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ASIA–PACIFIC

Cover art: Alisdair Macdonald

The governments of many Asia-Pacific countries see increasing their high-quality scientific output as essential to building an innovative, globally competitive, knowledge-based economy. And the data compiled in this 2013 Nature Publishing Index (NPI) show that the region is making progress towards this goal. An increasing number of Asia-Pacific research institutions are in the upper echelons of global contributors to the Nature journals, and authors from the region continue to increase their share of overall output (see page 10).

Japan remains the leader in Asia-Pacific and the most prolific at publishing papers in *Nature* itself. Nonetheless it is striking that Japan's contribution has a smaller proportion deriving from international collaborations than any other major Asia-Pacific nation. With a limited capacity to raise research funding, if Japan wishes to build on its legacy then high-level international collaboration must surely be a priority.

It is, however, China driving the pattern of growth (page 20) and for the first time it boasts the top Asia-Pacific institutional contributor to NPI: the Chinese Academy of Sciences. However, the giant player's output is increasing at a slower rate in the NPI than smaller players like Singapore and South Korea (page 26). It also falls a long way behind Singapore and Australia in its NPI contribution relative to its number of researchers (page 11). Important science figures in China are aware of its shortfalls and of what it needs to improve upon, and the country's ambition matches its growth. High-profile achievements like its recent successful lunar mission coupled with its continuing commitment to increase spending in research will no doubt bear significant fruit in years to come.

The other Asia-Pacific behemoth, India, needs to go much further before it challenges the top contributors (page 30). However, India's flagship technological achievements and investment proposals do provide some hope that it might start to see the sort of gains that China has over the past five years.

Asia-Pacific will continue to be an engine of growth for quality research output. And if the giants of the region, China and India, can match the efficiency of smaller nations like Singapore and Australia, the effect on global science and innovation will be truly transformative.

Nick Campbell
Head of Nature Publishing Group, Greater China

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NATURE PUBLISHING INDEX 2013 ASIA-PACIFIC
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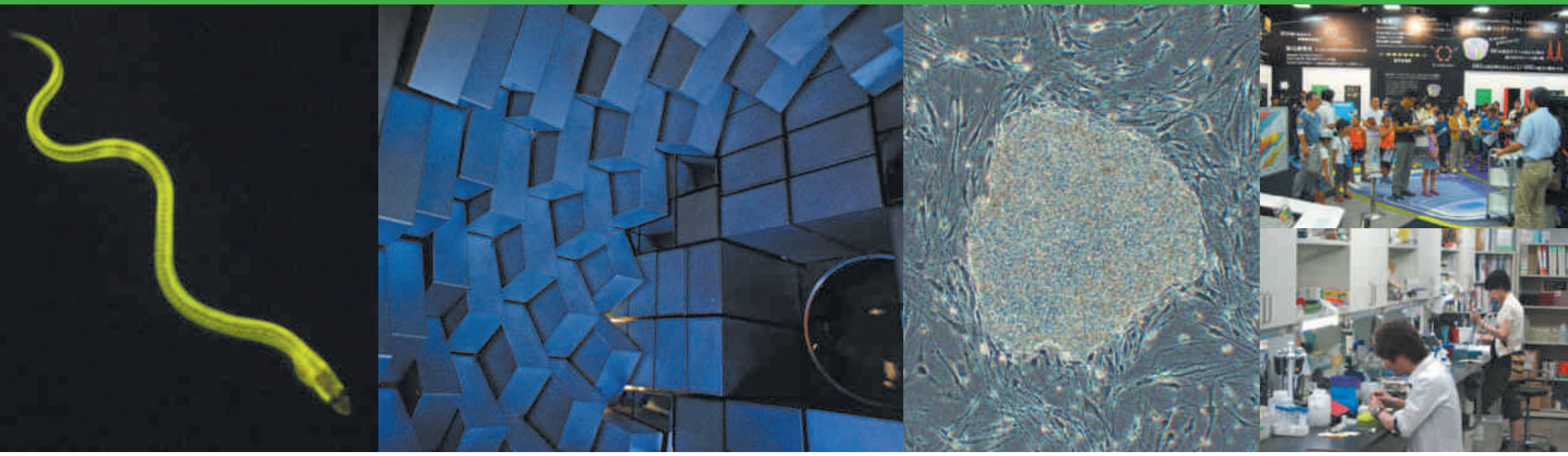


RIKEN

FROM BASIC RESEARCH TO SUSTAINABLE INNOVATION

With five major campuses in Japan and collaborations with institutions all over the world, RIKEN is Japan's powerhouse for basic and applied research. As the country's largest research organization, RIKEN is playing an important role in promoting innovation, and is strengthening its commitment to helping solve the biggest and most pressing challenges of our time.

A home for basic research

RIKEN has made dramatic advances in basic research and continues to take research to ever higher levels in a vast number of scientific fields including nuclear physics, neuroscience, materials science, computing, plant science, genomics and developmental biology. Every year, RIKEN welcomes outstanding students and junior researchers from Japan and all over the world to join its talented team. RIKEN's high-quality, high-performance research environment, combined with a unique bottom-up approach to scientific innovation, has enabled it to foster an environment in which researchers can thrive.

Top-notch facilities

RIKEN is home to a number of world-leading large-scale facilities. The K computer, one of the world's fastest supercomputers, has already delivered outstanding results in fields such as neural network simulation and drug discovery. SACLA, Japan's X-ray free electron laser, is set to deliver data at unprecedented resolution on the structures of atoms and molecules. The Radioisotope Beam Factory (RIBF) is being employed by researchers from all over the world to better understand the atomic nucleus and the creation of the universe.

Innovation

RIKEN is promoting innovation in many areas of special interest, such as regenerative medicine, technology for the life and medical sciences, emerging materials and green innovation. A number of new centers were created in 2013 to take on this challenge. RIKEN is committed to ensuring that its research in science and technology is put to the service of society through technology transfers and partnerships with the private sector.

Innovation in medical technology

The RIKEN Center for Life Science Technologies is an example of how RIKEN is developing new methods to understand and treat the human body, providing the fundamental building blocks for the development of new pharmaceutical and medical applications that will turn preemptive and personalized medicine into reality. And at the RIKEN Center for Developmental Biology, researchers are investigating the generation of human induced stem cells and their use in regenerative medicine; in 2013 RIKEN launched the first clinical research designed to test the use of induced pluripotent stem cells to treat human disease.

Public engagement

RIKEN recognizes the need to engage with society through education and communication. It is dedicated to making the best of its research accessible to the public, engaging with the local community and fostering a passion for science among young people. Thousands of visitors come to RIKEN every year for guided tours of its facilities. RIKEN scientists engage with their local communities by presenting lectures and workshops in museums and schools and organizing activities at science fairs and festivals.

RIKEN
www.riken.jp

Tokyo Institute of Technology (Tokyo Tech)

CELEBRATING DIVERSITY, DEPTH, AND YOUTH

It has been a big couple of years for Tokyo Institute of Technology (Tokyo Tech). In 2012, Yoshinori Ohsumi won the prestigious Kyoto Prize for his pioneering work on the molecular mechanisms underlying autophagy, the process by which cells break down dysfunctional or unnecessary cellular components. Then last year, he and Hideo Hosono, another Tokyo Tech professor who discovered iron-based superconductors and the seminal IGZO thin film transistors, were named Thomson Reuters Citation Laureates. This award goes to scientists whose publications have the most impact internationally. "It was quite memorable and quite an honour for Tokyo Tech since two out of three Japanese awardees in 2013 were on its faculty," says Takashi Tatsumi, the university's executive vice president for research whose own achievements in zeolite catalysis won him the 2012 Alwin Mittasch prize. And then, just this year, the university's Yasuharu Suematsu snagged the Japan Prize for his work on semiconductor lasers, used in long distance optical fiber telecommunication technology.

These prizes, however, show only the tip of the iceberg of Tokyo Tech's research prowess. While perhaps most famous for its chemistry, materials science, and mathematics, the university is also strong in physics, astronomy, environmental science, earth science, and other fields.

A testament to that diversity came in 2012, when the science ministry selected the university's Earth-Life Science Institute to be one of just nine projects under its World Premier International Research Center Initiative. Kei Hirose will lead a team of international specialists on an ambitious mission: to find out how our planet was formed, when and where life originated, and how it evolved.

Commercial success has followed closely on research developments. Sharp started the mass production of high performance liquid crystal displays for smart phones and tablet PCs driven by the IGZO thin film transistors invented by Hosono and his collaborators. With the tremendous energy-efficiency of these transistors, these displays extend the battery life of smartphones. In 2013 LG put large-sized organic light emitting diode TVs with IGZO-TFTs on the market. Lithium ion batteries, advanced IC cards, and drug delivery systems are also being spun off from university research.

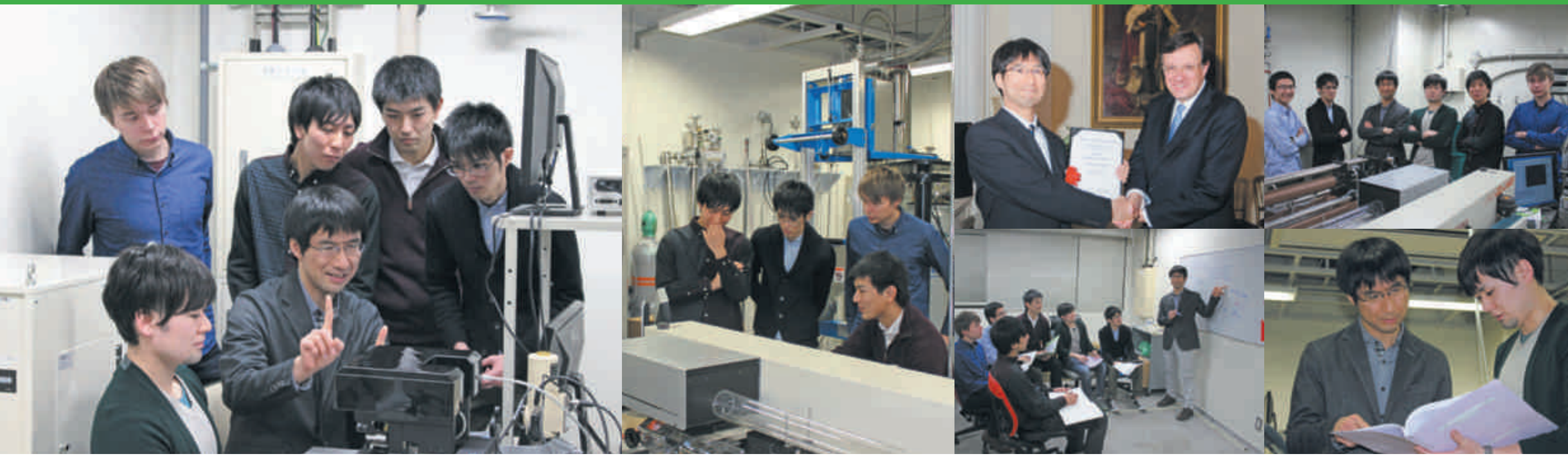
Aside from its influential publications, patents, and research programmes, Tokyo Tech is also extending its international influence more directly, through active recruitment of foreigners. Despite the impact of the 2011 earthquake, the university increased its number of full-time foreign faculty by more than 20% over the last five years and the number of foreign graduate students, which now account for nearly 20% of the total, increased by more than 30% over the same period. "The great earthquake and subsequent nuclear accidents in 2011 were a setback, but our policies are working," says Tatsumi.

Policies for addressing the nationwide shortage of female professors are also succeeding. The number of female faculty jumped nearly 25% over the past five years. The university is targeting similar increases over the next five and ten year periods. "We have been actively recruiting female faculty and will continue our effort to increase that share," says Tatsumi.

Tokyo Tech, born in 1881 as the Tokyo Vocational School and established as a university in 1929, is young among Japanese universities. Faculty members under the age of 40 account for a third of the total, a ratio administrators are determined to maintain. To keep that youthful vigor, energetic students and postdoctoral researchers are aggressively recruited. "We always strive to establish a supportive environment for young researchers who can proactively tackle new scientific challenges," says Tatsumi. ■

TOKYO TECH

www.titech.ac.jp/english/



Terahertz technology takes off

Sandwiched between infrared radiation and microwaves and lacking good emission sources or detection methods, terahertz radiation has long been overlooked in basic and applied research. Yukio Kawano, a researcher in the Quantum Nanoelectronics Research Center at Tokyo Tech, is changing that. His series of terahertz discoveries could benefit a wide range of industrial and basic researchers.

Kawano, for example, learned how to image terahertz waves with several hundred micrometre wavelengths at 400 nanometre spatial resolution. That resolution—equivalent to 1/540 of the wavelength—surpasses analytical detection limits. He also discovered a way to use graphene transistors for ultra wide-band terahertz and infrared detection, with frequencies ranging from 0.76 to 33 terahertz. The frequency can be tuned by changing the magnetic field. And, using terahertz spectroscopic imaging, his team imaged and analyzed the flow of electrons within a semiconductor, the electric field distribution around a metallic antenna, and the crystal structure of a polymer. The semiconductor analysis revealed previously unknown spatial properties of electrons in semiconductors. "Passive near-field terahertz imaging without an external terahertz source allows direct measurement of a sample's inherent energy distribution without being influenced by the external light source," he says.

These breakthroughs have landed Kawano a plethora of awards, including the Sir Martin Wood Prize, the Japan IBM Science Prize, and most recently the Japan Society for the Promotion of Science Prize.

Kawano now hopes to make his discoveries useful in other fields. Astronomers might be able to detect the faint terahertz waves coming from space. Physicists can study phenomena at low energy excitation levels in a quantum condensation system. And a terahertz analysis of biological polymers could offer an understanding of the exchange mechanism of energy in biological systems.

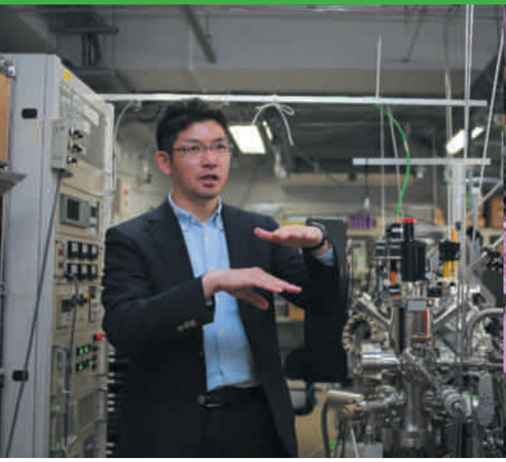
But Kawano's ultimate goal is single molecule terahertz spectrum imaging. To reach that spatial resolution however, he will need an even more sensitive detector.

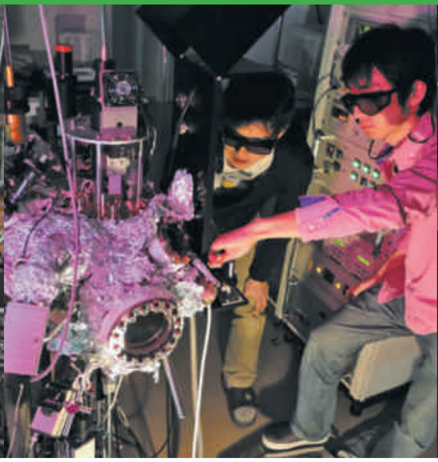
Kawano is used to innovating to push his science forwards. He succeeded with the near-field terahertz imaging at nanometre resolution by loading all the elements needed—aperture, probe, and detector—onto one semiconductor chip. "It was a completely different point of departure from the conventional probes," Kawano says.

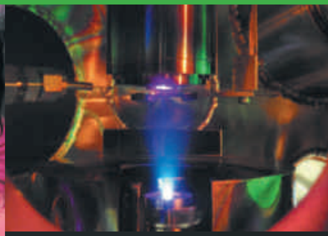
At Tokyo Tech, Kawano has what he needs to succeed, including a state of the art clean room and microfabrication instruments for making the graphene and semiconductors. And an adept technician ensures smooth work flow. "The equipment's always in good shape," says Kawano. His team has been supported generously, including a JPY 157 million grant from the JSPS. He also gets grants directly from industry, hungry to capitalize on the discoveries to make novel semiconductor materials and transistors, antennae, polymer materials, and drugs. Kawano is currently collaborating with industry to develop and commercialize his terahertz imaging system.

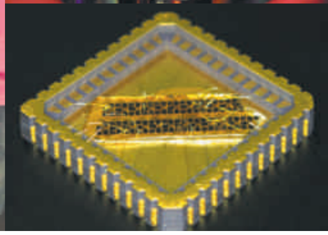
Kawano's laboratory has also become a breeding ground for the next generation of materials scientists. Exchange students from Italy, Finland, and China have worked in his laboratory, and the United States sends students as part of the National Science Foundation's Nano Japan Program. These young scientists have won the TeraNano Prize, the Young Research Award from the International Symposium on Terahertz Nanoscience, and the Best Poster Award at the 2013 IEEE EDS WIMNACT-37 meeting. Terahertz-based technology looks ready to flourish.

Quantum Nanoelectronics Research Center,
Department of Physical Electronics,
http://diana.pe.titech.ac.jp/kawano/eng/









Metal oxide makeover

In 2004, Akira Ohtomo and his colleague discovered an astounding phenomenon. A metallic interface between two insulating oxides can conduct electricity with similar capacity to a silicon semiconductor. Metal oxides got a whole new look. They used to be considered a "sort of ceramics," says Ohtomo, a materials researcher at Tokyo Tech, "not an electronic material that could be the central component of logic circuits."

The idea that these transparent circuits could function as semiconductors threw the door open to a wide range of applications, including invisible electronics devices. Ohtomo's team verified this in another transparent material in 2007. From transparent displays to invisible electronic tags and hidden security sensors, the discovery could extend the information transmitting and reading devices that characterize the "ubiquitous network society" to the realm of the unseen.

But there is a hitch. The high quality films needed to create the effect can, with current technology, be created only on single crystalline substrates with a typical size of ten square millimetres. The small size of devices greatly limits the applications. "To this end, we have a big challenge—perfect epitaxial growth on a non-crystalline substrate," says Ohtomo.

Ohtomo is taking on the challenge, designing semiconductors that can stay intact even when grown on large glass substrates, by enlisting the latest nanomanipulation technology. If crystalline materials are deposited on a glass surface, random nuclei form a polycrystalline film. Ohtomo found that periodic relief structures added to the glass surface can bring about an ordered, preferential orientation. In some of these studies, tilting and twisting of each grain was found to decrease systematically as the period of the relief structures was decreased to several micrometres. With current nanofabrication techniques, that resolution can be reduced even further, to several tens of nanometres. "It may be possible to make large single crystalline domains on glass substrates," he says.

Ohtomo's research on electronic reconstruction at oxide interfaces has implications for various areas of electronics, such as magnetic tunnel junctions and Josephson junctions. And many intriguing physical phenomena, such as high-Tc superconductivity, ferromagnetism, ferroelectricity, and thermoelectricity, also occur in naturally layered structures of transition metal oxides. "This gives rise to the emergent interest in 'epitaxial' design of new compounds upon the atomic-scale layer-by-layer growth of artificial superlattices," says Ohtomo.

To extend the applications, Ohtomo's team developed an ultra-high vacuum pulsed-laser deposition system equipped with reflection high-energy electron diffraction. This system can rapidly optimize the growth temperature using an infrared semiconductor laser heater to make large temperature gradients. The result is the power to create atomically abrupt heterointerfaces and nearly identical oxygen stoichiometry.

There is much more work to do but the effort got a huge boost in 2012 when Ohtomo was picked as a leading researcher of the materials exploration group at the Materials Research Center for Element Strategy. He has also been supported by the university's Global Center of Excellence in chemistry. Tokyo Tech "offers flexibility for pursuing materials research and many opportunities for collaboration," says Ohtomo.

With more support, Ohtomo is confident that new nanoscale manipulation techniques will open the window of possibility even further. "This work has been a demonstration of the power of nanoscience to create new physical phenomena," he says. "Recently developed techniques to tailor new materials, atom-by-atom, should continue to reveal new effects at an ever-accelerating pace."

Department of Applied Chemistry
www.apc.titech.ac.jp/~aohtomo/english/

The earliest greenhouse gas producers

The impact of recent human activity on the atmosphere consumes the energy of many a scientist, but life on earth—in the form of microbes—has long been interacting with the earth's atmosphere. Thanks to the work of Tokyo Tech's Yuichiro Ueno, our understanding of that relationship is extending deeper and deeper into the earth's evolution.

Ueno researches the earth's early biosphere, its early atmosphere, and the interaction between them. His team develops techniques for determining stable isotopic ratios of carbon and sulfur in sedimentary rock. Those ratios can then be used as "tracers" for determining what kind of microbes and what atmospheric processes were active at a given time in history.

"I'm a geochemist developing analytical techniques for tracing the past biogeochemical cycling from the geologic record," he says.

For example, analyses of the distributions of four sulfur isotopes in hydrothermal rocks in Australia produced evidence of sulfate-reducing microbes in the early Archaean era, some 3.5 billion years ago, much earlier than previously thought. Likewise, carbon isotopes in Australian fluid inclusions gave evidence that microbes were producing methane around the same period. It was the first direct geological evidence of a phenomenon that might have been important in ameliorating severe temperatures resulting from decreased solar luminosity at the time. "These studies demonstrate that specific microbes were active in submarine hot springs 3.5 billion years ago," says Ueno.

Atmospheric studies complement the biosphere studies. For example, Ueno's survey of geological sulfur isotopes helped to resolve the mystery about why the earth did not freeze over during the Archaean period. His team found that elevated levels of carbonyl sulfide were able to retain solar energy in the atmosphere, warming the earth. "New greenhouse gases were present in the earth's early atmosphere," says Ueno. The study also suggests a causal explanation for the period of glaciation that followed—a decrease in the amount of carbonyl sulfide in the atmosphere.

"Our results make us realize that the interaction between microbial activity and environment, particularly atmospheric composition, is more important than previously thought," says Ueno.

But many mysteries remain. "We still do not adequately understand what caused the change of microbial ecosystems and thereby how the change influenced the earth's climate through its history," he says. "We need more data."

In the future, Ueno wants to focus the efforts of his large team of postdoctoral researchers and graduate students on quantitatively studying how the early atmosphere was reducing. For example, they will be looking at when and how the reducing atmosphere started oxidizing molecular oxygen.

The project would have been impossible if not for the geological largesse that Ueno's team has assembled at Tokyo Tech. He has spent over a decade sampling and carrying out field studies, helping the university to archive more than 200,000 rock samples. Ueno also played a part in establishing a new Earth-Life Science Institute with a stable isotope laboratory for developing new tracers that will enable them to look at the samples in new ways and decode new microbial activities and atmospheric processes. 'These are pure scientific studies aimed at understanding how the earth's environment was so different from present day earth," says Ueno. ■

Department of Earth and Planetary Sciences
www.geo.titech.ac.jp/lab/ueno/

The widening horizon

In 2013, the Asia–Pacific region increased its spending on science, upped its share of NPI output, and broadened the scope of its research. While Japan still leads the Asia–Pacific NPI, China is snapping at its heels. Of the smaller nations, Singapore is starting to live up to the aspirations laid out by its government to become a state of innovation.

Plus ça change, plus c'est la même chose — the 2013 Asia-Pacific Nature Publishing Index (NPI) turns the old expression on its head. On the surface, this latest snapshot of the regional science landscape appears similar to last year's. But there's a lot happening behind the bare numbers.

The number of articles contributed by Asia-Pacific researchers to the NPI has increased by 36% from 2012, and the region's share of the global NPI has also risen, from 28% to 31%.

The order of the top five Asia-Pacific countries is the same as for the past five years: Japan, China, Australia, South Korea and Singapore. But real signs of change are emerging. In 2013, for the first time, China contributed more articles to Nature journals than did Japan, although China still had a lower corrected count (CC). Also for the first time the Chinese Academy of Sciences (CAS) bettered the region's perennial leader, The University of Tokyo on corrected count. China is on pace to take over as the top Asia-Pacific contributor to the NPI within the next two or three years.

Further down the list, Singapore's multi-billion dollar research and development investment programme has been steadily increasing over the past decade and its NPI output almost doubled in 2013. Having catapulted its first institution, the National University of Singapore (NUS), into the Global Top 100 in 2012, Singapore boosted its presence this year with the addition of Nanyang Technological University (NTU). These two — along with Singapore's governmental Agency for Science, Technology and Research (A*STAR) — have pushed aside some much older institutions from larger countries for places in the regional top 20.

BASIC DIFFERENCES

One of the key drivers of the output increase in the NPI for Asia-Pacific nations has been growth in the still-young journal *Nature Communications*, which now accounts for 35% of all papers in the NPI, rising to 44% of the NPI Asia-Pacific. This online-only journal publishes papers across a broad range of disciplines, albeit with a lesser scientific reach, than *Nature* or any of the specialized research journals. Just over a quarter of articles in *Nature* featured authors from the Asia-Pacific region, compared to 39% of articles in *Nature Communications*; only *Nature Genetics* had a larger share of Asia-Pacific authors. So the influence of Asia-Pacific science, while growing, may not be as great as the raw NPI numbers suggest. The region's science community is acutely aware of this. In 2012, for instance, South Korea established its Institute for Basic Science (IBS) programme. The IBS is already showing its exploratory science credentials and is in eighth place in the country having published nine articles in Nature titles in 2013 (page 26).

Of the Asia-Pacific nations, Japan published the most papers in *Nature* in 2013, with 73. The country has a strong scientific heritage, and also boasts 16 scientific Nobel prizewinners, whereas China and South Korea have none. The NPI figures demonstrate this maturity in other ways. Japan topped the output in three subject categories in the NPI — physical sciences, life sciences, and earth and environmental sciences — showing that quality of its science is still unsurpassed in the region.

But maturity can also mean a lack of youthful exuberance. Japan's 23.7% growth in NPI output in 2013 was the smallest increase of any of the top five Asia-Pacific nations — following a five-year trend. And at 0.44 CC per thousand researchers, Japan's efficiency of production of science sits in the middle of the pack

On the back of sheer numbers, China has become the heavyweight, publishing more papers in the NPI than any other country in the region. And it is forging ahead technologically, with 2013 milestones including: the world's fastest computer; the world's deepest particle physics experiment; and landing an autonomous roving vehicle on the moon (page 20).

But these headlines do not tell the whole story. Senior Chinese scientific figures, both within the country and outside, have expressed concern that the country's core technologies still mainly depend on foreign innovation. (Similar comments have been made about South Korea and Taiwan.) China has also been criticized for spending small proportions of its expanding science and technology budget on actual research, with large sums set aside for administration. Critics point to management systems that discourage innovation and poorly-paid academics.

"On the back of sheer numbers, China has become the heavyweight, publishing more papers in the NPI than any other country in the region."

These points are supported by NPI data, which shows China to have the lowest efficiency levels of the top five countries – 0.19 CC per thousand researchers. And although the country's increase in science output since 2009 has been impressive, in the past year several countries — including South Korea, Taiwan and Singapore — have surpassed its growth rate.

