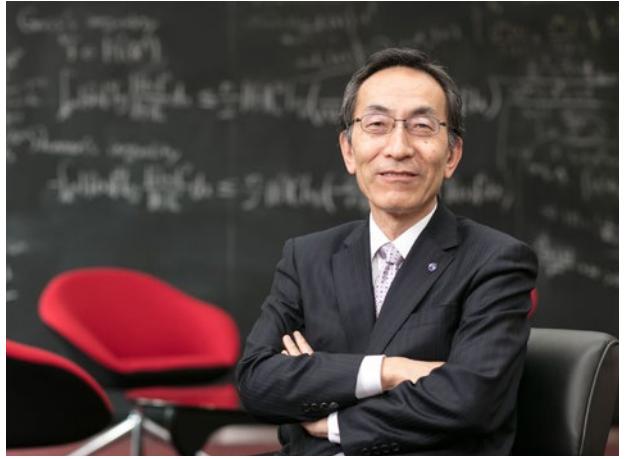


# ANNUAL REVIEW 2017-2018

## TOHOKU UNIVERSITY

[www.tohoku.ac.jp](http://www.tohoku.ac.jp)





## Welcome to Tohoku University!

One of my favourite things about the Tohoku region is the abundance of nature. Our four campuses reflect the seasons year round, but I think they are especially beautiful in the spring when the cherry blossoms bring the spirit of renewal and optimism with the start of every new academic year.

This past spring was indeed a season of change for our university and for me personally. I am honoured to serve as the 22nd president of Tohoku University.

The previous president, Susumu Satomi, who was appointed in 2012 after the Great East Japan Earthquake, stabilized and united a campus community rocked by disaster. He also put in motion plans to grow, a great example of which is the new campus extension at Aobayama.

I will continue that growth by driving creativity, innovation, exploration and discovery. I will do my best to ensure that Tohoku University is an institution that is always respected for the quality of our research and educational standards. Our most powerful tools are already here - our students, our researchers, our staff and the people in our community – and we will continue to nurture young talent who can break new barriers in research.

Tohoku University has achieved extraordinary things for over a century. I believe that with renewed passion and purpose, we can do even more together.

Hideo Ohno  
President, Tohoku University

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# History of Tohoku University

For more than a century, Tohoku University has embraced its role of not just grooming the next generation of leaders, but also arming them with the most innovative technology that the world's best research teams can produce.

And it achieved this by following the three tenets that have defined the university since its founding in 1907 – Research First, Open Door and Practice-oriented Research and Education.

Since the very beginning, the university's Open Door policy has allowed it to tap into valuable human resources. Departing from the norms of other imperial universities at the turn of the 20<sup>th</sup> century, Tohoku University accepted graduates from technical schools. And in 1913, it went a step further and – despite opposition from the government – became Japan's first university to accept female students.

Over the years, the university has been successful in attracting brilliant researchers from around the world. Following a Research First policy, these scholars pursued productive research and put their findings to work in the teaching of their students. This led to the spirit of Practice-oriented Research and Education that the university has become famous for.

Building on these three ideals, Tohoku University has consistently tried to use its research success to address both local and global problems.

Since the 2011 Great East Japan Earthquake, the university has been providing expertise and support to the region through technological development and reconstruction efforts. Seven years on, Tohoku University remains committed to the recovery of the region.



## Highlights 2017-2018



### Registered Buildings

Five buildings at Katahira Campus were granted the status of Registered Tangible Cultural Properties by the Japanese Agency for Cultural Affairs. They include Lu Xun's Lecture Hall, the University Archives and the Administration Building. The special status is conferred onto buildings and structures of historical significance and ensures their protection.



### Sendai Tanabata Festival

A group of mostly international students took part in Sendai's Tanabata Festival by making the iconic ornaments for a culture class. Their ornaments - which included origami cranes and more than 4,000 hand-made paper flowers - won the bronze award for original design and hung prominently along Ichibanchō during the 3-day festival.



### First TEDxTohokuUniversity

The inaugural TEDxTohokuUniversity was held on Aobayama Campus, bringing together students, faculty and local community members for a series of short, powerful talks aimed at inspiring change. The theme was Open Doors, which the student organisers hoped would reinforce the message that good ideas are best shared.



### 45 Years of Friendship with China

To mark the 45th anniversary of Sino-Japanese diplomatic relations, four Chinese provinces sent students to various regions around Japan to visit museums and institutions related to ecology. Tohoku University hosted a group from Jilin's Northeast Normal University. They visited Lu Xun's Lecture Hall, the University Archives, the International Research Institute of Disaster Science and the Ecollab. Tohoku University is especially well known in China for its first and most famous Chinese alumnus, Lu Xun - the man regarded as the most influential figure of modern Chinese literature.



year round and is open to everyone. There are seasonal competitions, with a Grand prize and a Website Prize handed out once a year and chosen among the best entries from all four seasons.

### Photo Contest

The inaugural Tohoku University Photo Contest announced its first Main Prize winners on Homecoming Day. "A Girl Braver than the Sun" won the Grand Prize, while "Sumo Circle - Dare to Try!" won the Website Prize. The Tohoku University Photo Contest runs



### Kick-off Symposia

Major fields within the Core Research Cluster held kick-off symposia this year. The Karolinska-Tohoku Joint Symposium on Medical Sciences explored the impact of biobanking and biochemistry on public health and next-generation medical care. And a symposium on materials science and spintronics, hosted by the Advanced Institute for Materials Research (AIMR) and Research Institute of Electrical Communication (RIEC), brought together international experts from a range of related disciplines.

### World Bosai Forum

The inaugural World Bosai Forum was held in Sendai to discuss the latest research and practices in disaster risk reduction. The four-day event featured some 50 sessions and addressed the progress made since the Sendai Framework for Disaster Risk Reduction was adopted by 187 countries in 2015. Participants also visited the region's tsunami-affected areas.

The World Bosai Forum is held biennially in Sendai in odd-numbered years, in partnership with the International Disaster Risk Conference which is held in Davos, Switzerland in even-numbered years.



### Farewell to President Satomi

The end of this academic year saw a changing of the guard at Tohoku University. A ceremony was held to say thank you and goodbye to former president Susumu Satomi and several other long-serving members of the university leadership who either retired or moved on.



### Cherry Blossom Saplings

University alumnus Hiroshi Saito, who graduated from the engineering department more than 50 years ago, donated 159 cherry blossom saplings to add colour and beauty to the new extension at Aobayama Campus. These were planted at a ceremony on March 28.

### Glee Club at Carnegie Hall

As part of the 10th Circle Wind Concert, Tohoku University's Mixed Chorus and Male Chorus Clubs were invited to take part in the Japan-US Glee Club Festival, held at the prestigious Carnegie Hall in New York.



## Reading the Wind

### Tohoku University Archery club

Historically, the bow and arrow has been used around the world for hunting and combat.

In Japan, early images depicting the country's distinctive longbow date back to the Yayoi period (c.300 BC-300AD).

Once associated with the samurai class of feudal Japan, kyudo or Japanese archery, saw a decline following the introduction of firearms. It was reintroduced into the school curriculum during the Meiji era (1862-1912) and many schools and universities offer it as an extra-curricular activity. Revered as a sport that requires great physical and mental strength, kyudo is still used in ceremonial rites and practiced widely as a recreational and competitive sport.

The western form of archery is lesser known in Japan but is practiced alongside kyudo at Tohoku University. Competitive archery involves shooting arrows at a target from a set distance and athletes talk of "reading the wind" as an essential component of the sport. Tohoku University's Archery Club was founded in 1990 and currently has more than 30 members including many female archers. The club has had good success at the National Seven University Athletic Games and the members look forward to making their mark at the All Japan Student Archery Championships.



