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WHERE GREAT MINDS MEET

• DAN SHECHTMAN • DAVID GROSS • DAVID PATTERSON • DIDIER QUELOZ • DOUGLAS OSHEROFF • DUNCAN HALDANE • EDMUND MELSON CLARKE • EFIM ZELMANOV • EI-ICHI NEGISHI • ERIC CORNELL • FRANCES ARNOLD • FRANÇOIS ENGLERT • FRASER STODDART • GERARD 'T HOOFT • GREGG SEMENZA • HARALD ZUR HAUSEN • HARTMUT MICHEL • IRWIN JACOBS • JAYANT BALIGA • JENNIFER DOUDNA • JEROME FRIEDMAN • JOHN HOPCROFT •

10 YEARS OF THE GLOBAL YOUNG SCIENTISTS SUMMIT

GYSS
SINGAPORE

WHERE GREAT MINDS MEET

10 YEARS OF THE GLOBAL YOUNG SCIENTISTS SUMMIT

Where Great Minds Meet:
10 Years of the Global Young Scientists Summit

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Dr Tony Tan, GYSS 2014

FOREWORD

When the Global Young Scientist Summit (GYSS) was conceptualised, my vision was for it to become an internationally recognised and prestigious event like the Lindau Nobel Laureate Meeting. To fulfil that vision, we set ourselves three objectives.

ONE

We wanted to inspire the next generation of scientists. The GYSS welcomes Nobel Prize laureates, Fields Medallists, Millennium Technology Prize honorees and Turing Award winners. These serve as peaks of excellence to inspire the next generation of young, bright scientists.

TWO

We wanted to build a strong global research network for young researchers in Singapore. Science is best done when it takes advantage of collaboration and interdependence across the world. The open sharing of information has never been more crucial as scientists across the world put their work up on open source platforms in a united fight against COVID-19. The challenges Singapore faces today—climate change, pandemic preparedness and an ageing population—affect not just us. No one country can tackle these problems alone. We need great minds to work across borders and disciplines to develop solutions for these global challenges.

THREE

We wanted to introduce Singapore's research and development (R&D) landscape to a wider audience and attract them to live and work in our country. Singapore's research ecosystem must have a good mix of local and international talent to be robust and thriving. We hope to welcome aspiring researchers to join our universities, institutes and centres of excellence to pursue their passions in our country.

Since its establishment in 2010, GYSS has hosted 88 eminent speakers and over 3,500 participants from over 40 countries. Many of them have gone on to do good work in their chosen fields.

As GYSS marks its 10th anniversary, we look forward to the dialogue and exchanges at future editions of GYSS. This will encourage all participants to continue their research pursuits and make a difference in society. In doing so, we will create a better and brighter future for generations to come.

DR TONY TAN KENG YAM
PATRON
GLOBAL YOUNG SCIENTISTS SUMMIT

→ President of the Council for Lindau Nobel Laureate Meetings, Countess Bettina Bernadotte, and Dr Tony Tan, GYSS 2013

↓ Sir Tim Hunt, Prof Ben Feringa and Prof Laurent Lafforgue, GYSS 2019

↘ Participants on a tour to the URA's Singapore City Gallery, GYSS 2015

THE STORY OF GYSS

Over the past 10 years, the National Research Foundation Singapore (NRF) has taken the Global Young Scientists Summit (GYSS) from an idea to a prestigious multi-disciplinary event that reliably attracts the top scientific minds around the world.

In 2010, as Chairman of the National Research Foundation (NRF), Dr Tony Tan attended the Lindau Nobel Laureate Meeting at Lake Constance in Germany and met with Countess Bettina Bernadotte, the daughter of the founder of the Lindau meetings. Inspired by their interactions, he found himself envisioning a similar event in Singapore, where young scientists could connect with and be inspired by eminent scientists from around the world.

FROM IDEA TO REALITY

As soon as he returned home, Dr Tan and the NRF began the conversation on how to bring his vision to fruition.

They wanted the event, which they named the Global Young Scientists Summit (GYSS), to become as internationally recognised and prestigious as the Lindau Nobel Laureate Meeting. They also knew, however, that for GYSS to make a mark on the global events calendar, it would need to be distinct in its own way and fill a niche.

The first key difference would be the summit's location. GYSS was one of the first events of its kind in Asia, with a focus on Asian participation. The NRF's goal in hosting such an event was to build a strong global research network for the country. To do so, the first summit sought participants under the age of 35 from universities and research institutions around the world that either had a significant presence in Singapore or a strong relationship with Singaporean research institutions.

