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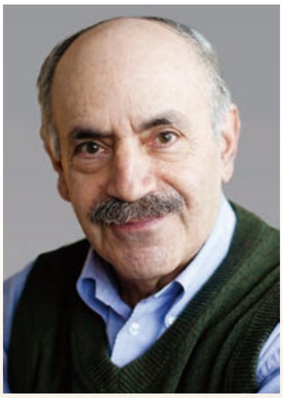
Japan Prize News
No. 64 Feb. 2021

JAPAN PRIZE

2021 Japan Prize Laureates Announced

Prof. Martin Andrew Green
Professor, University of New South Wales (UNSW Sydney)
Australia

Prof. Bert Vogelstein
Professor, Johns Hopkins University School of Medicine
USA



Dr. Robert A. Weinberg
Member, Whitehead Institute for Biomedical Research
Professor, Massachusetts Institute of Technology (MIT)
USA

Fields Eligible for the Award:
Resources, Energy, Environment, Social Infrastructure

Development of High-Efficiency Silicon Photovoltaic Devices

The cost of solar power dropped below the cost of fossil fuel generated power in the mid-2010s, and the world began to realize that the adoption of solar power could lead to the decarbonization of society through the adoption of solar power had become possible. The reason for this is that improved energy conversion efficiency had resulted in reduced costs of manufacturing solar photovoltaic devices, thus enabling the construction of large-scale solar power plants.

Prof. Martin Green has been researching improvements in energy conversion efficiency in crystalline silicon solar photovoltaic devices since the 1970s, and has proposed a variety of new technologies emphasizing the importance of suppressing the recombination of electrons and electron "holes". He achieved an energy conversion efficiency of 24.7% with his Passivated Emitter and Rear Cell (PERC) solar cells in 1999 (certified at 25.0% after standards changed in 2008), and PERC solar cells have been adopted for use in many crystalline silicon solar photovoltaic devices.

In addition, many of the individuals trained by Prof. Green have brought large-scale solar photovoltaic devices to markets around the world, and in doing so, have contributed to the increased adoption of solar power.

Fields Eligible for the Award:
Medical Science, Medicinal Science

For their pioneering work in conceptualizing a multi-step model of carcinogenesis and its application and impact on improving cancer diagnosis and therapy

In spite of improved survival rates, the grim fate of most diagnosed patients is to succumb to the disease or one of its associated comorbidities. Improved survival rates over the last several decades are, in part, the result of discovery of novel anti-cancer agents. The medical advancements underpinning discovery of novel therapeutics and improvements in access to care, and early detection were predicated on innumerable basic and clinical research findings that have elucidated the inner workings of cancer development and survival mechanisms. Understood as a general principle, cancer arises through the accumulation of genetic and epigenetic mutations and alterations that are favorable to the survival and expansion of the tumor cells. This concept has been termed "multi-step carcinogenesis model" and has served as a reliable and accepted foundation for subsequent oncological research. Many of the seminal studies underpinning the multi-step carcinogenesis model were the research discoveries made by Drs. Robert Weinberg and Bert Vogelstein.

JAPAN PRIZE

The creation of the Japan Prize was motivated by the Japanese government's desire to "contribute to the development of science and technology worldwide by establishing a prestigious international award". Supported by numerous private donations, the Japan Prize was established in 1983 with a cabinet endorsement.

This award honors scientists and researchers worldwide who are recognized for having contributed signifi cantly to the peace and prosperity of humankind through their original and outstanding achievements that have greatly advanced the progress of science and technology.

The eligible fields of this award cover all fields of science and technology. Every year, two fields for the award presentation are chosen by considering the developments in science and technology.

As a general rule, one award is given for each field and each laureate receives a certificate of merit, a prize medal and a cash prize.

The Presentation Ceremony is held annually in the presence of Their Majesties the Emperor and Empress of Japan and is also attended by the Speaker of the House of Representatives, the President of House of Councilors, the Chief Justice of the Supreme Court, and various ministers as well as eminent figures from various circles.

