HIROSHIMA UNIVERSITY UPDATE

HIROSHIMA UNIVERSITY

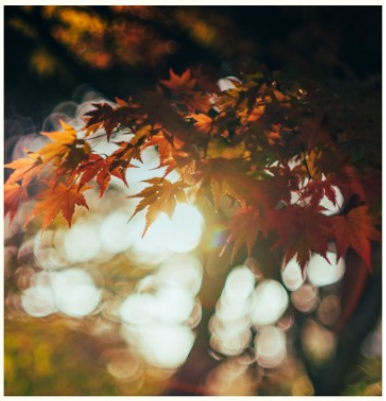
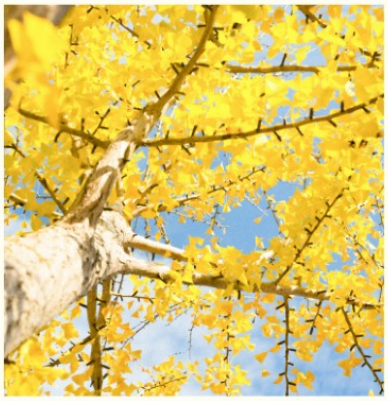
VOLUME 12 • OCTOBER 2020

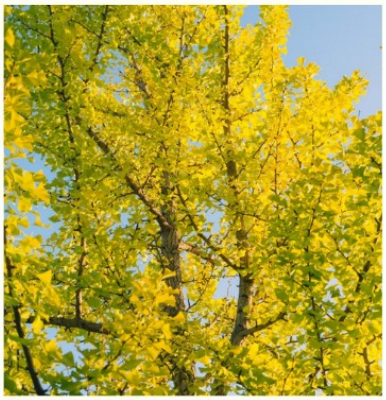
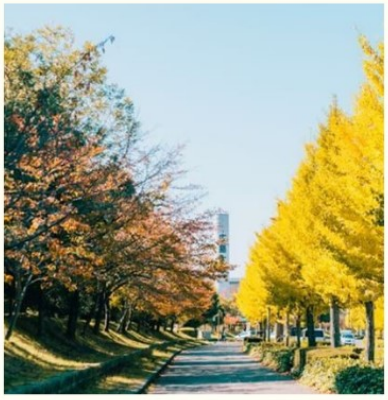
Find Hiroshima University's latest news and high-impact research here!

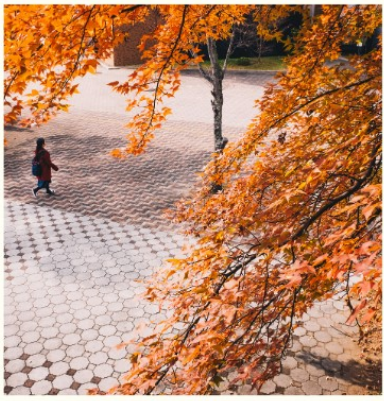
CAMPUS PHOTOS

FALL





HIROSHIMA UNIVERSITY

Embodying its founding principle of “a single unified university, free and pursuing peace,” Hiroshima University is one of the largest comprehensive research universities in Japan. Today, HU is making steady progress as a global university, taking on worldwide challenges and strengthening its global educational network by signing international exchange agreements with universities around the world and opening overseas bases at strategic locations.

HIROSHIMA UNIVERSITY

CONTENTS

In-person classes resume at HU as third term starts

Third term has started at Hiroshima University last October 2. The hustle and bustle on campus have come back for the first time in six months as autumn leaves started to turn red and gold. Classes will be held in-person and online as a result of lowering HU's alert level to Level 1 (Be careful; Minimum restrictions) under the university's restrictions index to halt the spread of COVID-19.

RECENT NEWS

RESEARCH FOCUS

SPECIAL FEATURE 05-06

INTERNATIONAL BRANCH OF ARIZONA STATE UNIVERSITY TO BE LAUNCHED ON HU'S HIGASHI-HIROSHIMA CAMPUS

HU is expected to gain further momentum for globalization under this agreement.

(L-R) US Embassy to Japan Minister Glassman, Education Minister Hagiuda, Hiroshima University President Ochi, and Mr. Yamamoto, a member of the House of Councillors. HU and Arizona State University's Thunderbird School of Global Management made a courtesy call on Japan's Minister of Education, Culture, Sports, Science, and Technology.

Hiroshima University newly signed a Memorandum of Understanding (MOU) with Arizona State University (ASU) which paves the way for establishing an international branch of ASU's Thunderbird School of Global Management campus within HU's Higashi-Hiroshima Campus — the first time for a Japanese national university to attract an international branch campus of a foreign university. HU is one of the 13 universities selected for the Type A category of the Top Global University Project, which is conducted by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT).

On August 5, 2020, HU's President Mitsuo Ochi, Executive Vice President Satoshi Watanabe, Minister Carolyn Glassman of the US Embassy in Japan, and Ai Konishi, general manager at Thunderbird School of Global Management, paid a courtesy visit to Education Minister Koichi Hagiuda.

"This is the first attempt at a national university, so I hope Hiroshima University will lead the way in a new direction," said Minister Hagiuda during the visit.

Under the project, ASU/Thunderbird School of Global Management will launch a bachelor's degree program with faculty members from ASU and HU collaborating and cooperating for its operation. The degree program will be centered around two approaches. In the "4+0" model, students study the four years at HU. The "2+2" model allows students to study the first two years at HU and the last two years at ASU. After completing the program, students will receive a bachelor's degree from ASU (either a Bachelor of Global Management or a Bachelor of Science in International Trade).

The program is taught in English with all classes — available both as online and in-person lectures — being designed from a global perspective that encapsulates international politics as well as international business and culture.

Full-scale acceptance of students is expected for August 2021.

In the future, the university aims to be recognized as a "Location in Japan for a Foreign University."

HU hopes to further internationalize Japanese national universities through this initiative. The university also expects that its ripple effects will lead to management reforms, through strengthening HU's financial base and management capability, and the revitalization of local communities via collaboration with the local government.

Press conference at the Ministry Education, Culture, Sports, Science, and Technology

HU'S NOVEL SEX SELECTION TECH TO HELP INDIA'S FARMERS GROW DAIRY HERDS

Hiroshima University (HU) scientists behind a new sex selection method received a grant from the Bill & Melinda Gates Foundation to develop a low-cost artificial insemination system for bovines that could boost the incomes of India's smallholder farmers by helping them grow their dairy herds.

The sex selection technique successfully separated X and Y sperms in mice by utilizing differences in the receptor genes expressed by each sex chromosome. Two receptors that play a key role in antiviral response and expressed only in the X chromosome — TLR7 and TLR8 — are responsible for slowing down X sperms, making it possible to set them apart from Y sperms.

HU scientists behind a new sex selection method received a grant from the Bill & Melinda Gates Foundation to develop a low-cost artificial insemination system for bovines

Professor Masayuki Shimada and colleagues at HU's Graduate School of Integrated Sciences for Life found that these receptors bind with antiviral drug Resiquimod which suppresses the movement of X sperms without causing damage. Another test using antiviral drug Imiquimod, which TLR7 binds with, showed similar results.

They found that in vitro fertilization of the quickest sperms that swam up the test tube containing the solution led to mice pups that were 90% male. Using the slower swimmers that stayed at the lower layer, meanwhile, resulted in mice pups that were 81% female.

Current artificial insemination systems for sexed semen require high investments for lab equipment which translates to expensive costs for a dose of bull semen.

Another drawback is reduced semen viability leading to lower conception rates.