The summit would also encompass multiple disciplines and prioritise the cultivation of use-inspired basic research that could tackle global challenges. In addition to the three Nobel Prize scientific disciplines of Physics, Chemistry, and Physiology and Medicine that the Lindau Meeting focuses on, the NRF also invited recipients of the Fields Medal, the Millennium Technology Prize and the Turing Award, expanding the event's scope to include the fields of natural science, mathematics, computer science and engineering.

Organising the inaugural GYSS was a monumental task and a first for Singapore. Without any existing standard protocols or programmes to serve as a frame of reference, developing most aspects of the event from scratch was a challenge.

Thankfully, the guiding ambitions were clear. The GYSS was to be a place where young scientists could be inspired by like-minded peers and eminent scientists to pursue their scientific dreams, and in turn, apply their minds to research that could address pressing global challenges.

(Centre) Prime Minister of Singapore and Chairman of Research Innovation and Enterprise Council, Lee Hsien Loong, with (far left) CEO of NRF, Professor Low Teck Seng, and GYSS 2020 speakers (from second left): Prof Alain Fischer, Prof Efim Zelmanov, Prof Kurt Wüthrich, Prof Leslie Valiant, Prof Kees Immink, Prof Klaus von Klitzing, Prof Leslie Lamport.

With that vision, the motto that would define GYSS for over a decade was born: excite, engage and enable. By giving young researchers a platform to meet distinguished scientists, the GYSS aimed to excite them to apply their minds to research; engage them by connecting them with like-minded peers and scientific leaders; and finally enable them to fulfil their research and career aspirations.

Despite the initial uncertainties about securing enough speakers and attendees for the new and then-unknown event, the organising team made it work by reaching out to peers and colleagues who were sitting on NRF's scientific panels and councils and who had a strong association with Singapore's R&D landscape.

The organising committee was able to secure 15 prize-winning scientists across a diverse range of disciplines to speak to and inspire young scientists at the inaugural GYSS, thanks to Singapore's networks in the international research and scientific ecosystem as well as Dr Tan's personal friendships with the scientists themselves.

In hopes of making GYSS more accessible to overseas participants, the programme was designed to span four days in early January to coincide with the winter break for universities in Europe and the US. The programme's multidisciplinary approach, now a defining feature of GYSS, was also crucial for addressing the global challenges that were the focus of the summit.

Senior Minister of Singapore and Former Chairman of NRF, Teo Chee Hean and Her Royal Highness Princess Maha Chakri Sirindhorn, GYSS 2013

Her Royal Highness Princess Maha Chakri Sirindhorn, Senior Minister Teo Chee Hean and Countess Bettina Bernadotte, GYSS 2013

THE INAUGURAL SUMMIT

On 20 January 2013, just two and a half years after Dr Tan's trip to Lindau, 15 eminent speakers and 295 young scientists filled the University Cultural Centre Hall at the National University of Singapore (NUS) for the opening ceremony of the very first GYSS.

Amongst the guests were Countess Bettina Bernadotte, President of the Council for Lindau Nobel Laureate Meetings, and Her Royal Highness Princess Maha Chakri Sirindhorn of Thailand, a member of the Lindau Honorary Senate—a testament to Lindau's support for GYSS.

At the newly opened EduSports complex (now known as the Stephen Riady Centre) at NUS, the speakers held plenary sessions and panel discussions on topics ranging from extreme metrology to the role of computation in molecular biology. These talks were followed by masterclass workshops and small group sessions where speakers interacted with the participants in a more informal and intimate setting.

The ensuing two days introduced local and international participants to Singapore's R&D landscape through site visits to the laboratories at the Agency for Science, Technology and Research (A*STAR), NUS, Nanyang Technological University, Singapore (NTU Singapore) and the Singapore-MIT Alliance for Research and Technology (SMART). Participants also visited the Urban Redevelopment Authority's Singapore City Gallery, Marina Barrage and Gardens by the Bay to observe the country's own urban solutions in action. In the evenings, dinners and social events gave attendees the rare opportunity to mingle with some of the world's most accomplished scientists.

The inaugural GYSS also saw the introduction of the first annual Singapore Challenge. For the competition, participants submitted a research proposal to address the challenges of sustainable development in highly populated cities. The ten finalists pitched their ideas to a panel of judges on the final day, with the winning proposal awarded an NRF fellowship and US$100,000 to fund the research.

The inaugural prize went to Lynette Cheah of Singapore for her proposal of an adaptive and demand-responsive transportation system to tackle urban traffic congestion. Cheah, now an Associate Professor of Engineering Systems Design and leader of the Sustainable Urban Mobility research group at the Singapore University of Technology and Design, highlighted that winning the Singapore Challenge provided her with further opportunities to secure research grants and collaborations.