"Resources, Energy, the Environment, and Social Infrastructure" Field

Achievement : developing high-efficiency silicon photovoltaic devices

Prof. Martin Andrew Green (Australia)

Born: July 20, 1948 (Age: 72)
Professor, University of New South Wales (UNSW Sydney)

Predicted Growth of Solar Power

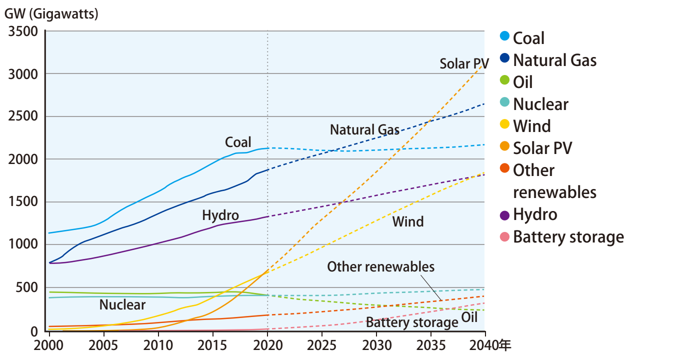
In order to realize our dreams of achieving a decarbonized society, there needs to be a shift towards the use of electrical power generated by renewable sources that do not emit carbon dioxide, a contributing factor to global warming. Renewables include solar, wind, and geothermal power, but in the past, introducing such sources was difficult due to the increased costs when compared to fossil fuel-fired power plants and hydroelectric power.

In the mid-2010s, solar power costs dropped below those of fossil fuel power, and thus began the era of solar power plants being able to be built cheaper than fossil fuel plants. Solar power generation is expected to undergo rapid expansion in the future (see above graph).Behind this paradigm shift is the ability of solar photovoltaic devices (commonly known as solar cells) to convert solar energy to electric power at high rates of efficiency, and the reduction in power generation costs that have allowed for the construction of large-scale solar power plants. Prof. Green has been working on improving conversion efficiency of crystalline silicon solar photovoltaic devices since the 1970s, and he has achieved many successes over that time.

The mechanisms behind solar photovoltaic devices and solar power generation

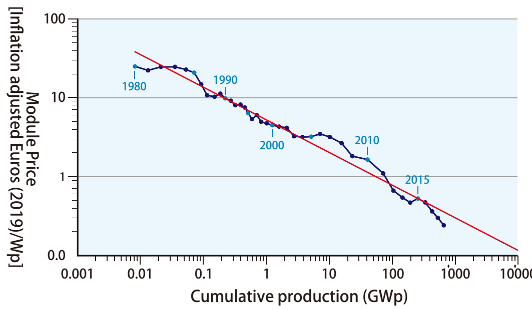
There are many types of devices that generate power from sunlight, but crystalline silicon (a type of semiconductor) is said to be found in approximately 95% of solar photovoltaic devices in use around the world.

Installed power generation capacity by source in the State Policies Scenario, 200-2040



Source: IEA World Energy Outlook 2019

Price reduction and spread of solar photovoltaic devices



Up until 2000, improvements in conversion efficiency were a major factor in the reduced cost of solar photovoltaic devices, but in the 2000s, the increased size of power plants also began to contribute to lower prices. Prof. Green has contributed to both elements of that equation, having been involved in both technological development and the cultivation of individuals who are involved in the evolution and expansion of solar power generation. (Source: Photovoltaics Report, Fraunhofer Institute for Solar Energy Systems, ISE with support of PSE Projects GmbH, 16 September 2020)

The majority of those are a p-n junction solar cells, which have p-type silicon is placed adjacent to n-type silicon. When struck by photons from the sun, the energy causes the release of a negatively-charged electron and a positively-charged "hole," whereby the electron moves into the n-type silicon and the hole moves into the p-type silicon. That charge then flows out the electrodes (or contacts) as electrical power.

A high energy conversion rate can be obtained if every electron-hole pair that is generated can be extracted as power, but in practice, energy is lost when the electrons and holes recombine. (See figure on following page.)