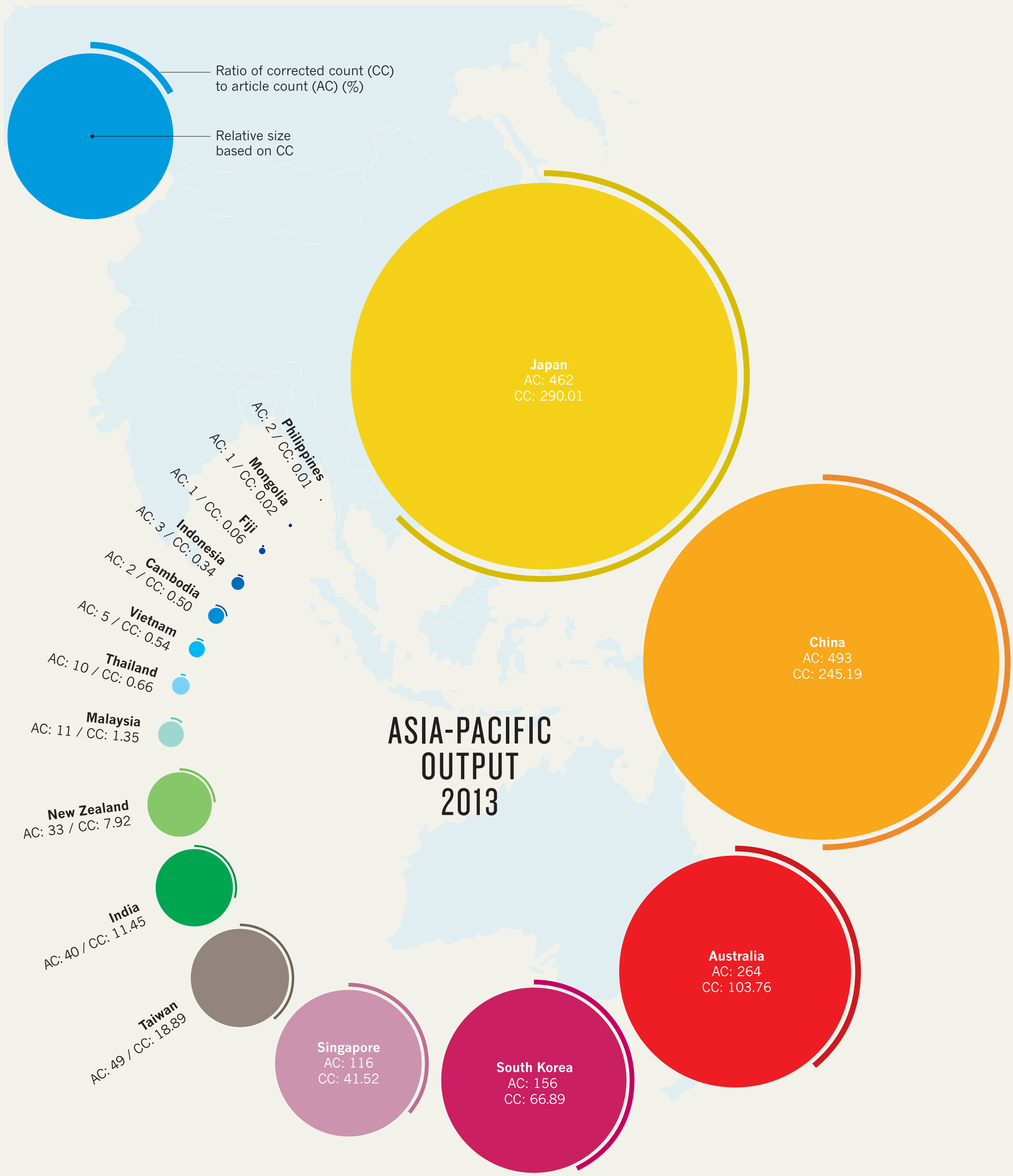
The Australian figures for 2013 show solid achievement (page 24). Its contribution to Nature journals grew by more than 50%. The NPI data shows that the efficiency of its researchers is competitive, and it has the second highest level of international collaboration in the region. The top Australian institutions are climbing steadily up the world rankings, and three — the University of Melbourne, the Australian National University, and the University of Queensland — are in the regional top 20. Whether the nation's output continues to grow, particularly in its strength of environmental science, will depend largely on the level of support from its new conservative government.

South Korea could be one to watch in the NPI. With high levels of investment in science and technology announced by both government and private enterprise, and the first papers emerging from its new IBS programme, the nation is on the verge of considerable expansion in basic science (page 26). Already its output is growing faster than China's, and it is third after Japan and China in both the physical sciences and chemistry.

Singapore's small population — a mere 0.4% of China's — will always pose difficulties for it in regional comparisons. But it has the fastest growth rate in science of any country in the region, high levels of researcher efficiency and strong collaboration. Singapore is gaining a reputation for its innovation and in order to leverage this, much of the nation's effort is concentrated in its three world-class research institutions, NUS, NTU and A*STAR; other institutions do not figure in the upper echelons of the NPI (page 27). ■

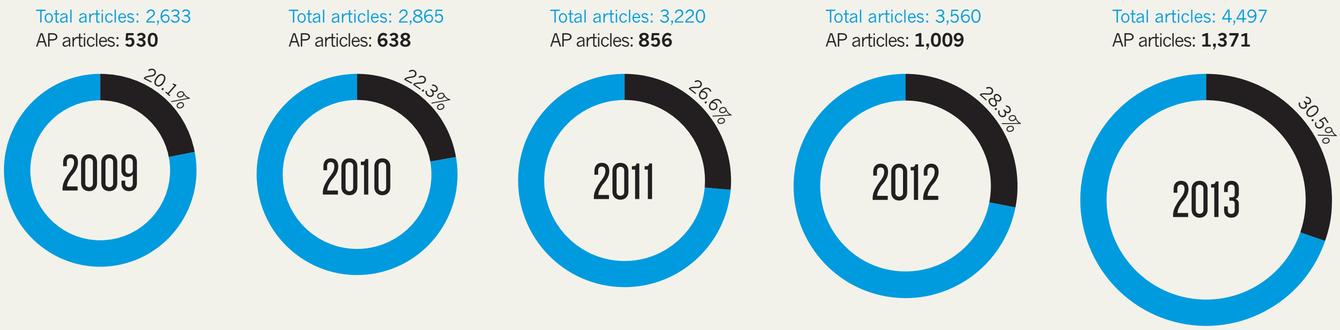
RESEARCH OUTPUT

The size of the bubble corresponds to each country/territory's corrected count for 2013. The ratio of corrected count to number of articles is shown on the circumference: a shorter line signals more international collaborations



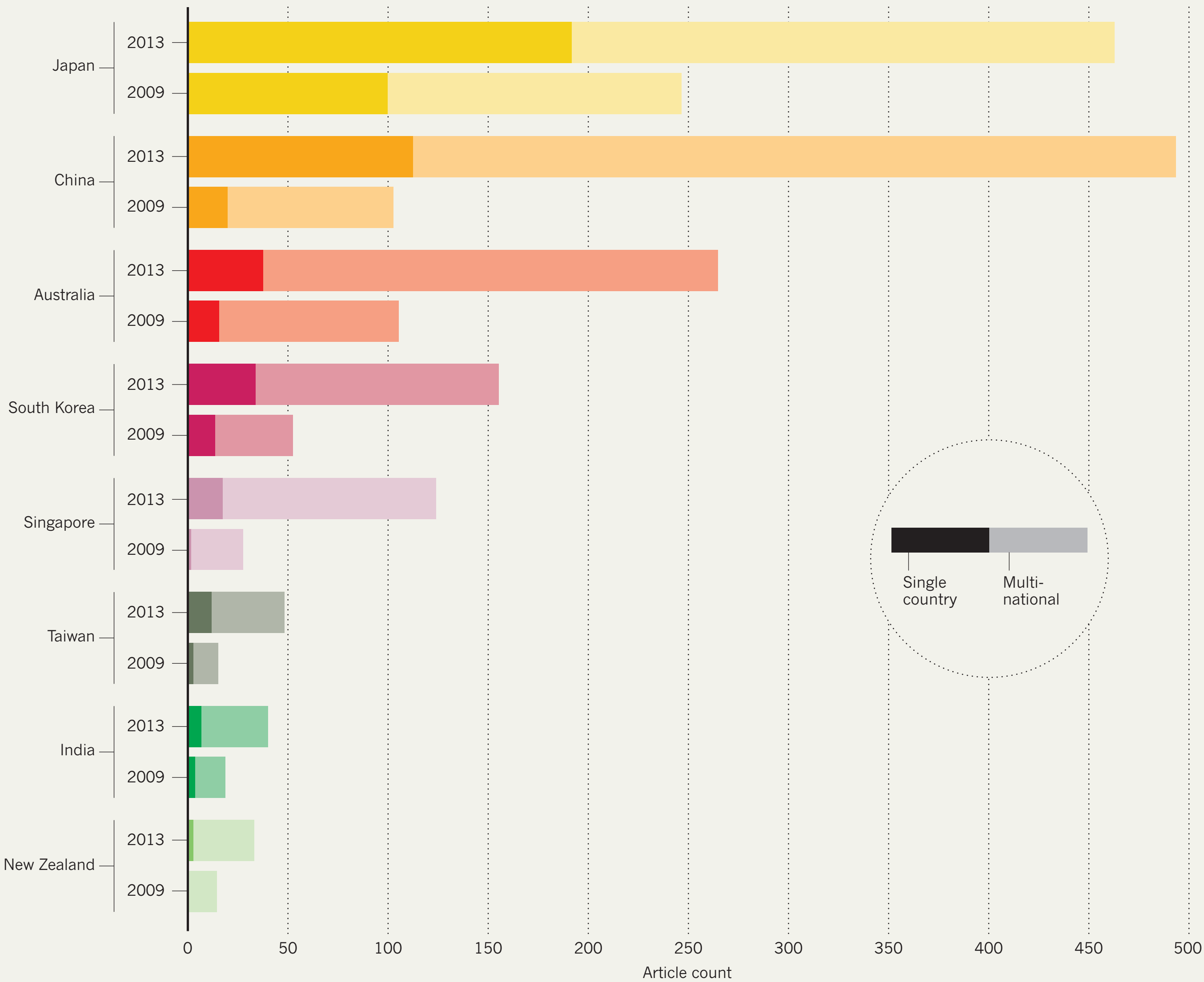
GROWTH IN THE NPI

Along with growth in the number of articles in the NPI, the share attributable to Asia-Pacific (AP) researchers has also increased.



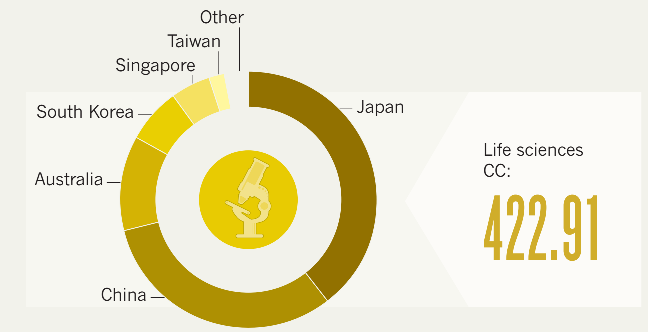
COLLABORATION TRENDS

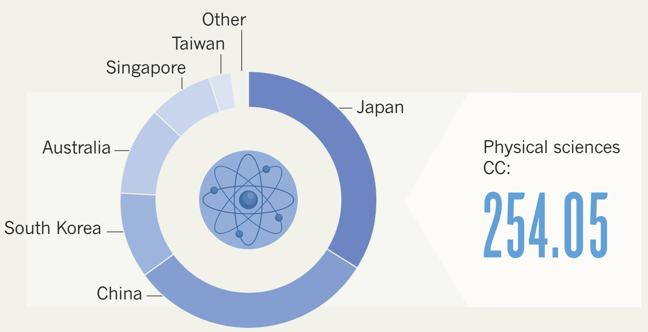
Over the past five years, article counts have increased for all the top eight countries/territories in the NPI. However, this growth is unevenly split between articles wholly authored by scientists within one country/territory and articles that represent international collaborations.

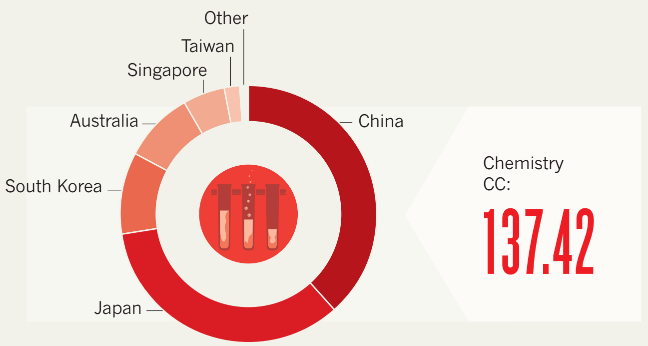


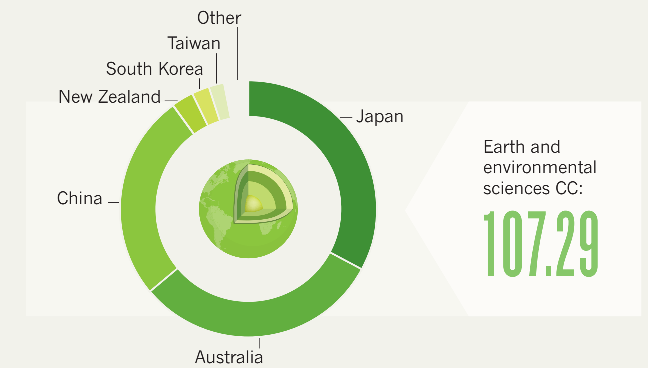
RESEARCH AREAS

Each country/territory's share of the corrected count (CC) by the following subject areas: chemistry, earth and environmental sciences, life sciences and physical sciences.



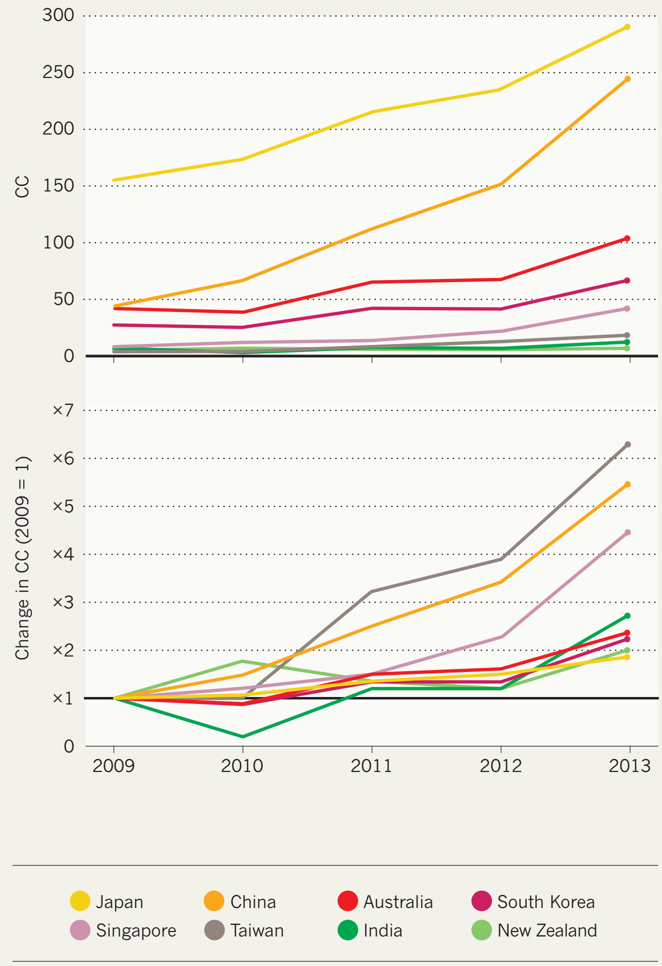






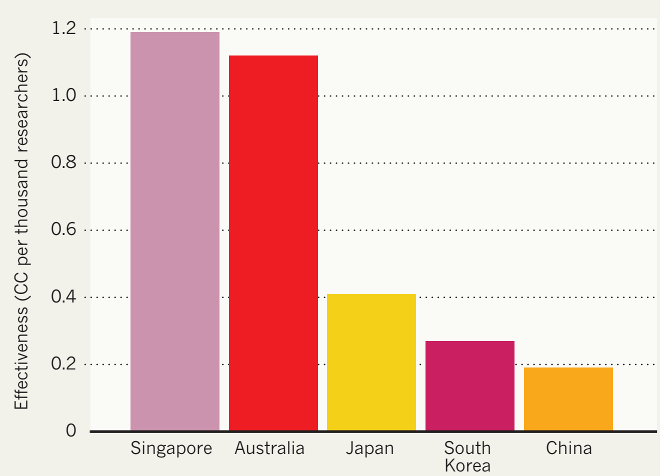
OUTPUT GROWTH

Charting the corrected count in absolute numbers shows the margin by which Japan leads other countries/territories (top). However, seen as a relative change (bottom) the figures show improvement for Taiwan, China and Singapore.



RESEARCHER EFFICIENCY

Dividing a country's CC by its number of researchers gives a measure of the effectiveness of its scientists.



SOURCE: UNESCO

Tokyo Medical and Dental University (TMDU)

LEADING THE WAY IN BASIC AND CLINICAL LIFE SCIENCE RESEARCH AND EDUCATION

There can be no doubting the pedigree of Tokyo Medical and Dental University (TMDU). Its headquarters is in Ochanomizu, a part of the Japanese capital known for scholarship since the 17th century. It took over from its predecessor, the Tokyo National School of Dentistry, the nation's first institute for dentistry education, in 1946. Since then, it has grown into one of the most influential medical research institutions in the world.

TMDU is ranked eighth in Japan, and in the top 300 worldwide in the *Times Higher Education* (THE) World University Rankings 2013–2014. It scores especially highly on the number of citations per research paper published by its staff. Yet the university has no plans to rest on its laurels.

Its goal is to become one of the top 100 universities in the world within the next 10 years. One way it hopes to achieve this is through greater international links. Personnel exchange agreements have already been completed with 77 universities in 26 countries, and overseas education and research bases have been established in Chile, Ghana, and Thailand. One of every five international medical graduate students in Japan studies at TMDU.

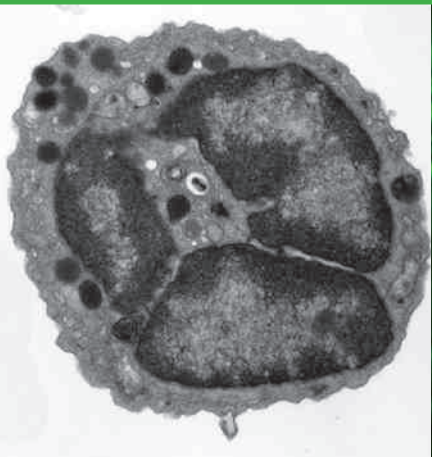
Recent efforts such as these are already bearing fruit. In 2013, TMDU was awarded Research University status under a Japanese Government programme to encourage the country's best research institutions to perform even better. To help it achieve this, the university has developed a five-pillar strategy that involves ensuring the recruitment and development of excellent personnel, fostering an environment in which high-quality research can flourish, reinforcing university governance, promoting cooperation with industrial enterprises and increased use of research administrators.

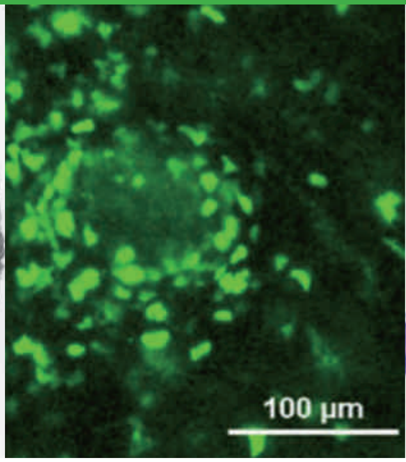
TMDU is also keen to explore new ways of teaching and doing research. Recent pilot projects include a programme that allows graduate students to work under multiple supervisors to broaden their horizons beyond their primary fields, and the development of a joint university graduate school system under which participants' coursework can be completed at any of six research institutions, including four national research centres. Detailed negotiations on the creation of joint degree programmes with the University of Chile and Chulalongkorn University in Thailand are underway. The university also intends to develop a tenure-track system to help attract high calibre international researchers.

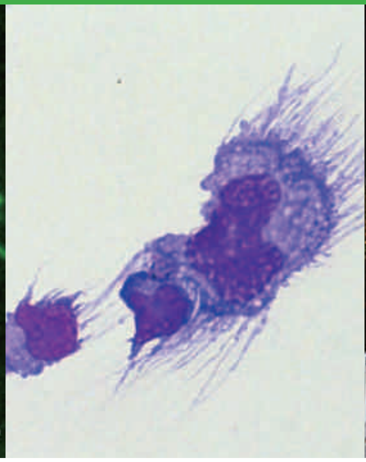
Other recent innovations include the establishment of the TMDU Bioresource Research Centre as a repository for human tissue, serum and DNA samples to facilitate translational research into personalized medicine, and of a bank to house strains of genetically modified mice to support gene-based research. The university is also leading a network designed to increase cooperation between industrial enterprises and medical universities.

Moving forward, TMDU is looking into setting up an animal experimentation institution for medium- to large-sized animals, which would meet the high standards set by the Association for the Assessment and Accreditation of Laboratory Animal Care. Efforts are being made to employ a greater proportion of younger, female and international researchers. Plans are also being made to develop a strategic research organization led by TMDU president Takashi Ohyama, and to increase capital investments.

The university is cooperating with industry in a variety of ways designed to produce outstanding research. It is hoped that the planned establishment of the TMDU Organization for Propulsion of Medical Innovation (OPMI) and increased use of research administrators will play







important roles on this front. TMDU plans both to hire new researchers, including those with experience of working in the pharmaceutical industry, and to place existing researchers with industry, to work on research with clearly defined medical and health-care objectives. It is involved in efforts to draw up regulations to address conflicts of interest and uphold the highest standard of bioethics so as to promote responsible cooperation between industrial enterprises and universities, including in the special context of personalized medicine. It will also promote the education of medical staff trained to make the most of genetics in the diagnosis and treatment of patients.

These initiatives and programmes may help TMDU achieve its ambition of becoming one of the top 100 universities in the world. Ultimately however, this will only be achieved if its staff continues to produce high-quality research of the kind outlined below.

Putting the spotlight on immune system regulation

Most antigens are proteins that occur on the surfaces of viruses, bacteria, fungi or cells. TMDU researchers are investigating the how the immune system learns to respond to non-protein antigens such as carbohydrate chains. They are also looking more broadly at the role of host immunity in diseases and how that relates to the development of effective immunotherapies, as well as working towards a better understanding of intracellular mechanisms underpinning viral replication in the hope of identifying therapeutic molecules. Other promising research areas include elucidating the distinguishing characteristics of immune reactions through analysis at the molecular level, and a focus on oral mucosal dendritic cells.

New tools uncovering the protective roles of basophils

Basophils are white blood cells that can be stained using basic dyes. Their presence in circulating blood was identified more than 120 years ago. Attempts to understand their roles have been hindered by their rarity — they represent less than 1% of peripheral blood leukocytes — and the absence of basophil-deficient animal models.

TMDU researchers have recently developed new ways to investigate the functions of basophils in health and disease. Hajime Karasuyama's laboratory has established a basophil-depleting antibody and engineered basophil-deficient mice. His team has discovered that these cells help protect us from parasitic infections, such as those caused by ticks and helminths, while also contributing to the development of allergic disorders such as atopic dermatitis. This work may lead to the development of anti-parasite vaccines and novel strategies for treating allergies.

A novel source of dendritic cells that could inspire new ways to fight disease

Dendritic cells (DCs) play crucial immune system roles both by helping prevent overreactions under steady-state conditions and by absorbing fragments of antigens to present to the antigen-specific immune system to trigger attacks following infection. Toshiaki Ohteki's group recently discovered a novel source of DCs called DC progenitors. These generate no other haematopoietic cells. Each can produce up to 1,000 fresh DCs. This discovery will provide insights into the DC differentiation pathways, as well as new avenues for the development of therapies for infectious diseases, cancers and autoimmune diseases.

ARTICLES: 462

CORRECTED COUNT: 290.01

Japan

Japan is still the leading science nation in the Asia–Pacific NPI, with five institutions in the regional top 10 and the global top 50. But it has a serious rival in China, whose research output is growing at an extraordinary rate. The Japanese government's recent pro–science stimulus package might have arrived at just the right time for the country to fight back.

In January 2013, the prime minister, Shinzo Abe, introduced an economic stimulus package that showed a return to Japan's historical confidence in, and reliance on, science. Under the former administration, budget austerity had reduced salaries of scientists and forced cutbacks in large research projects. But Abe's government approved a shot in the arm worth more than US$7 billion.

The money will help Japanese scientists respond to the country's changing landscape. Japan is still coping with the legacy of the Tohoku earthquake and tsunami, the subsequent disabling of the Daiichi nuclear power plant near Fukushima, and the virtual shutdown of its nuclear industry.

With nuclear power unavailable, Japan now draws nearly 90% of its energy from fossil fuels — almost all of which are imported. The stimulus package trebled support for research into next-generation energy resources, and increased spending on several programmes aimed at lowering energy consumption. Cleaning up the ailing power plant will cost hundreds of billions of dollars — and will depend on large efforts in engineering, health and environmental research.

Japan is also facing serious competition from China at every level. And as this year's NPI lays bare, China's enormous science effort is beginning to challenge Japan's research dominance. Relations between the two countries are frosty at best; the whole world watches as the two square off diplomatically and militarily over disputed Senkaku islands in the South China Sea. Perhaps this rivalry explains, in part, the small level of collaboration in the NPI between Japanese and Chinese researchers.

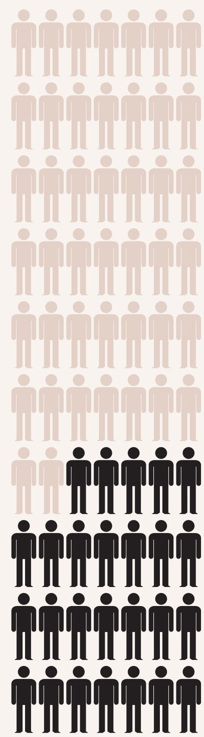
INVESTING IN SCIENCE

The Abe government expects a return from its investment in research — and soon. About a quarter of the science stimulus — some US$1.8 billion — is earmarked for commercialization of university research. Much of the rest is for projects with industrial or clinical applications. The stimulus will also pour funding into the development

JAPAN TOP TEN

Japan has 60 institutions in the Asia-Pacific top 200

Asia-Pacific rank 2013	Institution	National rank 2013	Corrected count 2013	Articles 2013	National rank 2012	Corrected count 2012	Articles 2012	National rank 2009–13	Corrected count 2009–13	Articles 2009–13
2	The University of Tokyo	1	57.19	128	1	39.72	116	1	206.76	509
3	Kyoto University	2	23.57	58	2	22.47	55	2	106.63	248
4	RIKEN	3	21.88	81	3	19.14	79	3	93.71	325
5	Osaka University	4	17.98	40	4	18.22	54	4	84.05	214
7	Tohoku University	5	17.41	49	5	10.50	30	5	52.63	150
15	Nagoya University	6	10.68	33	6	8.55	27	6	41.41	117
18	Hokkaido University	7	8.45	25						
24	National Institute for Material Science (NIMS)	8	6.89	16				8	23.89	71
29	Tokyo Institute of Technology	9	6.21	18	9	5.47	17			
30	National Institutes of Natural Sciences (NINS)	10	6.07	22	10	4.60	16			



Researcher density (each figure represents 200 researchers per million inhabitants)

JAPAN 2013

POPULATION: 126.4 M

RESEARCHERS: 656,032

SOURCE: UNESCO

and maintenance of Japan's research infrastructure—renovation of the SPring-8 synchrotron, for instance, and the construction of data links between Japan's universities and RIKEN's K supercomputer, the world's fastest computer in 2011 and still ranked fourth today.

Stem cell research — mainly the area of reprogrammed adult cells known as induced pluripotent stem cells (iPS), in which Japan leads the world — was a major recipient in the stimulus package, following an important year. 2013 started with a paper in *Nature* from Japan's National Institute of Radiological Sciences that demonstrated that iPS cells, when injected into mice, behave similarly to embryonic stem cells. Significantly, iPS cells do not automatically trigger the immune system, as had previously been feared.