The US$2.7 million grant allows researchers to build a new system that simplifies the artificial insemination process for sexed semen so it can be easily replicated even by small bull centers at a low cost. Once in place, the researchers project that a dose of bull semen would only cost farmers US$5. They plan to transfer the technology to India after three to five years of research.

"The most beneficial point is that any special skills are not required," Professor Shimada said, adding that their research aims to address livestock production issues.

In 2018, the Food and Agriculture Organization of the United Nations released a study on dairy development and poverty reduction which said that "within livestock, the dairy sector is regarded as carrying particular promise to contribute to SDG1" or the goal to end poverty.

HU hopes to produce research that can help achieve UN Sustainable Development Goals.

About the study

Umehara T, Tsujita N, Shimada M (2019) Activation of Toll-like receptor 7/8 encoded by the X chromosome alters sperm motility and provides a novel simple technology for sexing sperm. PLoS Biol 17(8): e3000398. doi:10.1371/journal.pbio.3000398

Umehara, T., Tsujita, N., Zhu, Z., Ikedo, M., & Shimada, M. (2020). A simple sperm-sexing method that activates TLR7/8 on X sperm for the efficient production of sexed mouse or cattle embryos. Nature Protocols, 15(8), 2645–2667. doi:10.1038/s41596-020-0348-y

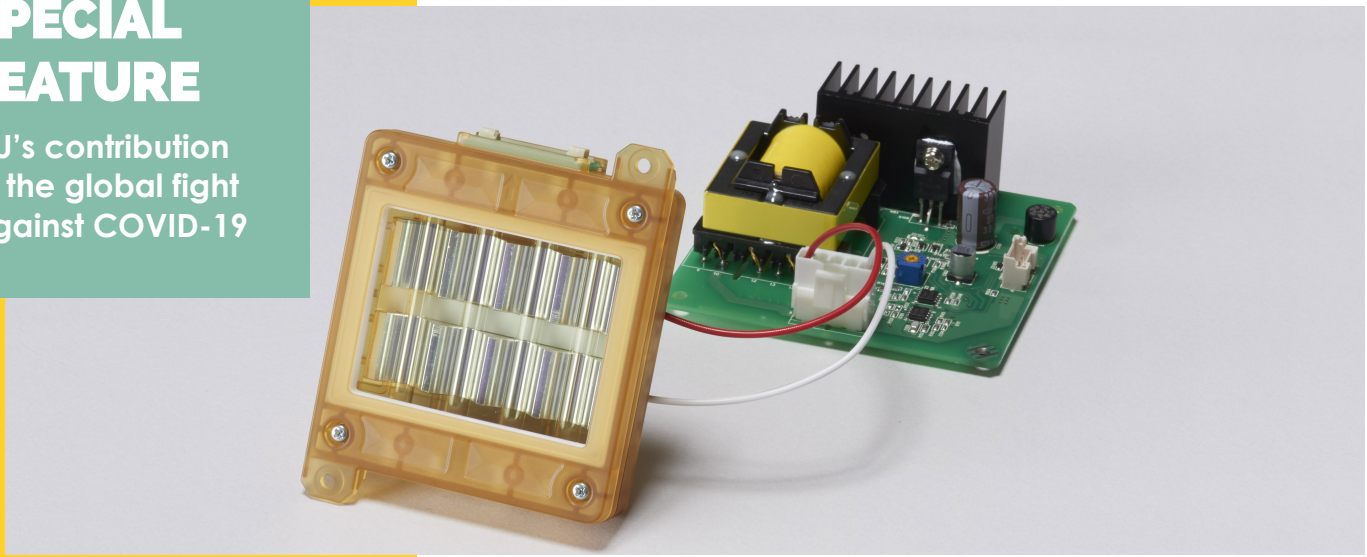


Photo Courtesy of Ushio, Inc.

STUDY SHOWS FIRST PROOF THAT A SAFER UV LIGHT KILLS VIRUS CAUSING COVID-19

Researchers offer first proof that Ultraviolet C light with a 222 nm wavelength — which is safer to use around humans — effectively kills the SARS-CoV-2 virus.

A study conducted by Hiroshima University researchers found that using Ultraviolet C light with a wavelength of 222 nanometers which is safer to use around humans effectively kills SARS-CoV-2 — the first research in the world to prove its efficacy against the virus that causes COVID-19.

Other studies involving 222 nm UVC, also known as Far-UVC, have so far only looked at its potency in eradicating seasonal coronaviruses that are structurally similar to the SARS-CoV-2 but not on the COVID-19-causing virus itself. A nanometer is equivalent to one billionth of a meter.

An in vitro experiment by HU researchers showed that 99.7% of the SARS-CoV-2 viral culture was killed after a 30 -second exposure to 222 nm UVC irradiation at 0.1 mW/ cm^2. The study is published in the American Journal of Infection Control.

Tests were conducted using Ushio's Care222™ krypton-chloride excimer lamp. A 100 microliter solution containing the virus (about 5×10^6 $TCID_{50}$/mL) was spread onto a 9-centimeter sterile polystyrene plate. The researchers allowed it to dry in a biosafety cabinet at room temperature before placing the Far-UVC lamp 24 centimeters above the surface of the plates.

222 nm vs 254 nm UVC

Previous studies showed that due to its limited penetration depth, Far-UVC poses minimal health risks to human skin and eyes as it is unable to reach the living cells beneath. This makes it a safer but equally potent alternative to the more damaging 254 nm UVC germicidal lamps increasingly used in disinfecting healthcare facilities.

Since 254 nm UVC harms exposed human tissues, it can only be used to sanitize empty rooms. But 222 nm UVC can be a promising disinfection system for occupied public spaces including hospitals where nosocomial infections are a possibility.

The researchers, however, suggest further evaluation of the safety and effectiveness of 222 nm UVC irradiation in killing SARS-CoV-2 virus in real-world surfaces as their study only investigated its in vitro efficacy.

The Far-UVC research is one of the four COVID-19 studies conducted by Hiroshima University scientists that received funding from the Japan Agency for Medical Research and Development.

Drs. Hiroki Kitagawa, Toshihito Nomura, and Hiroki Ohge of Hiroshima University Hospital's Department of Infectious Diseases, and Dr. Takemasa Sakaguchi of the Hiroshima University Graduate School of Biomedical and Health Sciences were behind the study.

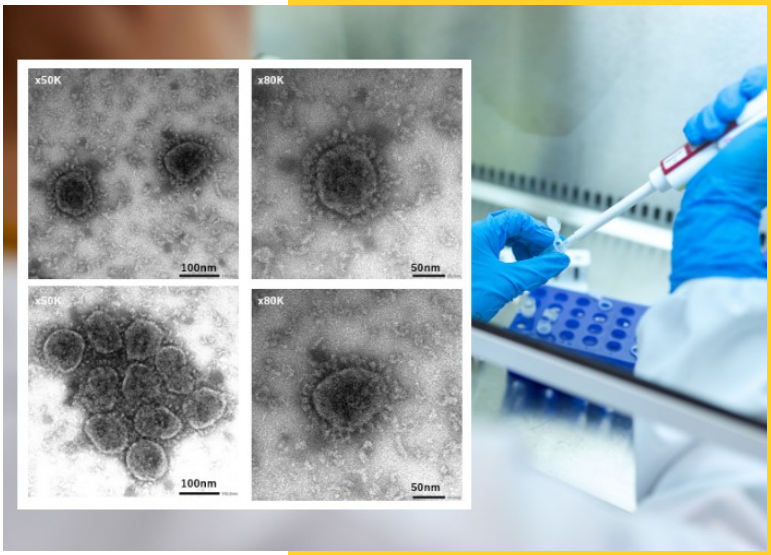
Many laboratories in the university are conducting research on the novel coronavirus under the "Hiroshima University CoV-Peace-Project."