PERC solar cells and Prof. Green's role in improving solar cell efficiency

In 1954, Bell Labs invented the p-n-junction crystalline silicon solar photovoltaic device. That device was improved and developed for commercial use at COMSAT Labs in the US during the 1970s, but energy conversion efficiency peaked at 17%.

In 1975, Professor Green pointed out that electron and hole recombination needed to be suppressed in order to improve energy conversion efficiency, and suggested that by doing so, they would be able to improve solar cell performance by 1.5 times. After achieving efficiencies of 18% in 1983, he continued to invent new technologies and set new efficiency records. In 1999, he achieved that 1.5 times improvement with an efficiency of 24.7% (certified at 25% after changes in standards in 2008).

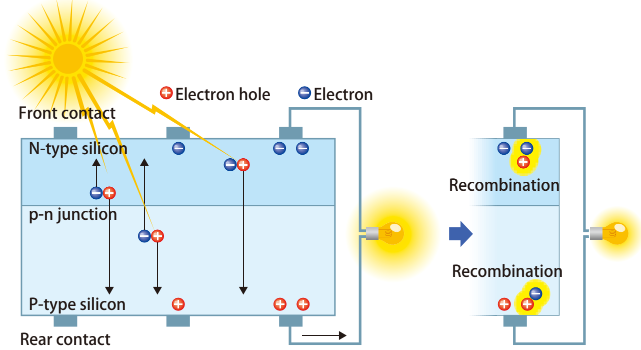
Prof. Green brought about that incredible result with the solar photovoltaic device shown in the diagram above. In addition to using other conventional technologies, recombination is suppressed in different areas of this device by oxidizing the front and rear surfaces to deactivate them (called passivation) and by making the interface between the silicon and the electrode as small as possible to keep diffusion local. The structure shown in the diagram is called a PERC or PERL (Passivated Emitter with Rear Locally-diffused) solar cell, and it is the most common type of crystalline silicon solar photovoltaic device in use today.

Building a more secure society with solar power generation

A variety of solar photovoltaic devices are in use today, and some even have

Source : Google Earth

Noor Abu Dhabi PV Power Plant, a gigawatt-level solar power plant in Abu Dhabi. This power plant is installed with p-n junction crystalline silicon cells, which use the same structure as the PERC development by Prof. Green. They are considered environmentally friendly because they can generate between 10 and 30 times the amount of energy required to produce the devices, though this is dependent on location and technologies used.



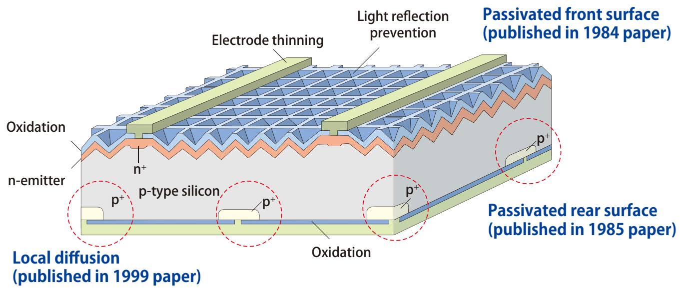
energy conversion efficiencies as high as 50%. However, most of those devices are currently in use in outer space and other specialized environments, or they are still in the research and development stage.

The crystalline silicon solar photovoltaic device invented by Professor Green is now in use around the world, but he did not end his involvement there. He has continued to perfect his invention by improving energy conversion efficiency, increasing performance, and reducing costs. As a result, he has helped make solar power generation a viable means of achieving a decarbonized society.