Japanese authorities also have been clarifying the legislation governing the use of stem cells. Approval for the first human trials of iPS cells — a clinical study aimed a treating macular degeneration, a significant cause of blindness — was granted in record time from ethics committees and the government.

RECORD APPROVAL

Substantial funding was also directed towards underwater investigation, which is already paying scientific dividends. In March the deep-sea drilling vessel, Chikyu, successfully extracted methane from methyl hydrate deposits 300 metres under the sea floor. Reservoirs of such hydrates are thought to contain more fossil fuel than all other sources combined. Chikyu proved its worth in a quite different arena in early December. Drilling into a fault-line a kilometre beneath the seabed and under seven kilometres of water, Chikyu uncovered the cause of Tohoku earthquake — a slippery layer of clay only five metres thick between two tectonic plates. The international project has generated a plethora of significant papers, confirming an earlier theory published in *Nature* in 2013 by a team that included a scientist from the Japan Agency for Marine-Earth Science and Technology.

Unsurprisingly, the aftermath of the earthquake and tsunami generated a lot of activity to measure impact, deal with consequences, and try to prevent similar disasters. The Fukushima Health Management Survey questioned 90,000 evacuees about their mental state two years after the disaster.

The responses revealed major mental health problems — anxiety, depression, post-traumatic stress disorder — among the otherwise healthy survivors. In October, as increased levels of radiation were reported to emanate from the stricken power plant, the government asked for international assistance to help Japanese nuclear scientists and engineers stabilize the situation.

IMPACT MEASURED

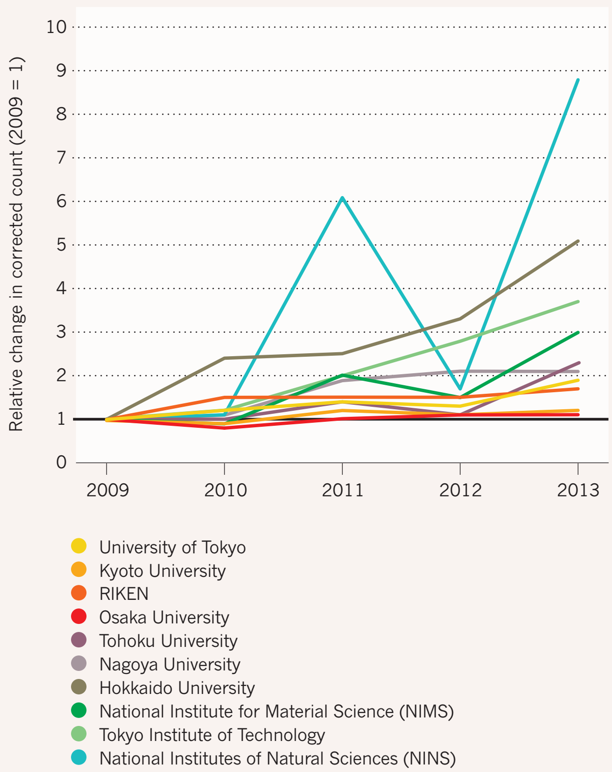
The university most affected by the tsunami, Tohoku University in Sendai, has bounced back strongly in the NPI rankings. Tohoku's traditional strengths of materials and physical sciences were well represented in its NPI papers last year, particularly in studies to do with atomic spin. Nearly a quarter of Tohoku's CC came from nine articles to do with spintronics or atomic spin published in *Nature Communications, Nature Materials* and *Nature Physics,* and there were several other papers on astrogeology and the magnetic interactions of materials.

The university is also generating significant Nature publications in the biological sciences. Tohoku published several papers concerning blood and its formation, for instance, and the molecular basis of behaviour.

Japan's top four institutions — The University of Tokyo, Kyoto University, RIKEN and Osaka University — have remained stable in the NPI for the past five years, with Tokyo still producing more than double the number of papers as its nearest Japanese rival. However, Asia-Pacific regional leadership has shifted to the Chinese Academy of Sciences — the first time since NPI's inception that The University of Tokyo has been overtaken. ■

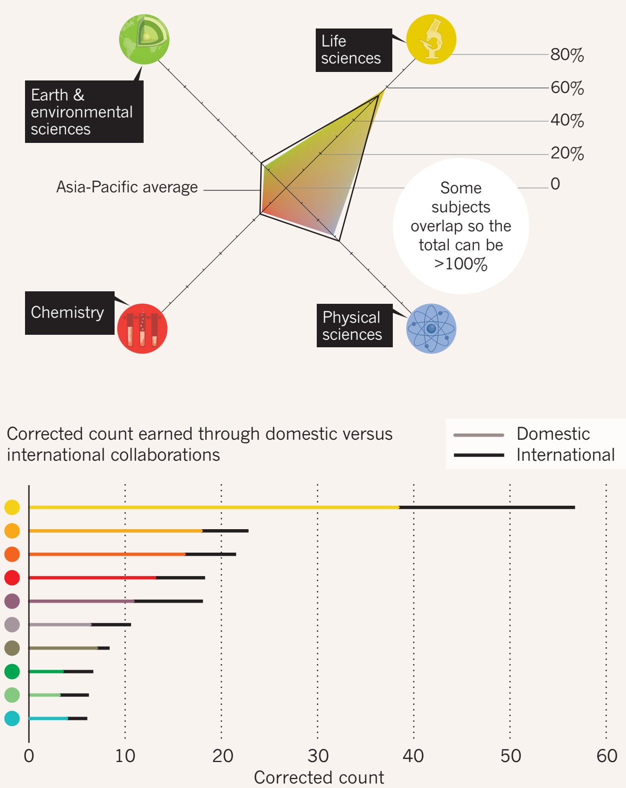
INSTITUTIONAL PUBLISHING TRENDS

Charting the changes in output from the top 10 institutions since 2009.



RESEARCH STRENGTHS

The subject areas in which Japan achieved its corrected count.







Hiroshima University

DRIVING RESEARCH STANDARDS EVER HIGHER

In 2013, Hiroshima University was named as one of 22 institutions awarded Research University status by the Japanese Government. Under this programme, universities already known as centres of research excellence are encouraged and supported to achieve even more. This honour shows not only the high standards being set at the university, but also the level of expectation that society at large has of it.

These are responsibilities that Hiroshima University takes seriously, yet its ambitions extend further still. Its leadership believes that through an ongoing programme of improvements and restructuring, it can become one of the top 100 universities in the world. Those appointed as distinguished professors and distinguished researchers at the university already receive a broad range of support to help them maximize their efforts and potential. They are, for example, provided with the full services of research administrators and technical personnel so that they can use their time as effectively as possible.

Those engaged in fields of research deemed to have especially high potential are given extra space and resources to help them carry out their work. The university is planning to expand its research horizons by providing more of this additional assistance, especially for those engaged in interdisciplinary work. In future, it will place greater emphasis on the formation of research hubs beyond the borders between the university and state agencies.

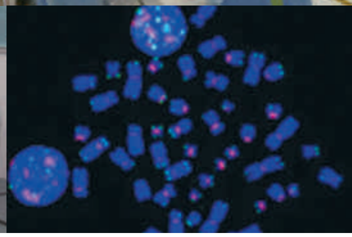
Hiroshima University believes in offering motivated and capable students the opportunity to study abroad. This not only can provide rewarding and enriching experiences, but also allows those who wish to broaden their horizons in this way to learn how to live in other countries. The university works in cooperation with its partner universities overseas to develop common postgraduate and degree programmes, as well as participating in a variety of other schemes that provide opportunities for our students to study abroad. Alongside these efforts, increasing international student numbers forms an important part of the university's plans to boost its research capabilities. That is why it is taking steps to help it achieve its aim of doubling the number of international students to 2,000 within four years.

The university is fully committed to engaging in projects that will help stimulate revitalization of the local community and economy, by, for example, engaging in research collaborations with local industries. It hopes to make changes to its existing infrastructure that will make it possible to increase these contributions further.

Toshimasa Asahara, president of Hiroshima University

Successful societies need to nurture their human resources. It is important that we all learn to understand social differences and develop sufficient intellectual independence and wisdom to form individual judgments, and to act upon them. This is why Hiroshima University has worked hard in the past to enhance its programmes of liberal arts education, and believes further developments will be required in the future.

Dr Toshimasa Asahara, president of Hiroshima University, says "Hiroshima University would never be swayed by significant social changes as long as we pursue the defined goal of fostering human resources. We will keep working to achieve this mission, that is, contribution to future society by fostering human resources with a broad view, deep insight and rich humanity."



TOWARDS PEACEFUL, FREE AND SAFE TOMORROWS

World-class graduate education

Hiroshima University is seeking to attract more graduate students through its Leading Graduate Education Programme. Launched in October 2012, it includes the Phoenix Leader Education Programme and the TAOYAKA Programme, both of which have been selected to receive support under a Japanese Government scheme to promote efforts to develop world-class degree programmes. Phoenix and TAOYAKA are new interdisciplinary PhD programmes, which, it is hoped, will produce global leaders capable of creating new forms of knowledge that transcend the boundaries of conventional academic and research disciplines. Based on the university's particular specialisms and strengths, the Leading Graduate Education Programme is designed to improve the originality of students, broaden their perspectives, and develop their ability to take action and resolve problems. The curriculum also includes a group of common core subjects to impart the spirit of peace to Hiroshima University students. In this way we will nurture personnel who can address problems in a creative manner, view the world based on broad knowledge, and act globally.

New ways to respond to radiation disasters

Radiation is as important as ever in medicine, industry and nuclear power in the 21st century, yet our related safety systems remain fragile. Meanwhile, recent political instability in some parts of the world raises the threat of nuclear terrorism. There is a global need for experts who can work effectively in situations of nuclear disaster or nuclear terrorism to reduce risks and optimize safety.

Hiroshima University's Research Institute for Radiation Biology and Medicine, and University Hospital have a long history of wide-ranging research into radiation hazards caused by the atomic bombing of Hiroshima in 1945, and of medical treatment for people who suffer from atomic bomb radiation. Based on these experiences and achievements, the Phoenix Leader Education Programme is designed to produce global leaders with sufficient clarity of vision and cross-disciplinary training to take effective leadership roles in radiation disaster recovery.

The basis of the programme is radiation disaster recovery studies, which includes elements of medicine, environmental studies, engineering, sciences, sociology, education and psychology. It is designed to establish a new system of leadership and response to radiation disasters that will enhance safety and security in the 21st century. Phoenix Leaders are expected to act globally to make use of their expertise and capacity to protect human lives, the environment and societies from the risks associated with radiation.

Enhancing lives through science and technology

Hiroshima University's TAOYAKA programme promotes freedom and peace while building on and expanding conventional peace studies and education. TAOYAKA societies are flexible, enduring and peaceful, as well as having a global perspective. They can be brought about through multi-dimensional innovations in science and engineering, society, culture and entrepreneurship policy. Recent years have shown the enormous potential of novel technologies to improve lives in the developing world radically.

To develop young global leaders, the five-year TAOYAKA PhD programme offers interdisciplinary educational opportunities in cultural and technological innovation, and their social implementation. A wide range of interdisciplinary course work on campus is integrated with intensive on-site experience in disadvantaged areas in both developed and developing countries, with special emphasis on improving lives by deploying advanced science and engineering.

HIROSHIMA UNIVERSITY

www.hiroshima-u.ac.jp/





Okinawa Institute of Science and Technology Graduate University (OIST)

A NEW DAWN FOR INTERDISCIPLINARY RESEARCH

Based on a bold vision of creating a world-class, interdisciplinary research university on a subtropical island 400 miles south of mainland Japan, the Okinawa Institute of Science and Technology Graduate University (OIST) is a graduate school like no other. Set amidst coral reefs, white sand beaches and emerald seas, OIST boasts stunning vistas and a modern, vibrant campus with state-of-the-art equipment and facilities including an electron microscope suite, a DNA-sequencing centre, a supercomputing centre and spectroscopy laboratories. The new multi-use auditorium at OIST has already hosted internationally-renowned artists including I Musici as well as lectures delivered by Nobel laureates.

The campus, located on the west coast of Okinawa — the largest in the Ryukyu Islands archipelago — contains 700,000 square feet of research buildings and accommodates a community of upwards of 600 researchers, students and support staff. Interdisciplinarity is at the heart of OIST's core values: by removing the barriers between disciplines altogether, OIST is overturning conventional approaches to research and education.

In contrast to other universities in Japan, OIST has a highly international profile and scope. All of the teaching and research at the institute is conducted in English, and over half of the faculty and students are recruited from overseas. Funded primarily by the Japanese Government, OIST opened its doors to the first cohort of students from across the world in September 2012, after receiving accreditation in November 2011.

"In record time, we have been able to build a fully functioning research graduate school and have been successful in attracting high-level faculty and students," says Neil Calder, vice president for communications and public relations at OIST. "The vision is to nurture leaders of the next generation of scientists who can succeed on the global stage."

Cultivating research excellence

Uniquely, the institute offers training and personalized development through a specialized 5-year PhD programme. Students are encouraged to broaden and deepen their knowledge of areas outside their main field of study by working alongside leading researchers in neuroscience, mathematical and computational sciences, environmental and ecological sciences, physics, chemistry, and molecular, cell and developmental biology.

"From the word go, students have the opportunity to work side-by-side with researchers and have access to world-class equipment and laboratories," says Calder. As part of the PhD programme, a laboratory rotation system ensures that students gain valuable experience in a variety of research projects and techniques. Calder adds, "Our students are asked to join research projects outside their speciality. A physicist may go to a biology lab, a mathematician to neuroscience lab, a chemist to a genetics lab and so on, students can pick up the language and learn from these diverse interactions."

The relatively small size of the institute creates a favourable 2:1 student-to-faculty ratio and also provides a warm community feel. "You have to be there to feel the sense of openness and welcoming atmosphere," says Kiyoshi Kurokawa, academic fellow of the National Graduate Institute for Policy Studies and member of the OIST Board of Governors.

One of OIST's strengths, Kurokawa explains, is its ability to begin from scratch, based on an entirely different ethos to traditional 'big city' universities in Tokyo, Kyoto and Osaka. Guided by the principles of interdisciplinarity, quality and sustainability, Kurokawa envisions that OIST will make its mark as "a small but impactful hub of innovation that will develop future leaders in science."

Taking a global view

Promoting internationalization and cultivating a culture of open communication is key to enabling young researchers to

engage with today's global challenges and technological developments. More and more universities in Japan are now intensifying their efforts to promote international exchange and research collaborations.

"Science has no borders," says Hitoshi Murayama, director of the Kavli Institute for the Physics and Mathematics of the Universe (IPMU) at the University of Tokyo. Commenting on how OIST and other universities in Japan can become more globally competitive, Murayama says, "I feel that scientists in Japan have been somewhat isolated from the rest of the world, and often do not receive the recognition they deserve. Science is supposed to be objective, but it is conducted based on human connections. We need the Japanese academic community to be more plugged in to the international community."

In practical terms, Murayama urges young scientists to "go out, give talks, communicate, interact and chat with others". He emphasizes that "it is absolutely critical that the scientific research addresses questions that appeal to the global community of scientists."

On a day-to-day basis at OIST, students are encouraged to build on their communication skills, exchange ideas and draw on the wealth of learning opportunities available. Calder similarly advises young scientists to "get away from their desks, go to seminars and talk with other students and researchers" to develop a wider perspective and "create a seed-bed of learning".

In addition to hosting regular science-communication workshops throughout the academic year, OIST provides training for researchers to present their work at seminars and international conferences, and also offers intensive language training in both Japanese and English.

Collaborating for success

Already the graduate university has established collaborative agreements with more than 20 leading universities and institutes overseas. In the area of marine biology, for example, OIST has formed collaborative agreements with the Woods Hole Oceanographic Institution (WHOI) and the Marine Biological Laboratory (MBL) in Woods Hole to accelerate discovery in the environmental, biological and biomedical sciences. These agreements are designed to facilitate student and staff exchanges, and encourage joint research implementation.

OIST is also developing strong collaborations with industry. For example, OIST and Shionogi & Co., Ltd. are undertaking collaborative projects to advance pharmaceutical research and development, and address unmet medical needs. Due to OIST's designation as a Special Private School Corporation, the institute has the go-ahead to engage proactively with various innovative projects.

Working with Sony Computer Science Laboratories, scientists at OIST are exploring how to maximize efficiency in renewable energy technologies such as solar panels and wind turbines.

"The most important thing is that you have to be crazy enough to think that you can change the world," says Hiroaki Kitano, president and chief executive officer of Sony Computer Science Laboratories, and adjunct professor at OIST. "Innovation emerges when you identify real issues in the world and decide to solve [them] or make things happen in a very fundamental way, rather than following well-accepted but not very fundamental approaches. It is essential to identify the basic premise or assumption first, and turn it around to solve the issue."

Kitano adds that diversity is key to success in innovation and in cultivating individuals with an international outlook. He encourages students to travel around the world and experience different cultures, as innovative ideas "often come from deep thinkers who have free spirits, obsession and dedication."

While noting that OIST is embarking on a new and unprecedented endeavour to change the way that research and training at the doctoral level is conducted in Japan, Kurokawa is confident that OIST will "become more and more recognized because of its very uniqueness" and that science in Japan will undoubtedly benefit from having more "out-of-the-box thinkers and doers".

For early- or mid-career researchers with an interest in discovering more about opportunities at OIST first-hand, Kurokawa advises, "Come and visit, and perhaps join various workshops and seminars. Browse the OIST website — and be part of this exciting experience."

ARTICLES: 493

CORRECTED COUNT: 245.19

China

China's investment in science is bearing fruit. In 2013, it published more articles in NPI journals than any other Asia–Pacific nation. Significantly, in January that year, the Chinese Academy of Sciences (CAS) knocked The University of Tokyo off the top of the NPI institutional rankings. China has ambitious projects underway that challenge not only Japanese but European and US institutions.

For China, 2013 was a year of scientific discoveries, technological feats and the construction of cutting-edge facilities.

In February a team from China and the US, led by Xiangdong Ji of Shanghai Jiao Tong University (SJTU) initiated the world's deepest particle-physics experiment, PandaX, aimed at detecting particles of dark matter in pools of liquid xenon deeper than 2.5 km underground.

In June, China sent its fifth crewed spacecraft, Shenzhou 10, to dock with China's space station, Tiangong 1. It is the first stage of a plan to construct a bigger modular station around 2020, four years before the planned end of the International Space Station programme. Also in June, the Tianhe-2 (or Milky Way-2) supercomputer became the world's fastest, with an operating speed of 33.9 petaflops per second – nearly twice as fast as the previous leader.

China's high-definition Earth observation satellite, Gaofen 1, started operating in December to survey and monitor environmental processes, particularly to collect data on natural disasters such as earthquakes.

Earlier in December, another arm of its space programme made news when China became the third country, after the US and Russia, to explore the moon. The Chang'e-3 lunar probe landed safely and delivered China's first robot rover, Yutu (or Jade Rabbit), which is equipped with ground-penetrating radar, spectrometers and cameras.

Chinese scientists are also exploring the oceans for knowledge. Under the country's 12th Five-Year Plan (2011-15) a National Deep Sea Center will be set up and its deep-diving submersible, Jiaolong, upgraded.

China can now also lay claim to the oldest-known primate skeleton, the earliest collection of fossilised dinosaur embryos — found in their crushed shells — and the earliest-known member of the bird family. These discoveries were published in *Nature* in 2013 by scientists from CAS and from other domestic and international institutions.

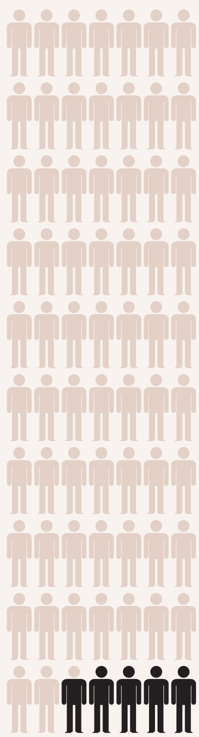
China is allocating an increasing proportion of its GDP to science and technology: 1.98% in 2012; expected to rise to 2.2% by 2015. President Xi Jinping, who took office in March 2013, is continuing his predecessor's

CHINA TOP TEN

China has 65 institutions in the Asia-Pacific top 200

Asia-Pacific rank 2013	Institution	National rank 2013	Corrected count 2013	Articles 2013	National rank 2012	Corrected count 2012	Articles 2012	National rank 2009–13	Corrected count 2009–13	Articles 2009–13
1	Chinese Academy of Sciences (CAS)	1	63.15	165	1	36.38	93	1	147.70	399
9	University of Science and Technology of China (USTC)	2	15.11	37	2	9.46	17	2	39.67	87
10	Tsinghua University	3	13.83	39	3	8.99	34	3	39.39	116
14	Peking University	4	11.16	48	4	8.72	35	4	33.15	131
17	BGI	5	10.50	32	5	6.62	30	5	23.86	73
21	Nanjing University	6	7.89	19	6	6.27	20	6	18.87	101
35	Fudan University	7	5.72	25	7	4.70	15	7	17.79	49
36	Zhejiang University	8	5.70	25				8	15.64	64
37	Shanghai Jiao Tong University (SJTU)	9	5.63	35	9	3.90	13	9	15.01	57
39	The University of Hong Kong (HKU)	10	4.99	18	10	2.92	14	10	14.67	68

Researcher density (each figure represents 200 researchers per million inhabitants)



CHINA 2013

POPULATION: 1.354 B

RESEARCHERS: 1.318 M

SOURCE: UNESCO

fiscal promotion of science and has emphasized that such investment should be a driving force for the country's economic development.

However, in 2013, Mu Rongping, director-general of the CAS Institute of Policy and Management, told the American Association for the Advancement of Science that China suffers from a lack of innovation. Critics blame a system that bases funding allocation on other considerations than merit.Only a small proportion of its science and technology budget is spent on basic research, academics are poorly paid and government agencies are not well coordinated.

Many Chinese enterprises depend on foreign innovation for core technologies. World Bank data show that in 2012 China earned US$1 billion in intellectual property fees while paying out US$17.7 billion. But, Chinese researchers are not without creativity: the Tianhe-2 supercomputer and China's space programme are both examples of how the country contributes significant home-grown improvements to existing technologies.

Chemistry is China's strength in the NPI. In that field, its top three institutions — CAS, University of Science and Technology of China (USTC) and Xiamen University — published 38 chemistry articles in Nature research journals in 2013. But 33 of these were in the online-only journal *Nature Communications*. The top two contributors to the more prestigious *Nature Chemistry* were Japan's Kyoto and Nagoya Universities (see Top Institutions by Journal, page 46). CAS earned about half of its CC from articles published in *Nature Communications*.

CAS LEADING THE WAY

CAS is the leading light among Asia-Pacific institutions. It comprises more than 100 research centres, of which the Institute of Physics (17%) and the Shanghai Institutes for Biological Sciences (13%) make the greatest contributions to CAS's NPI output. In 2013, CAS ranked 6th in the Global Top 100, up from 14th in 2012 and 23rd in 2011.

The notable riser in 2013 was Nanjing University, whose output in the physical sciences lifted it from 14th to 6th in China. Nanjing published more articles in *Nature Physics* than did any other Asia-Pacific institution in 2013 and was ranked third for papers in *Nature Materials*.

Of the top Chinese institutions, the highest proportional growth since 2009 has been shown by the global genomics company BGI, which is now China's fifth-ranked institution. Genome sequences published by BGI in *Nature, Nature Genetics* and *Nature Communications* help explain the evolution of predatory instinct in falcons and salt adaptation in the desert poplar, among other insights.

Almost 90% of the NPI articles from both BGI and SJTU came from international collaborations. For BGI this is to be expected as gene sequencing typically requires many collaborators. For instance, a typical genomics paper may have in excess of 200 authors affiliated with more than 150 institutions from across 20 countries.

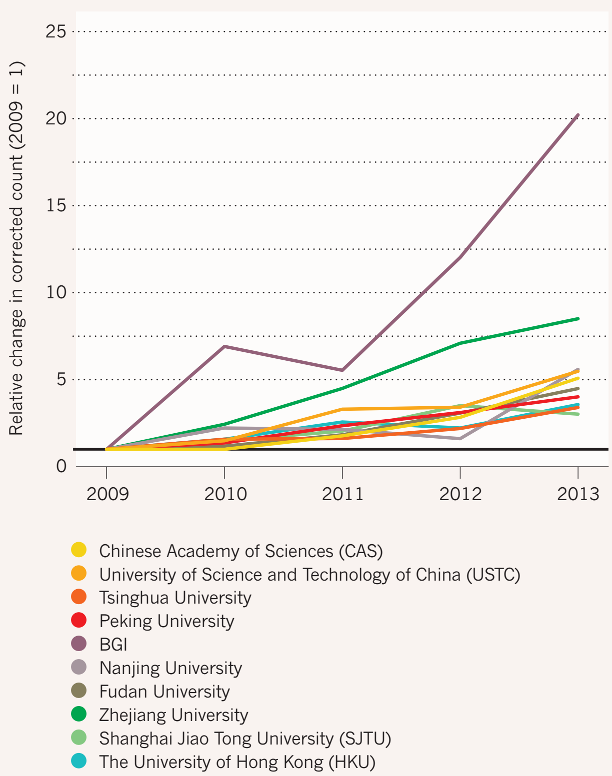
For SJTU, however, international cooperation is a strategy for improvement. It offers joint degrees with universities in the US, France and the UK, and a PhD exchange scheme with the University of Cambridge. It also has cooperation agreements with more than 100 universities and research institutions worldwide. SJTU claims to have the most returnees under the 1000 Talents scheme, a government-funded scheme that offers top Chinese researchers substantial incentives to return home. Despite recording an increased article count, SJTU was the only institution in the top ten whose corrected count decreased in 2013. This may be due in part to extensive international and domestic collaboration. SJTU published papers with 63 other Chinese institutions, compared with USTC's 24 and Tsinghua's 18.

China's range of international partners is changing: it increased collaboration with Denmark, Canada and Australia, at the expense of research with the US. Many collaborations have government support.

Since 2008 the National Natural Science Foundation of China (NSFC) has worked with the Danish National Research Foundation to establish ten research centres in cancer research, nanotechnology, renewable energy and communication technology. This link is starting to yield high-quality results. ■

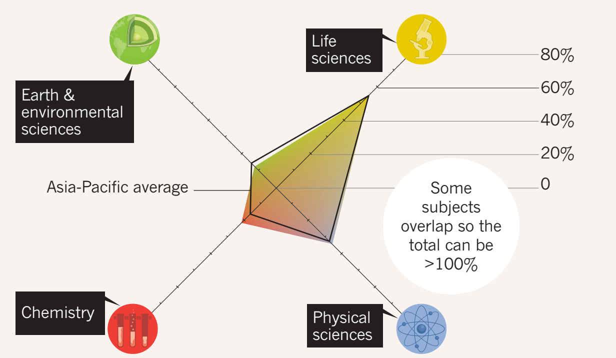
INSTITUTIONAL PUBLISHING TRENDS

Charting the changes in output from the top 10 institutions since 2009.

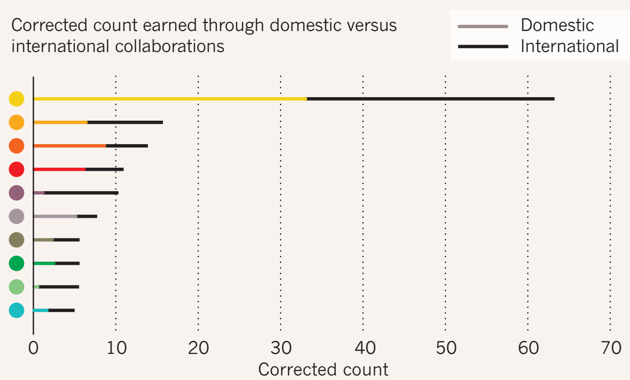


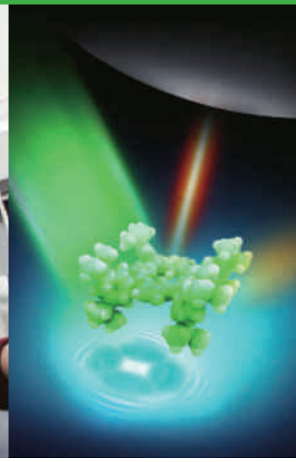
RESEARCH STRENGTHS

The subject areas in which China achieved its corrected count.