## In the Driver's Seat

### Tohoku University Kart Racing Club



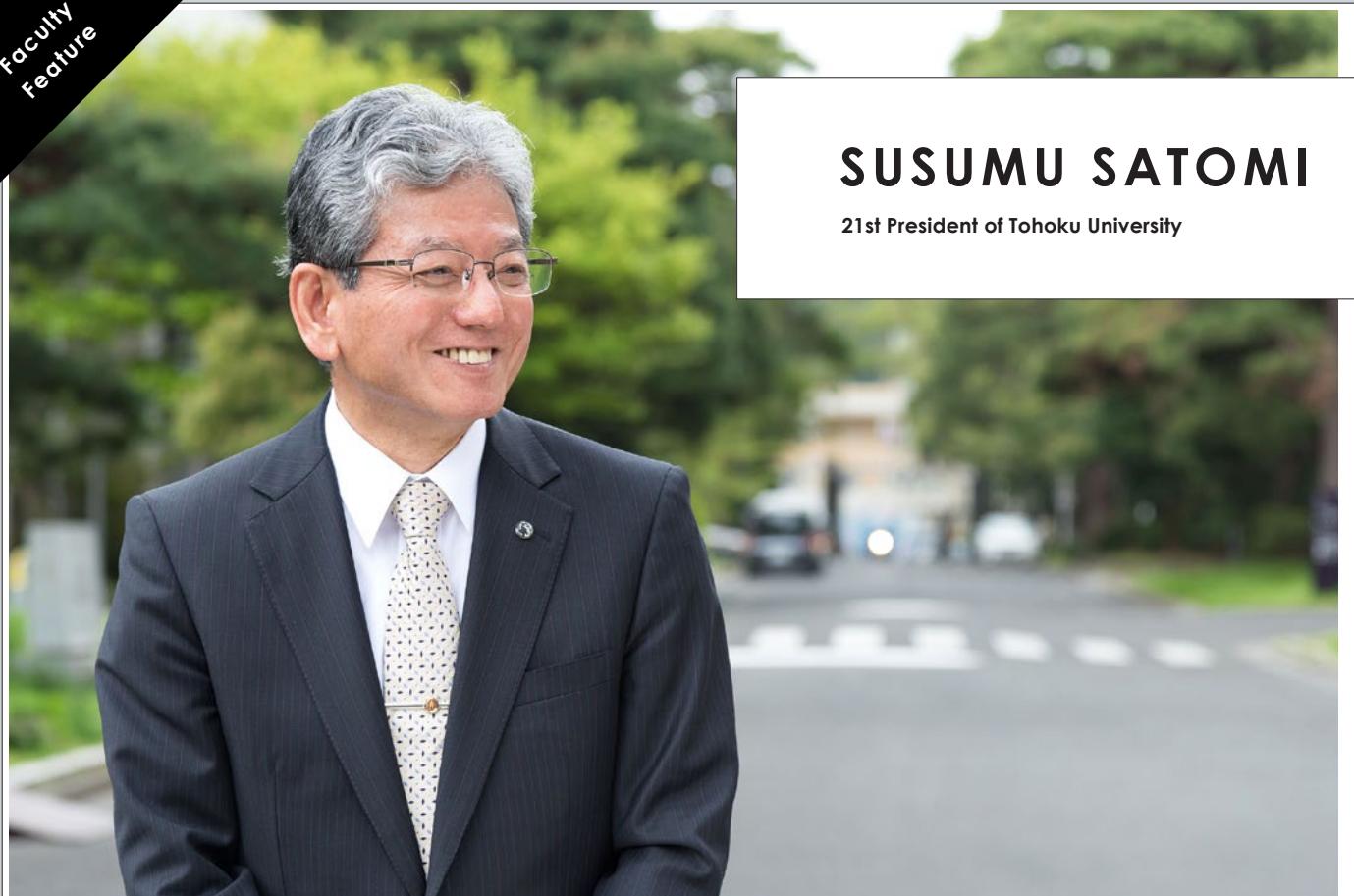
Tohoku University's Kart Racing Club doesn't have a track on campus to practice on, so instead, it operates out of the Sportsland Sugo Motorsports facility in Miyagi Prefecture, one of the largest motorsports facilities in Japan. It boasts four specialized racing courses, including one for go-karting.

The club stores its karts in a garage at the circuit and students get together during the week and at weekends. Club members have the opportunity to watch international

races live and also gain first-hand experience by working at the tracks. Kart racing is commonly perceived as a low-cost and relatively safe stepping stone to the higher ranks of motorsports.

While the mechanics of go-karting is fairly simple, it takes good judgement, skill and physical fitness to be able to drive a kart. New members can practice on rental karts at Sportsland Sugo and can, with adequate training, get a license.





## SUSUMU SATOMI

21st President of Tohoku University

### In Conversation

Susumu Satomi has had a long history with Tohoku University. An alumnus of the medical school, he established himself at the Second Department of Surgery at Tohoku University Hospital from 1977 and worked his way to a full professorship by 1995.

He made national headlines a few years later when he performed the first kidney transplant from a brain-dead donor in Japan, and raised organ donation awareness through the introduction of organ donor cards. He would later serve as hospital director from 2004 to 2012, before being appointed university president.

During his six-year tenure as president (2012 – 2018), the university grew its international profile and was one of

the original three institutions selected to be a Designated National University by the Japanese government in 2017.

Before stepping down on March 31, 2018, President Satomi shared some of his favourite memories of his time at the university.

#### How has Tohoku University changed since you were a student?

There are a lot more international students now, and Japanese students are more willing to travel. When I was a student, we never thought of going abroad. We also didn't have the money for it.

Life was very simple back then. My friends and I shared living quarters, had meals together and students from



different departments would come and hang out. We were very close and knew each other very well. We even knew when money from our parents would arrive, so we knew who to borrow money from or ask for a treat when our own money ran out.

#### What inspired you to study medicine?

My father always told me that being a doctor is a good job because you won't go out of business and you will always be respected.

#### In the immediate aftermath of the 2011 earthquake and tsunami, you mobilized hospital resources to help with the recovery efforts. Talk us through that.

At the time of the earthquake I was director of the hospital and working in my office at the top of a nine-storey building. One month earlier, there was an earthquake in New Zealand where many buildings collapsed. I briefly wondered if the building I was in would collapse. When the shaking stopped, my colleagues and I went down to the designated evacuation spot to establish the disaster countermeasure headquarters.

Because of the magnitude of the earthquake, we assumed that many patients would have fallen and equipment would have disconnected. But luckily, the ward had modern earthquake-proof construction so the impact wasn't as bad as we had feared. Although some people were injured, there were no casualties and we were very thankful for that.



#### What was the hardest decision you made that day?

I had to decide that the hospital would not be an evacuation centre for the general population. People nearby saw the lights and wanted to seek shelter with us, but we could not accommodate them and help people who needed medical care at the same time.

Many people were probably quite mad at us, when we redirected them to other evacuation shelters, but I felt strongly that we had to prioritize treating the sick and injured because we were a hospital.

#### What was your priority coming into the presidency? Did you accomplish everything you wanted?

My priority these last six years was to calm things down after the earthquake. The six years were necessary for us as a region to recover and regain positive thoughts. Now, I feel that we can finally concentrate more fully on education and research again.

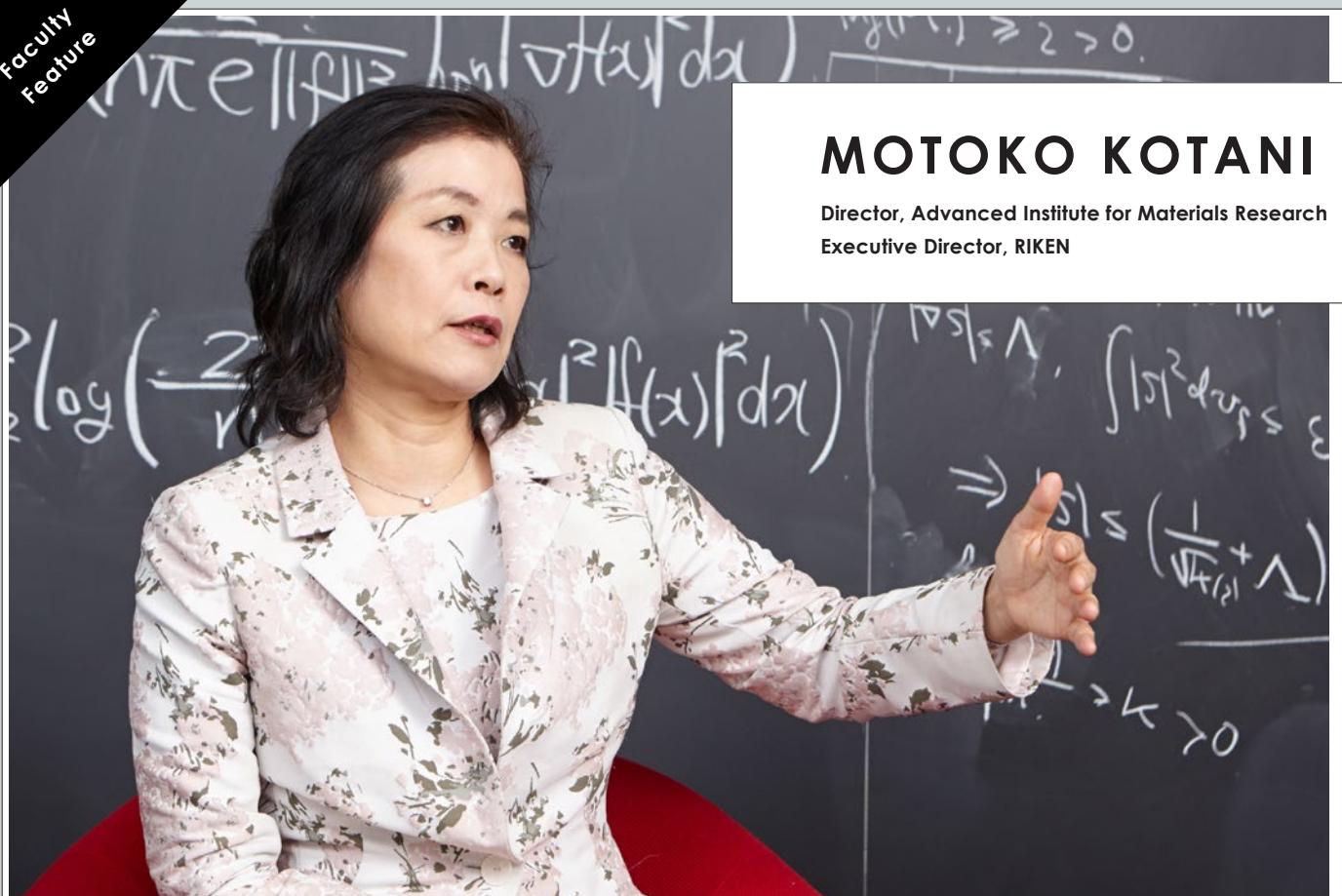
I would like Tohoku University to be a respected university, not just a university that is high in some rankings. I want the university to be recognized by the international community as a place where education and research is properly conducted. I think I managed to create a foundation for this, a good point to start. The rest is up to the next group of people.