About the study

Kitagawa, H., Nomura, T., Nazmul, T., Omori, K., Shigemoto, N., Sakaguchi, T., & Ohge, H. (2020). Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination. American Journal of Infection Control. doi:10.1016/j.ajic.2020.08.022

NEW TREATMENTS AND PROMISING TECH VS COVID-19 EMERGE FROM HU'S LABORATORIES

Therapeutic drugs, a novel test method, a fully automated testing process, and a way to conduct medical diagnosis remotely are just some of the research being done at Hiroshima University to beat COVID-19.



SARS-CoV-2 under an electron microscope

A couple of days before October, the world hit another bleak milestone as the number of deaths due to COVID-19 reached one million. It has been nearly nine months since the first known death from the disease, then still an unnamed mysterious viral pneumonia, was recorded. And there are still a lot of unknowns with COVID-19 and the coronavirus causing it.

The virus has upended every aspect of daily life, including how we work and study. Like in other universities, the pandemic had impacted major events at Hiroshima University such as the entrance and graduation ceremonies, which had to be simplified due to crowd restrictions, while classes were moved online. Laboratories at the university also had to deal with partial lockdowns.

Last April, as infections reached a million, the university joined the global fight against the pandemic through the "Hiroshima University CoV-Peace-Project." Many laboratories at the university started working on treatments and innovations to help us better take care of each other and beat the virus. The university is currently awaiting approval of two patent applications for COVID-19 therapeutic drugs.

Future of disinfection

In September, one of the laboratories at HU has released its study results which provided the first proof that Far-UVC or Ultraviolet C light at a wavelength of 222 nm effectively kills SARS-CoV-2, the virus that causes COVID-19. As previous researches have shown that Far-UVC poses minimal health risks to human skin or eyes, it could be a promising disinfection tool for occupied public spaces.

Dr. Hiroki Kitagawa, an infectious disease specialist at Hiroshima University Hospital and co-author of the study, said they are now verifying the potency of Far-UVC in zapping the virus in clinical settings such as patient rooms.

The Far-UVC research was one of the four studies at the university funded by the Japan Agency for Medical Research and Development (AMED) .

Fully automated testing

Another AMED-funded study the university is working on is the development of a fully automated coronavirus testing system that will produce a rapid and accurate diagnosis of coronaviruses. The system will automate both the pre-processing of clinical samples and PCR testing.

Dr. Hidetoshi Tahara from the Graduate School of Biomedical and Health Sciences is heading the project that can potentially reduce waiting time for results, allow testing of multiple samples, and offer insights on the virus' evolution by mutation and phylogenetic analysis using next generation sequencer. By minimizing the need for human interaction, this technology can also prevent infection risks of health care professionals.

New testing method

One study that received a JPY 49 million grant from AMED is looking into a new way of testing for COVID-19 via saliva samples. HU virologist Dr. Takemasa Sakaguchi is leading this research using lectins, a protein that binds to glycans — high mannose sugars that serve as markers of pathogens.

He hopes this novel testing method would be used in detecting SARS-CoV-2 and influenza viruses which are expected to spread simultaneously in winter.

Reducing risks to healthcare providers

Minimizing infection risk to health workers while providing real-time medical diagnosis is the focus of another AMED-funded study.

Dr. Nobuaki Shime of the Department of Emergency and Critical Care Medicine at the university's Graduate School of Biomedical and Health Sciences is developing a system for healthcare providers to conduct auscultation and analysis of respiratory sounds remotely.

HU is also providing scientific advice as part of a technical committee that helps Hiroshima Prefecture enact its pandemic protocols.

Photo Courtesy of Dr. Mitsuo Sakai

HOW THE HUMBOLDT SQUID'S GENETIC PAST AND PRESENT CAN SECURE ITS FUTURE

Marine biologists studying the genetic structure of the Humboldt squid population found it is vulnerable to overfishing by fleets on its migration path.

A group of marine biologists is pushing for more international collaboration to manage the Humboldt squid population after their study to identify its genetic stocks revealed its vulnerability to overfishing by fleets trying to feed the world's hunger for squids.

Hiroshima University marine biologist Gustavo Sanchez led a team of researchers to find out the genetic structure of the Humboldt squid population in the Eastern Pacific Ocean using two types of DNA markers — the mitochondrial ND2 gene and nuclear microsatellite loci.

The team found that Humboldt squids could trace back their population to three historical matrilineage that spread out during the late Pleistocene and that the species has at least two contemporary genetic stocks homogeneously co-distributed in the northern and southern hemispheres.

More than a single genetic stock

Different genetic stocks within a species are usually defined by where they feed and breed. But in Humboldt squids, DNA markers showed no north-south divide.

The equator doesn't serve as a natural barrier to separate the different genetic stocks of these fast swimmers which exposes them to fishery fleets along their migration route.

"Our results suggest that rather than independent marine policies from each country, the sustainability of this squid requires an international marine policy," Sanchez said.

To ensure sustainable fishing, countries in South America where the squid is traditionally found have established yearly catch quotas. But the study found this approach ineffective, especially as catch restrictions are absent in international waters on the squid's path.

"Countries fishing this squid have established catch quotas with no consideration that the total amount varies from year to year, and that the amount of squid caught influences the number of squids next year. By doing so, the genetic contribution of the offspring every year will also clearly fluctuate. In such a situation, there is a risk of having a genetic erosion with a smaller number of squids which are also less likely to adapt rapidly to the changing environment," he explained.

"From our study, it is also clear that the squids caught by different countries also belong to at least two different populations, with likely different genetic contribution for the next generation. Catching these squids without knowing that their genetic contribution is different, is also very risky."

Securing the squids' future

Although quick to adapt, warmer temperatures mean less food, smaller maturity size, and fewer eggs to replenish the population. The squids recently expanded their migration route toward the poles, risking capture by new vessels. Humboldt squids typically spawn once in their one-year lifespan then die, making their future volatile if fishing goes unchecked.

And such fears are not farfetched.

It's eastern relatives, the Japanese flying squid, has suffered the same fate. Years of overfishing and changing climate depleted their population at an alarming rate. The shortage worries the fishing town of Hakodate whose identity and economy are intertwined with the squid.

Sanchez said Hakodate's experience could be a grim warning of things to come for his country Peru.

> **Our results suggest that rather than independent marine policies from each country, the sustainability of this squid requires an international marine policy.**

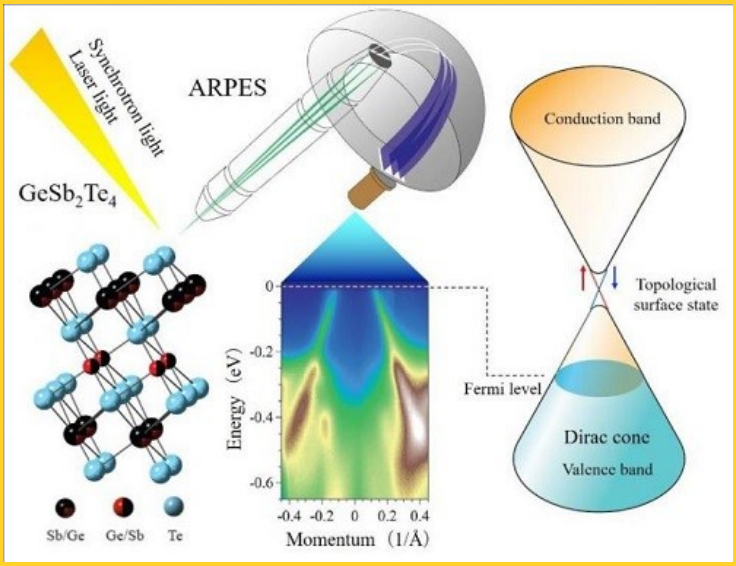
"The Humboldt squid is the second most important economical species in Peru. That means that when we have less squid, that will affect also the economy of the country," he said.