Corrected count earned through domestic versus international collaborations





University of Science and Technology of China (USTC)

PURSUING EXCELLENCE IN SCIENCE

The University of Science and Technology of China (USTC) is one of the most important innovation centres in the country, and is always ranked among its best universities. It is particularly strong in fields such as quantum manipulation, nanotechnology, high-temperature superconductivity, speech processing, fire science and life sciences.

The USTC takes the lead in many major science projects, such as quantum satellite research and dark-matter detection. It is also an active contributor to significant international projects, such as the International Thermonuclear Experimental Reactor (ITER) and the European Organization for Nuclear Research (CERN).

In 2013, the USTC won more than 20 renowned awards in science and technology. For example, a team of USTC physicists led by Professor Xianhui Chen received the first prize in Chinese Natural Science for their contributions to the field of superconducting materials; for the previous three years, there had been no recipients of this prize.

Some of the latest research highlights are described below.

PHYSICS AND CHEMISTRY

High-energy physics at the particle colliders

A team led by Professor Zhengguo Zhao in the School of Physical Sciences made weighty contributions to the study of di-boson production, triple-gauge boson couplings and the discovery of Higgs particles via the ATLAS experiment at the Large Hadron Collider (LHC) of CERN. Zhao also greatly contributed to the observation of the Zc particles that were suggested to represent the charmed multiquark states, using the Beijing Spectrometer (BESIII) at the Beijing Electron Positron Collider (BEPCII), and, for the first time, observed over 10 new decay modes of the charmonium states cJ and c. As a result of these outstanding achievements, Zhao was elected as an academician of the Chinese Academy of Sciences (CAS), which is the highest academic honour in the country.

Inorganic solid-state chemistry

Professor Yi Xie and her group at the Hefei National Laboratory for Physical Sciences at the Microscale (HFNL) pioneered research into the design and synthesis of inorganic functional solids with efforts to modulate their electron and phonon structures. Xie established the methodology known as the "synergetic use of binary characteristic structures" for the synthesis and assembly of inorganic functional materials, proposed a strategy for modulating the electron and phonon transport properties with phase transitions at the nanoscale, developed new high-efficiency thermoelectric materials systems, and discovered the relationship between the fine/electronic structures and the thermoelectric/optoelectronic properties of two-dimensional semiconductor crystals. As a female scientist, Xie is the youngest academician of the CAS among those elected in 2013.

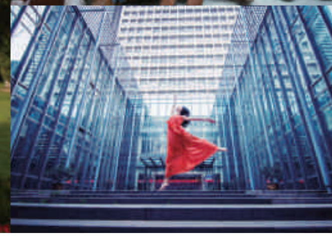
Carbon aerogels sop up hydrocarbons

A team led by Professor Shuhong Yu at the HFNL is pursuing carbon aerogel production from biomass. The team selected bacterial cellulose pellicles — a commonly used, inexpensive, nontoxic form of biomass consisting of a tangled network of cellulose nano fibres — as a precursor for the production of ultralight carbon nanofibre aerogels on a large-scale. This biomass can easily be produced on an industrial scale through microbial fermentation.

QUANTUM INFORMATION AND QUANTUM TECHNOLOGY

The Synergetic Innovation Centre for Quantum Information and Quantum Physics (SIC–QIQP), head by Professor Jianwei Pan, was established and financially supported by the Chinese Ministry of Education. It focuses on bringing together teams of multi-disciplinary researchers to form a dynamic national network for developing scalable quantum technologies.



Foiling quantum hackers

A research team led by Professor Qiang Zhang and Professor Tengyun Chen at the SIC–QIQP successfully demonstrated the measurement-device-independent quantum key distribution by developing up-conversion single-photon detectors with high efficiency and low noise. The new quantum-encryption method provides the ultimate security against hackers in real-world cryptography applications, and greatly improves the security of quantum-encryption systems. This research was selected as one of the Highlights of the Year in *Physics* by the American Physical Society.

A milestone in satellite-based quantum communication

A collaborative team led by Professor Chengzhi Peng at the SIC–QIQP achieved comprehensive and direct verification of quantum communication between satellites and ground stations. This research lays the necessary technical foundations for a global quantum-communication network based on ground–satellite quantum communication by launching the quantum science experimental satellite of China.

Optical spectroscopy goes intramolecular

A team led by Professor Zhenchao Dong at the SIC–QIQP reported an optical spectroscopic-imaging approach that achieves subnanometre resolution and resolves the internal structure of single molecules. This development could lead to new techniques for probing and controlling nanoscale structure, dynamics, mechanics and chemistry. This research was listed among China's top 10 science news stories in 2013.

ENVIRONMENTAL AND EARTH SCIENCES

Penguins thrived in Antarctica during the Little Ice Age

New research led by Professor Liguang Sun in the School of Earth and Space Sciences showed that penguin populations in the Ross Sea of Antarctica spiked during the short cold period, called the Little Ice Age, which occurred between AD1500 and 1800. These results run contrary to previous studies that found increases in Antarctic penguin populations during warmer periods and decreases during colder periods, suggesting that populations living at different latitudes in the Antarctic might respond differently to climate change.

Uncovering the mystery of subduction zone earthquakes

Based on analytical data from four of the highest magnitude subduction zone megathrust earthquakes, the conclusion was drawn that low-frequency radiation is closer to the trench at shallower depths and high-frequency radiation is farther from the trench at greater depths, in general. This scientific breakthrough was achieved by a team led by Professor Huajian Yao.

LIFE SCIENCES

New evidence for curing type 2 diabetes

Research teams led by Professor Rongbin Zhou and Professor Zhigang Tian in the School of Life Sciences revealed a new mechanism through which omega-3 fatty acids inhibit inflammation and prevent type 2 diabetes. The research results were published in *Immunity* in June 2013 and highlighted in the same issue of the journal.

Identifying liver-resident natural-killer cells with immune memory

A team also led by Professor Zhigang Tian identified liver-resident natural-killer (NK) cells that possess unique immune memory characteristics absent from normal NK cells.

LincRNA-p21 as a novel key player in regulating the Warburg effect

A research team led by Professor Mian Wu and Professor Yide Mei, at HFNL and the School of Life Sciences, has revealed a novel mechanism whereby lincRNA-p21 regulates the Warburg effect under hypoxic conditions. They demonstrated, for the first time, that lincRNA-p21 is an important regulator of the Warburg effect, and also identify lincRNA-p21 as a valuable therapeutic target for cancer. ■

ARTICLES: 264

CORRECTED COUNT: 103.76

Australia

Australia has improved its NPI score by almost every measure. The country's greatest strengths are still the earth and environmental sciences. The new conservative government, however, is creating an uneasy atmosphere: there is no science minister in the cabinet, and several agencies — particularly those dealing with climate change — are being closed down.

After several years of a relatively unstable, minority Labor government — under whose stewardship there were 4 science ministers in 16 months — one might have expected Australia's science community to welcome a new administration. Elected in September 2013 with a significant majority, the conservative government is led by a former health minister, Tony Abbott, who is known to support medical research.

But some of the government's actions have unnerved Australia's scientists. Many of Abbott's cabinet ministers and advisers have dismissed the idea of human contribution to global warming — the evidence for which Australian scientists have been prominent in collecting. The Abbott government, which campaigned to repeal a carbon tax, was quick to start closing agencies responsible for climate advice and assistance, citing high cost and inefficiency. Then, for the first time since 1931, the prime minister failed to appoint a minister for science or research. Instead, responsibilities are split between several portfolios: education, health and, primarily, industry.

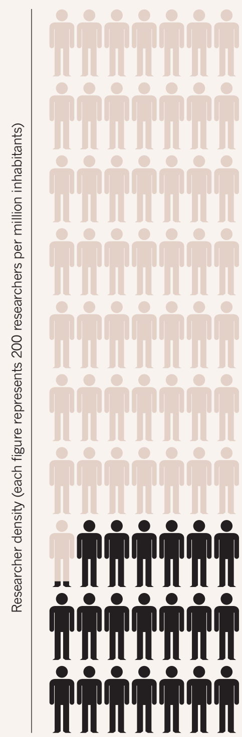
The government also brought with it a change in scientific priorities: a stronger emphasis on linking government-funded research to industry; indications that it will redirect about AUD$100 million from science and humanities to medical research; a freeze on public service hiring, which CSIRO staff say will disproportionately affect Australia's national research body; and a general tightening of spending across the board.

The government's apparent disdain for environmental conservation generally, and "green tape" in particular, threatens to undermine Australia's strong publishing record in earth and environmental sciences. As it did last year, Australia accounted for about a third of the papers in this category for the Asia-Pacific NPI. CSIRO is the Asia-Pacific's most prolific contributor to *Nature Climate Change*, while the University of Western Australia, the University of Queensland and James Cook University (JCU) made up three of the other top four contributors. Indeed, earth and environmental sciences is the only

AUSTRALIA TOP TEN

Australia has 28 institutions in the Asia-Pacific top 200

Asia-Pacific rank 2013	Institution	2013 National rank	2013 Corrected count	2013 Articles	2012 National rank	2012 Corrected count	2012 Articles	2009–13 National rank	2009–13 Corrected count	2009–13 Articles
8	The University of Melbourne	1	15.33	69	1	10.78	48	1	44.02	205
11	Australian National University (ANU)	2	12.64	33	2	8.10	21	2	34.91	94
16	The University of Queensland (UQ)	3	10.62	50	3	7.08	41	3	34.22	159
23	The University of New South Wales	4	7.33	31	4	4.44	24	4	23.79	129
25	The University of Sydney	5	6.51	37	5	3.96	16	5	21.65	88
26	Monash University	6	6.33	30	-	-	-	6	18.17	89
28	The Commonwealth Scientific and Industrial Research Organisation (CSIRO)	7	6.33	29	7	3.88	21	7	18.11	76
33	The Walter and Eliza Hall Institute of Medical Research (WEHI)	8	5.89	22	8	3.82	22	8	12.86	53
53	The University of Western Australia (UWA)	9	2.58	24	9	2.00	26	9	10.67	102
62	Macquarie University	10	2.09	13						



AUSTRALIA 2013

POPULATION: 23 M

RESEARCHERS: 92,649

SOURCE: UNESCO

category in which Australia challenges the NPI output of heavy hitters China and Japan. Even so, it could not maintain its 2012 position at the top, and has slipped to second in this category.

IMMUNE BOOST

In the life sciences, Australia ranks third in the NPI Asia-Pacific behind China and Japan. However, it is persistently strong in immunology. Four of the top five Asia-Pacific institutions contributing to *Nature Immunology* were Australian: the University of Melbourne, the Walter and Eliza Hall Institute of Medical Research (WEHI), Monash University and the University of New South Wales (UNSW). For example, WEHI researchers generated international interest with a paper that described a mechanism through which eating leafy greens boosts the level of protective immune cells in the human gut.

Because Australia's science budget is small compared to that of China and Japan, it can only become involved in 'big science', such as particle physics, astronomy, systems biology, large medical trials and oceanography, by leveraging its expertise and geographic position in collaborative work. Researchers at eight of Australia's top ten institutions worked with international partners on well over half their Nature papers. Scientists at tenth-placed Macquarie University collaborated internationally in all their NPI papers — teaming up with scientists from Japan, China and South Korea as well as with researchers in Europe, the US and Canada. Macquarie University has long been known for its strength in research into optics, lasers and photonics. Two of its three articles with highest CC — to which its researchers contributed most—were published in *Nature Nanotechnology* in this area. The third reported the discovery in Antarctica of kimberlites, the major commercial source of diamonds.

Several of Australia's more interesting NPI papers show fruits of the significant and ongoing expenditure on science and data management infrastructure that began in 2004. In February, for example, researchers from Australia's Antarctic Climate and Ecosystems Cooperative Research Centre, Macquarie University, and the University of Tasmania — collaborating with scientists from Japan — reported in *Nature Geoscience* they had discovered the elusive fourth source of the deep-ocean streams of cold water from Antarctica that help to regulate the Earth's climate. The final piece of the puzzle was supplied by sensors attached to elephant seals which send data via satellite to Australia's Integrated Marine Observing System (IMOS) in Hobart where they are stored, processed, and posted on an open website.

In another significant paper published in *Nature Climate Change*, researchers at JCU and CSIRO used the Edgar database, which combines bird observations taken from the Atlas of Living Australia with climate projections from the Tropical Data Hub, to demonstrate that bird species are likely to move toward the poles as a consequence of climate change.

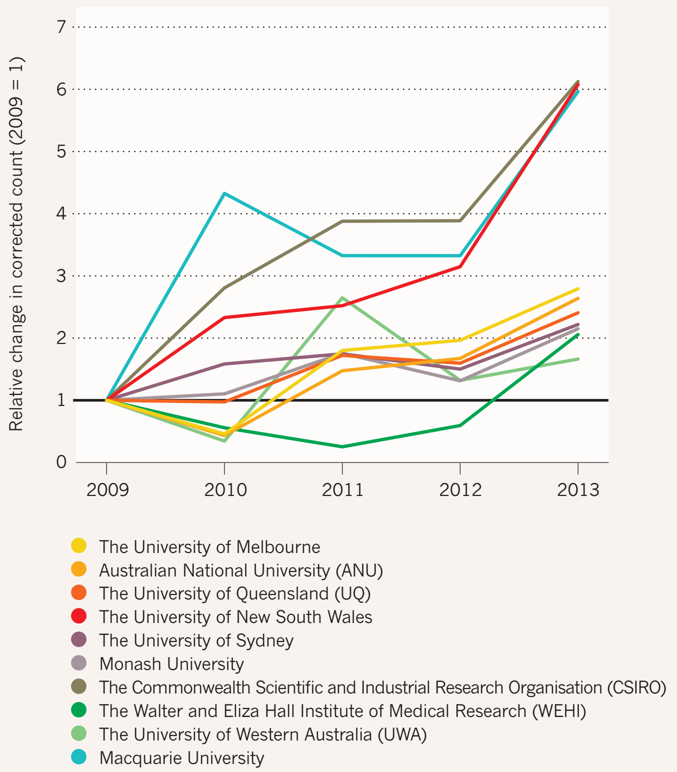
GROUP OF EIGHT

Once again Australia's NPI rankings are dominated by the older, established Group of Eight research universities, seven of which are in the country's top ten. The one omission is the University of Adelaide, which is 12th and rising. Australia's top three institutions all retained last year's position.

In fourth place is this year's rising star, UNSW, up from eighth with contributions across a broad range of journals. Its six papers in *Nature* included two articles that herald significant steps toward the development of the world's first silicon-based quantum computer. A leader of this quantum effort, Andrea Morello, was this year's winner of the Malcolm McIntosh Award: Australia's top prize for early-career physical scientists. He was joined by UNSW colleague Angela Moles, who won the Frank Fenner Prize — the corresponding award for biological sciences — who reported in *Nature Communications* that taller plants show slower rates of molecular evolution. ■

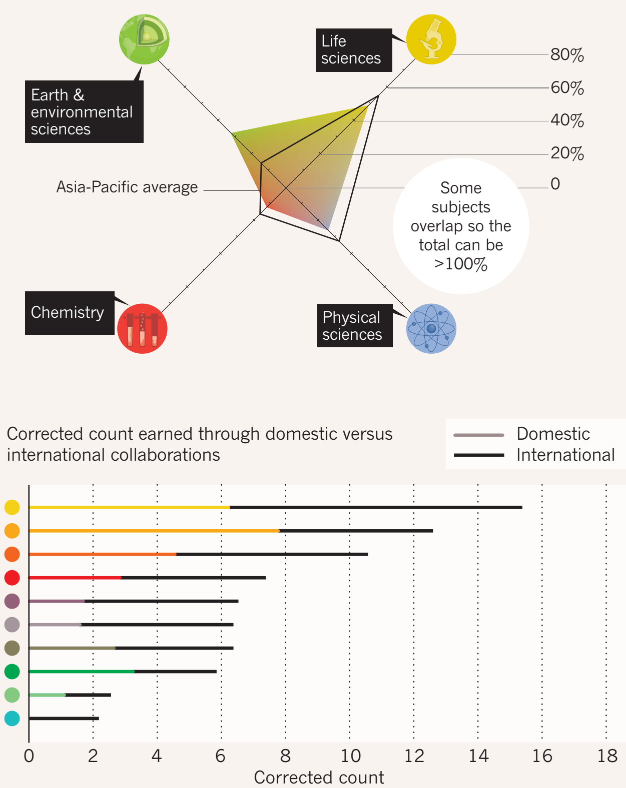
INSTITUTIONAL PUBLISHING TRENDS

Charting the changes in output from the top 10 institutions since 2009.



RESEARCH STRENGTHS

The subject areas in which Australia achieved its corrected count.



ARTICLES: 156

CORRECTED COUNT: 66.89

South Korea

South Korea increased its NPI research output significantly in 2013, an improvement on a quiet 2012. Increasing government funding for basic research will provide a solid footing.

South Korea's output in Nature research journals rose substantially in 2013. The trend is likely to continue owing to increased investment in scientific and technological research, announced by President Park Geun-hye.

The nation consistently leads the Asia-Pacific for research spending, measured as gross domestic expenditure on research and development (GERD) as a proportion of GDP, and Park's government aims to reach 5% by 2015. The president has said that within five years the proportion of government R&D spending on basic science will increase from 35% to 40%.

Funding for the Institute of Basic Science (IBS), modelled on Germany's Max Planck institutes, is already producing results. In 2013, its first full year, IBS reached eighth place among South Korean institutions in the NPI, propelled by articles from three of its nanoscience research centres. There are plans to open 50 research centres by 2017, an increase from the 13 in operation at the end of 2013. South Korea has traditionally placed emphasis on making improvements and advances on technology invented elsewhere, so the IBS represents a significant shift.

Its top institution, the Korea Advanced Institute for Science and Technology (KAIST), increased its NPI output on the previous year. With focus on IT and bioengineering, KAIST was the most prolific Korean institute in the NPI physical and life sciences. In one of its two *Nature* papers, KAIST scientists reported a novel synthetic biological technique for producing petrol through metabolic engineering of the *Escherichia coli* bacterium. South Korea is strong in biotechnology generally; Seoul National University and KAIST ranked first and third, respectively, in contributions to *Nature Biotechnology* on genetic and metabolic engineering techniques.

Large corporations such as LG and Samsung heavily influence the direction of South Korea's science. Samsung accounts for 17% of the country's GDP and spent US$10.4 billion on R&D in 2012-13, second only to Volkswagen among global research companies. In early 2013 Samsung also announced a ten-year, KRW1,500 billion (almost US$1.4 billion) programme to support basic research in universities.

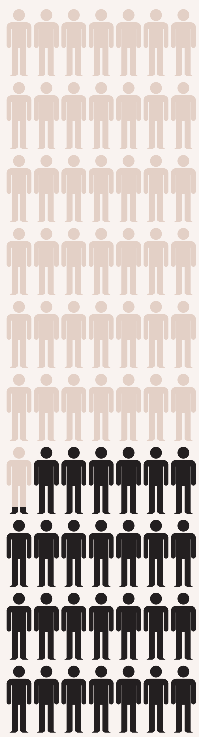
South Korea topped Bloomberg's Global Innovation Index of 2013, with high scores for its number of patents, manufacturing capability, research spending as a proportion of GDP, and the proportion of high-tech companies. With IT and electronics so important to its economy, it's not surprising that South Korea's NPI publishing record is strongest in the physical sciences, mostly for research with commercial application. Of the country's CC, 11% came from publications in *Nature Materials* and *Nature Photonics*.

SOUTH KOREA TOP TEN

South Korea has 25 institutions in the Asia-Pacific top 200

Asia-Pacific rank 2013	Institution	National rank 2013	Corrected count 2013	Articles 2013	National rank 2012	Corrected count 2012	Articles 2012	National rank 2009–13	Corrected count 2009–13	Articles 2009–13
13	Korea Advanced Institute of Science and Technology (KAIST)	1	12.12	23	1	5.46	14	1	34.18	125
20	Seoul National University	2	8.14	37	2	4.60	26	2	26.93	66
22	Pohang University of Science and Technology (POSTECH)	3	7.34	18	3	4.03	15	3	16.97	45
40	Sungkyunkwan University	4	4.87	17	4	3.67	10	4	13.77	42
46	Korea University	5	3.80	12	5	2.62	11	5	12.82	43
49	Samsung Electronics Co., Ltd	6	2.91	7	6	2.43	6	6	10.58	43
73	Yonsei University	7	1.86	13				7	10.37	25
82	Institute for Basic Science (IBS)	8	1.69	9	8	1.95	5	8	7.14	30
84	Ulsan National Institute of Science and Technology (UNIST)	9	1.62	5	9	1.85	6			
87	Hanyang University	10	1.56	9	10	1.67	4			

Researcher density (each figure represents 200 researchers per million inhabitants)



SOUTH KOREA 2013

POPULATION: 48.6 M

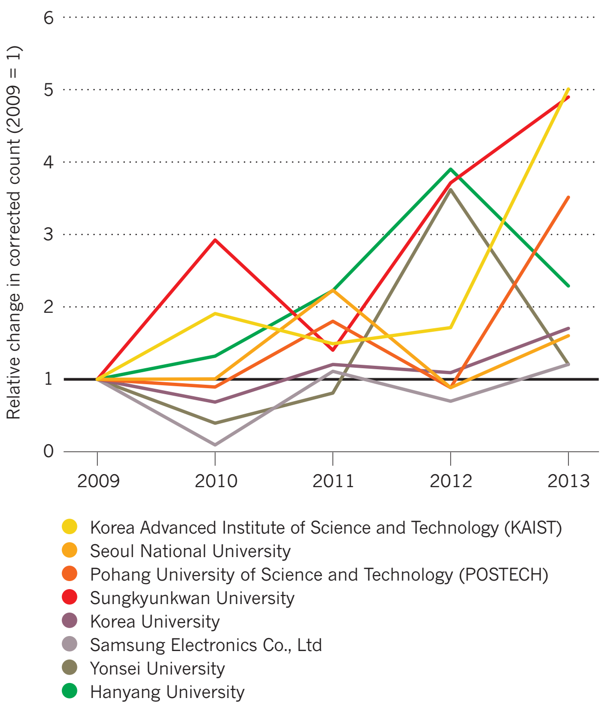
RESEARCHERS: 264,118

SOURCE: UNESCO

Yet *Nature Communications* was the journal in which South Korean scientists were most prolific. It accounted for almost half of the country's NPI publications (72 out of 156), including the report from Samsung scientists and colleagues from four other institutions who created an electrically controlled graphene switch which can be used in developing superconducting quantum information devices. New funding will consolidate graphene, the atom-thick sheets of carbon, as one of South Korea's key strengths. The Korean Graphene Project will receive KRW49 billion (US$46 million) to commercialize technologies; and there are plans to build two new IBS institutions focusing on the science of graphene and related 2D materials. One of these will be hosted at Sungkyunkwan University, which is heavily financed by Samsung. These two institutions top the list for graphene-related patents globally. Sungkyunkwan scientists published three graphene papers in Nature journals in 2013, and, in January, Samsung demonstrated flexible graphene touchscreens that could be used for small devices such as mobile phones. ■

INSTITUTIONAL PUBLISHING TRENDS

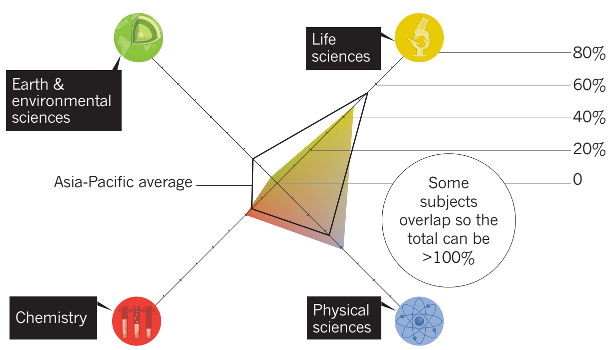
Charting the changes in output from the top institutions* since 2009.



*These are the only institutions that appear in the NPI in each of the past 5 years

RESEARCH STRENGTHS

The subject areas in which South Korea achieved its corrected count.



ARTICLES: 116

CORRECTED COUNT: 41.52

Singapore

Singapore's boasted a 3.7% GDP increase in 2013 — and its science output grew too. The island nation's 2013 NPI research output was almost double that of the previous year.

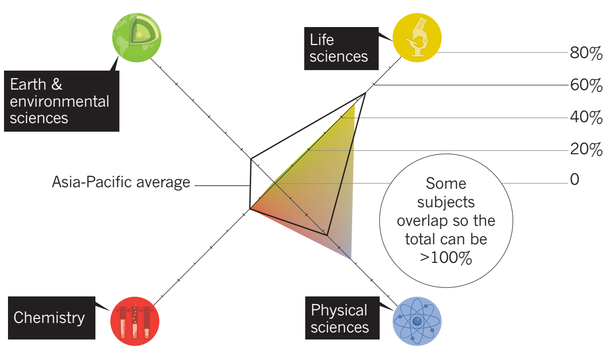
As a small, resource-poor nation, Singapore relies on its acumen to support the country's high standard of living. In this respect it resembles Switzerland, both countries consistently rank in the top ten of the Global Innovation Index of the World Intellectual Property Organization and Cornell University. The World Economic Forum ranks Singapore second to Switzerland in its 2013 list of the world's most competitive economies. Hong Kong and Japan are the other Asian representatives in the top ten.

In the past, this relentless drive for innovation has hindered Singapore's climb up the NPI. Applied research, geared towards projects that can quickly be translated into products or those that solve immediate problems, has not traditionally been published in Nature journals. And, when research is driven by high levels of international collaboration, as has usually been the case for Singapore, the contribution to corrected count is diluted.

But times are changing. The addition of *Nature Communications*, which encourages submissions in fields that aren't covered by other Nature journals, has provided more scope for publishing research from countries with Singapore's strengths. Almost 40% of all NPI papers involving authors from Singapore's top two institutions, the National University of Singapore (NUS) and the Nanyang Technological University, appear in that journal.

RESEARCH STRENGTHS

The subject areas in which Singapore achieved its corrected count.



MATURING RESEARCH

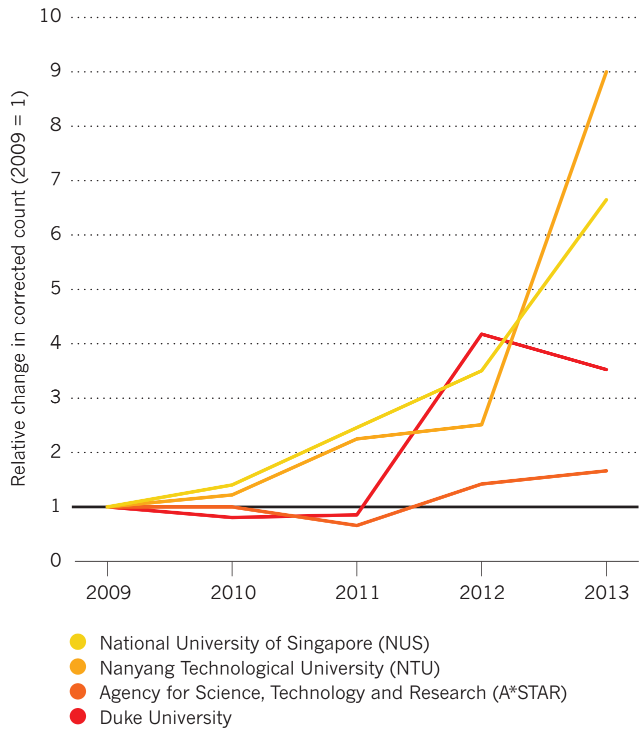
As Singapore's research enterprise matures — training more PhD students, establishing institutes and attracting corporate research centres — its scope is widening beyond the immediately applicable, and its researchers are becoming less dependent on outside input. The country has long been a centre for biotechnology — in the NPI nearly three-quarters of papers from the national research body, the Agency for Science, Technology and Research (A*STAR) involve molecular biology — and now Singapore is devoting significant resources to the study of innovative new materials. Eight of the 13 Nature group papers submitted from the NUS with a corrected count of more than 0.5 fall into this category.