#### What will you miss most about being here at Tohoku University?

The view from my office window is very nice. Especially during the cherry blossom season. I'm a bit sad that I won't be able to enjoy the view from there any more.

*Many people were probably quite mad at us when we redirected them to other evacuation shelters, but I felt strongly that we had to prioritize treating the sick and injured because we were a hospital.*



## MOTOKO KOTANI

Director, Advanced Institute for Materials Research  
Executive Director, RIKEN

### By the Numbers

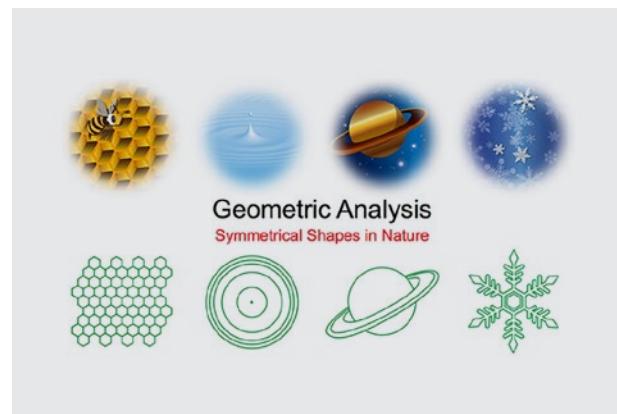
Motoko Kotani was a curious child, a self-described loner who found both adventure and solace in books. While her younger brother was the school soccer star popular with everyone, Kotani spent her days reading her way through the stacks in her local library.

"I would read anything - history, science, detective stories, biographies. I was very curious and always had many questions," says Kotani. "I tried to talk to my teachers - like a kid asking Why? Why? Why? all the time - and I was frustrated because they could not answer my questions."

Eventually one teacher did and one subject proved to be a life changer. "The mathematics teacher was the only one who listened to me. He would either correct me if I was wrong, or praise me if I was right. It was stimulating to have such discussions and that is how I came to like mathematics."

### A Mathematician in Life

Kotani would go on to study mathematics at the University of Tokyo and receive a D.Sci from Tokyo Metropolitan University. After several years as a researcher and lecturer, she joined the Mathematical Institute at Tohoku University's Graduate School of Science in 1999.



Kotani's research is in geometry, focusing on the symmetry of figures, and how understanding of discrete groups is improved through the inclusion of geometric structures. In 2000, Kotani developed a mathematical idea that provides the tools to understand the relationship between the characteristics of materials in the macroscopic everyday life and the microscopic, atomic world.

"Every material consists of single atoms. If we want to use materials, we need to understand their properties – for example texture, elasticity or colour – which depend entirely on the structure and characteristics of the atoms involved. So, if you want to develop new materials, you need an understanding at the microscopic or atomic level."

*There are common features behind the different disciplines of materials science, but they haven't always been able to explain themselves to each other. Now we have mathematics as our common language.*

### A Mathematician at Work

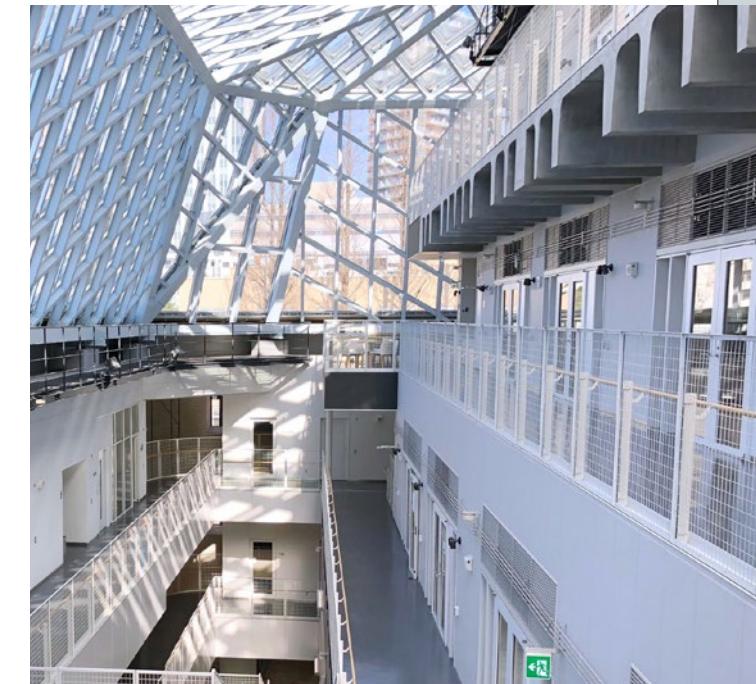
In 2012 Kotani was appointed director of the Advanced Institute for Materials Research, one of Tohoku University's flagship institutes. AIMR was originally established to create new and innovative materials by bringing together researchers from the fields of materials science, physics, chemistry and engineering.

Kotani brought mathematics to the mix, playing a bridging role and serving as principal investigator of the Mathematics Unit while leading the administration and operations of the institute.

"There are common features behind the different disciplines of materials science, but they haven't always been able to explain themselves to each other. Now we have mathematics as our common language."

According to Kotani, discrete geometric analysis is useful because it can be a bridge between scales and take into account detailed geometric data and the relationship between structure and property.

"To understand the reasons behind certain properties, there needs to be a description of disordered systems which lead to particular characteristics. And discrete geometric analysis is the discipline that makes a description of these structures possible."



### A Mathematician for Life

Kotani speaks often of mathematics being a catalyst for freedom. She contends that developing materials in the traditional way would lead to improvements but not a revolutionary breakthrough.

"Traditional development is confined to the 2- or 3-dimensional space. However, with mathematics you have complete freedom to investigate higher dimensions, construct ideas for new materials and create a recipe to realize the materials of your dreams."

It's rare that a person who has devoted a life to one field should crave more time to think about it. But like the child who kept asking why, Kotani, the adult, admits she's still looking for answers.

"After I retire, I want to spend my days reading and thinking and creating new mathematical ideas without any distractions. Now I have a position in the university where I get a lot of information and ideas from around the world. When I retire, I want to shut all that down and concentrate on just thinking."

# Education & Exchange Programs

Tohoku University's growing global network offers students more opportunities than ever before.



## Out-going Exchange Programs

For Japanese students keen to go abroad, there is a range of short-term and double degree programs.

In 2017, a new Faculty-led Program (FL) was added to provide more thematically-focused alternatives to the traditional language-driven Study Abroad Program (SAP). "The faculty members who lead these programs have a personal connection. They are either from that country or graduates of the partner institutions and have contacts there with whom they can co-design dynamic curricula," says Kazuko Suematsu, deputy director of the Global Learning Center (GLC).

For example, the FL "Canadian Heritage and Nature Group

"Experience" is led by Martin Robert, an associate professor at the GLC, who is from Canada. Robert's program focuses on indigenous history, the environment and other issues important to Canadians.

Similarly, participants of FL "Subculture: History and Race" enjoyed learning about America's deep south with the help of North Carolina native Ryan Spring, an associate professor at the Tohoku University Institute for Excellence in Higher Education (IEHE).

There are currently five countries in the FL series – Canada, Germany, Spain, Russia and the US – with plans for more to be added in 2018/19.

## In-coming Exchange Programs

Tohoku University's popular exchange programs continue to attract hundreds of new students each year, creating a culturally diverse student population.

In line with the importance Tohoku University places on research, the Junior Year Program in English (JYPE) and the graduate-level Cooperative Laboratory Study Program (COLABS) have, at their core, research oriented curricula that allow students to explore a wide range of topics in science.

For the more arts inclined, there is the International Program in Liberal Arts (IPLA), which offers subjects like economics, literature and intercultural communication, aimed at promoting the understanding of Japanese culture. Intellectual exchanges between professors and students, as well as hands-on participation in local festivals and community events, are integral parts of the exchange experience.