The species' conservation status may still be unknown but new knowledge of its genetic stock can help inform policies to manage its population.

About the study

Sanchez, G., Kawai, K., Yamashiro, C. et al. Patterns of mitochondrial and microsatellite DNA markers describe historical and contemporary dynamics of the Humboldt squid Dosidicus gigas in the Eastern Pacific Ocean. Rev Fish Biol Fisheries 30, 519–533 (2020).
doi:10.1007/s11160-020-09609-9

DISCOVERY OF MASSLESS ELECTRONS IN PHASE-CHANGE MATERIALS PROVIDES NEXT STEP FOR FUTURE ELECTRONICS



What's in the picture?

(Left) Crystal structure for the intermixed crystalline phase of the phase-change compound $GeSb_2Te_4$.

(Middle) Angle-resolved photoemission spectrum of crystalline $GeSb_2Te_4$ by showing the linearly dispersive band crossing the Fermi level.

(Right) Schematic band structure of the crystalline $GeSb_2Te_4$ based on this study.

Researchers have found electrons that behave as if they have no mass, called Dirac electrons, in a compound used in rewritable discs, such as CDs and DVDs. The discovery of "massless" electrons in this phase-change material could lead to faster electronic devices.

The international team published their results on July 6 in ACS Nano, a journal of the American Chemical Society.

The compound, $GeSb_2Te_4$, is a phase-change material, meaning its atomic structure shifts from amorphous to crystalline under heat.

Each structure has individual properties and is reversible, making the compound an ideal material to use in electronic devices where information can be written and rewritten several times.

″Phase-change materials have attracted a great deal of attention owing to the sharp contrast in optical and electrical properties between their two phases," said paper author Akio Kimura, professor in the Department of Physical Sciences in the Graduate School of Science and the Graduate School of Advanced Science and Engineering at Hiroshima University.

″The electronic structure in the amorphous phase has already been addressed, but the experimental study of the electronic structure in the crystalline phase had not yet been investigated."

The researchers found that the crystalline phase of $GeSb_2Te_4$ has Dirac electrons, meaning it behaves similarly to graphene, a conducting material that consists of a single layer of carbon atoms.

They also found that the surface of the crystalline structure shares characteristics with a topological insulator, where the internal structure remains static while the surface conducts electrical activity.

″The amorphous phase shows a semiconducting behavior with a large electrical resistivity while the crystalline phase behaves like a metallic with a much lower electrical resistivity," said Munisa Nurmamat, paper author and assistant professor in the Department of Physical Sciences in the Graduate School of Science and the Graduate School of Advanced Science and Engineering at Hiroshima University.

″The crystalline phase of $GeSb_2Te_4$ can be viewed as a 3D analogue of graphene."

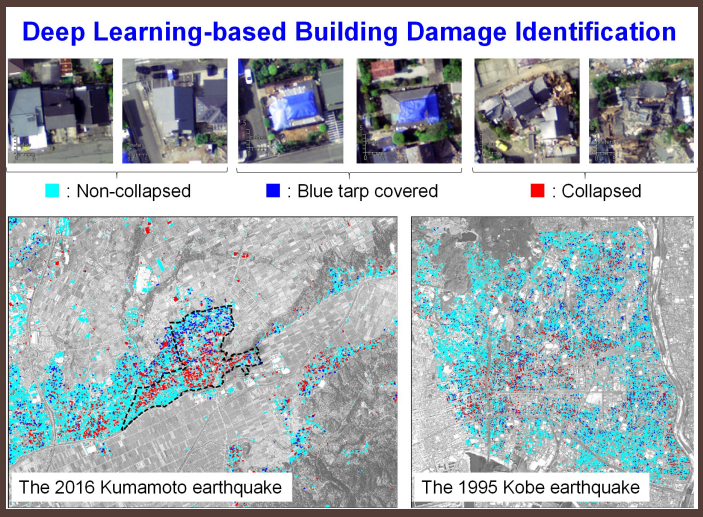
Graphene is already considered by researchers to be a high-speed conducting material, according to Nurmamat and Kimura, but its inherently low on- and off-current ratio limits how it is applied in electronic devices.

As a 3D version of graphene, $GeSb_2Te_4$ combines speed with flexibility to engineer the next generation of electrical switching devices.

About the study

Nurmamat, M., Okamoto, K., Zhu, S., Menshchikova, T. V., Rusinov, I. P., Korostelev, V. O., . . . Kimura, A. (2020). Topologically Nontrivial Phase-Change Compound GeSb2Te4. ACS Nano, 14(7), 9059-9065. doi:10.1021/acsnano.0c04145

AI TAUGHT TO RAPIDLY ASSESS DISASTER DAMAGE SO HUMANS KNOW WHERE HELP IS NEEDED MOST



You'll be happy for machines to take over this job.

This photo shows the distribution of damage estimated by the convolutional neural network model for Mashiki town in the 2016 Kumamoto earthquake (L) and Nishinomiya City in the 1995 Kobe earthquake (R). Hiroshima University researchers created a post-disaster damage assessment CNN model that does not need pre-disaster images to make an evaluation.

Researchers at Hiroshima University have taught an AI to look at post-disaster aerial images and accurately determine how battered the buildings are — a technology that crisis responders can use to map damage and identify extremely devastated areas where help is needed the most.

Quick action in the first 72 hours after a calamity is critical in saving lives. And the first thing disaster officials need to plan an effective response is accurate damage assessment. But anyone who has seen aftermath scenes of a natural catastrophe knows the many logistical challenges that can make on-site evaluation a danger to the lives of crisis responders.

Using convolutional neural network (CNN) — a deep learning algorithm inspired by the human brain's image recognition process — a team led by Associate Professor Hiroyuki Miura of Hiroshima University's Graduate School of Advanced Science and Engineering trained an AI to finish in an instant a task that usually requires us to devote crucial hours and personnel at a time when resources are scarce.

Previous CNN models that assess damage require both before and after photos to give an evaluation. But Miura's model doesn't need pre-disaster images. It only relies on post-disaster photos to determine building damage.

It works by classifying buildings as collapsed, non-collapsed, or blue tarp-covered based on the seven damage scales (D0-D6) used in the 2016 Kumamoto earthquakes by the Architectural Institute of Japan.

A collapsed building is defined as D5–D6 or major damage. Non-collapse is interpreted as D0–D1 or negligible damage. Intermediate damage, which was rarely considered in previous CNN models, is designated as D2-D3 or moderate damage.

Researchers trained their CNN model using post-disaster aerial images and building damage inventories by experts during the 1995 Kobe and 2016 Kumamoto earthquakes.

The researchers overcame the challenge of identifying buildings that suffered intermediate damage after confirming that blue tarp-covered structures in photos used to train the AI predominantly represented D2-D3 levels of devastation.

