assisting B lymphocytes in the production of antibodies. Using mice, Dr. Miller discovered that T lymphocytes are produced by the thymus, which was considered a vestigial organ at the time. Dr. Cooper, on the other hand, hypothesized that there are two cell lineages with different functions in adaptive immunity and verified their existence through experiments on chickens. Their pioneering achievements laid the foundation for the next half century of developments in immunology from basic concepts to applied research. The development of new therapeutic drugs for cancers and immune disorders, which has been attracting much attention in recent years, would not have been possible without Dr. Cooper and Dr. Miller's discoveries.

"B and T lymphocytes", the key players in adaptive immunity

Living organisms have an ingenious defensive mechanism called "immunity" that provides defense against foreign invaders, such as pathogens, which threaten the body's normal functions and condition, thereby preventing the host from contracting epidemics. The immune system keeps a record of past invasions, so that it could respond immediately to defend the host in case of a recurring attack by the same pathogen.

A living body has two types of defense mechanisms: "natural immunity", which is innate to living organisms, and "adaptive (acquired) immunity", which is specifically triggered in response to foreign invaders that penetrate natural immunity's defense barrier.

When foreign invaders such as pathogens break through the epithelial barrier into the body of the host, natural immunity immediately responds by attacking the invader with a cell group consisting of macrophages, neutrophils and natural killer cells. A short time later, the more sophisticated adaptive immunity takes over. The main constituents involved here are the B lymphocytes (B cells) and T lymphocytes (T cells).

Up until the early 1960s, when Dr. Cooper and Dr. Miller began their research, interest among researchers was concentrated on antibodies. The central concern of immunology in the first half of the twentieth century was "humoral immunity", or immune phenomena involving antibodies.

In contrast to antibodies contained in the serum, or the liquid part of the blood, immune phenomena caused by lymphocytes contained in blood cells are called "cellular immunity". Since the 1940s, immune responses involving lymphocytes, separate from humoral immunity, gradually came to be better understood, and over time, facts suggesting the existence of two types of immunity were reported. However, not until Dr. Cooper and Dr. Miller reported their research results could the existence of the two types be confirmed and the cells involved identified.

Tlymphocytes were being produced by the mysterious organ, "the thymus"

After studying at the University of Sydney Medical School, Dr. Jacques Miller went to London in 1958 and began studying the pathogenesis of lymphocytic leukemia in mice at the University of London. At the time, Dr. Miller was strongly influenced by the leading immunologists, Dr. Peter Medawar and his pupil, Dr. James Gowans. Through experiments on rats, they discovered that lymphocytes play an important role in the rejection of grafts.

Lymphocytic leukemia in mice, which Dr. Miller was studying, develops and spreads from the thymus due to viral infection.

Having hypothesized that the thymus is where virus multiplication takes place, Dr. Miller decided to remove the thymus gland of a newborn mouse and see if injecting a virus would cause leukemia to develop. The treated mouse grew unexpectedly weak, and dissection revealed a reduction in lymphocytes in the lymph nodes and spleen.

Next, Dr. Miller transplanted a skin graft to the same mouse to see if it would be rejected. He knew from Prof. Medawar and Gowans' research that lymphocytes would normally cause the graft to be rejected. But to his surprise, Dr. Miller observed that the skin of a heterologous mouse was successfully engrafted on the mouse with its thymus removed.

Also, by marking the lymphocytes and observing their movement throughout the body, he confirmed that lymphocytes originate from the thymus, which was regarded as a mysterious organ at the time.

These experiments confirmed that the thymus is the organ that produces and delivers lymphocytes. When he reported this discovery in 1961, Dr. Miller named this lymphocyte the thymus-dependent lymphocyte, which later came to be known as the "T lymphocyte", with the T taken from the word, thymus.

In addition, Dr. Miller discovered that there are two types of lymphocytes with different functions, and that the thymus-dependent lymphocytes (T lymphocytes) are not only involved in immune responses that reject skin grafts, but also play a role in supporting the function of myeloid-dependent lymphocytes (B lymphocytes) responsible for the production of antibodies.