Participants in the Direct Enrollment Education Program for the humanities and social sciences (DEEP-Bridge) take Japanese language and co-learning classes alongside local students.



## Summer Programs

For a quick taste of student life in Sendai, summer is a great time to visit Tohoku University for the wide range of special programs on offer.

The Tohoku University Engineering Summer Program (TESP) features two weeks of graduate-level classes taught by renowned professors in the fields of robotics, electrical and electronic engineering (EEE) and structural materials engineering (SMEC). "It's an opportunity for students to get a nice overview, and to interact with others working in different technology and application fields. It's a good starting point

for future collaborations," says Professor Kazuya Yoshida, who coordinates the program.

At the undergraduate level, there is the Tohoku University Japanese Program (TUJP), where participants attend lectures on Japanese language, history, economy and the arts.

In 2017, a new four-week program called Engineering Japan was designed in partnership with the University of Washington, aimed at introducing students to science and engineering principles through lectures and activity-based laboratory projects.



# Community Outreach @ Tohoku University

Throughout the year, Tohoku University connects with its wider community through workshops and events held on and around campus. It also fosters university-community partnerships by providing public access to university expertise and resources.

## Kawatabi Field Center

The Kawatabi Field Center is a 2,200ha agricultural research facility dedicated to investigating safe, sustainable and environmentally sound methods of food production. It is one of three field research sites used by the Graduate School of Agricultural Science and is located on forest and grassland near Naruko hot springs, 70 kilometers northwest of Sendai. It is the largest university farm in Japan.

The center supports community education and outreach programs by hosting field trips, workshops and open days. Among the programs designed for the young and old is the annual blueberry picking and jam making workshop. Faculty and staff take participants on a tour of the orchard and gardens while providing information on caring for the plants.

Once blueberries and other fresh produce have been harvested, everyone is taken back to the classroom to make jam and sample goods from the center's kitchens. The workshops promote hands-on, experiential learning and give members of the public a chance to have a look around the university's facilities.



## Excavated Kawauchi Artefacts

Back in the Edo period, the outer walls of Sendai castle and the samurai residence of the ruling Date clan used to sit on the land that is now Kawauchi Campus. Over the years, especially when the new Tozai subway line was built, many artefacts from that era were unearthed. They recently went on display at Tohoku University's Main Library.



## MIT Visit with Science Angels

As part of Tohoku University's on-going efforts to encourage women in science, the Center for Gender Equality Promotion (TUMUG) hosted its first collaborative project between the Science Angels and students from the Massachusetts Institute of Technology.

Titled "Let's STEAM!" (referring to the acronym for Science, Technology, Engineering, Arts and Mathematics), the event featured fun experiments with some 50 local children.



## Donto Festival

Every January, Miyagi residents rid themselves of bad luck as well as pray for health and good fortune during the Donto festival. The centuries-old purification ritual calls for participants to shed their clothes and do a (mostly) naked pilgrimage in the dead of winter to the local shrines where they burn their new year decorations and articles of bad luck in a big bonfire to put the past behind them. Tohoku University staff and students also brave the cold to join the festivities and make the pilgrimage to Osaki-Hachiman Shrine.



## Science Café and Liberal Arts Salon

Tohoku University has been working to make science more accessible, taking interesting ideas out of the labs into the local communities through a lecture series called Science Café.

Held once a month at downtown locations like Media-theque, the 2-hour interactive event provides an opportunity for anyone who is interested, to attend a free lecture on the latest in science research, take part in experiments and chat

with researchers, students and like-minded people over drinks.

Running in tandem with the Science Café series is the similarly popular Liberal Arts Salon, fashioned after the social and intellectual gatherings of 17th and 18th century Europe. The Liberal Arts Salon is held three times a semester and features themes chosen from the university's wide range of liberal arts subjects.

# Making Rational Choices

**Yoshimichi Sato is on a quest to understand why people do the things they do.**



Yoshimichi Sato never expected to be a scholar. Never even thought he would go to university, let alone become a successful sociologist associated with some of the biggest names in academia. But sometimes, rational choices lead to surprising outcomes.

Born in Shitamachi, in eastern Tokyo, Sato grew up around small shops and factories. His father was a self-made man who left school after junior high and became a streetcar conductor. Sato's teenage ambition was to own a small shop.

"My main hobby at that time was making radio controlled airplanes. I thought it might be a good idea to be the owner of a model airplane shop and be self-employed. So my plan was to go to technical school to study the design of these airplanes."

It was while working on calculations for crafting radio-controlled airplanes that Sato discovered the beauty of mathematics. Deciding that there might be a better

future in numbers, Sato applied to the University of Tokyo, where he developed an interest in sociology and the application of mathematics to social phenomena.



## From Tokyo to Tohoku

(with a couple of stops in America)

Sato arrived at Tohoku University as an associate professor in 1992, having completed his course work at the University of Tokyo's Graduate School of Sociology.

While researching Rational Choice Theory, Sato received a two-year fellowship to the University of Chicago. "I was really lucky because some of the leading figures in Rational Choice Theory were there. We had seminars every other week with experts like Gary Becker and James Coleman, Nobel winners and young emerging stars. It was a really intellectually stimulating time."

Next, Sato explored the issue of trust among strangers. "Why are we able to so easily trust taxi drivers, bus drivers, chefs in restaurants, even though we don't know them?"

For that study, Sato spent a year at Cornell University working with fellow sociologist Michael Macy and learning to create models using computer simulation.

Upon returning to Tohoku University, Sato was appointed director of the Centre for the Study of Social Stratification and Inequality (CSSI). In his 10 years in charge, he encouraged multidisciplinary research and fostered a multicultural environment.

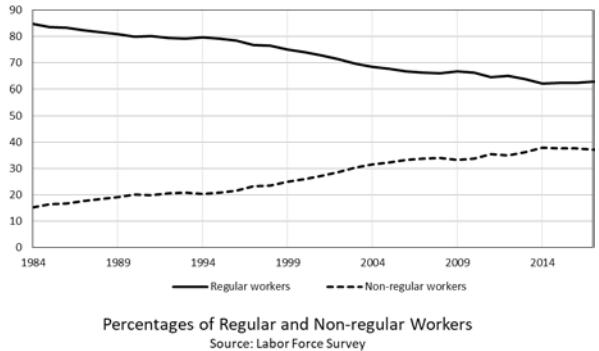
### Social Stratification, Intentional Change and Trust

Now the vice dean of the Graduate School of Arts and Letters, Sato continues to work simultaneously on several projects such as social stratification and intentional social change.

He is analyzing income discrepancies between regular and non-regular workers for their impact on society, and also looking at the mechanisms that determine the success and failure of social planning and organized movements.

Going forward, Sato has formed a small international research group to study the chain reaction of social

**"Why are we able to  
so easily trust taxi drivers,  
bus drivers,  
chefs in restaurants,  
even though  
we don't know them?"**



exclusion. "If you're unemployed, maybe you can't pay your rent and you become homeless, or maybe you get divorced because you can't support your family. So you're excluded from employment, excluded from the housing market, excluded from marriage. That's the chain reaction that leads to social exclusion."

The group is using computer simulation to create a model community, to study ways that social institutions can help prevent the chain of exclusion from happening.