Since ground truth data from field investigations of structural engineers were used to teach the AI, the team believes its evaluations are more reliable than other CNN models that depended on visual interpretations of non-experts.

When they tested it on post-disaster aerial images of the September 2019 typhoon that hit Chiba, results showed that damage levels of approximately 94% of buildings were correctly classified.

Now, the researchers want their AI to outdo itself by making its damage assessment more powerful.

"We would like to develop a more robust damage identification method by learning more training data obtained from various disasters such as landslides, tsunami, et cetera," Miura said.

"The final goal of this study is the implementation of the technique to the real disaster situation. If the technique is successfully implemented, it can immediately provide accurate damage maps not only damage distribution but also the number of damaged buildings to local governments and governmental agencies."

About the study

Miura, H.; Aridome, T.; Matsuoka, M. Deep Learning-Based Identification of Collapsed, Non-Collapsed and Blue Tarp-Covered Buildings from Post-Disaster Aerial Images. Remote Sens. 2020, 12, 1924. doi:10.3390/rs12121924

SCIENTISTS DISCOVER WHY A RARE SYNDROME IS GIVING PEOPLE DISEASES LINKED TO ANOTHER GROUP OF GENETIC DISORDERS

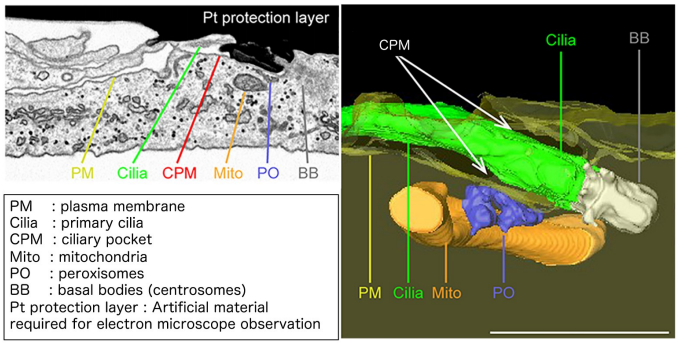
Scientists found out why people with Zellweger syndrome also get sick with genetic disorders linked to dysfunctions of the cilia or the cell's "antenna."

Zellweger syndrome is a rare disease which at its mildest form can cause developmental delays in childhood and vision and hearing loss in adulthood. At its most severe, it can mean weak muscle tone, feeding and respiratory problems, and neonatal seizures. Those who have its extreme form typically do not survive beyond age one.

The origin of this syndrome is traced to a deficiency in the cell's metabolizers called peroxisomes. But, it is unknown why those who have this disease also experience genetic disorders — like polycystic kidney disease and retinitis pigmentosa — linked to ciliopathy or ailments caused by anomalies in the cell's cilia, an antenna-like protrusion that picks up signals required for embryonic development and adult tissue maintenance.

Hiroshima University researchers who were looking into the health effects of ciliary cholesterol insufficiency found what's making patients with peroxisome disorders sick with ciliopathy-associated symptoms.

Their findings are published in The Embo Journal



The figure on the right is a 3D reconstitution of serial electron microscope images of the primary cilia. It shows the peroxisome in contact with the ciliary pocket to supply cholesterol to the primary cilia. The figure on the left is an electron microscope image of the primary cilia in a plane.

Peroxisomes' novel role revealed

Their research ushered in the discovery of a new function being performed by peroxisomes as suppliers of cholesterol to the primary cilia. They also learned that an undersupply of ciliary cholesterol causes ciliopathy symptoms to appear in those with Zellweger syndrome.

"It has been reported that ciliary cholesterol is more enriched than cholesterol in other plasma membranes. However, it remains unclear how cholesterol is supplied to primary cilia," cell biologist Tatsuo Miyamoto, who led the research team, said.

"This work contributes to clarifying that the damaged intracellular transport of cholesterol in the peroxisome -deficient Zellweger syndrome patient cells reduces the level of ciliary cholesterol to cause ciliopathy. Thus, we have known the pathological mechanism of ciliopathy in Zellweger syndrome."

In order to find out if peroxisomes transport cholesterol to the primary cilia and if a deficit in ciliary cholesterol induces ciliopathy symptoms to manifest in people living with Zellweger syndrome, the researchers combined genome editing-based reverse-genetics in human cells with 3D-CLEM/FIB-SEM, the most advanced electron microscope technology.

Key to future treatments

Although Zellweger syndrome and most ciliopathies are rare diseases, Miyamoto explained that the primary cilia also contain proteins associated with cancers and some common disorders.

"Since ciliary cholesterol is assumed to regulate the activities of these proteins, ciliary cholesterol control might be a new target to develop the drug to cure not only ciliopathy but also common diseases such as cancers and psychiatric or neurological diseases," he said.

"Therefore, our next challenge is to establish the control technology and medicine for ciliary cholesterol dynamics."

About the study

Miyamoto, T., Hosoba, K., Itabashi, T., Iwane, A. H., Akutsu, S. N., Ochiai, H., . . . Matsuura, S. (2020). Insufficiency of ciliary cholesterol in hereditary Zellweger syndrome. The EMBO Journal, 39(12). doi:10.15252/embj.2019103499

OFFSPRING OF MICE FED IMBALANCED DIETS SHOWN TO BE NEUROLOGICALLY 'PROGRAMMED' FOR OBESITY

Pregnant mice fed diets high in omega-6 fats and low in omega-3 fats are shown in a new study to produce offspring that went on to chase hyper-caloric diets.

Pregnant mice fed a diet high in omega-6 fats and low in omega-3 fats produce offspring that go on to exhibit "hedonic"—pleasurable but excessive—levels of consumption of hyper-caloric diets, according to researchers at Hiroshima University.

Omega-6 fats are found in grapeseed oil, corn oil and sesame oil, and are a staple of several salad dressings in world cuisine. Omega-3 fats are found in fish, perilla oil, and linseed oil. A diet balanced with these fats is considered essential for healthy brain growth.

The researchers also found that the offspring exhibit increased in utero growth of dopamine-producing neurons in the midbrain—the neurological reward system. They believe that exposure to this high omega-6/low omega-3 diet increases growth in these neurons in the fetus's brain during a specific period during pregnancy, driving dopamine release in the offspring's brain, and thus primes the offspring for hedonic consumption of sugar- or fat-rich diets over the course of their life.

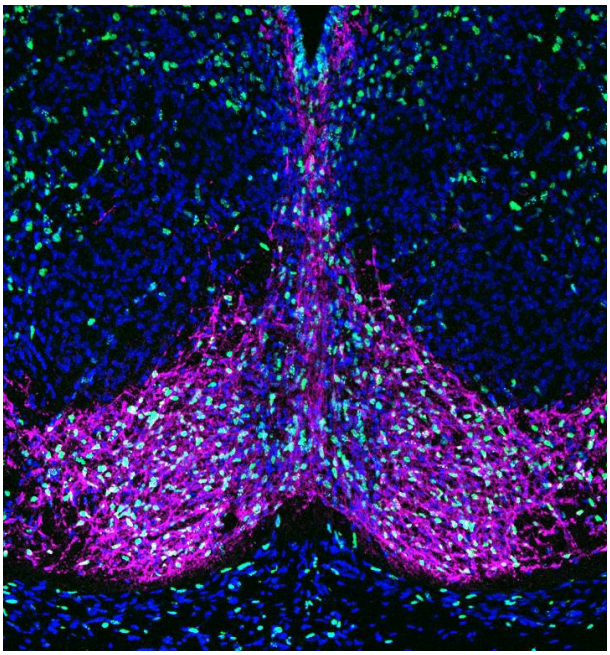
The findings were published in the peer-reviewed journal Communications Biology, on August 28.