In its first year of operation researchers at Nanyang's Centre for Disruptive Photonic Technologies published significant papers in *Nature Communications* on optical cloaking and a graphene-based light sensor that received widespread global coverage. The centre, founded and headed by Nikolay Zheludev, is a good example of how Singapore has attracted international expertise to establish globally linked research units. Another instance is Nobel laureate Sydney Brenner's Molecular Engineering Laboratory at A*STAR. To broaden Singapore's research horizon Brenner has now established several laboratories where postdoctoral researchers can work without close supervision on issues that interest them.

Singapore's small population can support only a limited number of institutions that contribute to the NPI: about 20 in total. Of those, only three carry real weight. NUS at 6th, Nanyang at 12th and A*STAR at 19th are all in the top 20 of the Asia-Pacific region and significant players on the world stage, holding their own against counterparts in much larger countries. In the Asia-Pacific region, NUS ranks higher than Australia's top institution, the University of Melbourne. Both NUS and Nanyang score higher than South Korea's number one, the Korea Advanced Institute of Science and Technology. NUS (46) and Nanyang (73) are rocketing up the Global Top 100 — Nanyang up 140 places from 2012. ■

INSTITUTIONAL PUBLISHING TRENDS

Charting the changes in output from the top institutions* since 2009.



*These are the only institutions that appear in the NPI in each of the past 5 years

SINGAPORE TOP TEN

Singapore has 3 institutions in the Asia-Pacific top 200

Asia-Pacific rank 2013	Institution	2013 National rank	2013 Corrected count	2013 Articles	2012 National rank	2012 Corrected count	2012 Articles	2009–13 National rank	2009–13 Corrected count	2009–13 Articles
6	National University of Singapore (NUS)	1	17.61	62	1	9.41	47	1	39.64	175
12	Nanyang Technological University (NTU)	2	12.59	37	2	6.63	36	2	28.08	138
19	Agency for Science, Technology and Research (A*STAR)	3	8.20	40	3	3.57	14	3	22.28	74
206	Singapore University of Technology & Design (SUTD)	4	0.51	3	4	0.62	4	4	1.07	10
216	Temasek Life Sciences Laboratory	5	0.48	1				5	0.89	3
273	National Cancer Centre Singapore	6	0.33	3	6	0.26	4	6	0.64	19
275	National University Health System (NUHS)	7	0.33	6	7	0.25	5	7	0.58	9
307	Novartis International AG	8	0.26	2	8	0.08	1			
310	Singapore General Hospital	9	0.26	3				9	0.51	3
320	Duke University	10	0.23	7				10	0.48	1

SINGAPORE 2013

POPULATION: 5.31 M

RESEARCHERS: 32,031

SOURCE: UNESCO / WORLD BANK

Regional round-up

Outside the top five countries in the Asia-Pacific there is a steep drop-off in NPI output. Only 3 of the 11 other nations in the region — Taiwan, India and New Zealand — have a corrected count of more than 1.5. Many of the NPI contributions from the remaining eight nations derive from studies about locally relevant issues such as important food staples, tropical diseases, ecology and geology.

TAIWAN

In the five years since 2009, Taiwan's publishing record in the Nature research journals has increased by a greater proportion than any other Asia-Pacific nation, including China. Yet Taiwan produces less than half the output of Singapore.

Billionaire tycoon Samuel Yin is using his personal fortune to make Taiwan a bigger player. In January 2013, he announced a US$100 million contribution to create the biennial Tang Prizes, which will bestow higher prize money than the Nobel Prizes. The Academia Sinica, Taiwan's national research academy, will award the prizes to global leaders in the fields of sustainable development, biopharmaceutical science, Chinese studies and the rule of law, beginning in 2014.

The Academia Sinica (ranked 27 in the Asia-Pacific) and the National Taiwan University (43) account for more than half of Taiwan's scientific output in the NPI. The nation's other institutions publish just a handful of articles a year in Nature research journals and are not fixtures.

In 2013 Taiwan made its greatest proportional contribution in the NPI subject area of physical sciences, with the nation's contribution to chemistry and life sciences dropping below the Asia-Pacific average. Three *Nature Nanotechnology* papers wholly authored by Taiwanese scientists put the country in third place in contributions to that journal. These articles reported on the use of nanomaterials for DNA sequencing, for optical imaging of stem cells and for observing ballistic heat transport at room temperature.

INDIA

India's recent economic growth has stuttered in the last two years. In 2012-13, the country recorded its slowest growth rate in a decade. One fifth of India's 1.2 billion people live in poverty. It faces huge demands for improved power, roads, jobs and housing. Yet science, and progress towards meeting these demands in particular, is hampered by bureaucracy and corruption. National spending on science and technology is still below 2% of GDP.

Some recent developments are positive. In late 2012, the Indian government outlined a five-year plan that included a huge boost to spending on research facilities. This plan proposes, but does not commit the government to, spending 2.5 times more on research and design than in the previous five years, including contributions to new international telescopes. At home, there are plans for a neutrino observatory, a next-generation synchrotron, two new research reactors, and new institutes in emerging disciplines. The expanded scientific enterprise will entail significant increase in the number of researchers per capita — a metric that is currently an order of magnitude lower in India than in China.

The country's leadership is making encouraging noises; in November, C.N.R. Rao, the science advisor to the prime minister, Manmohan Singh, publicly criticized India's poor science funding and performance. And India had some notable successes in 2013. In November it launched Mangalyaan, its unmanned Mars Orbiter Mission — the country's first mission to Mars — one of 58 space missions planned over the next five years.

The Tata Institute of Fundamental Research (TIFR) publishes more in the NPI than any other Indian institution. In one notable paper in *Nature Methods*, four scientists from TIFR's biological sciences department described a new technique that lets scientists see the tiny steps taken by protein molecules as they carry material around a cell. On the strength of that paper, TIFR ranked second in the Asia-Pacific in that journal.

NEW ZEALAND

New Zealand science and innovation was boosted in 2013 with the start of two new programmes. In May, the prime minister, John Key, announced ten National Science Challenges — strategic multidisciplinary research areas that will produce lasting benefits — with initial funding of NZ$73.5 million (US$62 million) over four years on top of the existing budget. More funds were allocated in October, on the occasion of the delivery of the first tranche for three of these challenges: healthy foods, resilience to natural hazards, and understanding the Antarctic and Southern Ocean. The last topic is already a strong focus of New Zealand science and featured in three 2013 papers — one in *Nature* and two in *Nature Geoscience* — looking at the dynamics of Antarctica's ice sheets at different stages of Earth's history. Contributions to these papers came from the Victoria University of Wellington and the University of Otago.

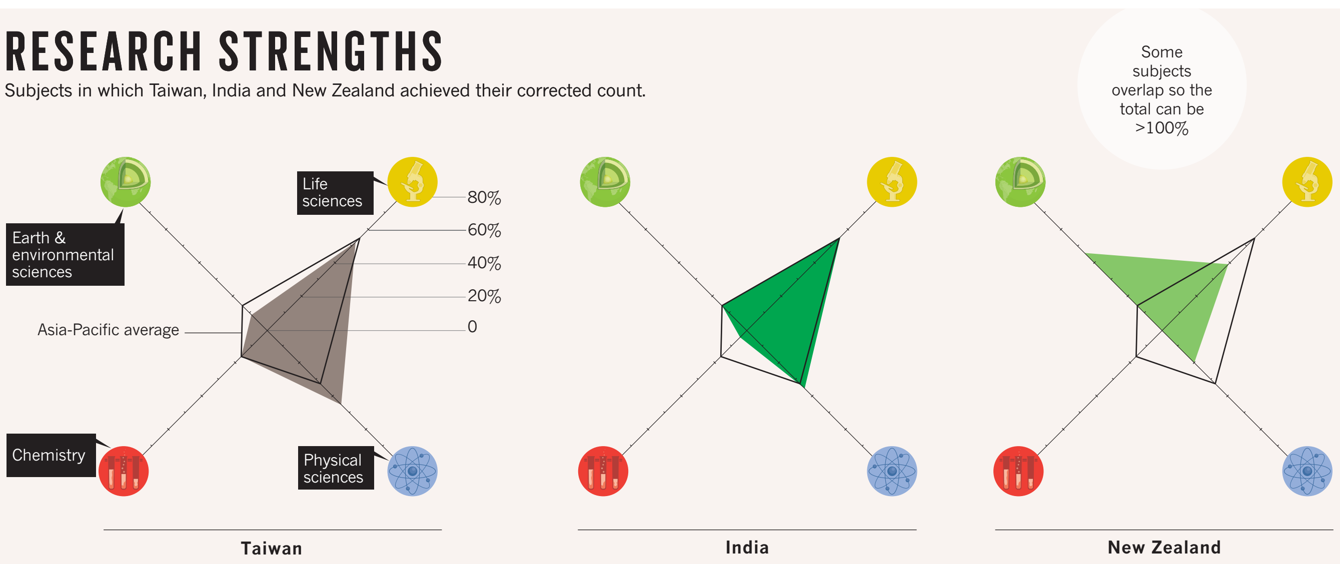
The second new programme concerns commercialization of innovative ideas, which will be guided by Callaghan Innovation, a high-tech development institute formally established by the government in February. Callaghan Innovation administers more than NZ$140 million in R&D grants, as well as conducting its own pure and applied research and offering services to industry. The organization has already funded more than 10 projects, including helping a start-up company establish an electrospinning plant to manufacture nanofibres and accelerating the growth of a cyber-security business. Both programmes emphasize the importance of collaboration. New Zealand records the highest level of international collaboration (94% of its Nature research papers) of all the Asia-Pacific nations.

New Zealand is recognized for climate change and geoscience research. And in the NPI, almost half of its corrected count came from earth and environmental sciences. New Zealand ranks fourth in the Asia-Pacific in that category, yet its top institution — the University of Otago — earned most of its CC from the life sciences, particularly medicine and genetics. One study, published in *Nature Communications*, located the receptor in the mouse brain for a protein crucial to fertility; this finding could help research infertility and stimulate the search for new forms of contraception.

The country is still coping with the aftermath of the February 2011 earthquake that badly damaged Christchurch. The drop in ranking of the academic institution most affected, the University of Canterbury, is not surprising even though it took two years to register in the NPI. In addition to losing buildings and facilities, the university has seen a drop-off in student enrolment and has reduced staff numbers. But in 2013, a record number of PhD students enrolled at the university and will most likely boost research output.

RESEARCH STRENGTHS

Subjects in which Taiwan, India and New Zealand achieved their corrected count.



REGIONAL RANKINGS

How the countries line up

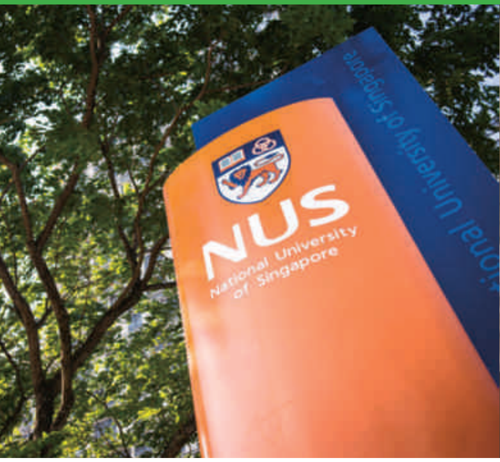
COUNTRY	2013 Asia-Pacific rank	2013 Corrected count	2013 Articles	2012 Asia-Pacific rank	2012 Corrected count	2012 Articles	2011 Asia-Pacific rank	2011 Corrected count	2011 Articles	2010 Asia-Pacific rank	2010 Corrected count	2010 Articles	2009 Asia-Pacific rank	2009 Corrected count	2009 Articles
Japan	1	290.01	462	1	234.40	398	1	216.60	362	1	173.01	266	1	153.83	248
China	2	245.19	493	2	150.03	303	2	110.04	225	2	68.12	152	2	44.30	102
Australia	3	103.76	264	3	68.26	223	3	64.63	172	3	39.63	129	3	42.56	106
South Korea	4	66.89	156	4	40.82	112	4	41.01	92	4	24.80	69	4	28.56	54
Singapore	5	41.52	116	5	21.19	71	5	13.50	53	5	11.26	44	5	9.17	29
Taiwan	6	18.89	49	6	11.68	38	6	9.68	26	6	7.31	27	6	6.84	19
India	7	11.45	40	7	8.24	25	7	8.53	30	7	2.93	17	7	4.03	14
New Zealand	8	7.92	33	8	4.64	24	8	5.30	28				8	3.00	16
Malaysia	9	1.35	11	9	0.76	4	9	0.72	3	9	1.22	10	9	0.43	3
Thailand	10	0.66	10	10	0.75	5	10	0.60	1	10	0.49	8	10	0.36	5
Vietnam	11	0.54	5	11	0.62	11	11	0.50	5	11	0.29	1			
Cambodia	12	0.50	2	12	0.17	3	12	0.31	5				12	0.04	1
Indonesia	13	0.34	3	13	0.12	2	13	0.31	3	13	0.11	1			
Fiji	14	0.06	1	14	0.06	3				14	0.02	2			
Mongolia	15	0.02	1												
Philippines	16	0.01	2	16	0.02	1	16=	0.07	1						

Grey coloured slots in previous years represent the following countries not in this year's NPI:
Myanmar (2011, rank 15), Tonga (2010, rank 12), Papua New Guinea (2012, rank 15; 2011, rank joint-16; 2009, rank 11), Bangladesh (2011, rank 14; 2010, rank 8; 2009, rank 13).

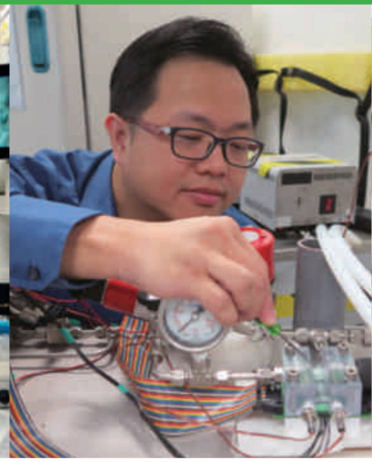
OTHER COUNTRIES

The remaining countries in the 2013 NPI are Cambodia, Fiji, Indonesia, Malaysia, Mongolia, the Philippines, Thailand and Vietnam, with only Malaysia managing a CC greater than one. However, one Malaysian institution, the Malaysian Palm Oil Board, made the Asia-Pacific Top 200 (at 118). In collaboration with US scientists, it published two *Nature* papers on the genetics of two commercially important oil palm species, *Elaeis guineensis* from Africa and *E. oleifera* from South America. Malaysia is the world's second-largest producer of palm oil (Indonesia is first), an important commodity that accounts for 34% of global vegetable oil production.

Most of the papers from Thailand were published in *Nature Genetics*, including three articles produced by a global consortium on factors associated with breast cancer risk. The Thai contributors were the Ministry of Public Health and the National Cancer Institute. Researchers in Vietnam published on the distribution of the dengue virus and on the genetics of the malaria parasite in Cambodia. Cambodian scientists contributed to the latter paper, as well as another genetic study published in *Nature Communications* by scientists from the Royal University of Phnom Penh and collaborators who found that mitochondria in aboriginal Cambodian populations support the theory of human migration from Africa, via India, around 60,000 years ago. Scientists from Mongolia contributed to genetic studies on tigers and other big cats. Researchers in the Philippines published on some of the risk factors for coronary heart disease. Fiji's single author collaborated with scientists from Australia, France and New Caledonia to investigate how climate change may affect fish stocks in the Pacific Ocean —critical to the future of island nations such as Fiji. ■







National University of Singapore

A LEADER IN RESEARCH IN ASIA AND BEYOND

From its founding in 1905 as a modest medical school, the National University of Singapore (NUS) has developed into a research-intensive institution that is consistently ranked among the world's leading universities.

With top researchers and state-of-the-art facilities, NUS aspires to create world-class research peaks on a broad base of research excellence. A total of 23 university-level research institutes and centres, along with 16 faculties and schools, form a dynamic network for education and research. NUS also hosts three of Singapore's five Research Centres of Excellence (RCEs)—specializing in quantum technologies, cancer and mechanobiology—and is a partner in a fourth RCE that draws on the strengths of NUS in life sciences and sustainability research.

As a global university centred in Asia, NUS brings Asian perspectives and expertise to bear on issues relevant to the region and beyond. A rigorous academic culture and a spirit of enterprise drive high-impact research and innovation at Singapore's flagship university.

High-Impact Research

At NUS, researchers push the boundaries of discovery, with a focus on the development of practical research applications that benefit society. Recent highlights include the following:

- An NUS research team developed synthesis strategies that are able to direct the assembly of metallic nanocrystals into well-defined ordered structures in which every architectural element can be rationally and independently varied. The architectural engineering of these structures, named heterogeneous metallic nanocrystals (HMNCs), has the potential to further the versatility of metallic nanocrystals and their applications.
- A study by researchers at the Cancer Science Institute of Singapore at NUS has found that *SALL4*—a potent stem cell gene and an emerging oncogene (cancer-causing gene)—can be used as a prognostic marker as well as a therapeutic target for hepatocellular carcinoma (HCC). The scientists have also proposed an approach that inactivates the gene to kill HCC cells and prevent tumour formation.
- NUS researchers have shown that the epitaxial growth of an optically inert $NaYF_4$ layer on $NaGdF_4$@$NaGdF_4$ core-shell nanoparticles gives access to unprecedented and tunable optical properties for a broad range of activators. This study highlights the possibility of constructing novel luminescent nanoparticles with high designability and tunability, which has important implications for advanced bioimaging.
- NUS researchers conducted microscopy and spectroscopy experiments to investigate the initial growth of Bi on epitaxial graphene on SiC(0001), finding edge reconstructions responsible for energy-gap opening in a Bi(110) nanoribbon. The results reveal the semiconducting nature of such Bi nanoribbons, opening up possibilities for room-temperature bismuth nanoribbon-based electronic devices.
- NUS researchers have devised a unique approach to co-deliver and co-activate multiple photosensitizers with single wavelength near-infrared light. Furthermore, they have demonstrated that a photosensitizer loaded upconversion fluorescent nanoparticle can be used as an *in vivo* targeted photodynamic therapy agent, which may serve as a platform for future non-invasive deep cancer therapy.

To further its research mission, NUS continues to develop its infrastructure and pursue ventures with key partners. For example, NUS has established a new Centre for Aerospace Engineering, which will carry out cutting-edge research with its industry partners, DSO National Laboratories, SIA Engineering and ST Aerospace. The

new Singapore Centre for Nutritional Sciences, Metabolic Diseases and Human Development was recently launched as a collaboration between the Yong Loo Lin School of Medicine at NUS and the Singapore Institute for Clinical Sciences of the Agency for Science, Technology and Research. The Keppel-NUS Corporate Laboratory—a collaboration between NUS, the Keppel Corporation and the National Research Foundation—is being set up to meet future challenges of the off-shore industry.

Recognizing that new breakthroughs are more likely to result from cross-disciplinary initiatives than through traditional divisions of inquiry, NUS has developed integrative research clusters on major themes: Finance and Risk Management, Biomedical Science and Translational Medicine, Ageing, Integrative Sustainability Solutions, Materials Science, and Asian Studies. These clusters provide a novel infrastructure to foster synergy among specific knowledge domains, enabling researchers to tackle complex, multi-disciplinary issues. The cross-disciplinary approach is also evident in its educational programmes, such as the NUS Graduate School for Integrative Sciences and Engineering, which encourages its students to transcend traditional subject boundaries.

Alliances at Home and Abroad

Through key alliances in the East and West, NUS further fosters research and education in Singapore and overseas. For example, at the Duke-NUS Graduate Medical School, Phase II of the partnership to provide medical education and conduct patient-oriented research is underway. Yale-NUS College, opened in August 2013, is ushering in a new model of liberal arts and science education for a complex, globalized world.

The University Town at NUS is home to the national-level Campus for Research, Technology and Enterprise (CREATE), an initiative of the National Research Foundation of Singapore. CREATE houses 15 interdisciplinary groups from 10 renowned universities—Massachusetts Institute of Technology, ETH Zurich, Technical University of Munich, Technion-Israel Institute of Technology, Hebrew University of Jerusalem, Ben-Gurion University, Peking University, Shanghai Jiao Tong University, University of Cambridge, and University of California, Berkeley.

NUS also leverages the close proximity of its main campus to several of Singapore's key science and technology hubs, building partnerships with industrial and government entities. Additional collaborations are facilitated by NUS Enterprise, a university-level cluster dedicated to promoting enterprise and managing the University's intellectual property in various fields.

Further afield, NUS was the first foreign university to establish a research institute in the Suzhou Industrial Park, one of the most developed industrial zones in China. NUS has also signed an agreement regarding the Sino-Singapore Tianjin Eco-City, with plans of using the eco-city as a basis to study the impact, benefits and challenges of developing green buildings.

As a thought leader in Asia, NUS takes an active role in developing global initiatives. NUS President Professor Tan Chorh Chuan has been appointed the Chair of the Global University Leaders Forum (GULF) by the World Economic Forum for a two-year term commencing in 2014. He has also recently been appointed to the Global Learning Council, a new consortium of education and technology research leaders, created by Carnegie Mellon University (CMU).

In its global approach to transformative education and cutting-edge research, NUS strives to provide real-world solutions and influence the world's future for the better. ■

A guide to the NPI

A complete guide to understanding the compilation, structure and definitions used in the Nature Publishing Index. For more information see nature.asia/publishing-index.

The Nature Publishing Index (NPI) is maintained by Nature Publishing Group (NPG), a division of Macmillan Publishers that publishes *Nature*, the international science weekly, and more than 30 Nature-branded primary research and review journals covering a broad spectrum of the life sciences, physical and chemical sciences, and clinical medicine. NPG journals are among the most cited in scientific literature and are renowned for their publication of high-quality, high-impact research.

The NPI ranks institutions and countries/territories according to the number of primary research articles they publish in the Nature family of journals in a one-year period. It presents both raw numbers of published articles with author affiliations to a given country or institution, and a corrected count (CC) adjusted according to the relative contribution of each author to each article based on the percentage of authors from that institution or country in the paper's affiliations. This CC is tallied over a period of one year and is used to measure contribution to Nature research journals. Only articles printed during the ranking period are included — advance online publications are not included until assigned an issue number and sent to press. *The Nature Publishing Index 2013 Asia-Pacific* covers the period from 1 January 2013 to 31 December 2013.

The index, online at nature.asia/publishing-index, is updated every week with a moving window of one year of data. The index website provides links to the abstracts of all articles used to calculate CCs, providing the details of individual papers and authors contributing to an institution or country's rank in the index and making the index fully transparent. It also provides data for review articles published in Nature journals for the Asia-Pacific region. Review articles are not included in the annual rankings, however, because reviews are commissioned by journal editors rather than being submitted by researchers.

NATURE PUBLISHING INDEX ASIA-PACIFIC

The Asia-Pacific index is updated weekly and includes articles published in the latest issues of the Nature journals. Users of the index website can subscribe for email alerts to keep up to date with the latest results from the region. A print publication presenting the frozen data for each calendar year is published each year.

NATURE PUBLISHING INDEX GLOBAL TOP 100

The Global Top 100 is an index of the top 100 institutions based on publications in *Nature* and the Nature research journals. The index is updated annually in March.

CORRECTED COUNT

The NPI is based on an article's CC — a calculation that takes into account the number of affiliated institutions per author and the percentage of authors per institution. All authors are factored to have contributed equally to each article. The maximum CC for any article is 1.0. The overall CC for a country/territory reflects the sum of the corrected counts of all institutions in that region. The rules governing the calculation of CC with respect to the way affiliations are presented are adjusted regularly to account for new scenarios.

The NPI is based on affiliation data drawn from Nature journal articles published on nature.com. There is great variability in the way authors present their affiliations and every effort is made to count affiliations consistently, making reasonable assumptions (outlined on the index website) to determine the CCs, which are approximations based on these assumptions and no counts are definitive.

RANKINGS, GRAPHS AND LISTS

Country rankings

Countries and territories are ranked according to CC and can also be filtered by article type using the selector at the top of the page. Clicking on a country name will display a list of institutions within that country/territory.

Institution rankings

The institutional rankings track institutions in the Asia-Pacific region (including India and Australasia) according to their CC. Data for primary research articles (Articles, Letters and Brief Communications), reviews or a combination of both can be viewed by selecting the appropriate tab in the article filter at the top of the page. By default, the top 50 institutions are listed; clicking on 'Show all' at the bottom of the list will display all of the institutions. Clicking on the number in the 'Articles' column displays a list of all the articles from that particular institution.

Global institutional rankings are also available on the Global Top 100 website. The global index page shows the list of institutions ranked by CC. Clicking on the number in the 'Articles' column lists the NPG articles contributing to the corrected count.

Rankings by Nature journal

The journal rankings group all articles from the Asia-Pacific region according to Nature research journal, and can be filtered by article type. By default, the top five institutions are listed for each journal. Clicking on 'Show All' lists all of the institutions from the Asia-Pacific that have affiliations listed in that journal, and clicking on the number of articles displays a list of the articles from that journal with affiliations from that institution.

Rankings by subject area

The rankings by subject area track institutions in the Asia-Pacific region in four subject areas: chemistry, earth & environment, life sciences and physical sciences.

Historical rankings

The historical rankings track data by Asia-Pacific country for primary research articles (reviews are not included) for past years. Clicking on the year at the top of the table displays the rankings for that year based on the CC.

Historical graphs

These graphs provide a visual representation of the historical data based on research articles (only). Users can select up to five institutions or countries and the graph can be redrawn to represent the selection.

Latest research

The latest research section provides a breakdown of the latest publications in Nature journals from the Asia-Pacific region by country/territory, including journal name and article title. ■

THE NPI ONLINE: HOW IT WORKS

Research published in Nature journals from the Asia-Pacific region can be tracked online through a comprehensive service which is updated weekly. nature.asia/publishing-index-asia-pacific offers a 12-month rolling view of how institutions are ranking and the journal in which to find particular articles, letters and brief communications.