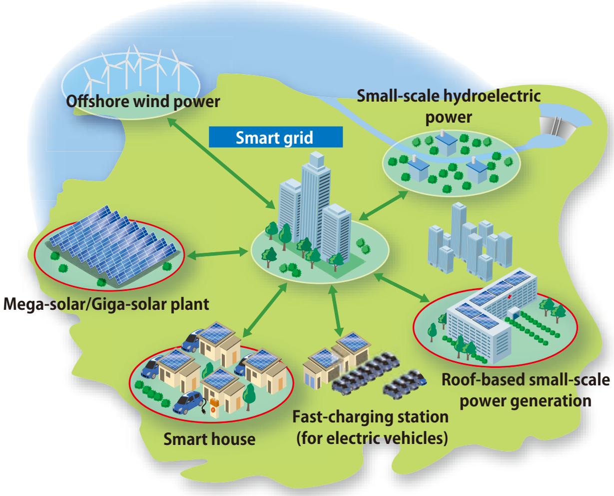
Solar power is a clean energy source not only because it emits no carbon dioxide when producing power, but also because solar power produces more energy than the energy used to manufacture and dispose of solar cells. Moreover, solar power can be flexibly adapted to meet various needs, from large-scale megawatt and gigawatt level power plants to small-scale residential generation using roof-top solar arrays. Distributed electric power generation through small-scale facilities can help reduce the severity and scale of damage caused during natural disasters. When solar power and other renewables become the backbone of our electric power generation infrastructure, we will have attained the ability to produce electricity in a more sustainable way.

History of improvements in power generation efficiency

1954	Bell Labs invents crystalline silicon solar cell
1973	COMSAT Labs achieves 17% efficiency, remains peak thereafter
1975	Professor Green proposes new concept suggesting potential 1.5 times increase in efficiency using advanced recombination suppression
1983	Prof. Green achieves 18% efficiency Achieved through passivation of silicon-electrode interface and current extraction through local tunnel junction
1983	Prof. Green invents PERC Uses passivation of front and rear surfaces
1999	Prof. Green achieves 24.7% efficiency
2008	Prof. Green solar cells certified at 25.0% efficiency



Commercialized version of Prof. Green's high efficiency solar photovoltaic device (based on diagram in his 1999 paper). The blue text denotes technologies created by Prof. Green.



Large and small-scale solar power plants can be distributed throughout a region and can be tailored to match the natural and urban environments of the area. Other types of renewable energy power plants can also be constructed, and if the entire system is connected by a smart grid, it can redistribute power as needed and ensure continued power supply in the case of disaster.

"Medical Science, Medicinal Science" field

Achievement : or their pioneering work in conceptualizing a multi-step model of carcinogenesis and its application and impact on improving cancer diagnosis and therapy

Prof. Bert Vogelstein (USA)
Born: June 2, 1949 (Age: 71)
Professor, Johns Hopkins University School of Medicine

Dr. Robert A. Weinberg (USA)
Born: November 11, 1942 (Age: 78)
Member, Whitehead Institute for Biomedical Research
Professor, Massachusetts Institute of Technology (MIT)

Summary: Discoveries of oncogenes and tumor suppressor genes and proposal/verification of the multi-step carcinogenesis model.

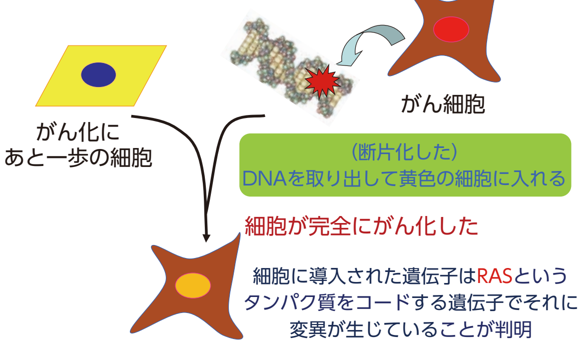
Dr. Weinberg discovered the presence of cellular genes, called proto-oncogenes, which can be converted to cancer-causing oncogenes by a mutation(s). He also contributed in the discovery of a gene, now called a tumor suppressor gene, that is required for the protection of cells to become cancer cells. Dr. Vogelstein independently searched for actual mutated genes in human cancer cells and discovered numerous new genes that are critical to the development of cancer. On the basis of these achievements, the concept of "multi-step carcinogenesis model" was established. Although many other investigators contributed to this field, Drs. Weinberg and Vogelstein stand out in that they continued their innovative research as the pioneers and leaders in corroborating this concept. In fact, Dr. Weinberg experimentally demonstrated the requirement of multiple oncogenes to convert normal cells into cancer cells, while Dr. Vogelstein verified the concept by molecular genetics combined with histopathology of large intestinal lesions, from which human colorectal cancers arise, to show the association of a series of mutations in cancer-associated genes. Thus, they revealed pivotal roles for certain human oncogenes and tumor suppressor genes in the propagation and suppression of numerous common human cancers. Their discoveries have also led to the opening of the field of cancer genomics, now an especially powerful force in discerning and developing mechanism-based human cancer diagnostics and therapeutics.