Meanwhile, mice whose mothers had not consumed the imbalanced omega-6/omega-3 diet did not exhibit as much overeating behavior, even when tempted by the presence of such food.

Since the 1960s, the Western diet has experienced a significant uptick in the presence of polyunsaturated omega-6 fats, and in ratios to polyunsaturated omega-3 fats that historically humans had never experienced before.

The ratio between these two types of fats is important because biochemically they compete with each other for incorporation into cell membranes, and an omega-6/omega-3 imbalance in the membranes of red blood cells is correlated with weight gain. An earlier study on mice had found that consumption of an imbalanced omega-6/omega-3 diet by the pregnant mother replicates this imbalance in the offspring's brain and even impairs brain development.

The Hiroshima researchers also found that a dopamine-inhibiting drug eliminates the hedonic consumption of the offspring, further supporting the notion that the dopamine signaling plays a critical role in driving this behavior.



The magenta staining shows brain cells that release dopamine. The green staining shows newly generated cells. The blue staining shows all cells.

"This suggests that adult mice gorging themselves on hyper-caloric diets were in effect neurologically programmed to do so by their mother's own consumption patterns," said Nobuyuki Sakayori, paper author and assistant professor from the Graduate School of Biomedical and Health Sciences at Hiroshima University.

The scientists were keen to stress that the ratio of omega-6 to omega-3 fat in the mouse diet is much higher than that experienced by most humans, and that their work lays the foundation for further, epidemiological studies on humans to see if the pattern holds for us.

But if it does, this could provide a new strategy for preventing obesity in children by managing the type of fats that pregnant mothers consume, akin to how mothers today generally avoid consumption of alcohol.

"This could work much better than existing anti-obesity campaigns or food taxes," Sakayori continued, "because instead of fighting against the brain's reward system, such a strategy focuses right from the start on the development of that system."

About the study

Sakayori, N., Katakura, M., Hamazaki, K. et al. Maternal dietary imbalance between omega-6 and omega-3 fatty acids triggers the offspring's overeating in mice. Commun Biol 3, 473 (2020). doi:10.1038/s42003-020-01209-4

REMNANTS OF AN ANCIENT ASTEROID SHED NEW LIGHT ON THE EARLY SOLAR SYSTEM

Researchers have shaken up a once accepted timeline for cataclysmic events in the early solar system.

About 4.5 Ga (giga-anum, or billion years ago), as a large disc of dust and ice collapsed around our newly formed star, planets and smaller celestial bodies were formed.

What followed was a chaotic and violent period of collisions and impacts as the familiar eight planets carved out their orbits to resemble the balanced system we observe today.

Geological and geochemical records indicate that after about 600-700 million years after formation – but still early in the solar system's existence – the Earth-Moon system experienced a period of frequent and cataclysmic impacts from asteroids and other bodies. This period is dubbed the late heavy bombardment (LHB) period.

It was once thought that this period had a relatively sudden onset, but a research team at Hiroshima University and The University of Tokyo in Japan have found evidence that this bombardment period may have started much earlier, and decreased in intensity over time.

The team published their findings on August 26 in Earth and Planetary Letters.

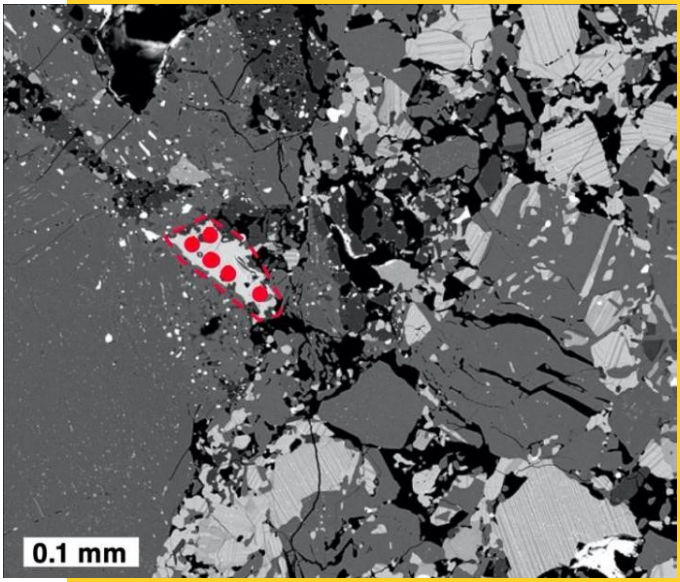
"According to Apollo's lunar rock studies from the 1970s, the Earth, Moon, and the entire inner solar system are thought to have suffered from numerous meteoritical impacts at around 3.9 Ga. This event is regarded as a key process during the early evolution of our planet," said Mizuho Koike, an author of the study and an assistant professor from The Graduate School of Advanced Science and Engineering at Hiroshima University.

"However, the validity of the LHB idea is being questioned recently. To settle this debate, a solid database of the 'impact ages' is required."

The team started building this database using rocks found on Earth that originated from a large, ancient asteroid, called Vesta, to see if they could corroborate the timeframe of the LHB period. If the solar system indeed experienced the LHB period roughly 3.9 Ga, Vesta, like Moon, would likely hold similar evidence of such an event around the same time period.

What the team found was a record of impacts 300 to 500 million years earlier than expected.

"We found that the rocks from Vesta recorded the multiple impacts that occurred between 4.4 to 4.15 Ga, clearly earlier than the predicted peak of LHB at ~3.9 Ga. In contrast, no impact evidence was identified at 3.9 Ga or later. These findings suggest that Vesta (and probably other asteroids as well) did not record the LHB. Instead, they experienced massive impacts at the earlier stage," said Koike.



The light gray grain surrounded by the red dashed line is a phosphate mineral, whose U-Pb age was determined as 4.15 billion-year-old. (Meteorite's name: Juvinas)

It is still unclear what this means for the LHB period as a whole, but Koike and her colleagues plan to further investigate the chronology of the early solar system.

"Our study reveals that the previously expected impact model was not correct, at least on Vesta," Koike said.

"Extrapolating this to the wider solar system, the concept of LHB may not be appropriate to the planets' evolutions, including to the Earth and Moon. To verify such an examination, we are planning to investigate the impact histories on other asteroids and planetary materials by applying our present analytical techniques."

By doing so, the team may be able to add to their database and, ideally, peer with more clarity into our solar systems distant past.

> **Our study reveals that the previously expected impact model was not correct, at least on Vesta.**

About the study

Koike, M., Sano, Y., Takahata, N., Iizuka, T., Ono, H., & Mikouchi, T. (2020). Evidence for early asteroidal collisions prior to 4.15 Ga from basaltic eucrite phosphate U–Pb chronology. Earth and Planetary Science Letters, 549, 116497.
doi:10.1016/j.epsl.2020.116497

RESEARCHERS UNCOVER A JAPANESE TEMPLE'S ANCIENT ART SECRETS

Researchers uncovered ancient Buddhist paintings possibly dating back to over 1,300 years ago kept hidden in plain sight on soot-covered temple columns.

Photo courtesy of Noriaki Ajima and Yukari Takama

On temple columns blackened by soot, a group of researchers uncovered ancient paintings showing eight Buddhist saints possibly dating back to over 1,300 years ago.

The images were found at the main hall columns of Shiga Prefecture's Saimyoji Temple, widely believed to be built during the Kamakura-era (1185–1333) and the first to be designated as a national treasure by Japan. The researchers unmasked the secrets the columns have kept hidden in plain sight using infrared cameras.