Demonstrating the two types of immune systems using chickens

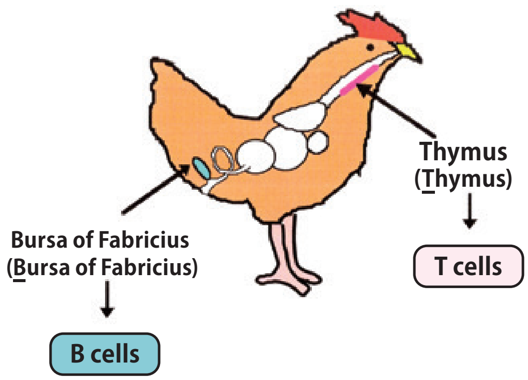
Dr. Max D. Cooper became a pediatrician after graduating from the Tulane University School of Medicine. From 1963, he conducted research at the University of Minnesota under Prof. Robert Good, a leading figure in immunology research. At the time, Dr. Cooper was fascinated by a report indicating the possibility that the bursa of Fabricius in chicken is involved in the production of antibodies. Follow-up studies by other researchers also suggested that the bursa of Fabricius is responsible for immune functions different to that of the thymus, but there was no conclusive evidence.

Meanwhile, Dr. Cooper, from his clinical experience as a pediatrician, found hints of the existence of the two types of immune systems. In a patient with a certain hereditary immunodeficiency disease, Dr. Cooper detected sufficient levels of antibodies despite an abnormal proliferation of herpesviruses. However, in the case of another hereditary immunodeficiency disease, the patient was highly resistant to viral infection although no antibody response could be observed. From these cases, Dr. Cooper hypothesized that there are two types of adaptive immunity: one in which antibodies are involved and one in which it is not.

To confirm the role of the bursa of Fabricius and the thymus, as well as the existence of the two types of adaptive immunity, Dr. Cooper conducted the following experiment.

Newborn chickens whose bursa of Fabricius or thymus had been removed were irradiated with X rays to destroy any cells that may have been created before hatching. Their immune functions were then examined in detail. The results showed that the chicken whose bursa

Dr. Cooper's experimental results



	Antibody production	Rejection of skin grafts
Chicken with the bursa of Fabricius removed	↓↓	OK
Chicken with the thymus removed	Mostly OK	↓↓

Chickens with the bursa of Fabricius removed cannot produce antibodies. In chickens with the thymus removed, rejection of skin grafts do not occur. This experiment confirmed the existence of B lymphocytes responsible for antibody production and T lymphocytes responsible for rejection reactions.

of Fabricius had been removed had no antibodies, while the chicken whose thymus had been removed had lost the ability to reject skin grafts, just like the mouse with its thymus removed (see figure).

This experiment revealed that cells derived from the bursa of Fabricius are essential for antibody response, and that cells derived from the thymus are involved in the rejection of skin grafts. Thus, the existence of the B lymphocyte lineage responsible for humoral immunity and the T lymphocyte lineage responsible for cellular immunity was demonstrated. Cells derived from the bursa of Fabricius came to be called "B lymphocytes" with the B taken from the word, bursa. Thereafter, Dr. Cooper and his colleagues revealed that in humans, B lymphocytes are produced in the bone marrow, whose initial is also B.

Dr. Cooper further extended his findings to other animals through his discovery that the basic mechanism of controlling adaptive immunity by the two lymphocyte lineages is widely preserved in vertebrates, from humans to jawless species such as the lamprey, thereby deepening our understanding of the evolution of adaptive immunity.

Epoch-making contributions to modern immunology and to the treatment of intractable diseases and cancer

Dr. Cooper and Dr. Miller's accomplishments established the basic concepts underlying modern immunology and served as the driving force behind the significant advances in immunology that followed. In addition to major advances in the understanding of the pathology of numerous immune disorders including autoimmune diseases, allergies and chronic inflammatory diseases, their concepts have also been adapted into many new therapeutic and diagnostic drugs. More recently, there has been grown anticipation surrounding the substantial progress being made in new epoch-making cancer treatments that utilize antibodies and immune cells, such as antibody drugs, immune checkpoint inhibitors and genetically modified T-cell therapies. These developments are manifestations of the power of modern immunology, of which the foundation was laid by Dr. Cooper and Dr. Miller's pioneering research, and their legacy will continue to widely benefit society into the future.

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 13,000 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.