Dr. Weinberg's achievements

Dr. Weinberg helped launch this new era of human cancer genes. In elegant and original research, he introduced extracted and fragmented DNA from cancer cells and then introduced the fragmented DNA into cancerous cells and found an appearance of cancer cell clones (Fig. 1). When he then analyzed the cancer cell-derived genes in these cells, he discovered a mutated form of the *RAS* gene. Normal RAS gene product is important for the promotion of cell growth and it is transiently activated by cell growth signals and then converted into an inactive state to prevent excessive cell growth. On the other hand, the product of the mutated RAS continues to remain in the active form; in analogy to car driving, the driver keeps stepping on the accelerator (Fig. 2).

This "oncogene" was simultaneously discovered by other groups, but Dr. Weinberg further advanced his study using primary cultured cells, which cannot be transformed by the mutant *RAS* gene alone. He then demonstrated that these primary cells become cancer cells by introducing multiple oncogenes. During this research, Dr. Weinberg also assumed the presence of genes the products of which suppress cancer cell development and greatly contributed to the discovery of *RB* gene, the first of so-called "tumor suppressor genes"; in analogy to car driving, the driver puts on the brakes. Thus, these studies lead to the establishment of a paradigm that cancer will arise by the appearance of oncogenes and disappearance of tumor suppressor genes (Fig. 3).

Figure 1：がん遺伝子の発見



Dr. Vogelstein's achievements

Dr. Vogelstein took a different approach, using methods of molecular genetics combined with histopathology of large intestinal lesions to show that a series of mutations in cancer-associated genes (*i.e.*, *APC*, *RAS*, *TP53*, and others) were associated with the progression from benign adenomas to increasingly aggressive colon adenocarcinomas, establishing a foundation of multi-step carcinogenesis model (Fig.5). In fact, Dr. Vogelstein was among the first to demonstrate that TP53, which was originally considered as an oncogene, is a tumor suppressor gene. His discoveries, in parallel with those of Dr. Weinberg, have also led to the opening of the field of cancer genomics, now an especially powerful force in discerning and developing mechanism-based human cancer diagnosis and therapeutics. On the basis of the series of discoveries, Dr. Vogelstein has authored conceptual cornerstone of modern cancer research, namely, the *Vogelgram*.