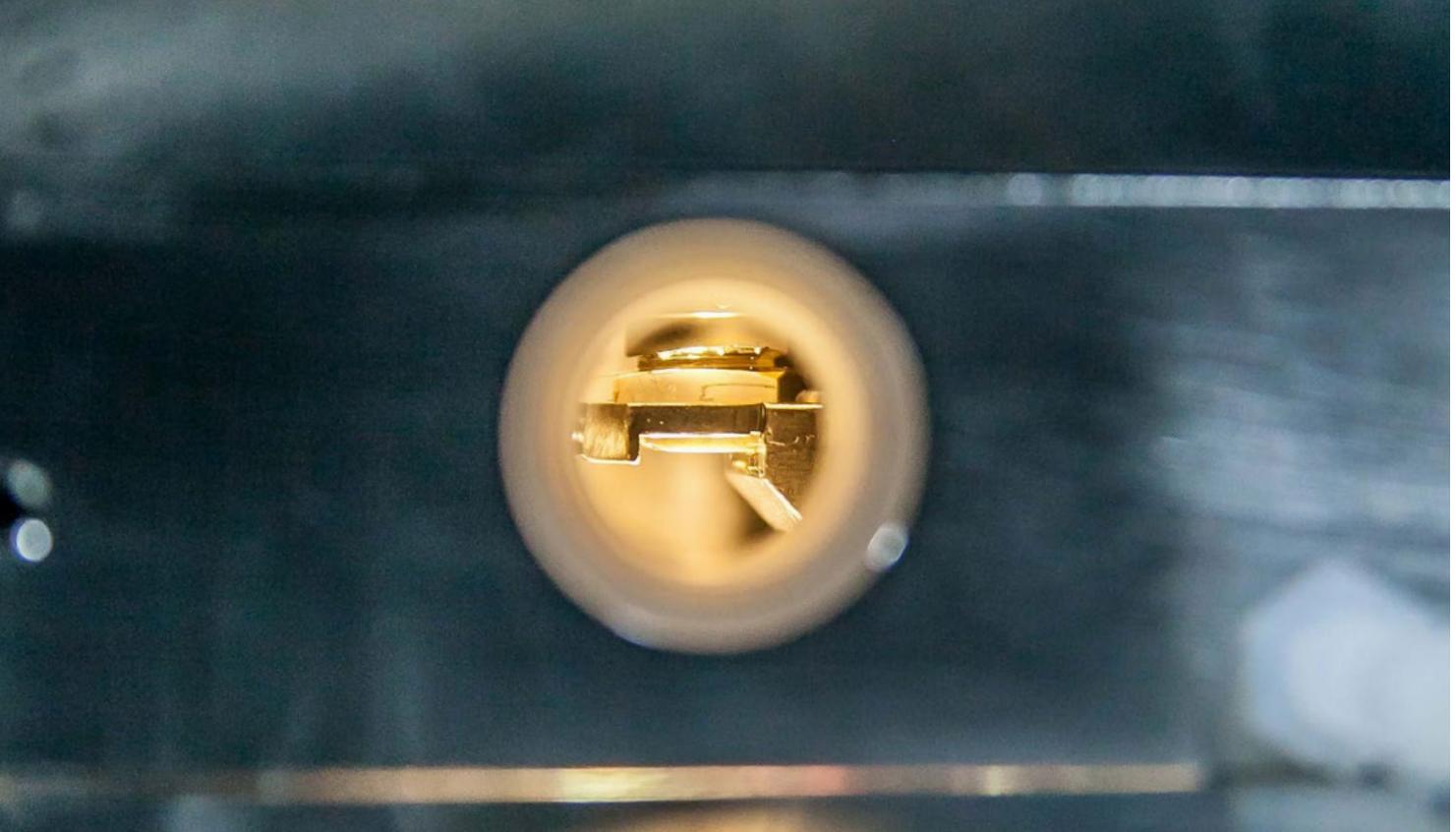
### The Social Sociologist

When he's not working, Sato relaxes by playing the guitar. "Growing up, my heroes were guitarists like Jeff Beck and Eric Clapton, so when I got into college I rewarded myself with a guitar and played a lot of rock."

These days, Sato is learning to play jazz, taking private music lessons twice a month. He keeps a guitar in his office and would usually oblige when asked to play. "It's hard to play rock when you're old. For me now, jazz is better." An unsurprisingly rational choice.

Yoshimichi Sato is vice dean of the Graduate School of Arts and Letters. He is also a professor of sociology and behavioral science.





Research Highlight

## Forcing liquids into a squeeze

Kazue Kurihara is developing advanced techniques to measure the forces interacting between non-transparent liquids and solids.

Watching water rippling across the surface of a pond, it's hard to imagine a substance more fluid. But at the nanoscale, strange things happen and substances can behave unexpectedly.

A decade ago, some researchers wondered whether water becomes viscous when trapped in tiny crevices, especially between two water-loving materials. For instance, what happens when water moves around confined spaces in the body?

"It was a controversial question at the time," says Professor Kazue Kurihara. "One group said that there was no change in the viscosity of confined water, but another group said there was."

In 2006, Kurihara developed a measurement technique that settled the debate. The technique could be used to significantly improve scientists' understanding of the science of friction, lubrication and wear. Better lubricants and wear-resistant material could save automobile, hard disk drive and micromachine manufacturers billions of dollars a year.

### Thick, viscous water

Based at the Institute of Multidisciplinary Research for Advanced Materials, Kurihara heads one of only a few labs in the world studying the forces that emerge where two materials meet. Her research uses a tricky instrument developed in the late 1960s called the surface-force apparatus (SFA). The SFA uses springs and light waves to measure the forces interacting between two materials as they are gradually brought into contact and then pulled apart.

When the SFA was modified to study interactions across liquids, the entire apparatus had to be immersed in the liquid subject. To avoid contaminating samples, it had to be disassembled and reassembled for every experiment. "It required a lot of patience," says Kurihara, who has also worked as a researcher in the United States and Sweden and is regularly invited to speak at international events. Today, researchers just sandwich liquid droplets between two smooth materials to cut assembly times.

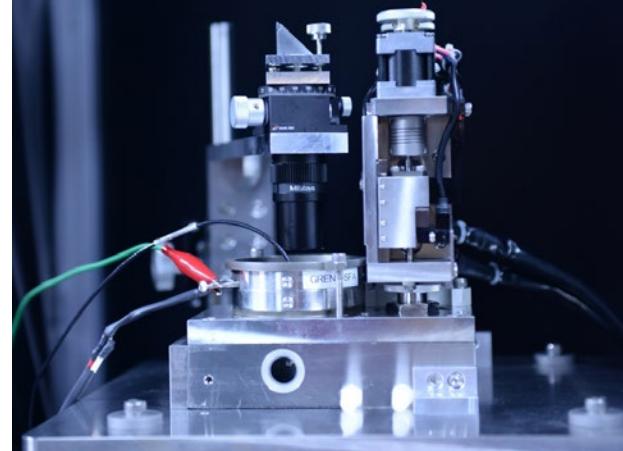
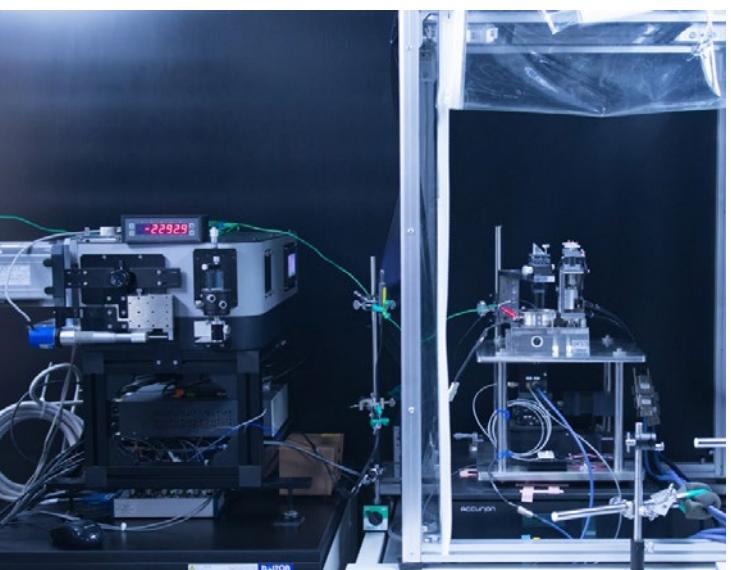
By the early 1990s, the SFA had been used to measure a

**Based at IMRAM,  
Kurihara heads one of only  
a few labs  
in the world studying  
the forces that emerge  
where two materials meet.**

range of nanoscale phenomena in confined liquids, including the weak forces that attract molecules to each other, known as van der Waals forces, and adhesive capillary forces.

But one important force remained unexamined: the resistance of a liquid to a perpendicularly applied — or shear — force, which determines its viscosity. Kurihara was eager to take on the challenge. She developed a highly sensitive technique called the resonance shear method that could measure how liquids confined between two surfaces, from one micrometer down to zero nanometers apart, reacted to shear force introduced by moving the top surface from side to side in a controlled manner.

Kurihara used this technique to analyze a droplet of water, and discovered that its viscosity increases two-to-fourfold when confined to a space less than one nanometer wide. Viscosity is a crucial property of a good lubricant. The confined water droplet's viscosity was just high enough, and increased sharply over a narrow distance, to make it a good lubricant. Kurihara's findings demonstrated the potential of



using a very thin layer of water as a lubricant.

She has since applied the technique to a range of materials in different applications. One study assessed the viscosity of a calcium-carbonate-based building sealant and another tested cosmetics that elicit a "middle feeling" between the moisturizing shittori and refreshing sappari classes of products typically found in Japan. "Lubrication is everywhere," says Kurihara. "If there is movement, then you need a lubricant."

### Reflecting distance

Despite these advances, one major limitation of the SFA remained, which many groups had struggled to address: it could only be used to study transparent liquid and solid surfaces. In 2008, Kurihara completed the development of a new apparatus called the twin-path SFA that could measure the interactions between non-transparent liquids and solids such as metals, ceramics and polymers. "I wanted to really open up the field for materials science research," she says.

The problem with the traditional SFA was in the way it calculated distance by transmitting light through the two surfaces and interfacing liquid. Kurihara's apparatus instead measures distance by reflecting light against a mirror on the lower surface. It can achieve a distance range of 1 nanometer to 5 micrometers. The model has since been sold to two universities and two commercial laboratories through a license agreement with a scientific instruments manufacturing company.