Article filter
An article filter at the top of most ranking lists allows users to track research articles and gives an option to access data on reviews

Research Articles
This is the default display reflecting the index's focus on primary research articles

To view a list of articles click on the number in the right hand column. Rankings by country, by journal and historical data from the last five years are also available

Research Articles | Reviews | All

Institution	Corrected Count[2]	Articles[3]
1. The University of Tokyo, Japan	39.4	116
2. ⊞Chinese Academy of Sciences (CAS), China	37.88	91
3. Kyoto University, Japan	22.47	55
4. ⊞RIKEN, Japan	18.96	78
5. Osaka University, Japan	18.18	54

Reviews
This displays data for review articles

Research Articles | Reviews | All

Institution	Corrected Count[2]	Articles[3]
1. The University of Auckland, New Zealand	3.25	4
2. The University of Sydney, Australia	2.7	4
3. The University of Tokyo, Japan	2.46	4
4. Monash University, Australia	2.4	5
5. The University of Melbourne, Australia	2.09	5

All
This displays both primary research articles and reviews

Research Articles | Reviews | All

Institution	Corrected Count[3]	Articles[4]
1. The University of Tokyo, Japan	41.86	120
2. ⊞Chinese Academy of Sciences (CAS), China	38.94	94
3. Kyoto University, Japan	22.47	55
4. ⊞RIKEN, Japan	20.85	82
5. Osaka University, Japan	18.59	56

Expanded Affiliations
Many organizations, such as the Chinese Academy of Sciences and Singapore's Agency for Science, Technology and Research (A*STAR), are umbrella agencies for many affiliated institutions. Such organizations are indicated by a plus mark ('+') in the index lists and can be expanded to show the contribution from each constituent institution

Research Articles | Reviews | All

Institution	Corrected Count[3]	Articles[4]
1. The University of Tokyo, Japan	41.86	120
2. ⊟Chinese Academy of Sciences (CAS), China	38.94	94
Shanghai Institutes for Biological Sciences (SIBS), CAS	6.42	15
Institute of Biophysics (IBP), CAS	4.67	15
Institute of Physics (IOP), CAS	3.6	9

Clicking on a plus mark (+) will show any affiliated institutions of an organization, listed in order of their corrected count

Clicking on an article count brings up a chronological list of the research articles and reviews published by that institution in the last 12 months

Articles
The number of articles encompasses the total contributions of a particular institution or country and each body is credited once per article. Clicking on the number of articles in any of the index ranking lists presents a complete list of the articles published by an institution or country/territory in the past year. Among these are the articles counted in the index along with the Nature journal in which it was published and the corrected count the article achieved. Hovering over the article title reveals its DOI and clicking on the title opens the article abstract on nature.com

Research Articles | Reviews | All

Journal	Title	CC[2]
Nature	An integrated encyclopedia of DNA elements in the human genome	0.02
Nature Biotechnology	Genome mapping on nanochannel arrays for structural variation analysis and sequence assembly	0.09
Nature Cell Biology	c-Abl promotes osteoblast expansion by differentially regulating canonical and non-canonical BMP pathways and p16 expression	0.22
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Clicking on the title of the article leads to its full text on the journal website

These rankings are updated weekly and are based upon papers published as research Articles, Letters and Brief Communications in Nature and Nature monthly research journals (excluding journals from scientific societies)

The University of Tokyo

DEMONSTRATING STRATEGIC LEADERSHIP

When, in 1877, the University of Tokyo was established, it was a leading force in the government's efforts to modernize Japan. Now as Japan struggles to redefine itself in a new and complicated international setting, where academic activity is inherently a global and competitive activity, that leadership role is just as significant, says Yoichiro Matsumoto, the university's executive vice president. Its mission is big: to define what Japan's future will be.

The government has been struggling to do this. "What kind of country they want to make out of Japan and what kind of leadership role Japan will play in the world are not clear. There is also no strategy for bringing such a vision to reality," he says. The University of Tokyo seeks to fill this void under the strategic leadership of President Junichi Hamada.

Central to those efforts are the university's basic research projects. "Even if they take time to initiate and their significance is not immediately clear to some people, our basic research projects have helped to build an economic and cultural foundation at home and they have even become an asset for the whole region. The combination of inventions makes real innovation," says Matsumoto.

University researchers are leading several of the collaborative Center of Innovation programs recently selected by the government. These projects set priorities—such as mental and physical health and sustainability—for a Japan ten years in the future and seek innovative ways to make that vision a reality. The research is meant to be "high risk" and is accompanied by risk management policies. Hiroshi Kiyono, for example, is collecting health-related data from a million Japanese to create a health and longevity policy platform while ensuring ethical use of the data. Makoto Gonokami is harnessing coherent photon technology to create innovative manufacturing techniques—"without screws, welding and with little burden on the environment." The university also received funding from the Program for Leading Graduate Schools, which aims to overhaul graduate education while cultivating new academic and industrial leaders.

To carry out its research mission, the university will have to balance demands from the government that threaten to narrow, rather than expand, the focus of universities. Over the past several years, the government has tended to push universities to make profit and assume short-sighted governance policies.

Indeed, times have been tough for Japanese universities. Full-time tenure positions are decreasing as universities rely more on temporary academic positions. Following severe budget cuts, one-half of funding for top universities now comes from competitive grants and other external funds, compared to one-third less than a decade ago. With an increased burden from administrative duties and grant-writing, professors have less time to spend on research even though they work longer hours.

The University of Tokyo and ten other top universities teamed up in 2009 to take stock of the situation. They are, for example, finding ways to increase the visibility of Japanese universities. They are also working with a consortium of top European universities to boost exchanges as part of efforts to reverse a worrisome trend—the drop in the number of Japanese students who go abroad.

The road ahead is full of challenges, but they are confident that the accumulated wisdom from the university's hundred plus years of history will offer "a view from a higher perspective," one that will "optimize the entire society."

THE UNIVERSITY OF TOKYO
www.u-tokyo.ac.jp/en/

THE UNIVERSITY OF TOKYO

Racing against viral evolution

The H7N9 strain that ripped through Shanghai killing dozens last spring tested our capacity to understand new viruses and China's ability to contain an epidemic. It was tragic—but through concerted efforts by health officials and researchers around the globe, a much worse scenario was averted. Such sustained, global efforts, rooted in a dynamic research network, have become crucial part of our efforts to avoid a pandemic.

Yoshihiro Kawaoka's laboratory at the University of Tokyo is a vital hub in this global battle. Kawaoka has set himself a challenge: to understand, and ultimately predict, the pandemic potential of influenza viruses by picking them apart at the molecular level. "Unless we unravel the viral and cellular determinants and mechanisms that define disease severity and transmissibility, we will not be able to predict the pandemic potential of novel strains, which would allow us to implement countermeasures to curtail future pandemics," he says.

His group was the first to figure out that the H7N9 virus can replicate in the lower respiratory tracts of nonhuman primates, offering an explanation of the virulence and high fatality rate witnessed last spring. The research, enabled by generous sharing of materials by scientists at the Chinese National Influenza Center that allowed Kawaoka to quickly obtain viral samples, also demonstrated that the virus can be transmitted by respiratory droplets in ferrets, suggesting that a global pandemic in humans was a real possibility.

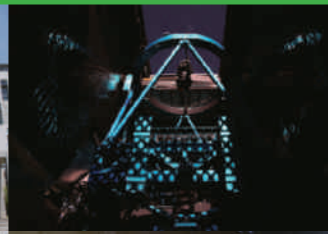
Ferrets have become a seminal model for studying the molecular mechanisms involved in the transmission of influenza viruses thanks to Kawaoka's previous pioneering study of the H5N1 virus. Highly pathogenic avian H5N1 influenza viruses have circulated in parts of Asia for over a decade, infected more than 600 people, and killed more than 350 of them. But since sustained human-to-human transmission had not been witnessed, some dismissed these viruses as low risk. Kawaoka's study showed how a mutation in a viral receptor-encoding gene could turn it into virus transmissible though respiratory droplets. "This finding calls for the continued development and stock-piling of vaccines against highly pathogenic avian H5N1 influenza viruses and thus has major implications for pandemic preparedness planning," says Kawaoka.

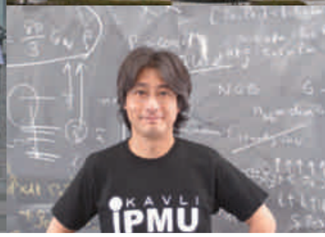
The viral genomes are always changing, and even subtle changes can have a devastating outcome. Kawaoka's group demonstrated, for example, that the strain of H1N1 circulating in 2009 was more pathogenic than previously known H1N1 strains. In particular, their animal studies showed severe lesions in the lungs of mice, ferrets, and non-human primates. "These findings highlighted the potential threat to human health of new emerging influenza viruses," says Kawaoka.

Constant vigilance is necessary, and the University of Tokyo has made that possible. The biosafety-level 3 laboratory enables the team to study virulent pathogens. And, Kawaoka says, hard-working and creative students turn around experiments quickly. This next generation in the battle against a pandemic is receiving comprehensive training in various virology techniques, learning reverse genetics and the production of large virus mutant libraries, interacting with scientists from different backgrounds and institutions, and presenting findings at national and international scientific meetings.

These young researchers will be needed in the future. Thousands of influenza virus strains have been sequenced, and the basic functions of influenza virus proteins have been studied for several decades. Despite all these advances, "we still do not understand the key features that determine the severity of influenza virus infections in humans, and the transmissibility of influenza viruses among humans," says Kawaoka. The race to keep up with rapidly evolving viruses will continue. ■

Division of Virology, Department of Microbiology and Immunology, Institute of Medical Science
www.ims.u-tokyo.ac.jp/imsut/en/



THE UNIVERSITY OF TOKYO

Deep and wide, SuMIRe surveys the cosmos

Last year, the Andromeda galaxy was captured as never before. By spreading across the sky with the area of ten full moons, the Subaru Telescope caught the entire galaxy in one shot. And the color image had such a high resolution—870 million pixels—that individual stars could be picked out and galaxies billions of light years away could be seen through the Andromeda galaxy's disk.

The image was made possible by the SuMIRe project, a collaboration led by the Kavli Institute for the Physics and Mathematics of the Universe at The University of Tokyo. Project scientists will combine imaging and spectroscopy to conduct a large-scale census of the universe with an ambitious mission: "The ultimate goal is to understand the origin and fate of the Universe," says Hitoshi Murayama, the institute's director.

The Subaru Telescope, built by the National Astronomical Observatory of Japan and one of the world's largest telescopes, can peer deep enough into space to pick up faint objects billions of light years away. At the same time, it boasts the biggest field of view, about 1,000 times that of the Hubble Space Telescope and 100 times that of other ground-based telescopes with similar apertures.

SuMIRe will enhance that power. The first phase of the project is an imaging survey using the Hyper Suprime-Cam (HSC), a new camera whose wide field of view enabled the capture of Andromeda and whose wide aperture allows it to go deeper than a competing project (the Dark Energy Survey in Chile). This phase is already approved to run for 300 nights on Subaru—what Murayama calls, "an unprecedented allocation on a shared community facility."

The second phase is a spectroscopic survey using a Prime Focus Spectrograph on Subaru. This spectrograph will catapult the sensitivity to levels that allow researchers to analyse the nature of dark energy, thereby uncovering the fate of the universe.

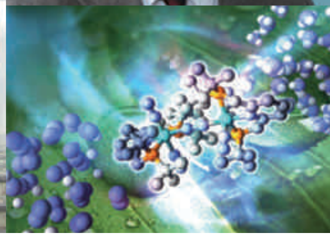
The project is led by Kavli IPMU, but many international collaborators play essential roles. Princeton University and Johns Hopkins University bring experience in large-scale census and camera design. The California Institute of Technology and the Jet Propulsion Laboratory use their expertise to build tiny robots that control optical fibers with tremendous accuracy. Researchers from Marseille contribute knowledge in design and optics. A Brazilian team proved very good at handling optical fibers. Taiwan's Academia Sinica Institute of Astronomy and Astrophysics build precision mechanical devices. Of course, bringing all that expertise together takes a toll: "Teleconferences that involve four continents are very difficult to schedule. Somebody gets sleep deprived," says Murayama. "But lacking any one of them, the project would not succeed."

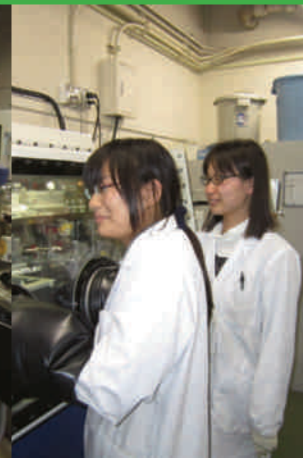
These international partnerships helped SuMIRe 'rise from the ashes' after one of its Japanese grants was slashed. The project still faces a challenge—namely a $20 million shortfall—but Murayama hopes the Japanese government will come through. There's too much to lose, especially for the country's reputation in hosting international partners. "Once the survey starts this year, our young scientists will have an ample opportunity to exploit the power of the beautiful data set," says Murayama.

Those data hold an unprecedented range of astronomical possibilities. These include studies of the tiny variations in density created when the entire universe was smaller than an atomic nucleus and inferences about the distribution of dark matter that formed stars and galaxies. In addition, researchers will be able to measure the universe's expansion with such precision that they will be able to calculate whether it will expand for ever or reach an end.

KAVLI IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

www.ipmu.jp/





THE UNIVERSITY OF TOKYO

Ammonia revolution

The Haber-Bosch process, which converts atmospheric nitrogen to ammonia, revolutionized agriculture in the early twentieth century. As the crucial industrial process in the production of fertilizer, this process accounts for about half of the nitrogen that is contained in our DNA and proteins. "It's no exaggeration to say that half of our bodies are made in the factory through the Haber-Bosch process," says Yoshiaki Nishibayashi.

But Nishibayashi wants to do away with it.

At his laboratory in the University of Tokyo's Institute of Engineering Innovation, Nishibayashi is taking on the challenge of finding a substitute process. The problem with the Haber Bosch process is that it requires a huge amount of energy.

"One of the most important challenges facing chemists is to find a way to fix nitrogen that doesn't use fossil fuels and that is energy efficient," says Nishibayashi. "It's our ultimate goal."

His team has succeeded in creating ammonia from nitrogen at room temperature and standard pressure using a molybdenum complex as a catalyst. While he admits that there are still many problems to be worked out, he is confident that this discovery will lead to a next-generation nitrogen fixing process.

Using a simple iron complex as a catalyst, he has also synthesized silylamine, which can be readily turned into ammonium by adding water. This was the first time anyone had synthesized ammonia from nitrogen gas at ambient pressure and temperature using anything but molybdenum.

Now, the challenge is to make the process sufficiently efficient. The molybdenum catalytic reaction that is currently used in Nishibayashi's laboratory is six times more efficient than the first successful conversion using molybdenum in 2003, but it is still not feasible.

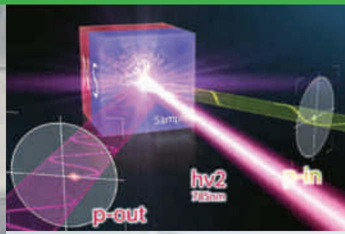
Nishibayashi is now pursuing techniques to increase that efficiency by improving the catalytic activation. Another problem is that the process requires costly hydrogen and reducing agents. "We need to find a cheaper way to make this reaction work," he says. His team is currently analyzing the structure of the reaction to find solutions to these problems. His next target is to develop a catalytic reaction to synthesize ammonia from nitrogen gas and hydrogen gas, something he thinks possible based on his success in doing the same using a stoichiometric reaction 15 years ago. His ultimate goal, however, is to develop a process for the catalytic formation of ammonia from dinitrogen, water and sunlight.

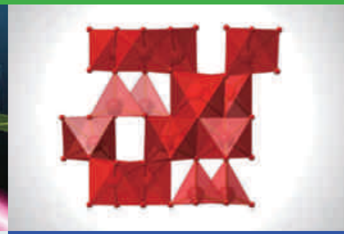
The challenges are many, but the School of Engineering has provided significant support in overcoming them. Starting in 2005, for example, Nishibayashi was selected for a Young Leaders Cultivation Program. These grants aim to raise the next generation of scientists and engineers: "they have given me the chance to supervise the laboratory and focus on science at the same time. This research wouldn't have been possible otherwise," says Nishibayashi.

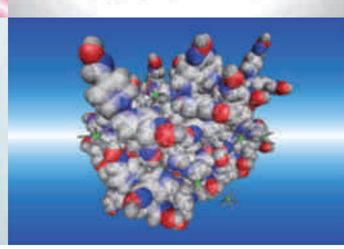
Success in these endeavours will have many great and unpredictable implications. Ammonia effectively stores and transports hydrogen, so a cheap and sustainably produced source could be a boon for a hydrogen-fuelled society. Researchers are now investigating its potential use in fuel cell batteries. Japan is just starting a national project to develop these ideas. Of course the most important and most urgent application is to save the earth from the environmental menace resulting menace resulting from the the Haber-Bosch process. "For the future development of mankind, it's something we must do," says Nishibayashi.

Institute of Engineering Innovation, School of Engineering

http://sogo.t.u-tokyo.ac.jp/english/




THE UNIVERSITY OF TOKYO

Making the most of magnetic materials

Magnetic recording media that possess unprecedented reliability, hybrid motors that do not depend on rare earth elements, next-generation wireless communications that ensure stable and secure transmission, and paint that can protect signals coming from a sensitive surgical device from interference or block unwanted phone calls in a movie theatre.

These are just some of the vast array of applications of magnetic chemistry being developed by researchers at Shin-ichi Ohkoshi's laboratory at The University of Tokyo.

Most recently, the team developed a magnet that could switch the polarization plane of light by 90 degrees. This discovery, which could be used in optical switching or optical memory for computers, resulted from an investigation into the relationship between the crystal structure of Prussian blue materials and their magnetic and optical properties. The discovery built on earlier work in which the properties of Prussian blue were used to make magnets that were sensitive to humidity and non-magnets that could be turned into magnets when they were irradiated with light.

The group has also given new life to iron oxides, which are safe and cheap but whose use in magnets has been limited because of their small coercive force. The ε-iron oxides synthesized in Ohkoshi's laboratory have, even at room temperature, a coercive field greater than any seen in ferrite magnets—useful features for manufacturers of hybrid motors and magnetic recording media.

Titanium oxide, which is often used in cosmetics and white pigments, also got a makeover. The λ-titanium oxide developed by Ohkoshi's group is the first example of a metal oxide exhibiting light-induced phase transition at room temperature. Using this λ-titanium oxide could produce much optical recording media with higher density than conventional germanium-antimony-tellurium optical discs. Moreover, because of the low pressure of its phase transition, "λ-Ti_3O_5 has the possibility as a solar heat storage material in which solar heat is stored and energy is released by pressure," says Ohkoshi.

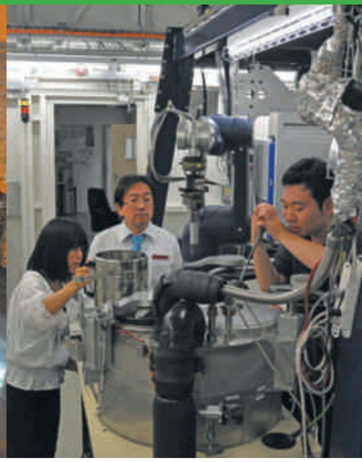
These exciting developments have been a boon for up-and-coming researchers. Members of Ohkoshi's laboratory have received over 20 awards, including poster presentation awards at international conferences, The University of Tokyo President Prize, and the Dean of School of Science Prize. "I push my staff members or students to present at conferences," says Ohkoshi.

Ohkoshi's team now sits in a dense web of international collaborations in which it provides samples or carries out joint measurements with some 20 research groups in Europe, the USA, China, and elsewhere. Ohkoshi has worked with a UK research group through a Japan-UK exchanging program, served as an invited professor at Durham University in the UK, the University of Pierre and Marie Curie and the University of Bordeaux in France, and, most recently, Palacký University in the Czech Republic as part of a European Union project. In Tokyo, he also hosts professors, researchers, and students from universities around the world.

Efforts by The University of Tokyo's Technology Licensing Organization and the Division of University Corporate Relations to exploit the research have paid off with 115 patent applications and 46 registered patents. Unsurprisingly, the unique and powerful technology is luring in industry: Ohkoshi collaborates with more than 20 companies, and another 60 parties from within Japan and outside have expressed interest. "I strive to make a harmonious research environment that can contribute to society," he says.

Department of Chemistry

www.chem.s.u-tokyo.ac.jp/en/


THE UNIVERSITY OF TOKYO

Opening up channels

Membrane channels that allow proteins, ions and other molecules to pass in and out of cells and the membrane transporters that drive this process carry out a bewildering range of subtle functions, including ensuring that the appropriate molecules pass through membranes at the correct times. A basic understanding of these mechanisms could be applied to the development of more effective drugs for cancer, better antibiotics, and new methods for studying and treating mental disorders, but the key molecules involved are difficult to isolate and characterize.

The University of Tokyo's Osamu Nureki is not fazed. He brings a powerful array of analytic techniques, including x-ray crystallography, x-ray free electron laser imaging, molecular kinetic simulations, genetic and patch clamp analyses, and spectroscopic assays, to bear on these tiny but critical players.

His goal is practical and conceptual. "Using these tools, I want to understand the various molecular mechanisms of different membrane channels and membrane transporters. Based on that, I want to find a common principle working in the diverse mechanisms," says Nureki.

For example, a recent study used high resolution imaging to show how membrane channels called channelrhodopsins open when activated by light. Many researchers now manipulate channelrhodopsins with light to study single neurons even in live, moving animals, and others are investigating whether this effect can be used to treat patients with psychiatric diseases. Nureki's study offers the potential to design new forms of channelrhodopsins. "We should be able to make new tools that can be used in basic neuroscience and contribute to the development of new treatments for mental health problems," says Nureki.

Another transporter named MATE, which is very active in the liver and kidney, helps to expel drugs and other foreign chemical compounds from cells. Nureki produced high-resolution, three-dimensional images of MATE alone and when binding antibiotics. The images showed MATE to be composed of two lobes of six membrane-penetrating helices that, depending on pH levels, take on one of two formations — one straight and one bent. The analysis shows how a drug is recognized and, when MATE is in the bent form, expelled from the cell.

The results of the MATE study also suggested clinical applications. Expression of MATE in pathogens can make them resistant to antibiotics, and expression in cancer cells can make the cells resistant to chemotherapy. In such cases, inhibiting MATE would help to improve the effectiveness of these drugs. Nureki screened peptides that bind with MATE and found inhibitory proteins that penetrate bacterial membranes and disable MATE. "Since any drugs are usually expelled from the cell, until now it's been impossible to make an inhibitory protein to MATE. We've opened the path to doing just that."

Nureki wants to continue the work, focusing on the relationship between the dynamics of the membrane channels and higher order processes such as pathogenesis and aging. He also wants to map out the range of impacts that other physical factors—light, temperature, pressure, electric field variation—have on the channels and the related proteins. Eventually he wants to link these high-resolution structural analyses to drug development, and he already collaborates with Japan's big drug makers.

Nureki credits access to the world's most powerful synchrotron light at SPring-8 and outstanding graduate students at The University of Tokyo with the series of successes. "Being able to get great students on consistent basis was the biggest support," he says.

Department of Biophysics and Biochemistry, Graduate School of Science

www.nurekilab.net/index.php/en

Asia–Pacific Top 200

The 2013 edition of the Nature Publishing Index (NPI) includes 757 institutions based in the Asia-Pacific region, up from 738 last year. Below are the top 200, ranked by corrected count (CC), with last year's scores shown for comparison alongside the 5-year cumulative totals. International institutions that have labs in the Asia-Pacific region are included; funding agencies are excluded.
For more information see A guide to the NPI (page 34) ■

2013					2012			2009–2013		
RANK	INSTITUTION	COUNTRY	CORRECTED COUNT (CC)	ARTICLES	RANK	CC	ARTICLES	RANK	CC	ARTICLES
1	Chinese Academy of Sciences (CAS)	China	63.15	165	2	36.38	93	2	147.70	399
2	The University of Tokyo	Japan	57.19	128	1	39.72	116	1	206.76	509
3	Kyoto University	Japan	23.57	58	3	22.47	55	3	106.63	248
4	RIKEN	Japan	21.88	81	4	19.14	79	4	93.71	325
5	Osaka University	Japan	17.98	40	5	18.22	54	5	84.05	214
6	National University of Singapore (NUS)	Singapore	17.61	62	9	9.41	47	10	39.64	175
7	Tohoku University	Japan	17.41	49	12	8.55	27	6	52.63	150
8	The University of Melbourne	Australia	15.33	69	6	10.78	48	7	44.02	205
9	University of Science and Technology of China (USTC)	China	15.11	37	8	9.46	17	9	39.67	87
10	Tsinghua University	China	13.83	39	10	8.99	34	11	39.39	116
11	Australian National University (ANU)	Australia	12.64	33	13	8.10	21	12	34.91	94
12	Nanyang Technological University (NTU)	Singapore	12.59	37	35	3.57	14	23	22.28	74
13	Korea Advanced Institute of Science and Technology (KAIST)	South Korea	12.12	23	27	4.03	15	18	26.93	66
14	Peking University	China	11.16	48	11	8.72	35	15	33.15	131
15	Nagoya University	Japan	10.68	33	7	10.50	30	8	41.41	117
16	The University of Queensland (UQ)	Australia	10.62	50	15	7.08	41	13	34.22	159
17	BGI	China	10.50	32	18	6.27	20	20	23.86	73
18	Hokkaido University	Japan	8.45	25	20	5.47	17	19	23.89	71
19	Agency for Science, Technology and Research (A*STAR)	Singapore	8.20	40	16	6.63	36	17	28.08	138
20	Seoul National University	South Korea	8.14	37	24	4.60	26	14	34.18	125
21	Nanjing University	China	7.89	19	49	2.35	6	31	17.79	49
22	Pohang University of Science and Technology (POSTECH)	South Korea	7.34	18	58	1.95	5	32	16.97	45
23	The University of New South Wales	Australia	7.33	31	33	3.82	22	28	18.17	89
24	National Institute for Material Science (NIMS)	Japan	6.89	16	36	3.25	15	26	19.05	55
25	The University of Sydney	Australia	6.51	37	25	4.44	24	21	23.79	129
26	Monash University	Australia	6.33	30	32	3.88	21	24	21.65	88
27	Academia Sinica	Taiwan	6.33	25	37	3.21	20	35	14.71	61
28	The Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Australia	6.33	29	29	3.96	16	29	18.11	76
29	Tokyo Institute of Technology	Japan	6.21	18	23	4.60	16	30	17.91	68
30	National Institutes of Natural Sciences (NINS)	Japan	6.07	22	96	1.16	7	40	12.88	53
31	Keio University	Japan	6.01	22	28	3.96	19	25	19.66	67
32	National Institute of Advanced Industrial Science and Technology (AIST)	Japan	5.98	15	14	7.30	23	16	28.82	87
33	The Walter and Eliza Hall Institute of Medical Research (WEHI)	Australia	5.89	22	68	1.70	8	41	12.86	53
34	Kyushu University	Japan	5.79	13	19	5.81	20	22	22.39	74
35	Fudan University	China	5.72	25	30	3.90	13	36	14.67	68
36	Zhejiang University	China	5.70	25	22	4.70	15	33	15.64	64
37	Shanghai Jiao Tong University (SJTU)	China	5.63	35	17	6.62	30	27	18.87	101
38	NTT Group	Japan	5.51	10	38	3.16	5	37	13.77	25
39	The University of Hong Kong (HKU)	China	4.99	18	41	2.92	14	34	15.01	57
40	Sungkyunkwan University	South Korea	4.87	17	34	3.67	10	38	13.77	42
41	Sun Yat-sen University	China	4.79	17	51	2.24	12	52	8.54	44
42	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan	4.63	13	40	2.93	11	44	11.04	36
43	National Taiwan University	Taiwan	4.29	11	60	1.87	14	56	7.92	35
44	Xiamen University	China	4.16	9	47	2.38	6	39	13.13	25
45	Tata Institute of Fundamental Research (TIFR)	India	3.94	9	79	1.46	3	50	9.28	19