Figure 2：正常型と変異型RASタンパク質の働きの違い

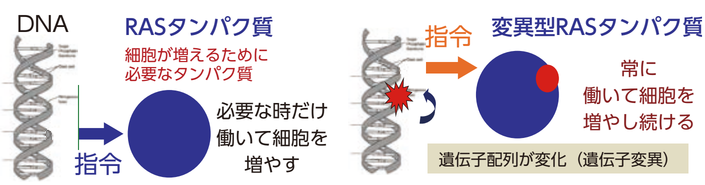


Figure 3：がん細胞の発生；概略

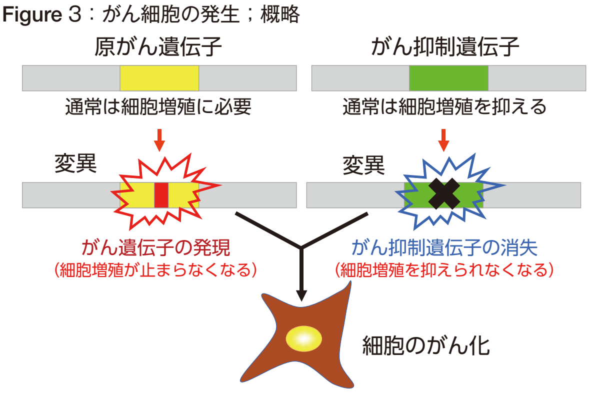
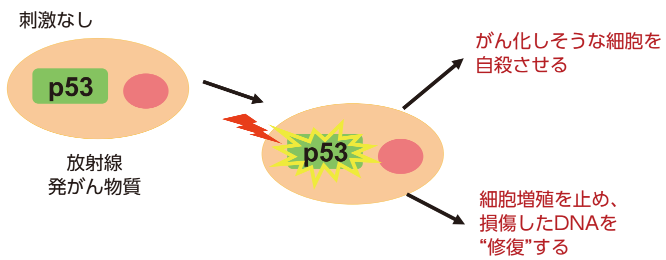


Figure 4：正常ながん抑制因子p53（*TP53*遺伝子産物）の働き

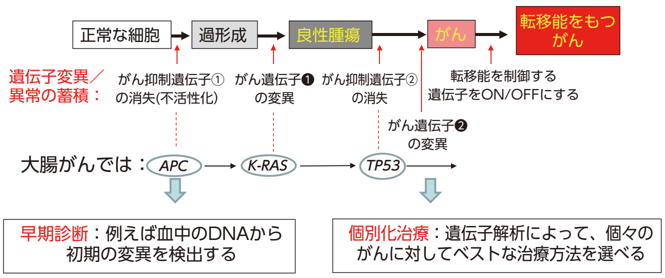


The ripple effects of the achievements by Drs. Weinberg and Vogelstein

The scientific and social contribution of the work by Drs. Weinberg and Vogelstein has been immeasurable to the cancer field. Their efforts have provided a paradigm of cancer progression that has shaped our view up through today. While this has produced important changes in how cancer is diagnosed and treated, the complexity of cancer evolution has proven much greater than any could have imagined. Drs. Weinberg and Vogelstein have published influential conceptual cornerstones articles of modern cancer research, namely, *Hallmarks of Cancer* by Dr. Weinberg, together with Dr. Douglas Hanahan (Fig. 6), and *Vogelgram* by Dr. Vogelstein (Fig. 5).

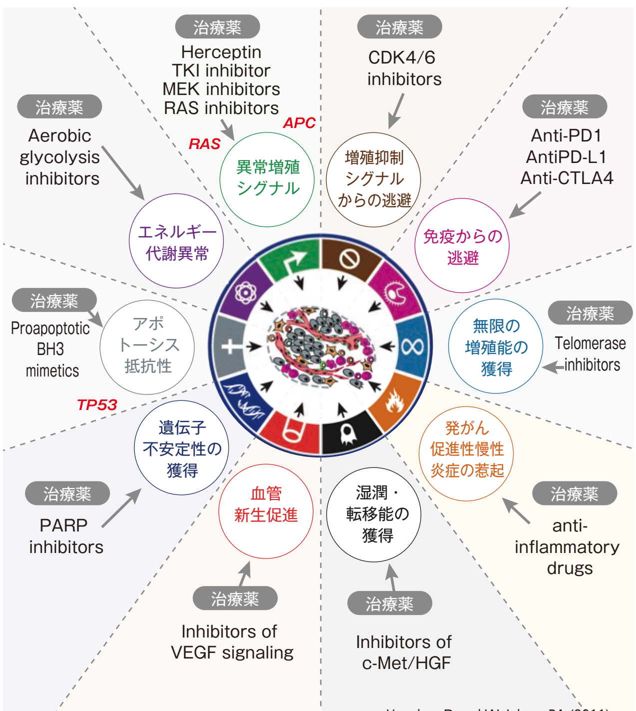
Overall, the paradigm set out by these two investigators has established principles that have enabled an understanding of the complexity of cancer, especially in providing a strong rationale for early cancer detection and intervention. Their accomplishments have served as the basis for many of the contemporary developments of targeted cancer therapies. Indeed, the notion of "precision medicine" in oncology has been synthesized from many of their ideas. Overall, their work has not only advanced basic cancer research, but also created the transformative field of cancer drug development that is improving the lives of many cancer patients.