Kurihara's team plans to further develop the apparatus, to study surface forces at different temperatures. "I hope to develop a science of 'forcemetry' that uses force to detect unknown phenomena."

Kazue Kurihara is a professor at the Institute of Multidisciplinary Research for Advanced Materials.



# Team HAKUTO and the Google Lunar XPRIZE

A 10-year race that inspired engineers, entrepreneurs and innovators to take big steps towards robotic space exploration.



Ten years ago, the Google Lunar XPRIZE challenge was issued – a competition offering 30 million US dollars in prizes to the first privately funded team that can land a rover on the Moon, travel more than 500 meters and transmit high definition images back to Earth.

The challenge attracted more than 30 teams from all over the world, inspiring engineers, entrepreneurs and innovators to take big steps towards robotic space exploration.

Japan's Team HAKUTO - comprising Tokyo-based startup ispace inc., members of Tohoku University and experts contributing pro bono – was one of only five competitors left when the challenge officially ended in January 2018 without a winner.

## White Rabbit on the Moon

Despite missing out on the main prize, Team HAKUTO came close. It completed development of its rover, and even received an XPRIZE Milestone Prize worth half a million US dollars in 2015 for the rover's mobility technology.

The rover, known as SORATO, is based on more than a decade of R&D work by Professor Kazuya Yoshida's laboratory at Tohoku University's Department of Aerospace Engineering.

Yoshida is no stranger to great space achievements – his Space Robotics lab has contributed to numerous Japanese space missions over the years, including an asteroid probe Hayabusa, which successfully brought soil samples from the asteroid Itokawa back to the Earth in 2010.

SORATO's design features the miniaturization of complex machines and the tight integration of electronics. Its body is made of resilient, lightweight Carbon Fiber Reinforced Plastic (CFRP) materials with solar panels to take advantage of the sun. And the wheels have thermal insulation to prevent the extreme temperatures of the lunar surface - more than 100°C at noon, below -150°C at night - from affecting the rover's body.

SORATO is also fitted with four cameras capable of covering 360 degrees and capturing high definition images which can be transmitted to Earth via data-compression technology. The cameras allow human pilots to remotely drive



the rover with near real time vision of its path. Additionally, the rover has an infrared Time of Flight 3D Camera to detect and avoid mission endangering hazards.

Amazingly, even with all this technology on its back, SORATO weighs in at a very compact 4 kilograms.

In November 2017, an international panel of judges conducted a detailed review of Team HAKUTO's final mission plan and came away impressed.

"With space, every kilogram is very expensive and you have to try to be small and not use too much power," said Chanda Gonzales-Mowrer, Prize Lead for the Google Lunar XPRIZE. "I've been impressed with how Team HAKUTO has taken a lot of the technologies available now on Earth and adapted them for use in space in a very efficient package. And they've been able to produce this inexpensively, compared to what governments are doing."

Although Team HAKUTO made steady progress through the decade of competition, it did not have a landing vehicle and was dependent on fellow competitor TeamIndus - with whom it signed a ride-share agreement in 2016 - to travel to the Moon together on board India's Polar Satellite Launch Vehicle rocket.

In December, SORATO was shipped to India for final preparations amidst much fanfare and optimism. But a few weeks later, TeamIndus was forced to concede that it would not be able to launch by the competition deadline, stranding SORATO on Earth.

## Man on the Moon

Despite the setback, HAKUTO members say they remain committed to lunar exploration. The team had raised over 90



million US dollars in investments - the most of any XPRIZE competitor – and development has already begun on its own modular lunar lander.

While the Moon was previously thought to have little more than dry rocks and sand, recent scientific data has hinted at the existence of water, prompting renewed interest in lunar missions.

"At the extreme north and south poles of the Moon, sunlight always comes from the horizon at a very, very narrow angle. This means that if there are any concave features, like a crater, the bottom never gets sunlight," says Yoshida. "With the temperature as low as -170°C, it is so cold there that even water cannot evaporate. These areas are called cold traps, and if any volatile materials ever existed on the Moon, they might still exist in those pockets."

ispace and the members of Team HAKUTO say they plan to conduct multiple lunar missions in the next few years.

"Lunar exploration is definitely happening, but not because there's anything wrong with Earth," says Yoshida. "Rather, I think that it is simply human nature to continue exploration, always moving forward and upwards. We thought we were done with the Moon, but it turns out that we still have a lot to learn about it."

Professor Kazuya Yoshida is director of the Center of Robotics for Extreme and Uncertain Environments. His research activities cover dynamics and control of space robotic systems, ranging from orbital free-flying robots to planetary exploration rovers.



*"I think that it is simply human nature to continue exploration, always moving forward and upwards.  
We thought we were done with the Moon, but it turns out that we still have a lot to learn about it."*

# The First Triumvirate:

Tohoku University named one of the original three Designated National Universities



Tohoku University was officially named a Designated National University by the Japanese Government in June 2017. It was one of the original three universities - alongside University of Tokyo and Kyoto University - to be selected under this new system, which the Ministry of Education, Culture, Sports, Science and Technology (MEXT) hopes will raise the standard of Japanese institutions.

"Being selected is an honour," says Susumu Satomi, who stepped down as university president in April 2018 after six years at the helm. "It's both an acknowledgement of our past success and a show of confidence in our future advances in research and education."

With the structural reforms that will come with the new



status, the university plans to further strengthen its research capabilities, internationalise its teaching curriculum and implement more outreach programs to enhance its global competitiveness.

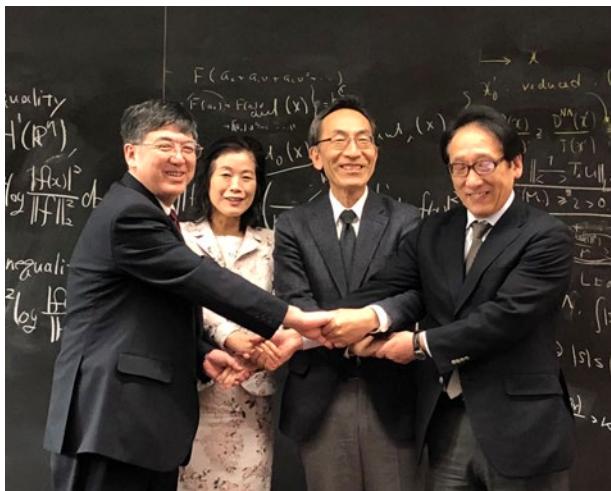
## Research

As a first step, Tohoku University will further advance four areas that it presently excels in - materials science, spintronics, next-generation medicine and disaster science. These will form part of a Core Research Cluster that will include:

- Advanced Institute for Materials Research (AIMR)
- Center for Innovative Integrated Electronic Systems (CIES)
- Tohoku Medical Megabank Organization (ToMMo) and
- International Research Institute of Disaster Science (IRIDeS)

To promote collaboration opportunities, the university will establish the Organization for Advanced Studies (OAS). While the OAS will initially focus on the four priority fields, there are plans to add five more: cosmic physics, environmental and Earth science, machine science, data science and Japanese studies.

The university aims to create a dynamic three-stage cycle:  
• boosting funding through the development and commercialization of innovations that benefit society



- using this funding to enhance fundamental research and education at the university
- using this fundamental research to develop new innovations of social benefit

"The new status will give us more independence to develop ties with third parties and establish other sources of income, which we will use to further improve our capabilities in research and education," says new president Hideo Ohno. "This cycle will be beneficial to the university as well as the local and global communities we aim to help."

## Education

The Advanced Graduate School will incorporate all current graduate programs from the different divisions to create more interdisciplinary collaborations. These include the International Joint Graduate Programs, which aim to attract higher caliber global talent.

There will be increased financial support for graduate and undergraduate students.

Study Abroad Programs will be enhanced and a new quarter academic system will provide more exchange flexibility.

## Governance Reform

The provost, introduced in 2018 with executive powers over academic matters, is responsible for strategic planning and will create a more efficient administrative structure.

The new status will also deregulate the current system for student capacity and provide more autonomy over the management of assets and facilities.

## Being Part of the Community

The cornerstone of every Tohoku University project is the belief that universities have a responsibility to be innovative and explore creative solutions to worldwide problems. To that end a Science Park Zone with facilities to test and develop new products, will be established at the new Aobayama extension.

There are plans for a student village with new dormitories and cross-cultural events to provide an international experience at home. And to inspire students, there will be wide ranging lectures and discussions on site, led by cross-appointed experts from industry.



# Campus Report

Tohoku University aims to make life comfortable for everyone by supporting a diverse and inclusive environment on campus. From childcare facilities to student support services, there are also great cafés for friends of the university to drop by.



## Student Support

### Student Services Building

A new building with student services has opened near the South Exit of Aobayama subway station. The facility features a restaurant, cafeteria with halal food, a convenience store and an open space for students to gather. On the second floor is a student support center that provides multilingual support for international students looking for accommodation, and help with credit card and insurance applications.