2013					2012			2009–2013		
RANK	INSTITUTION	COUNTRY	CC	ARTICLES	RANK	CC	ARTICLES	RANK	CC	ARTICLES
46	Korea University	South Korea	3.80	12	46	2.43	6	42	12.82	43
47	University of Tsukuba	Japan	3.39	11	39	3.04	12	43	11.25	43
48	China Agricultural University	China	3.23	10	91	1.19	7	79	5.42	25
49	Samsung Electronics Co., Ltd	South Korea	2.91	7	61	1.85	6	47	10.37	25
50	Yokohama City University	Japan	2.89	12	162	0.55	4	62	6.79	33
51	The University of Tokushima	Japan	2.68	8	99	1.10	4	91	4.42	20
52	Chinese Academy of Medical Sciences & Peking Union Medical College	China	2.58	14	50	2.34	15	63	6.77	48
53	The University of Western Australia (UWA)	Australia	2.58	24	57	2.00	26	45	10.67	102
54	Kobe University	Japan	2.58	8	62	1.84	6	55	7.96	33
55	Kumamoto University	Japan	2.46	9	52	2.19	12	76	5.46	27
56	Sichuan Agricultural University (SAU)	China	2.44	3	173	0.48	2	120	2.95	6
57	Tianjin University	China	2.44	5	88	1.21	3	98	3.75	10
58	Xi'an Jiaotong University	China	2.42	10	98	1.11	7	78	5.44	23
59	Okayama University	Japan	2.41	11	86	1.24	5	73	5.62	24
60	Hiroshima University	Japan	2.40	10	42	2.77	11	48	9.84	43
61	Chinese Academy of Agricultural Sciences (CAAS)	China	2.25	11	48	2.36	10	66	6.21	31
62	Macquarie University	Australia	2.09	13	95	1.17	8	65	6.29	37
63	The Chinese University of Hong Kong	China	2.06	12	77	1.53	10	68	6.07	32
64	Swinburne University of Technology	Australia	2.06	5	100	1.08	4	84	4.96	15
65	National Institute of Agrobiological Sciences (NIAS)	Japan	2.05	5	164	0.53	3	94	4.04	14
66	The University of Adelaide	Australia	2.02	15	125	0.78	8	89	4.54	46
67	University of Otago	New Zealand	2.01	12	87	1.21	5	61	7.08	39
68	James Cook University (JCU)	Australia	1.98	11	31	3.89	12	58	7.24	33
69	Tokyo Medical and Dental University	Japan	1.93	11	65	1.79	10	49	9.73	50
70	China University of Geosciences	China	1.89	3	97	1.12	5	99	3.62	15
71	The University of Auckland	New Zealand	1.88	7	134	0.68	5	70	5.98	32
72	Jilin University	China	1.87	10	143	0.63	6	92	4.22	25
73	Yonsei University	South Korea	1.86	13	21	5.46	14	46	10.58	43
74	Northwest A & F University	China	1.85	4	454	0.05	1	154	2.10	6
75	Dalian University of Technology (DUT)	China	1.84	4	275	0.17	2	135	2.43	10
76	Nanjing Medical University	China	1.83	10	70	1.67	11	72	5.74	29
77	Kyoto Prefectural University of Medicine	Japan	1.80	2	336	0.12	2	158	2.06	6
78	Second Military Medical University	China	1.80	9	89	1.21	8	57	7.47	29
79	Gunma University	Japan	1.78	7	180	0.45	4	122	2.79	18
80	Sichuan University	China	1.74	8	221	0.26	7	125	2.53	24
81	Tongji University	China	1.69	9	116	0.83	8	121	2.90	23
82	Institute for Basic Science (IBS)	South Korea	1.69	9	629	0.01	1	179	1.70	10
83	Tokyo University of Science	Japan	1.65	8	55	2.08	6	82	5.26	21
84	Ulsan National Institute of Science and Technology (UNIST)	South Korea	1.62	5	69	1.67	4	107	3.29	9
85	Tianjin Medical University	China	1.62	5	382	0.08	3	178	1.70	8
86	University of Tasmania	Australia	1.59	9	74	1.57	11	80	5.31	36
87	Hanyang University	South Korea	1.56	9	43	2.62	11	59	7.14	30
88	University of Chinese Academy of Sciences (UCAS)	China	1.53	13	64	1.80	17	64	6.44	44
89	Soochow University	China	1.52	7	175	0.47	4	123	2.70	19
90	National Institute of Biological Sciences, Beijing (NIBS, Beijing)	China	1.51	8	53	2.18	4	53	8.09	22
91	Indian Institute of Science	India	1.50	2	677	0.01	1	156	2.08	8
92	Beijing Normal University	China	1.49	4	200	0.34	2	129	2.49	13
93	Victoria University of Wellington	New Zealand	1.48	8	307	0.14	3	108	3.29	20
94	Chinese Centre for Disease Control and Prevention (China CDC)	China	1.46	8	135	0.67	2	146	2.24	12
95	East China Normal University	China	1.43	6	67	1.72	4	96	3.86	15
96	Korea Institute of Science and Technology (KIST)	South Korea	1.41	7	84	1.33	6	85	4.93	21
97	Niigata University	Japan	1.41	7	288	0.16	2	182	1.68	11
98	Hunan University	China	1.40	3	-	-	-	199	1.48	4
99	National Chiao Tung University (NCTU)	Taiwan	1.38	3	73	1.61	4	95	4.03	16
100	Council of Scientific and Industrial Research (CSIR)	India	1.37	5	45	2.48	7	81	5.30	21
101	East China University of Science and Technology (ECUST)	China	1.36	3	93	1.19	2	119	2.98	7

	2013				2012			2009–2013		
RANK	INSTITUTION	COUNTRY	CC	ARTICLES	RANK	CC	ARTICLES	RANK	CC	ARTICLES
102	The Graduate University for Advanced Studies (Sokendai)	Japan	1.35	9	110	0.91	5	90	4.51	28
103	Huazhong University of Science and Technology (HUST)	China	1.35	4	26	4.41	14	60	7.10	26
104	Sogang University	South Korea	1.34	3	-	-	-	134	2.45	8
105	Wuhan University	China	1.32	3	94	1.18	6	116	3.02	15
106	Chiba University	Japan	1.27	10	82	1.37	9	75	5.54	31
107	Renmin University of China	China	1.27	3	-	-	-	198	1.49	8
108	Southern Medical University	China	1.23	4	370	0.09	2	197	1.50	9
109	Waseda University	Japan	1.22	8	106	1.00	6	71	5.92	28
110	Huazhong Agricultural University	China	1.21	6	548	0.02	2	132	2.46	13
111	National Centre for Neurology and Psychiatry (NCNP)	Japan	1.20	4	-	-	-	97	3.79	12
112	National Institute for Agro-Environmental Sciences (NIAES)	Japan	1.18	3	-	-	-	226	1.24	4
113	Japan Synchrotron Radiation Research Institute (JASRI)	Japan	1.17	8	63	1.81	8	74	5.59	30
114	National Cheng Kung University	Taiwan	1.17	5	395	0.08	2	209	1.38	9
115	Shizuoka University	Japan	1.17	4	373	0.09	1	168	1.88	8
116	Shiga University of Medical Science	Japan	1.16	5	351	0.11	3	191	1.54	14
117	Northeast Normal University	China	1.15	5	272	0.17	2	217	1.32	7
118	Malaysian Palm Oil Board (MPOB)	Malaysia	1.07	2	-	-	-	242	1.07	2
119	Griffith University	Australia	1.05	6	85	1.31	5	67	6.13	27
120	Kansai Medical University	Japan	1.05	2	111	0.89	1	153	2.10	5
121	Yunnan University	China	1.03	4	132	0.69	3	170	1.80	9
122	Nankai University	China	1.02	7	75	1.54	7	83	4.98	21
123	St Vincent's Institute of Medical Research (SVI)	Australia	1.02	2	281	0.17	2	207	1.40	6
124	Osaka Prefecture University	Japan	1.01	3	71	1.66	5	109	3.25	13
125=	Panasonic Corporation	Japan	1.00	1	-	-	-	201	1.44	3
125=	Shanxi University	China	1.00	1	-	-	-	223	1.25	2
125=	Central China Normal University	China	1.00	1	-	-	-	237	1.10	3
128	Ewha Womans University	South Korea	1.00	8	76	1.53	8	69	6.05	29
129	Women's and Children's Hospital	Australia	0.99	5	470	0.04	1	139	2.33	14
130	Chungnam National University (CNU)	South Korea	0.97	4	-	-	-	161	1.98	9
131	Kanazawa University	Japan	0.97	4	127	0.76	2	88	4.66	15
132	National Institute of Informatics (NII)	Japan	0.97	3	126	0.77	2	110	3.18	12
133	National Tsing Hua University	Taiwan	0.96	6	72	1.65	6	114	3.11	16
134	QIMR Berghofer Medical Research Institute	Australia	0.96	27	59	1.94	17	54	7.97	88
135	Korea Research Institute of Chemical Technology (KRICT)	South Korea	0.96	3	-	-	-	162	1.95	6
136	Chungbuk National University	South Korea	0.96	3	297	0.14	2	232	1.14	6
137	Tokyo Women's Medical University	Japan	0.96	2	196	0.36	4	142	2.27	13
138	Curtin University	Australia	0.95	9	124	0.78	3	103	3.40	21
139	Saitama Medical University	Japan	0.95	3	140	0.66	3	160	2.02	13
140	Kyoto Prefectural University	Japan	0.94	1	141	0.65	2	175	1.74	4
141	The University of Wollongong	Australia	0.94	4	113	0.85	5	127	2.52	13
142	Wuhan University of Technology	China	0.93	1	-	-	-	148	2.20	3
143	South China Agricultural University	China	0.92	2	193	0.38	1	219	1.30	3
144	Anhui Medical University	China	0.92	8	104	1.03	7	77	5.45	25
145	International Centre for Genetic Engineering and Biotechnology (ICGEB)	India	0.92	1	349	0.11	1	172	1.77	4
146	Kagoshima University	Japan	0.92	4	246	0.22	2	215	1.34	8
147	Nagoya Institute of Technology	Japan	0.88	2	-	-	-	241	1.08	3
148	Beijing University of Chemical Technology	China	0.87	3	-	-	-	288	0.87	3
149	Fujita Health University	Japan	0.87	2	305	0.14	2	155	2.09	11
150	National Kaohsiung Normal University (NKNU)	Taiwan	0.85	1	-	-	-	291	0.85	1
151	Hong Kong University of Science and Technology (HKUST)	China	0.84	4	44	2.51	5	51	9.07	17
152	Korea Institute of Ocean Science and Technology (KIOST)	South Korea	0.83	2	445	0.06	1	286	0.89	3
153	Korea Electrotechnology Research Institute (KERI)	South Korea	0.82	1	-	-	-	300	0.82	1

2013					2012			2009–2013		
RANK	INSTITUTION	COUNTRY	CC	ARTICLES	RANK	CC	ARTICLES	RANK	CC	ARTICLES
154	The National Institute of Radiological Sciences (NIRS)	Japan	0.82	1	152	0.59	1	205	1.41	2
155	Lanzhou University	China	0.80	4	158	0.56	3	189	1.56	11
156	Gyeongsang National University	South Korea	0.80	2	684	0.01	1	253	1.02	5
157	Deakin University	Australia	0.80	1	197	0.35	2	221	1.28	5
158	Bureau of Meteorology	Australia	0.79	5	234	0.24	3	206	1.40	12
159	High Energy Accelerator Research Organization (KEK)	Japan	0.79	3	118	0.83	3	133	2.46	13
160	Nagoya City University	Japan	0.77	4	192	0.38	4	194	1.51	12
161	Dalian National Laboratory for Clean Energy (DNL)	China	0.77	2	311	0.14	1	279	0.90	3
162	Qingdao University	China	0.76	2	379	0.09	2	280	0.90	6
163	The University of Newcastle	Australia	0.76	4	210	0.32	4	152	2.11	16
164	Korea Research Institute of Bioscience and Biotechnology (KRIBB)	South Korea	0.76	3	486	0.04	2	136	2.42	12
165	Doshisha University	Japan	0.75	1	261	0.19	1	186	1.58	6
166	Tokyo University of Agriculture	Japan	0.75	1	-	-	-	224	1.24	3
167	Okazaki Institute for Integrative Bioscience (OIIB)	Japan	0.74	4	304	0.14	2	257	1.01	8
168	Yanshan University	China	0.73	1	-	-	-	319	0.73	1
169	Kyung Hee University	South Korea	0.73	8	83	1.36	6	113	3.11	21
170	Garvan Institute	Australia	0.70	5	155	0.57	4	102	3.47	20
171	Southwest University	China	0.70	4	670	0.01	1	176	1.73	7
172	Southeast University	China	0.70	4	248	0.21	3	111	3.15	12
173	Novogene Bioinformatics Institute	China	0.70	2	-	-	-	331	0.70	2
174	National Institute of Genetics (NIG)	Japan	0.69	4	112	0.87	3	112	3.11	17
175	Korea Institute of Machinery and Materials (KIMM)	South Korea	0.69	1	-	-	-	335	0.69	1
176	University of Ulsan	South Korea	0.68	5	157	0.57	7	211	1.37	15
177	Chinese National Human Genome Centre at Shanghai (CHGC)	China	0.67	2	178	0.46	1	167	1.88	10
178	Shenyang Normal University	China	0.67	3	283	0.17	1	171	1.79	6
179	Academy of Military Medical Sciences (AMMS)	China	0.66	4	-	-	-	150	2.15	7
180	Queensland University of Technology	Australia	0.66	4	123	0.78	3	187	1.56	11
181	Gakushuin University	Japan	0.65	3	136	0.67	2	204	1.41	7
182=	International Superconductivity Technology Centre (ISTEC)	Japan	0.64	1	-	-	-	243	1.07	2
182=	Jiangnan University	China	0.64	1	-	-	-	348	0.64	1
184	Shinshu University	Japan	0.63	4	208	0.32	5	177	1.70	14
185	Korea Basic Science Institute (KBSI)	South Korea	0.63	5	452	0.05	1	126	2.52	15
186	Pasteur Institute	South Korea	0.62	1	-	-	-	357	0.62	1
187	Japan Atomic Energy Agency (JAEA)	Japan	0.62	6	92	1.19	7	101	3.57	22
188	National Institute of Biomedical Genomics (NIBMG)	India	0.61	1	-	-	-	358	0.61	1
189	Okinawa Institute of Science and Technology (OIST)	Japan	0.61	3	209	0.32	3	118	2.98	11
190	Linyi University	China	0.61	2	194	0.38	1	236	1.11	4
191	The Tokyo Metropolitan Institute of Medical Science	Japan	0.60	6	102	1.05	3	100	3.59	19
192	The New Zealand Institute for Plant & Food Research Ltd	New Zealand	0.60	1	-	-	-	317	0.75	4
193	Department of Agriculture, Fisheries and Forestry	Australia	0.60	3	-	-	-	369	0.60	3
194	Beijing Computational Science Research Center	China	0.60	3	-	-	-	370	0.60	3
195	Massey University	New Zealand	0.59	3	-	-	-	138	2.35	6
196	Murdoch Childrens Research Institute	Australia	0.58	3	-	-	-	372	0.58	3
197	Capital Medical University (CMU)	China	0.57	3	316	0.13	3	240	1.08	12
198	Japan Fine Ceramics Centre (JFCC)	Japan	0.57	4	387	0.08	1	227	1.24	9
199	Australian Institute of Marine Science (AIMS)	Australia	0.56	3	219	0.26	1	203	1.43	5
200	Australian Nuclear Science & Technology Organisation (ANSTO)	Australia	0.55	2	540	0.03	1	276	0.91	6

All corrected CC scores are shown to two decimal places. Unless indicated, scores that appear tied may be differentiated by a third (or higher) decimal place.

Rankings are based upon primary research papers published in 2013 as Articles, Letters and Brief Communications. Research reviews are excluded.

This table is based on the most recent data available as of 1 March, 2014. Owing to continual refinements of the data the figures in the database are liable to change and might differ from those printed in previous supplements.

Top institutions by journal

The Nature Publishing Index comprises 18 journals. The flagship journal is *Nature*, founded in 1869, and there are many subsidiary publications, including one online-only journal, *Nature Communications*. *Nature* and *Nature Communications* are multidisciplinary, whereas most others fall into one of the following four subject categories: life sciences, chemistry, physical sciences and earth and environmental sciences. The exception is *Nature Chemical Biology*, which falls under the first two categories. Below are the data for 2013 showing the top five institutions for each journal, along with their 2012 rank. ■

XX% The percentage of the Asia-Pacific NPI represented by each journal is shown, while the icons illustrate which scientific areas are covered by each publication.

NATURE (15.6%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The University of Tokyo	Japan	10.21	25	4
2	Chinese Academy of Sciences (CAS)	China	10.02	29	1
3	RIKEN	Japan	5.11	15	6
4	Tsinghua University	China	3.52	5	2
5	Kyoto University	Japan	3.48	14	5

NATURE CHEMISTRY (1.7%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Kyoto University	Japan	1.56	2	18
2	Nagoya University	Japan	1.40	2	6
3	Chinese Academy of Sciences (CAS)	China	1.16	3	15
4	Dalian University of Technology (DUT)	China	1.00	1	31
5	Nanyang Technological University (NTU)	Singapore	1.00	1	9

NATURE BIOTECHNOLOGY (1.2%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Seoul National University	South Korea	1.58	2	-
2	Chinese Academy of Sciences (CAS)	China	1.41	3	6
3	Korea Advanced Institute of Science and Technology (KAIST)	South Korea	1.00	1	-
4	BGI	China	0.84	3	1
5	RIKEN	Japan	0.80	1	-

NATURE CLIMATE CHANGE (3.0%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Australia	3.48	11	2
2	The University of Tokyo	Japan	1.78	4	15
3	The University of Western Australia (UWA)	Australia	1.61	3	5
4	The University of Queensland (UQ)	Australia	1.23	7	3
5	James Cook University (JCU)	Australia	1.16	4	1

NATURE CELL BIOLOGY (2.0%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Chinese Academy of Sciences (CAS)	China	2.56	5	1
2	Kansai Medical University	Japan	1.00	1	-
3	National University of Singapore (NUS)	Singapore	0.96	3	9
4	Shanghai Jiao Tong University (SJTU)	China	0.86	2	6
5	Tohoku University	Japan	0.75	1	15

NATURE COMMUNICATIONS (44.3%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Chinese Academy of Sciences (CAS)	China	31.80	78	2
2	The University of Tokyo	Japan	27.02	57	1
3	RIKEN	Japan	11.97	38	5
4	Tohoku University	Japan	11.95	24	10
5	National University of Singapore (NUS)	Singapore	11.49	24	6

NATURE CHEMICAL BIOLOGY (1.1%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The University of Tokyo	Japan	2.50	3	6
2	University of Tsukuba	Japan	1.00	1	13
3	Chinese Academy of Sciences (CAS)	China	0.91	1	4
4	Agency for Science, Technology and Research (A*STAR)	Singapore	0.85	1	-
5	Korea Advanced Institute of Science and Technology (KAIST)	South Korea	0.71	1	-

NATURE GENETICS (7.4%)

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Chinese Academy of Sciences (CAS)	China	3.71	8	4
2	BGI	China	3.44	10	1
3	The University of Tokyo	Japan	2.48	9	7
4	Kyoto University	Japan	1.59	9	38
5	National Institute of Agrobiological Sciences (NIAS)	Japan	1.52	3	-

3.1% NATURE GEOSCIENCE

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Chinese Academy of Sciences (CAS)	China	2.57	6	3
2	Australian National University (ANU)	Australia	2.09	7	8
3	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan	1.79	3	1
4	The University of Tokyo	Japan	1.25	4	4
5	China University of Geosciences	China	1.18	2	14

2.6% NATURE NANOTECHNOLOGY

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	National University of Singapore (NUS)	Singapore	1.72	3	-
2	The University of Tokyo	Japan	1.50	3	5
3	National Taiwan University	Taiwan	1.17	2	-
4	National Institute for Material Science (NIMS)	Japan	1.12	2	-
5	Indian Institute of Science	India	1.00	1	-

2.7% NATURE IMMUNOLOGY

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The University of Melbourne	Australia	3.99	12	1
2	The Walter and Eliza Hall Institute of Medical Research (WEHI)	Australia	2.66	8	2
3	Monash University	Australia	2.37	6	7
4	Osaka University	Japan	2.04	3	17
5	The University of New South Wales	Australia	1.39	3	-

2.4% NATURE NEUROSCIENCE

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The University of Tokyo	Japan	2.27	3	2
2	Osaka University	Japan	1.09	3	42
3	National Institute of Advanced Industrial Science and Technology (AIST)	Japan	1.00	1	-
4	The University of Queensland (UQ)	Australia	1.00	1	41
5	Fudan University	China	0.95	3	-

3.1% NATURE MATERIALS

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The University of Tokyo	Japan	1.84	4	2
2	Chinese Academy of Sciences (CAS)	China	1.81	6	3
3	Nanjing University	China	1.51	3	-
4	Tohoku University	Japan	1.21	5	6
5	Hokkaido University	Japan	1.09	2	23

2.3% NATURE PHOTONICS

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The University of Tokyo	Japan	2.98	6	5
2	Kyoto University	Japan	1.67	2	2
3	Australian National University (ANU)	Australia	1.64	4	-
4	Chinese Academy of Sciences (CAS)	China	1.56	3	9
5	Korea Advanced Institute of Science and Technology (KAIST)	South Korea	1.13	2	-

2.9% NATURE MEDICINE

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Southern Medical University	China	1.00	1	-
2	The University of Hong Kong (HKU)	China	0.80	2	-
3	Keio University	Japan	0.73	1	2
4	Pasteur Institute	South Korea	0.62	1	-
5	Chinese Academy of Sciences (CAS)	China	0.55	2	-

2.0% NATURE PHYSICS

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Nanjing University	China	1.50	2	-
2	NTT Group	Japan	1.41	2	9
3	Chinese Academy of Sciences (CAS)	China	1.21	4	8
4	National University of Singapore (NUS)	Singapore	1.12	2	12
5	The University of Tokyo	Japan	1.03	3	1

0.9% NATURE METHODS

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	The University of Tokyo	Japan	1.05	2	8
2	Tata Institute of Fundamental Research (TIFR)	India	1.00	1	-
3	Peking University	China	0.88	1	11
4	Kyoto University	Japan	0.82	1	-
5	Chinese Academy of Sciences (CAS)	China	0.73	1	1

1.8% NATURE STRUCTURAL & MOLECULAR BIOLOGY

RANK	INSTITUTION	COUNTRY	CC	ARTICLES	2012 RANK
1	Chinese Academy of Sciences (CAS)	China	1.83	4	1
2	Nanyang Technological University (NTU)	Singapore	1.20	4	-
3	Osaka University	Japan	1.11	2	-
4	Peking University	China	1.02	2	4
5	Hokkaido University	Japan	0.78	2	12

Global Top 100

2013					2012			2009–2013		
RANK	INSTITUTION	COUNTRY	CORRECTED COUNT (CC)	ARTICLES	RANK	CC	ARTICLES	RANK	CC	ARTICLES
1	Harvard University	USA	158.99	387	1	150.25	369	1	695.15	1629
2	Massachusetts Institute of Technology (MIT)	USA	84.68	228	4	60.58	199	4	278.51	844
3	Stanford University	USA	80.21	170	2	76.42	161	2	322.62	667
4	National Institutes of Health (NIH)	USA	73.46	181	6	43.82	143	5	271.17	732
5	Max Planck Society	Germany	70.65	216	3	64.53	188	3	316.69	877
6	Chinese Academy of Sciences (CAS)	China	63.15	165	14	36.38	93	16	147.70	399
7	French National Centre for Scientific Research (CNRS)	France	59.37	297	5	46.81	250	6	217.89	1091
8	The University of Tokyo	Japan	57.19	128	9	39.72	116	7	206.76	509
9	University of California San Francisco (UCSF)	USA	49.81	107	17	34.13	96	8	197.00	472
10	University of Cambridge	UK	48.52	151	8	39.80	137	9	173.86	579
11	University of Oxford	UK	42.70	136	13	36.97	131	14	158.84	548
12	Columbia University in the City of New York	USA	41.28	108	15	34.76	89	11	167.05	407
13	Helmholtz Association of German Research Centres	Germany	41.23	202	19	28.51	134	19	131.13	654
14	University College London	UK	37.29	121	38	16.21	79	28	106.00	367
15	University of Michigan	USA	36.07	88	21	25.89	76	21	127.65	364
16	University of California San Diego (UCSD)	USA	35.75	105	12	37.44	95	10	169.37	440
17	University of Pennsylvania	USA	35.70	101	27	21.24	58	23	122.05	335
18	University of California Los Angeles (UCLA)	USA	35.48	93	20	26.97	82	22	124.87	360
19	University of Washington	USA	33.52	110	7	40.97	102	15	155.67	451
20	Swiss Federal Institute of Technology in Lausanne (EPFL)	Switzerland	32.29	62	43	14.68	41	42	72.24	176
21	Swiss Federal Institute of Technology Zurich (ETH Zurich)	Switzerland	32.17	93	10	39.53	74	18	134.90	308
22	Cornell University	USA	31.44	91	33	19.54	67	24	118.77	341
23	University of California Berkeley	USA	30.86	97	11	38.98	100	12	165.30	431
24	The Johns Hopkins University	USA	30.23	92	18	32.82	94	17	138.79	410
25	Yale University	USA	29.99	78	16	34.46	82	13	163.15	372
26	Imperial College London	UK	24.67	97	76	9.38	62	41	73.00	319
27	Kyoto University	Japan	23.57	58	25	22.47	55	26	106.63	248
28	University of Illinois at Urbana–Champaign	USA	22.73	41	34	18.68	41	31	94.02	170
29	The Scripps Research Institute (TSRI)	USA	22.41	51	26	22.20	44	27	106.06	223
30	The University of Texas Southwestern Medical Center at Dallas	USA	22.23	42	44	14.61	32	40	77.01	160
31	RIKEN	Japan	21.88	81	32	19.57	80	30	94.39	327
32	Northwestern University	USA	21.83	47	22	25.34	54	25	113.51	232
33	New York University	USA	21.77	58	35	18.53	47	34	85.32	223
34	Memorial Sloan-Kettering Cancer Center	USA	21.72	61	39	16.17	44	39	81.62	206
35	Medical Research Council (MRC)	UK	21.66	48	40	16.12	38	36	83.88	179
36	California Institute of Technology (Caltech)	USA	21.55	61	24	24.44	66	20	128.02	300
37	University of Toronto	Canada	21.47	94	37	17.15	63	29	101.20	355
38	Princeton University	USA	21.20	56	30	20.39	44	32	87.60	193
39	University of Minnesota	USA	20.33	51	47	13.89	47	55	52.95	186
40	The University of Texas at Austin	USA	19.54	44	42	14.91	43	49	60.07	149
41	Osaka University	Japan	17.98	40	36	18.22	54	35	84.05	214
42	University of Chicago	USA	17.92	55	23	24.88	54	38	82.53	223
43	Washington University in St. Louis	USA	17.83	64	28	20.85	72	33	87.26	290
44	Ludwig Maximilian University of Munich (LMU)	Germany	17.75	74	70	9.75	52	53	56.63	280
45	Lawrence Berkeley National Laboratory	USA	17.62	62	48	12.97	73	45	65.45	297
46	National University of Singapore (NUS)	Singapore	17.61	62	74	9.41	47	87	39.64	175
47	Tohoku University	Japan	17.41	49	87	8.55	27	56	52.63	150
48	European Molecular Biology Laboratory (EMBL)	Germany	17.39	57	68	9.98	38	59	50.20	169
49	Delft University of Technology	Netherlands	17.14	29	151	5.14	12	100	35.42	70
50	The University of Manchester	UK	16.47	45	98	7.75	34	79	42.60	155