July - October,2016	November		End February, 2017	November		January, 2018	April
Consider the fields eligible for the 2018 Japan Prize	Determine the fields eligible for the 2018 Japan Prize Resources, Energy, Environment and Social Infrastructure Medical Science and Medicinal Science	Invite the nominations →	Closing of the nominations →	Selection Subcommittee for Resources, Energy, Environment and Social Infrastructure Selection Subcommittee for Medical Science and Medicinal Science ↑ Selection Committee →	Board of Directors →	Announce the Laureates of the 2018 Japan Prize	The 2018 Japan Prize Presentation Ceremony

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Johnson&Johnson Janssen Pharmaceutical K.K.

Motoko Yanagita
Professor
Graduate School of Medicine, Kyoto University

(alphabetical order, titles as of January, 2018)

Fields Eligible for the 2019 Japan Prize

Area of Physics, Chemistry, Informatics, Engineering

Materials and Production

Background and rationale:

The discovery and development of new materials with non-conventional properties and the development of advanced production technologies have brought about numerous innovations, thereby contributing greatly to the sustainable development of our society and to the improvement of safety in social infrastructure.

For instance, we have designed and synthesized artificial materials, such as semiconductors, polymers, nanomaterials, catalysts and magnetic materials with new functions, as well as new types of super heat-resistant materials and high-specific-strength structural materials.

We have also developed new industrial technology, such as design and manufacturing technologies supported by computational and data science, high-resolution/high-precision measurement techniques and nanostructured precision control processes, along with robot technology that improves the efficiency of production processes.

In order to make effective use of finite resources and build a sustainable society for the future, we are in need of epoch-making innovations in the development of new functional materials and structural materials, as well as in industrial design, production and operation technologies.

Achievement eligible:

The 2019 Japan Prize in the field of “Materials and Production” is awarded to an individual(s) who has made momentous scientific and technological breakthroughs by developing materials with new functions, developing new structural materials that support social infrastructure or improving technologies for industrial design, production and operation, which enable the creation of new products, services and industries that improve the quality, safety and security of people’s lives, thereby making a significant contribution to the sustainable development of society or to its potential for great advances in the future.

Area of Life Science, Agriculture and Medicine

Biological Production, Ecology

Background and rationale:

As we experience a population explosion and face global environment changes, most notably global warming, overcoming environmental and food problems is critical for the sustainable development of our society. To achieve this, we must protect the environment, which is the cradle for biological production, and at the same time, increase its bioproductivity and ensure the ecologically harmonious use of biological resources.

Developments thus far have included advances in production technologies, the creation of environmentally adaptive breeds, the realization of environmentally harmonious biological production, as well as the harnessing of organisms’ ability to produce useful substances, and the enhancement of functionality in foods.

There is also a great need for the advancement of basic science and technological innovation in such areas as the conservation and restoration of the environment and the ecosystems, sustainable utilization of ecosystem service, and ecological forecasting.

In the future, collaboration across various fields, such as geoscience, the social sciences and the health/human life sciences, will be crucial in tackling the issues of biological production and utilization, ecology and the environment, which cannot be solved independently by any one discipline.

Achievement eligible:

The 2019 Japan Prize in the field of “Biological Production, Ecology” is awarded to an individual(s) who has contributed significantly to the sustainable development of a society in harmonious coexistence with life and the environment, or to its potential for great advances in the future, through the establishment of innovative new concepts and the creation, development and dissemination of scientific and technological breakthroughs pertaining to biological production, as well as through advances in the basic sciences in ecology and the environment.

Fields Selection Committee for the 2019 Japan Prize

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Masayuki Yamamoto
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National Institute for Basic Biology

Adviser

Kazuo Kyuma
Executive Member
Council for Science, Technology and Innovation
Cabinet Office

(alphabetical order, titles as of November, 2017)

Schedule (2019-2021)

The fields eligible for the Japan Prize (2019 to 2021) 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
2019	Materials, Production
2020	Electronics, Information, Communication
2021	Resources, Energy, Environment, Social Infrastructure

Area of Life Science, Agriculture and Medicine

Year	Eligible Fields
2019	Biological Production, Ecology
2020	Life Science
2021	Medical Science, Medicinal Science