Figure5：がん化は多段階を経て起こる；模式図



Fearon ER and Vogelstein B (1990).
A genetic model for colorectal tumorigenesis. Cell 61, 759–767.より改編

Figure 6：“Hallmarks of Cancer”の各要素を標的に進められる
がん分子標的治療薬の開発



Hanahan D and Weinberg RA (2011).
Hallmarks of cancer: the next generation. Cell 144, 646-674. より改編

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 14,000 nominators, strictly comprised of prominent scientists and researchers from around the world invited by the Foundation, to nominate the candidates through the web by Web System. The deadline for nominations is the end of January 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, 2019	November		End January, 2020	November		January, 2021	April
Consider the fields eligible for the 2021 Japan Prize	Determine the fields eligible for the 2021 Japan Prize Resources, Energy, Environment, Social Infrastructure Medical Science, Medicinal Science	Invite the nominations →	Closing of the nominations →	Selection Subcommittee for Resources, Energy, Environment, Social Infrastructure Selection Subcommittee for Medical Science, Medicinal Science ↑ Selection Committee →	Board of Directors →	Announce the Laureates of the 2021 Japan Prize	The 2021 Japan Prize Presentation Ceremony

Members of the 2021 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

Members

Yoshinori Fujiyoshi
Distinguished Professor
TMDU Advanced Research Institute
Tokyo Medical and Dental University

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

Hiroto Ishida
Director
The Japan Prize Foundation

Kazunori Kataoka
Professor Emeritus/Project Professor, The University of Tokyo
Vice Chairperson/Director-General of Innovation Center of NanoMedicine (iCONM), Kawasaki Institute of Industrial Promotion

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 "Resources, Energy, Environment, Social Infrastructure" field

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President
Tokyo University of Science

Deputy Chairman

Koichi Hishida
Professor
Organization for the Strategic Coordination of Research and Intellectual Properties

Members

Tadafumi Adschiri
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Advanced Institute for Materials Research, Tohoku University

Muneo Hori
Director-General
Research Institute for Value-Added-Information Generation
Japan Agency for Marine-Earth Science and Technology

Yuya Kajikawa
Professor, School of Environment and Society
Tokyo Institute of Technology

Norichika Kanie
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Graduate School of Media and Governance, Keio University

Noboru Kikuchi
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Toyota Central R&D Labs., Inc.

Hisashi Nakamura
Professor, Research Center for Advanced Science and Technology
The University of Tokyo

Suguru Noda
Professor
Faculty of Science and Engineering, Waseda University

Taikan Oki
Professor
Graduate School of Engineering, The University of Tokyo

Nobuko Saigusa
Director, Center for Global Environmental Research
National Institute for Environmental Studies

Chiharu Tokoro
Professor
Faculty of Science and Engineering
Waseda University

Selection Subcommittee for the "Medical Science, Medicinal Science" field

Chairman

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

Deputy Chairman

Masanori Hatakeyama
Professor
Graduate School of Medicine
The University of Tokyo

Members

Teruo Fujii
Executive Vice President, The University of Tokyo
Professor
Institute of Industrial Science, The University of Tokyo

Hiroshi Hamada
Team Leader, Laboratory for Organismal Patterning
RIKEN Center for Biosystems Dynamics Research

Midori Kamimura
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TEIJIN PHARMA LIMITED

Hideki Katagiri
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Tohoku University School of Medicine

Noriko Osumi
Vice President, Tohoku University
Professor, Tohoku University School of Medicine

Rami Suzuki
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Ferring Pharmaceuticals Co., Ltd.