2013					2012			2009–2013		
RANK	INSTITUTION	COUNTRY	CC	ARTICLES	RANK	CC	ARTICLES	RANK	CC	ARTICLES
51	University of North Carolina at Chapel Hill	USA	16.27	53	41	15.24	52	48	60.45	224
52	Weizmann Institute of Science	Israel	15.53	28	29	20.54	34	46	62.15	130
53	The University of Edinburgh	UK	15.43	58	53	11.99	52	52	56.97	243
54	The University of Melbourne	Australia	15.33	69	63	10.78	48	70	44.02	205
55	Duke University	USA	15.23	51	31	20.03	67	37	82.62	247
56	The Rockefeller University	USA	15.18	33	59	11.35	31	43	70.20	152
57	University of Science and Technology of China (USTC)	China	15.11	37	72	9.46	17	86	39.67	87
58	Los Alamos National Laboratory (LANL)	USA	15.05	43	80	9.21	23	92	38.12	103
59	Rutgers, The State University of New Jersey	USA	14.80	44	58	11.48	34	47	61.43	165
60	Spanish National Research Council (CSIC)	Spain	14.51	80	60	10.94	55	60	50.06	263
61	McGill University	Canada	14.47	55	97	7.78	43	61	48.41	188
62	IBM Corporation	USA	14.07	20	114	6.66	11	85	39.71	59
63	The University of British Columbia	Canada	13.91	52	73	9.42	36	50	59.51	197
64	Tsinghua University	China	13.85	39	83	8.99	34	88	39.39	116
65	Utrecht University	Netherlands	13.79	64	52	12.08	46	65	47.48	205
66	University of Bristol	UK	13.67	48	51	12.30	41	57	52.58	186
67	Albert Einstein College of Medicine of Yeshiva University	USA	13.59	34	133	5.84	23	75	43.52	121
68	University of Wisconsin-Madison	USA	13.54	32	62	10.80	31	44	68.76	188
69	University of Zurich (UZH)	Switzerland	13.54	47	55	11.74	41	63	47.88	187
70	University of Colorado Boulder	USA	13.22	44	57	11.60	37	51	58.00	159
71	St. Jude Children's Research Hospital	USA	13.15	30	93	8.12	19	78	43.11	96
72	Australian National University (ANU)	Australia	12.64	33	94	8.10	21	105	34.91	94
73	Nanyang Technological University (NTU)	Singapore	12.59	37	217	3.57	14	168	22.28	74
74	Technical University Munich (TUM)	Germany	12.51	60	89	8.32	29	91	38.54	189
75	National Institute for Health and Medical Research (INSERM)	France	12.40	118	61	10.93	92	54	54.03	441
76	Baylor College of Medicine	USA	12.37	36	67	10.26	38	69	44.05	154
77	Korea Advanced Institute of Science and Technology (KAIST)	South Korea	12.12	23	195	4.03	15	135	26.93	66
78	University of California Davis	USA	12.07	39	91	8.20	41	67	46.69	159
79	The University of Texas MD Anderson Cancer Center	USA	11.96	41	50	12.56	33	62	48.05	158
80	University of Tübingen	Germany	11.48	35	123	6.19	21	121	30.95	111
81	Peking University	China	11.16	48	84	8.72	35	113	33.15	131
82	University of Basel	Switzerland	10.99	43	124	6.19	22	130	28.34	114
83	University of Southern California (USC)	USA	10.97	48	82	9.00	47	74	43.65	190
84	Argonne National Laboratory	USA	10.92	35	90	8.21	24	106	34.78	114
85	University of Hawai'i at Manoa	USA	10.90	45	221	3.52	23	153	24.12	106
86	National Institute of Standards and Technology (NIST)	USA	10.85	28	180	4.44	20	80	42.53	105
87	BGI	China	10.76	34	119	6.30	20	152	24.14	75
88	Nagoya University	Japan	10.68	33	65	10.50	30	82	41.41	117
89	University of Copenhagen	Denmark	10.64	77	64	10.59	54	77	43.34	252
90	University of Massachusetts Medical School (UMMS)	USA	10.64	30	56	11.68	28	68	45.77	113
91	The University of Queensland (UQ)	Australia	10.62	50	106	7.08	41	109	34.22	159
92	University of California Irvine (UCI)	USA	10.62	38	85	8.67	36	89	39.23	138
93	Howard Hughes Medical Institute (HHMI)	USA	10.57	26	75	9.41	66	98	37.11	551
94	Karolinska Institute	Sweden	10.31	59	137	5.68	32	111	33.47	193
95	University of Groningen	Netherlands	10.26	37	95	8.02	37	118	31.46	130
96	The Institute of Photonic Sciences (ICFO)	Spain	10.24	20	168	4.64	10	179	21.02	46
97	The Pennsylvania State University	USA	10.21	36	79	9.22	35	72	43.87	157
98	National Research Council (CNR)	Italy	10.04	57	92	8.13	49	93	38.01	224
99	Aarhus University (AU)	Denmark	9.94	39	131	5.86	33	114	33.01	137
100	University of Pittsburgh	USA	9.89	39	45	14.26	44	66	46.76	176

All CC scores are shown to two decimal places. Unless indicated, scores that appear tied may be differentiated by a third (or higher) decimal place.

Rankings are based upon primary research papers published in 2013 as Articles, Letters and Brief Communications. Research reviews are excluded.

This table is based on the most recent data available as of 1 March, 2014. Owing to continual refinements of the data the figures in the database are liable to change and might differ from those printed in previous supplements.





Nagoya University

WORLD-LEADING RESEARCH AND EDUCATION

Founded in 1939 as one of Japan's seven prestigious imperial universities, Nagoya University has expanded far beyond its original roots as a medical training college in the 1870s. The university today is renowned for its formidable research achievements across the natural and physical sciences. No fewer than four of the ten Japanese scientists to be awarded a Nobel Prize in the 21st century are affiliated with Nagoya University: two Nobel Laureates in Chemistry, Ryoji Noyori and Osamu Shimomura, and two Nobel Laureates in Physics, Toshihide Maskawa and Makoto Kobayashi.

Situated in Central Japan — in a region that has the greatest concentration of manufacturing industries in the country — Nagoya University has strong links with some of the world's leading automotive companies such as Toyota Motor Corporation, and the university supports basic research for the aerospace, ceramics and machinery industries. Technology transfer and research collaboration activities between the university and partners in Japan and overseas have transformed the city of Nagoya into a vibrant hub for research and innovation.

In August 2013, the university was selected to be part of the Program for Promoting the Enhancement of Research Universities launched by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). The project focuses on the development of research support structures including the establishment of a Research Administrator System in the university, as well as promoting interdisciplinary research and strengthening the university's global competitiveness.

Various initiatives spurred by the Hamaguchi Plan, brainchild of university president Michinari Hamaguchi, have brought in equipment, established new interdisciplinary programmes and institutes, and forged industrial collaborations.

Cultivating research expertise and leadership

Interdisciplinary approaches are an integral part of cutting-edge research at Nagoya University. The Institute for Advanced Research (IAR) was established in 2002 to produce internationally recognised academic research of the highest calibre."We provide one of the best research environments in the world," says Hamaguchi. In addition, Hamaguchi explains that the university secures outstanding faculty members and encourages postdoctoral fellows to enhance their skills through initiatives such as the Young Leaders Cultivation (YLC) programme. Launched in 2010, the YLC programme has supported young researchers in the fields of engineering, biosciences, materials science, mathematics, law and economics. The Institute of Transformative Bio-Molecules (ITbM), launched in 2013, brings together some of the best minds in synthetic chemistry, catalysis chemistry, systems biology, and plant and animal science to develop innovative functional molecules, which offer promising solutions to global food, biomass and energy issues.

Michinari Hamaguchi, president of Nagoya University

The Kobayashi-Maskawa Institute for the Origin of Particles and the Universe (KMI) is another centre of excellence dedicated to exploring new frontiers of modern physics beyond the Standard Model.

Nagoya University is now intensifying its efforts to cultivate leadership and attract some of the brightest minds through its Leading Graduate Schools programme, which now encompasses a wide range of fields across the sciences and humanities. The newly launched Graduate Program for Real-world Data Circulation Leaders

encourages students to explore the interface of innovation and socioeconomic models based on a multi- disciplinary research approach. The Women Leaders Program to Promote Well-being in Asia focuses on gender equality issues and offers high-level training to empower future leaders in critical areas such as global health and education.

In the realm of sustainability and green sciences, the Integrative Graduate Education and Research Program in Green Natural Science is nurturing the next generation of leaders who will advance renewable energy technologies and engage in global discussion of environmental issues.

The Leadership Development Program for Space Exploration and Research provides practical training that will enable students to design and develop satellite instruments, and to lead and implement space programmes. The Cross-Border Legal Institution Design programme is fostering leadership in legislation by taking a fresh, interdisciplinary approach to legal education and training. All of Nagoya University's graduate programmes enable students to gain practical experience by tackling real-world problems.

A global perspective

To strengthen collaborations with universities overseas, Nagoya University has established five education centres in Asia specialising in the Japanese law system to cultivate legal experts in each respective country and also runs a programme to train health service professionals.

As part of the Japanese government's Global 30 Project, which aims to facilitate international exchange and collaboration, Nagoya University's flagship departments offer English-taught programmes at both the undergraduate and graduate level. The university is welcoming an increasing number of international students, who now make up approximately a tenth of the university's enrolment.

"By creating an environment in which students can communicate with people from different backgrounds, they can not only broaden their perspectives but also engage in interdisciplinary research to solve problems that could not be addressed by conventional methods," says Hamaguchi.

The university's internationalisation activities are therefore closely linked to the drive to promote cross-disciplinary research and inspire future leaders "who can take a holistic view and think creatively beyond the bounds of traditional disciplines — this is very important for the creation of new knowledge and ideas," says Hamaguchi.

Collaboration and innovation

Interdisciplinary approaches are an integral part of cutting-edge research at Nagoya University's Graduate School of Pharmaceutical Sciences and the new Center of Innovation (COI), where researchers are conducting collaborative projects to influence society and mobility to realise an active and joyful lifestyle. Research at the COI is advancing technologies linked with social systems through pioneering efforts in a wide range of research areas, such as engineering, medical science, information science, brain science, science of art and social innovation design science. Being located in Nagoya, the world centre of manufacturing, the university has a strong will to contribute to innovation.

Nagoya University's state-of-the-art facilities are also attracting widespread interest from both researchers and private companies. The High Voltage Electron Microscope Laboratory enables researchers to observe chemical reactions with unprecedented precision. At the Nagoya University Synchrotron Radiation Research Center and the newly established Aichi Synchrotron Radiation Center, researchers from Japan and around the globe are exploring the frontiers of nanoscience and nanotechnologies.

With world-leading capabilities in research and development across multiple fields, Nagoya University is continuing to evolve as a thriving hub of knowledge creation and innovation. "We provide a free and vibrant academic culture that encourages students to think logically and creatively," says Hamaguchi. "Our goal is to support multifaceted research programmes and to cultivate the leaders of tomorrow." ■

NAGOYA UNIVERSITY

www.nagoya-u.ac.jp/en

NAGOYA UNIVERSITY

A fresh approach to biomolecular discovery

Nagoya University has world-class capabilities in integrating synthetic chemistry with systems biology to develop new, innovative biomolecules.

The Institute of Transformative Bio-Molecules (ITbM), launched in April 2013, is part of the World Premier International Research Center Initiative (WPI) supported by Japan's Ministry of Education, Culture, Science and Technology (MEXT). The overarching goal of the ITbM is to accelerate the development of useful, bio-based compounds with the potential to revolutionise healthcare, food, energy and environmental sciences.

Research at the ITbM focuses on the development of novel, 'transformative' molecules with finely tuned properties that can enhance biological functions such as the productivity of plant crops, advance the development of real-time bio-imaging systems, and lead to the discovery of new catalysts for organic synthesis.

The ITbM offers a uniquely integrated, cross-disciplinary research environment. Organic synthetic chemists, plant and animal biologists, and theoretical chemists work side by side in the Institute's interactive 'Mix Labs' specifically designed to facilitate interdisciplinary learning and exchange. The Institute has state-of-the-art live-cell imaging facilities, a mass spectrometry and nuclear magnetic resonance (NMR) spectroscopy centre, as well as a chemical-library screening centre to speed the process of identifying promising new compounds.

The ten Principal Investigators (PIs) at the Institute have expertise in fields spanning synthetic chemistry, physical organic chemistry, structural biology, bio-imaging, developmental genetics, agricultural science, applied biotechnology, and molecular modeling. The ITbM has set up a Cooperative-PI (Co-PI) system, whereby young researchers are paired with overseas PIs to extend the reach of the ITbM's activities and promote internationalisation.

The ITbM has strong collaborative links with ETH-Zürich in Switzerland, Queen's University in Canada, and the University of Washington in the United States — the three institutes affiliated with the ITbM's overseas PIs. The ITbM has also established collaborative research agreements with the National Science Foundation Center for Selective C-H Functionalization in the United States, and the RIKEN Center for Sustainable Resource Science in Japan.

All postdoctoral researchers at the ITbM are supervised by two PIs from different fields in order to encourage breadth of knowledge and critical thinking. The Institute offers a stimulating, international environment, with interactive seminars and workshops held throughout the year. Most of the work at the ITbM is conducted in English and Japanese. The Administration Department offers bilingual support to international researchers and students. The highly interdisciplinary nature of the research carried out at the ITbM encourages wide interaction, ongoing learning and professional development.

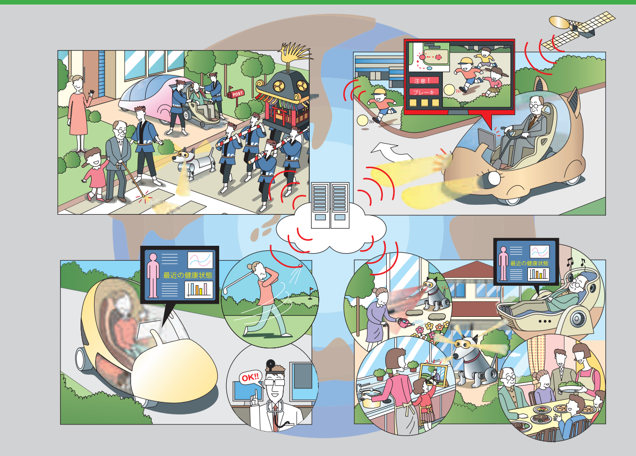
One of the core objectives of the Institute set out by Kenichiro Itami, director of the ITbM, is to 'attract top researchers worldwide and nurture the next generation of cutting-edge research, unrestricted by the bounds of traditional disciplines.'

By exemplifying a new, barrier-less approach to research in Japan and integrating the exciting possibilities of molecular design and applied biochemistry, the ITbM is now making its mark on the world stage. Building on Nagoya University's traditional strengths in synthetic chemistry and systems biology, the Institute is ideally positioned to make unprecedented discoveries in biomolecular research and drive the development of beneficial innovations for human health and the environment. ■

ITbM Nagoya University

WPI - Institute of Transformative Bio-Molecules (ITbM)

www.itbm.nagoya-u.ac.jp/



NAGOYA UNIVERSITY

Innovation for all

A commitment to developing end user-focused technologies that benefit human health and society forms the basis of Nagoya University's innovative research strategies.

The designation of Nagoya University as a Center of Innovation (COI) by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) is a testament to the university's outstanding commitment to advancing innovative research and ideas to improve human health and quality of life.

Nagoya University researchers are engaged in developing novel, user-focused solutions and technologies across a wide spectrum of fields — from engineering, medical science and information science to neuroscience and emerging fields such as the science of art, and social innovation and design. In addition to tackling fundamental R&D challenges, new technologies are leading to exciting new possibilities and capabilities in personalised healthcare and social structures.

"Our vision is for new innovations to enable people to enjoy active, fulfilling lives," says Nagahiro Saito, professor and presidential advisor at the Materials Science and Engineering Department, Nagoya University Graduate School of Engineering. With the development of new detection technologies, for example, it is now possible to monitor subtle changes in human health, thought, and emotions. State-of-the-art information science technologies can provide valuable risk-mapping tools to make transportation systems safer and more efficient. These unprecedented advances are changing ways of life at both the individual and the society level.

Improving mobility is a key area of research at Nagoya University that is not only limited only to transportation systems but also applies to responding to the needs of Japan's rapidly aging population. "Mobility in this sense can provide increased personal independence and better quality of life for the elderly," explains Saito. "Innovative solutions can help people to improve communication, and enhance social networks and care."

The acceleration of technology transfer through collaboration between universities and industries is therefore vital to nurture seminal research and bring innovative applications to market. Saito notes that "new and varied types of society–academia–industry collaborations will provide real solutions to societal problems", adding that the role of the university will become increasingly important in the birth of ideas and the development of prototypes, as well as the evaluation of performance, safety and consumer acceptability.

"By addressing simple challenges diligently, it is possible to address larger, more complex issues," says Saito, who himself investigates carbon catalysts to develop new molecular technologies. He advises young researchers not to lose sight of the connections between their investigations and the wider world.

Nagoya University was selected by MEXT as one of twelve COIs comprising top universities and institutes nationwide in October 2013. The COI Program is one of the main funding programmes under the Center of Innovation Science and Technology-based Radical Innovation and Entrepreneurship Program (COI STREAM), which is seen as a key pillar of Japan's efforts to promote sustainability and economic revitalisation. The COI initiative will undoubtedly play a major part in Japan's ability to address the key challenges of an aging population, while strengthening its international competitiveness in innovative research and commercialisation. ■

HUMAN ENJOY ACTIVE LIFE COMMUNITY MOBILITY

COI STREAM

Center of Innovation (COI)
www.coi.nagoya-u.ac.jp/

NAGOYA UNIVERSITY

Top-level doctoral education and research

Supported by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Japan Society for the Promotion of Science (JSPS), Nagoya University's Leading Graduate Schools programme is dedicated to fostering innovation and creativity, and inspiring the next generation of leaders in government, academia and industry.

Thinking green

Launched in December 2011, the Integrative Graduate Education and Research (IGER) Program in Green Natural Sciences fosters a multidisciplinary approach for training the next generation of global environmental leaders. Included in the programme of foundational science disciplines are chemistry, biology and physics, taught by outstanding faculty from the Nagoya University Graduate Schools of Science, Engineering, and Bioagricultural Sciences.

Educational support is also provided by visiting lecturers from institutes including Japan's Institute for Molecular Science, the National Institute of Basic Biology, RIKEN, the National Institute of Advanced Industrial Science and Technology, the Toyota Central R&D Laboratories, and the Toyota Physical and Chemical Research Institute, as well as overseas partner universities. The IGER programme provides opportunities for students to engage in face-to-face interactions with working scientists and industry leaders, offering an effective platform for education, research training and recruitment.

The programme is primarily designed to encourage a balance of both academic and industry-based skills, with opportunities for students to attend seminars to stimulate discussion and collaboration, as well as undertake English-language training and internships. Students receive guidance through evaluations and feedback as part of a 'Portfolio' system, aimed at broadening future career paths.

Gender equality is an integral part of the programme. A dedicated 'Women in Science Team' comprising around 20 eminent female scientists actively encourages young female students to become world-class scientific leaders through professional development seminars and career advice. Women make up around a quarter of the total number of 263 students currently enrolled in the programme.

The programme provides excellent opportunities for those who wish to develop leading-edge skills and deepen their research experiences. A number of financial support options are available on enquiry. The door is open to all graduates who have a spirit of *kokorozashi* — a determination and vision to succeed in a fast paced and competitive environment, and to contribute to our understanding of critical issues in the green natural sciences. ■

IGER

Integrative Graduate Education and Research Program in Green Natural Sciences

http://iger.bio.nagoya-u.ac.jp/index_e.php

Leadership in the legal sphere

The Cross-Border Legal Institution Design programme aims to cultivate legal experts who can transcend the boundaries of disciplines, cultures and nations. "To make a workable transplantation of law, a strong understanding of donor and recipient countries is essential," says Yoshiharu Matsuura, a professor at the Faculty of Law, Nagoya University. "This means that experts in legal transplantation must have in-depth knowledge of the two countries concerned and be able to work with experts in various disciplines."

The idea of building relationships with partners across academia, industry and government is central to Nagoya University's increasing efforts to instill a culture of collaboration at all levels. "Traditionally, the study of law was an individual pursuit. In contrast, the professional training provided by this programme is group-oriented," says Matsuura. "Students can learn how to develop legislative plans as part of a team, and how to work as good managers on cross-border projects."

Matsuura explains that the programme enables students to gain practical experience in legislative drafting and problem-solving. In addition, students and faculty can invite guest speakers to give two-week seminars on topics of their

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Top-level doctoral education and research

Forum at Nagoya University.

choice. These seminars not only enable students to hone their skills in planning and communication but also broaden their contacts and interactions with the wider community.

On completion of the course, students become highly skilled professionals who can make valuable contributions to the legal and social frameworks in their respective countries. Matsuura adds: "The programme encourages students to have a good command of at least one Asian language. We provide special language programmes for this purpose. Students will have a good command of English and one Asian language, which will help them become more effective in their work in cross-border institutional transfer."

Cross-Border Legal Institution Design

www.law.nagoya-u.ac.jp/~leading/en/index-e.html

The next generation of space explorers

The Leadership Development Program for Space Exploration and Research provides students with a sound basis for their future careers in space science and technology. Through an interdisciplinary programme of lectures combined with hands-on training, students can immerse themselves in the design and development of satellite instruments, as well as in planning and implementing various projects relating to ChubuSat, a micro-satellite jointly developed by a group of universities and aerospace industries led by Nagoya University.

The ChubuSat projects form an integral part of the programme, not only bringing together teams of students who have different skill sets and backgrounds, but also enabling individuals to broaden their perspectives, exchange ideas, and learn from real-world problem-solving situations. These projects are important in enabling students to develop effective project management skills.

The programme aims to cultivate space science professionals with an international outlook, and incorporates a range of leadership development seminars and global leadership training courses. Students can therefore develop their communication and leadership skills alongside their study of space science, observatories, the solar–terrestrial environment, advanced materials, signal processing and simulations.

Students are encouraged to deepen their experiences by undertaking internships at leading universities, research institutes and companies. Most recently, students have participated in internships at overseas institutes including the Dutch Institute for Fundamental Energy Research in Germany, INFN Gran Sasso National Laboratory in Italy, Institut de Mécanique des Fluides de Toulouse in France, the Joint Institute for Nuclear Research in Russia, Stanford University in the USA, the Swiss Federal Institute of Technology in Switzerland, the University of York in the UK, and the Weizmann Institute in Israel.

The programme offers two types of scholarship — full and basic — which are based on rigorous performance evaluations. Students are welcome to take any of the courses within the programme regardless of the scholarship level.

Leadership Development Program for Space Exploration and Research

www.frontier.phys.nagoya-u.ac.jp/index-e.html

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Top-level doctoral education and research

Exploring new horizons

The PhD Professional: Gateway to Success in Frontier Asia programme provides a hands-on, field-oriented research experience that takes a multidisciplinary approach to leadership training. The programme focuses on collaboration between Japan and 'Frontier Asia' countries including Vietnam, Cambodia, Thailand, Uzbekistan and Mongolia, with the goal of raising future leaders in the academic, industrial, governmental and non-profit sectors.

To mark the official launch of the programme in October 2013, an opening ceremony was held in Ulan Bator, Mongolia, and attended by Michinari Hamaguchi, president of Nagoya University, with guests including Tadayuki Hashimoto, chairman of IMB Japan, Kazuo Matsunaga, former Vice-Minister of Economy, Trade and Industry, Takuo Kidokoro, former ambassador to Mongolia, Nobumasa Tsutsui, chairman of Tokai Medical Products, and Fumio Kawaguchi, former chairman of Chubu Electric Power. The inaugural gathering presented a unique opportunity for students to learn about real-world business and development activities as experienced by top leaders in their respective fields.

The first cohort of students took part in a nine-day research excursion in Mongolia, which included a visit to a coal-fired electricity generating plant, as well as staying overnight at a traditional Mongolian ger. Through such activities, students were able to develop a deeper understanding of environmental and socioeconomic issues relating to agriculture, education, natural resources and renewable energy.

The programme hosts interactive seminars with some of the world's top thinkers and leaders. Recent discussion sessions have been held with guests including Toshihide Maskawa, Nobel Laureate in Physics 2008, and Kiyotaka Akasaka, the former United Nations Under-Secretary-General for Communications and Public Information.

Students can also take part in Japanese cultural experience programmes, for example, with visits to the Sano Art Museum in Shizuoka and the Tokugawa Art Museum in Nagoya. Future field research programmes are planned in Thailand and Cambodia in February, and Mongolia in March 2014. ■

PhD Professional : Gateway to Success in Frontier Asia

www.phdpro.provost.nagoya-u.ac.jp/eng/

Inspiring women leaders of tomorrow

As a multicultural region with diverse traditions and languages, Asia has a rich and complex history that continues to inform and shape the present. Key issues such as poverty and inequalities in health and gender continue to exist, despite Asia's explosive economic growth over the past quarter century.

Launched in 2013, the Women Leaders Program to Promote Well-being in Asia is designed to address these critical issues and foster women leaders who can make an impact in the areas of food, health, environment, social systems and education.

"Diversity is the driving force of Asian innovation," says programme coordinator Hiroko Tsukamura, a professor at the Graduate School of Bioagricultural Sciences, who has also held a position as director at the Office for Gender Equality and advisor to the President (gender equality) since 2006 at Nagoya University. Her commitment to and passion for the promotion of gender equality has brought about the launch of this programme. "We aim to achieve well-being in Asia through women's initiatives that transcend ethnicity, nationality, religion, and research fields."

The concept of well-being, Tsukamura explains, refers to "a state characterised

NAGOYA UNIVERSITY

Top-level doctoral education and research

by good physical, mental, social, and economic conditions, as well as the guarantee of individual rights and personal fulfillment." Enabling women to reach their leadership potential is an area of particular focus in Japan, where efforts to reduce the gender gap are intensifying.

The pioneering programme provides students with practical skills and knowledge across a wide range of disciplines, and emphasises the value of learning in real-world contexts. The programme will start October 2014 and is slated to open to about 20 students in its first year. Training and research opportunities at partner universities overseas and internships in collaboration with organisations such as the Japan International Cooperation Agency (JICA) are also available.

"We welcome highly motivated and talented young students," says Tsukamura. "To achieve sustainable well-being in Asia, the program aims to develop women leaders with the ability to understand situations from a comprehensive viewpoint, and who have a high degree of professionalism and a strong sense of responsibility."

Women Leaders Program to Promote Well-being in Asia

www.well-being.provost.nagoya-u.ac.jp/eng/

Real-world know-how

Nagoya University's Graduate Schools of Information Science, Engineering, Medicine, and Economics have jointly launched a five-year Graduate Program for Real-world Data Circulation.

Encompassing the fields of engineering, information science, healthcare, and economics, the new programme involves the study of real-world data to gain a deeper understanding of the driving forces behind today's innovations, technological developments, services, and industries, as well as the needs and desires of society at large.

With a focus on examining user-led design and development of products and services, the new programme is aimed at fostering leaders in industry, academia and government who can address the links and disparities between advanced technologies and social values.

One of the programme's distinguishing features is the emphasis on social values as the core principle of education. "Data in and of itself generally refers to a set or series of numbers," says Kazuya Takeda, professor of Information Science, Nagoya University. "However, without examining the association between those numbers and the physical, social or biological factors that yield them, valuable knowledge cannot be extracted."

Through a comprehensive programme of lectures that covers the key phases of data circulation — from the acquisition stage to the analysis and implementation of real-world data — students can develop expertise in their chosen disciplines, and gain practical knowledge of Japanese industries and the evolving socio-economic climate.

The programme will also enable students to explore contemporary issues such as the global division of labour, production and consumption in developing countries, and strategic research in industrially advanced countries.

For potential applicants, Takeda advises: "Do not be afraid of failure. The various experiences that you will have through this programme will enable you to keep on learning." The programme officially launches in April 2014.

Real-World Data Circulation Leaders

www.rwdc.is.nagoya-u.ac.jp/index-e.php