### New Childcare Facilities

Two new childcare centers have opened at Tohoku University to help support parents working or studying at the university. Previously, childcare services on campus had space for only 56 children. But now, with the addition of the new centers at Aobayama and Seiryo campuses, up to 250 children can be accommodated. This is the largest figure for a university in Japan.

### Hoshinoko Nursery School

A bequest from former patients of Tohoku University Hospital has been used to build a spacious childcare center near Seiryo Campus. The newly-built center has been welcomed by staff at Tohoku University Hospital who, until now, have had to compete with the public for spots to enrol their children in local day care services. The cute, wooden entrance was redesigned using materials from the original gate.

### Aobayama Midori Nursery School

Located on the third floor of the new student services building, the nursery school has a rooftop garden where children can have fun outdoors, playing with sand and water. With safety in mind, the emergency exit connects to a high-tech spiral slide, so that staff and children can make a quick exit from the building in the case of an emergency. The surrounding lush lawns of Aobayama Campus are ideal for outdoor walks.



## Campus Transport



## Cafés on Campus

### Mozart Klee's

Sendai's well-known Mozart Café chain has its Mozart Klee's coffee branch on the ground floor of Centennial Hall. Diners can relax on designer chairs in the open space, while enjoying a view of the gardens. The café offers tea and scones, as well as cake and drink sets. Lunchtime meals include pasta dishes.

### Seattle's Best Coffee

The only branch of American coffee giant Seattle's Best Coffee in Tohoku can be found inside Tohoku University's main library at Kawauchi Campus. In addition to coffee, it also offers a selection of snacks, hotdogs and green tea-flavoured drinks.



## Next-generation Transport System at Aobayama Campus

An advanced transport system is gradually being installed at Aobayama Campus. The project is being led by the New Industry Creation Hatchery Center (NICHE) and is part of Tohoku University's long-term goal to use the campus extension at Aobayama as a testing ground to develop new products and technology.

Phase one of the project began with the operation of campus shuttle buses and the opening of the subway line to Aobayama campus in 2016. Since mid-2017, the new campus mall has been used to test driverless electric buses. Clean energy mini EVs and shared bicycles are also in use.

The university is working alongside Sendai City, which was designated a National Strategic Special Zone in 2015, to trial and promote future technologies such as drones and autonomous vehicles. Once the safety of the new systems has been verified they will be introduced campus wide.



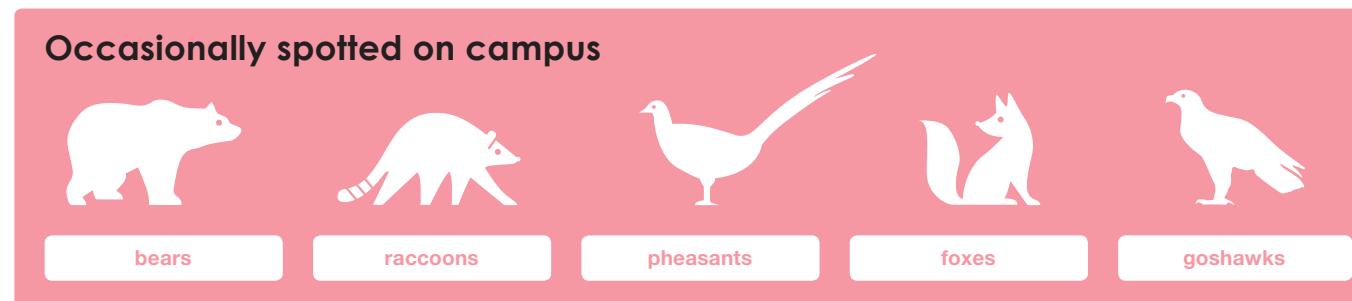
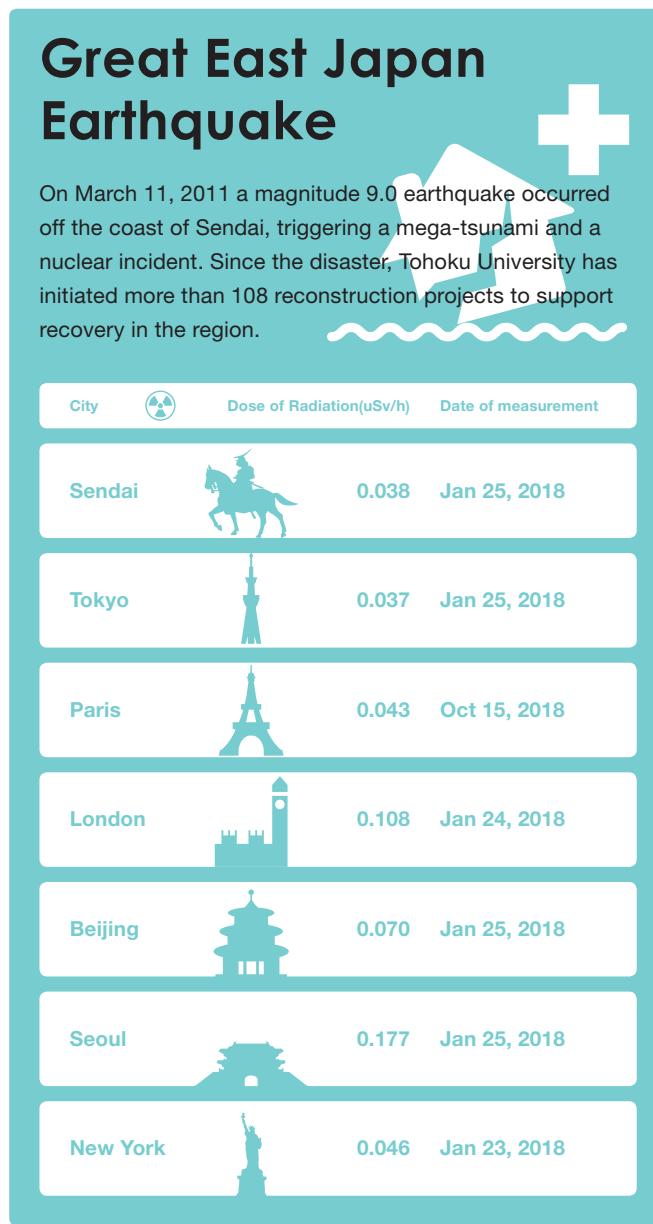
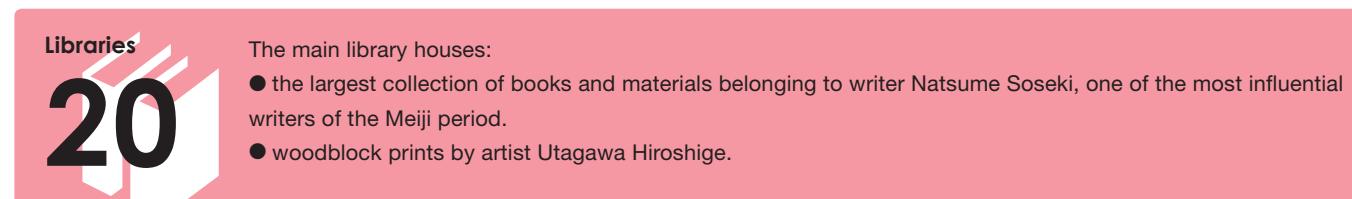
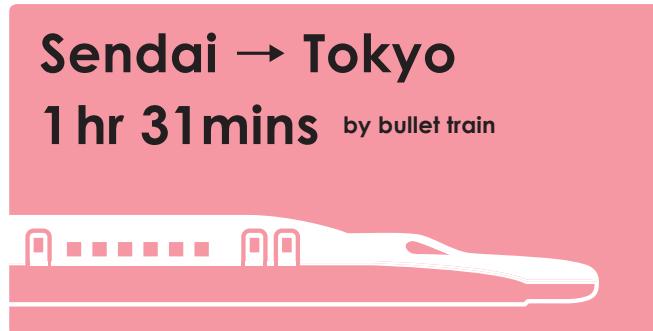
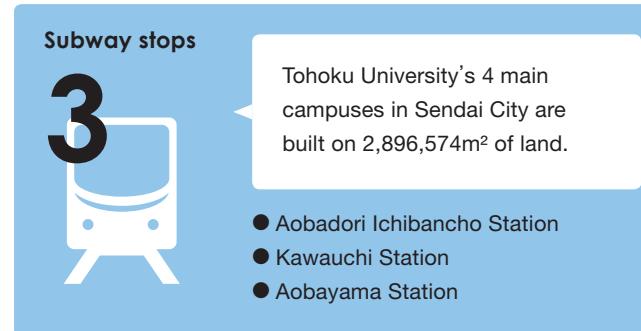
### Buddy's Table

Cozy wooden furniture and bar stools set the scene at Buddy's Table, a restaurant open for evening dining at Aobayama. It's a great place to meet for lunch or to wind down after a long day in the lab. Diners can listen to music while eating soul food: pizza, pasta and salad.