Junko Takita
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Kazuhiko Yamamoto
Director
RIKEN Center for Integrative Medical Sciences

Motoko Yanagita
Professor
Graduate Schools Medicine, Kyoto University

Yoshihiro Yoneda
Director General
National Institutes of Biomedical Innovation, Health and Nutrition

(alphabetical order, titles as of January, 2021)

Eligible Fields for the 2022 Japan Prize

Areas of Physics, Chemistry, Informatics, and 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. We have designed and synthesized artificial materials, such as semiconductors, polymers, nanomaterials, catalysts, magnetic materials, and new types of structural materials, and have seen notable progress in materials design for responsible consumption and production. We have also developed new industrial technologies, such as design and manufacturing technologies supported by computational and data science, high-resolution/highprecision measurement technologies, robotics, and precise nanostructure control process.

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 and production & operation technologies.

Eligible Achievements:

The 2022 Japan Prize in the fields of Materials and Production will be awarded to an individual or individuals who have made momentous scientific and technological breakthroughs that contribute significantly to the sustainable development of society or to its potential for great advances in the future. Such achievements will include the development of materials with new functions, development of new structural materials that support social infrastructure or improvement of technologies for industrial design and production & operation, which enable the creation of new products, services and industries that improve the quality and safety of people's lives.

Areas of Life Science, Agriculture, and Medicine

Biological Production, Ecology/Environment

Background and Rationale:

The existence of humankind is completely dependent on the sustainable and diverse use of Earth’s biological resources. However, the global expansion of human activities coupled with the increase in population is decimating the natural environment and biodiversity forcing humanity to reconsider how biological resources are used.

In order to improve the situation, it is necessary to perceive biological production, the environment, and ecological integrity from a unified viewpoint. This requires advancements in fundamental science that enable us to conserve the invaluable environment and ecosystems, protect biodiversity, and sustainably use ecosystem services, and the creation of scientific and technological innovations, including earth observation and ecosystem modeling. For the sustainable use of biological productivity, we require new developments including the creation of new breeds through genome editing, the application of ICT, AI and robotics for advanced production, the realization of environmentally friendly biological production, the harnessing of useful substances from organisms, the enhancement of food functionality, and the reduction of food loss and waste.

Eligible Achievements :

The 2022 Japan Prize in the fields of Biological Production, Ecology/Environment will be awarded to an individual or individuals who have significantly contributed to the creation, development, and dissemination of scientific and technological breakthroughs that enable the sustainable development of human society in harmony with the ecosystem, or to its potential for great advances in the future. This year's Prize places emphasis on contributions to the advancement of basic science in ecology and the environment, and progress in biological production technologies.

Fields Selection Committee for the 2022 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
- **Kohei Miyazono**
  Professor
  Department of Molecular Pathology
  Graduate School of Medicine, The University of Tokyo

Members

- **Yozo Fujino**
  President, Josai University
  Professor Emeritus, The University of Tokyo
  Professor Emeritus, Yokohama National University
- **Ken Furuya**
  Professor, Graduate School of Science and Engineering, Soka University
  Professor Emeritus, The University of Tokyo
- **Mariko Hasegawa**
  President
  The Graduate University for Advanced Studies SOKENDAI
- **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**
  University Professor
  Department of Chemistry
  Graduate School of Science, The University of Tokyo
- **Yuichi Sugiyama**
  Head
  Sugiyama Laboratory, RIKEN Baton Zone Program
- **Mariko Takahashi**
  The Science Coordinator
  The Asahi Shimbun
- **Masayuki Yamamoto**
  Professor Emeritus, The University of Tokyo
  Professor Emeritus, National Institute for Basic Biology

(alphabetical order, titles as of November, 2020)

Schedule (2022-2024)

The eligible fields for the Japan Prize (2022 to 2024) 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 fields for the next three years.

Areas of Physics, Chemistry, Informatics, and Engineering

Year	Eligible Fields
2022	Materials and Production
2023	Electronics, Information, and Communication
2024	Resources, Energy, Environment, and Social Infrastructure

Areas of Life Science, Agriculture, and Medicine

Year	Eligible Fields
2022	Biological Production, Ecology/ Environment
2023	Life Science
2024	Medical Science and Medicinal Science