Hiroshima University art history professor Noriaki Ajima, who is part of the team that made the discovery, said he knew there were paintings drawn on the pillars.

"This is because when you shine a bright light, you can see something like the face of a Bodhisattva," he said in Japanese. However, he thought they were made more recently during the Edo period (1603-1867).

The restoration of the temple's zushi, a cupboard-like case where the principal image of the Buddha is kept, in June last year provided an opportunity for them to do a full-scale survey upon the proposal of the chief priest. What they discovered using their infrared cameras was that the paintings possibly date farther back to the latter half of the Asuka period (592-710).

"It is generally believed that Saimyoji Main Hall was built during the Kamakura period and was expanded during the Nambokucho period," the professor explained.

"The first time I saw an infrared photograph, I was very surprised to find that the quality of the radiation was completely different from the ones I had studied since the Heian era, and after a detailed investigation, I came to the conclusion that it was the Asuka era."

Ajima explained that elements in the paintings like shapes of body parts, palm creases, and costume patterns suggest that they could have been made in the year 685.

He said the body shape and facial expressions were similar to the Kudara Kannon statue, named as a Japanese national treasure, and the paintings that decorate the Tamamushi no zushi — both belonging to the Horyu-ji Temple in Nara Prefecture and created in the middle of the 7th century.

The costume patterns in the column art were also similar to the ones used in the Tamamushi no zushi.

The style used to express the inner ear and palm creases, however, weren't as sophisticated as the ones used at the main hall mural of Horyu-ji Temple which was painted in the 8th century.

Because of this, Ajima placed the creation of the column art during the latter half of the 7th century — between the time the Kudara Kannon and Tamamushi no zushi were created in the middle of the 7th century and the painting of Horyu-ji Temple's main hall at the beginning of the 8th century.

Looking at literary history could also provide clues on when the paintings were made. Ajima explained that Inukami District in Shiga Prefecture where Saimyoji Temple is located was the home of 7th-century diplomat Inukami who in the year 684 was awarded a noble title under Emperor Tenmu's Yakusa no Kabane system. The next year, the emperor decreed that a Buddhist temple be built for each clan.

"If the main body of Saimyoji main hall was the temple of Inukami clan, built according to the imperial decree proclaimed by Emperor Tenmu the following year, 'Building a Buddhist temple for each clan,' there is no contradiction," he said.

The discovery of column art has raised the possibility that the main hall of Saimyoji Temple could be older than Horyu-ji Temple's main hall which is currently recognized as the world's oldest surviving wooden building.

Note: Professor Noriaki Ajima's answers were translated to English from Japanese.

STUDENTS TAKE ON MISSION OF PEACE STARTED BY ATOMIC BOMB SURVIVORS

Hiroshima University students are rising to the challenge of continuing the legacy of peace started by those who survived the atomic bombing 75 years ago.

The students vowed their commitment to a world free of nuclear weapons and discrimination as they read the "2020 Students' HIROSHIMA Declaration" last August 6 during this year's Peace Project celebration, an annual event commemorating the atomic bombing attack that devastated Hiroshima and Nagasaki in 1945.

As the population of living atomic bomb survivors decline, and their average age now exceeding 83 years old, the students said it is time for the next generation to carry on their fight.

"After experiencing one of the darkest moments in human history on August 6, 1945, the atomic bomb survivors, known as Hibakusha, have created and sustained a truly inspiring movement toward a nuclear-free world," the students said.

"Today, we honor their resilience. We pay our respects to those who walked the streets of Hiroshima on that day at 8:15 a.m., skin burned, clothes torn."

Despite a diminished attendance due to COVID-19 crowd restrictions, the event's message of peace remains as powerful.

The pandemic which had ravaged the globe had surfaced the issues of structural discrimination, disregard for humanity, and lack of solidarity within state relations, the students said.

"Our appeal for a nuclear-free world goes hand in hand with our call to end discrimination," they said.

"We see and hear the calls of the Black Lives Matter movement. We seek justice for people living in conflict. We feel the pain of women and LGBTBQIA+ people who face discrimination based on their gender or orientation."

HU whose foremost guiding principle is the pursuit of peace has devoted itself to peace education, exploring its different aspects from human security to science and technology.

"Through peace education, we can teach about the devastating effects of nuclear weapons while promoting empathy, respect, and human dignity," the students said.

The declaration was a product of a months-long students' peace summit held by the university's Center for Peace to envision the future of peace in a post-coronavirus world. Twelve students from six countries joined the summit.

HU President Mitsuo Ochi also unveiled at the event a viola made from trees that survived the nuclear explosion.

MOTHER LAND LANKA

HU STUDENTS' EFFORTS TOWARDS SUSTAINABLE PEACE IN SRI LANKA

Ryo Uchida and Yoshinari Kajishita, both from HU's Graduate School for International Development and Cooperation, played a central role in founding Mother Land Lanka (MLL) — a non-profit organization that works to build peace through the cultivation of indigenous herbal plants in the northern province, the main battlefield of the civil war in Sri Lanka.

Mother Land Lanka is currently engaged in the "Home Garden Project" in the Vavuniya District with the support of the Albion Co., Ltd. — a Japanese cosmetics distributor and manufacturer. This project provides a "place" for Sinhala, Tamil, Muslim, and other people with different ethnicity and religion to work together and coexist beyond the ethnic and religious boundaries through taking part in the activity of cultivating traditional indigenous herbal plants of the country.

"To build sustainable peace, we need to provide short-term and long-term projects: Promoting the regional industry and creating stable working opportunities are urgent for local people. I realized that it is necessary to create a foundation that can gather people who have the same spirit for peace and build a sustainable network with international and domestic partners," said Uchida.

MLL was registered as NPO in Sri Lanka in 2020, and is currently working on several projects and research to improve the lives of thousands of Sri Lankans.

CONSTRUCTION OF HU'S INTERNATIONAL EXCHANGE CENTER

In October 2020, the construction of Hiroshima University's International Exchange Center will begin at the Higashi-Hiroshima Campus as part of the project to create an international research center in Higashi-Hiroshima City.

The seven-story steel-reinforced concrete building — with a total floor area of 3,954m² — will have multiple functions, such as promoting innovation, facilitating the interaction and the exchange of knowledge between diverse people from both inside and outside Japan, and providing a safe and comfortable place to live for top overseas researchers and talented international students.

A hill of exchanges interwoven with greenery

The building's symbolic exterior design embodies a sustainable society, with an organic architectural shape and a layout plan that inherits the existing trees, hills, and pathways.

The building is scheduled to open in fall of 2021.

INTERNATIONAL JOINT DEGREE PROGRAMS WITH AUSTRIA, GERMANY UNIVERSITIES

In October 2020, Hiroshima University opened its first joint degree program for two of its graduate schools in cooperation with the University of Graz in Austria and Leipzig University in Germany. The program focuses on sustainable development — the basis for the construction of a sustainable global society.

Graduate School of Humanities and Social Sciences

Joint International Master's Programme in Sustainable Development (Hiroshima University – Leipzig University)

This program aims to develop students who possess the ability to conduct research and engage in practice based on the fundamental principles of international cooperation in development studies through social science approaches, in order to resolve the pressing regional and global issues related to the Sustainable Development Goals (SDGs), especially the issues of poverty reduction.