# University Facts & Figures

Tohoku University

Sendai City





## Tohoku University's Alumni Association

Joining the Tohoku University Alumni Association is the best way to stay in touch with events on campus! The Alumni Association hosts four regular events each year – the Kansai, Kanto, Kyushu area and Premium members' social gatherings. In addition to these, there are regional events run by local alumni organizations, as well as regular campus activities that all alumni are welcome to attend.

Homecoming Day is the largest alumni event on the annual calendar, with concerts, lectures and food stalls. It's a chance for alumni to revisit the campus, meet with former teachers, friends and current students.

### Registering your alumni branch with the Alumni Association

If you are an alumnus of Tohoku University and have an alumni branch in your city or country, you can register your branch with the Shuyukai Alumni Association at no cost. Once registered with us, contact information will be posted on our website, so that other alumni can be made aware of your activities.

Contact: [alumni@grp.tohoku.ac.jp](mailto:alumni@grp.tohoku.ac.jp)



### New alumni chapter founded in Thailand

The Tohoku University Alumni Association opened a Thai chapter in Bangkok on January 20, 2018. Thailand is the fifth country to have an alumni chapter, following Korea, China, Taiwan and Indonesia.

To commemorate the opening, a seminar on smart technology and natural disaster awareness was held, attended by senior staff from Tohoku University and some 50 alumni based in Thailand.

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# Welcome to Sendai, the City of Trees

Tohoku University's four main campuses are spread across the cosmopolitan city of Sendai, the cultural, political and economic center of Japan's north east (Tohoku) region.

Located some 300 kilometers - and a short 90-minute bullet train ride – from Japan's capital, Tokyo, Sendai is a city of fascinating contradictions.

It's a big, sophisticated metropolis with museums and music halls, trendy shops and cafes, and a home team in every major professional sport. But it also has a small city charm, easy friendliness and magnificent nature. In fact, for its Zelkova-lined streets and rivers that flow downtown, Sendai has the well-deserved nickname of Mori no Miyako, or the City of Trees. Through four distinct seasons, the city enjoys a temperate climate, with especially beautiful autumn colors and snow-covered landscapes in the winter.

A day trip away from Sendai are many of the region's other famous attractions, such as Matsushima Bay, dotted with small islands, pine trees and oyster farms. Known as one of Japan's three most scenic locations, Matsushima even inspired the most famous poet of the Edo period, Matsuo Basho.

For the more athletic, nearby Mt. Zao is a popular ski and hot springs resort. It is also the best place to view the famous Snow Monsters in winter.

Sendai is home to a million people – many of whom are students and academics. Anchored by Tohoku University, the city boasts some of the top research facilities and institutes in the world. With a vibrant and energetic population, the city celebrates colourful events throughout the year, while retaining many old traditions. The Aoba Street Festival, the Sendai Tanabata Festival, the Jozenji Streetjazz Festival and the winter Starlight Pageant are some examples of annual events that draw millions of visitors and participants from all over the country and across the globe.

Come join us in Sendai!

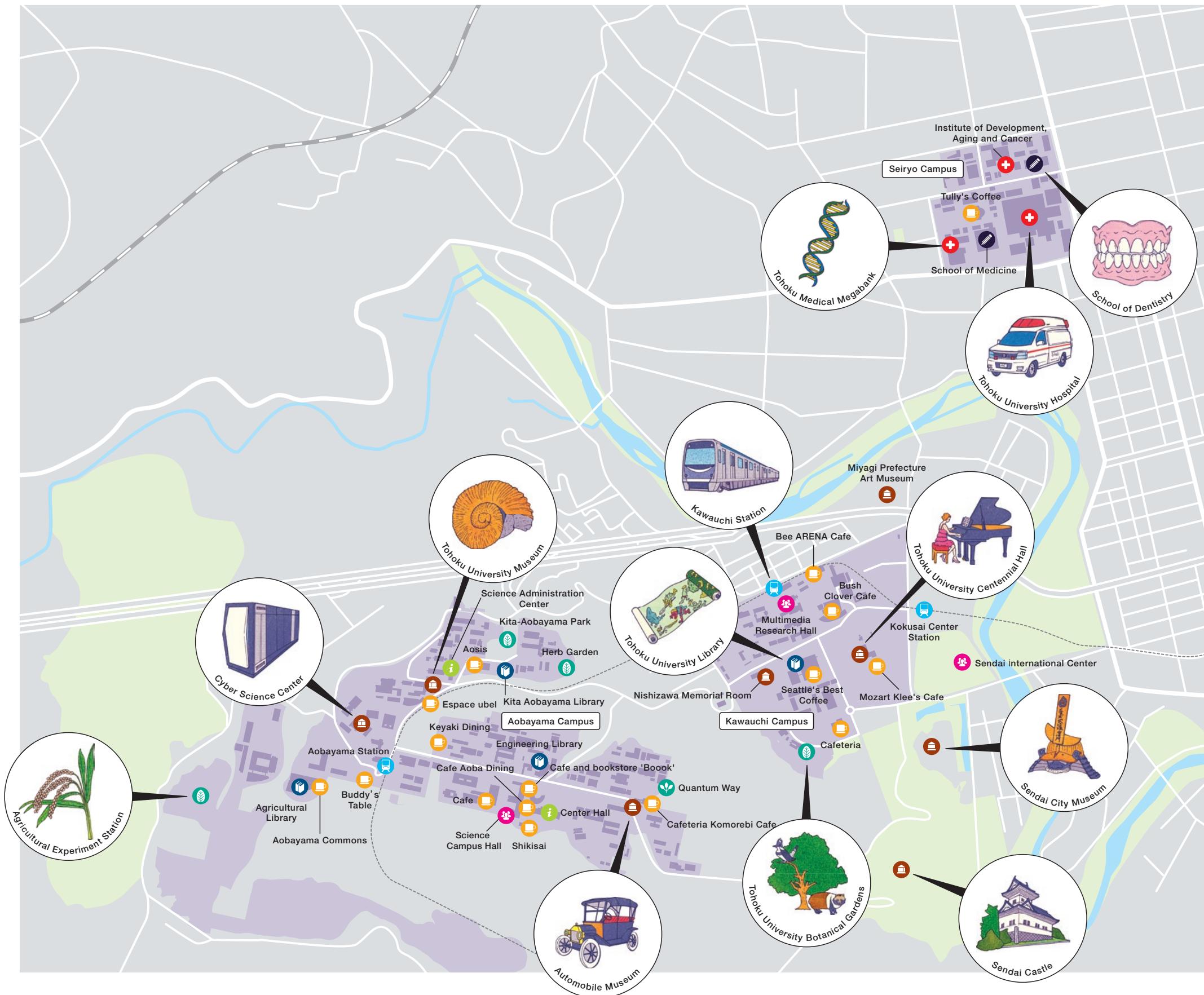


# In and Around Tohoku University

Tohoku University's four main campuses are spread across the cosmopolitan city of Sendai.

Medical	School of Medicine School of Dentistry Tohoku University Hospital Institute of Development, Aging and Cancer Tohoku Medical Megabank
Museums / Memorials	Automobile Museum Cyber Science Center Exhibition Nishizawa Memorial Room Quantum Way Sendai Castle Sendai City Museum The Miyagi Art Museum Tohoku University Museum Tohoku University Kawauchi Hagi Hall
Arts & Performance	Aobayama Station Kawauchi Station International Center Station
Stations	
Parks & Gardens	Botanical Gardens Herb Garden Kita Aobayama Park Agricultural Experiment Station
Libraries	Agricultural Library Engineering Library Kita Aobayama Library Tohoku University Main Library
Eateries	Aoba Dining Aobayama Commons Aosis Bee ARENA Café Buddy's Table Bush Clover Café Café and Bookstore 'Boook' Espace Ubel Keyaki Dining Komorebi Café Mozart Klee's Café Seattle's Best Coffee Shikisai Tully's Coffee
Conference & Event Venues	Multimedia Research Hall Science Campus Hall Sendai International Center
Schools / Faculties	Center Hall Science Administration Center

## Seiryo / Kawauchi / Aobayama Campus



# Katahira Campus



Eateries	Ban Thai Lanna Café Mozart Atelier Kazunori Ikeda Patisserie Restaurant Alley - Iroha Yokocho Sakura Kitchen Sindur Indian Food	University Facilities	Honda Memorial Room Lu Xun Lecture Hall Tohoku University Administration Tohoku University Archives
Sightseeing	Anagura Shrine Main Gate Otamayabashi Bridge Ryokusuan Tea House Yanagimachi Shrine Zuihoden	Conference	Katahira Kitamon Commons Sakura Hall TOKYO ELECTRON House of Creativity
Shopping Stores	Meiji Foreign Goods	Accommodation	Katahira Hall University House
Station	Aoba-dori Ichibancho Station	Parks	Academic City Memorial Park Hyojogawara Baseball Field Katahira Park Komegafukuro Walkway
		ATMs	Post Office

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