Graduate School of Advanced Sciences and Engineering

Joint International Master's Programme in Sustainable Development (Hiroshima University – Leipzig University)

This program aims to develop students who possess the ability to conduct research and engage in practice based on the fundamental principles of sustainable development in environmental studies, through science and engineering approaches, in order to resolve the pressing regional and global issues related to the SDGs, especially the environmentally-driven development issues caused by the rapid urbanization of developing countries.

LAUNCH OF THE HIRAKU-GLOBAL PROGRAM

On September 4, the HIRAKU-Global Program held its very first Starter Core Program (SCP) as a completely online event for the first HIRAKU-Global Faculty Members (HGFM) cohort, who were selected as talented Early Career Researchers (ECR).

This momentous occasion marked the beginning of the journey for the HGFM on their way to becoming world-class researchers who will be recognized as innovative, influential, and impactful academics in the global community.

The day-long intensive SCP offered the first genuine opportunity for the HGFM to be able to (virtually) meet and gain more specific knowledge in regard to the Program itself. Throughout the day, the first cohort were able to learn more about each other, the Program Mentors, the aspirations of the Program and the support systems and development opportunities available to them.

Furthermore, an insightful and interactive webinar/workshop entitled "Effective Mentoring Relationships," which was specifically tailored for the HGFM, was facilitated by Vitae (UK).

The HIRAKU-Global Program is a newly established ECR development program, funded by MEXT (Japan). Hiroshima University acts as the Lead Organization in collaboration with the Partner Organizations of Yamaguchi University, Tokushima University, and Ehime University. Please visit the link below to learn more about the Program:

www.hiroshima-u.ac.jp/en/hiraku-g

SCHOOLS (UNDERGRADUATE)

For undergraduate level, Hiroshima University consists of 12 schools which provide undergraduate courses including majors in the natural sciences, humanities, the social sciences, and many others.

School of Integrated Arts and Sciences
School of Letters
School of Education
School of Law
School of Economics
School of Science
School of Medicine
School of Dentistry
School of Pharmaceutical Sciences
School of Engineering
School of Applied Biological Science
School of Informatics and Data Science

ADVANCED COURSE

Special Course of Special Needs Education

GRADUATE SCHOOLS

Graduate level studies at Hiroshima University consist of 4 graduate schools below.

Graduate School of Integrated Sciences for Life
Graduate School of Biomedical and Health Sciences
Graduate School of Humanities and Social Sciences
Graduate School of Advanced Science and Engineering

INTERDISCIPLINARY GRADUATE EDUCATIONAL PROGRAM

In addition, three unique program offerings combine graduate level academic coursework with integrative research components.

Phoenix Leader Education Program (Hiroshima Initiative) for Renaissance from Radiation Disaster
TAOYAKA PROGRAM for creating a flexible, enduring, peaceful society
The Frontier Development Program for Genome Editing

AUTUMN TERM COMMENCEMENT CEREMONY

September 18, 2020

Voices from Graduates

"Japan — and specially Saijo — has a great environment for studying since it's quiet and people are very friendly. Here at HU, we learned about new research methods that we'll apply once we go back to Indonesia," said Astriyany and Suhaila Marisa, both master's degree graduates from the Graduate School of International Development and Cooperation.

HIROSHIMA UNIVERSITY IN FIGURES (as of May 1, 2020)

Undergraduate students
10,678 students

Postgraduate students
4,513 students

Staff members
3,555 members
1 for every 4.3 students

Undergraduate graduates
Cumulative **141,792** students

Doctorates conferred in AY 2019 **367** students

THE University Impact Rankings 2020
SDG4 (Quality education)
SDG6 (Clean water and sanitation)
SDG11 (Sustainable cities and communities)
1st Nationwide

Volumes in collections at the libraries
Approx. **3.47** million volumes
Approx. 229 volumes per student

Annual visitors to the libraries
Approx. **1.02** million visitors
4,231 visitors per open day

Total site area of Higashi-Hiroshima Campus
Approx. **2.49** million m²
Equivalent to 49 Hiroshima Municipal Baseball Stadiums (Mazda Stadium)

❶ 〈Hiroshima City (Midori District)〉
Elementary School
Junior High School
Senior High School

❷ 〈Higashi Hiroshima City〉
Kindergarten

❸ 〈Hiroshima City (Shinonome District)〉
Elementary School
Junior High School

❹ 〈Mihara City〉
Kindergarten
Elementary School
Junior High School

❺ 〈Fukuyama City〉
Junior High School
Senior High School

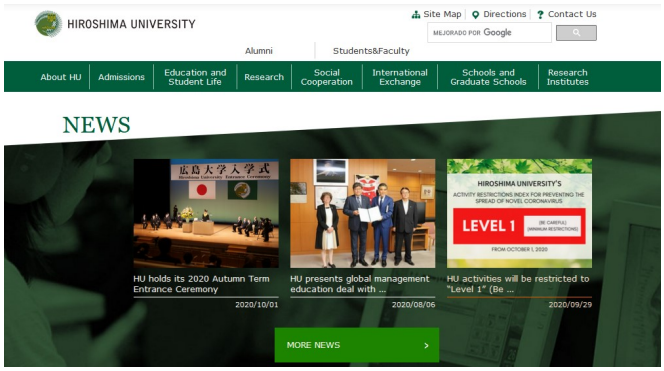
CAMPUS LOCATION

FIND MORE ABOUT HU

HU OFFICIAL WEBSITE –ENG

Latest News, Events and Research, as well as links to each university section are available from this webpage.

https://www.hiroshima-u.ac.jp/en



HU PROMOTIONAL VIDEO

Check out HU's video featuring the University's leading researches as well as everyday campus scenes.

Visit the following webpage to watch this video.

YouTube

https://youtu.be/OzZ4YBex8Ps

UPDATES FROM OUR LABORATORY

This webpage is the source for visitors worldwide to stay updated about what happens in the lab at HU.

https://www.hiroshima-u.ac.jp/en/laboratory-updates

NEW UNIVERSITY MASCOT

We now have a mascot!
Meet Hiroty

Get to know Hiroshima University's first-ever mascot and new phoenix mark. The phoenix mark's design is based on the motif of HU's symbol, "The Phoenix," which portrays the legendary immortal bird and a plant of the Palmae family known as the phoenix tree.

Phoenix Mark

HU has adopted the mythical bird as its symbol to signify its rebirth out of the ashes after Hiroshima was laid to ruins by the atomic bomb.

The mascot "Hiroty" has been designed to familiarize HU members with the phoenix mark. These artworks were designed by internationally renowned illustrator Mr. Hirofumi Kamigaki.

Hiroty, HU mascot

SOCIAL MEDIA ACCOUNTS

HU Facebook
@HiroshimaUniv.en
https://www.facebook.com/HiroshimaUniv.en

HU Research Facebook
@HiroshimaUniversityResearch
https://www.facebook.com/HiroshimaUniversityResearch

HU Twitter
@HiroshimaUnivEn
https://twitter.com/HiroshimaUnivEn

HU Research Twitter
@Hiroshima_Univ
https://twitter.com/HU_Research

HU YouTube
HiroshimaUniv
https://www.youtube.com/user/HiroshimaUniv

HU Instagram
@hiroshima_univ
https://www.instagram.com/hiroshima_univ

HU LinkedIn
HiroshimaUniv.en
https://www.linkedin.com/school/hiroshima-univ/

Free working space
East Library, Higashi Hiroshima Campus

UNIVERSITY OF
WORLD-WIDE REPUTE AND
SPLENDOR FOR YEARS INTO
THE FUTURE

HIROSHIMA UNIVERSITY