For the GYSS committee, all the planning paid off—the inaugural event received positive feedback from both participants and speakers who expressed a wish to return. Moreover, the speakers shared their positive experiences at GYSS with their peers, further bolstering the summit's reputation.

Professor Ada Yonath, GYSS 2013

Sir Anthony Leggett, GYSS 2014

FORGING LASTING RELATIONSHIPS

With its reputation steadily rising over the years thanks to positive word of mouth and media coverage, several eminent scientists accept the invitation to speak at GYSS each year. Some are even regular returning speakers—Professor Ada Yonath has attended every year since the first summit, while Professors Aaron Ciechanover and Michael Grätzel have both attended eight times. Other regulars include Sir Timothy Hunt, Sir Anthony Leggett and Professor Stuart Parkin. Profs Yonath, Ciechanover and Parkin are part of the 10th anniversary lineup as well.

The key success of the GYSS resides in two things: having the experienced speakers and the participants, and facilitating the interaction between them.

For those involved in organising and hosting GYSS, the outcomes of such interactions are some of the most rewarding aspects of the work. Speakers frequently complimented the PhD students and postdoctoral researchers who served as liaison officers to them. While the aim was for the students to gain experience and inspiration, one student liaison gained much more—he was offered a postdoctoral research position by Nobel laureate Professor Kurt Wüthrich through his outstanding diligence.

GYSS IN A CHANGING WORLD

Given that Singapore does not have a long illustrious history in scientific research like Europe or the US, it has been inspiring to witness the city-state bring together so many highly respected scientists and technologists as well as research students into a single venue.

GYSS' continued success can be attributed to its willingness to adapt and change with the times. While staying true to its original purpose of uniting inspiring scientists of different generations, the event has also taken steps to remain relevant and impactful over the years.

Each year, for example, the organising committee actively engages speakers who can address growing research trends and discuss pressing global issues such as the need for renewable energy and novel therapeutics.

The committee has also incorporated feedback from speakers and participants to become less formal. To create more opportunities for relaxed socialising, they replaced the traditional closing ceremony one year with a farewell party at a beach house, with the emcee even going so far as to jump into the pool himself to encourage everyone to let loose.

Deputy Prime Minister of Singapore and Chairman of NRF, Heng Sweet Keat, GYSS 2020

A MAKEOVER TO REMEMBER

Although GYSS is no stranger to adapting and evolving, the COVID-19 pandemic forced the biggest change in its history. As January 2021 drew close and neither the pandemic nor travel restrictions showing signs of easing, the organising committee had to decide whether to cancel the in-person summit or to host it online—a considerable task for an event that emphasises socialising and networking.

Driven by the desire to maintain the summit's momentum ahead of its 10th anniversary this year, the decision was made to host GYSS 2021 entirely in the virtual format. The organising committee had to be agile and flexible in planning for the unknown.

These plans included contingencies for the unique challenges of online meetings. To accommodate differing time zones and minimise the risk of connection issues and online fatigue, the programme was kept to only a few hours each day. For the first time in GYSS' history, speakers and moderators attended rehearsal sessions prior to the event to familiarise themselves with the online event platform. This was more time-consuming than holding a physical event, but there was mutual understanding that this was the 'new normal' in a different world.

Opportunities for participant interaction also had to be revamped. A video challenge was introduced so participants could showcase their research ideas in the form of a short video rather than an in-person presentation. The challenge received an overwhelming response. One of the winners submitted a rap song on cellular structures called mitochondria inspired by the musical *Hamilton*. To replicate the experience of meeting face-to-face, the attendees participated in small group video calls with their chosen scientist so they could have more intimate chats.

The most surprising—and rewarding—thing about these challenges were the opportunities they presented. If GYSS 2021 was forced by the pandemic to experiment with a different format, it was one that churned out spectacular results. The virtual setup reduced the barrier to participation and physical limitations, more than tripling the usual attendance of about 300 young scientists to nearly 1,000. It also engaged new speakers that may not have been able to take part in an in-person event.

Besides attendance, the online platform also encouraged more, rather than less, engagement. The committee noticed that the participants were more open to asking questions through the chat windows on the online platform.

With the hybrid model allowing GYSS to reach out to a wide population of brilliant scientists and participants, making the talks by the top minds of the world accessible to even more people, the committee is considering keeping the model to continue growing and extending GYSS' reach.

STRIDING INTO A NEW DECADE

In the years since Dr Tan's visit to Lindau, the GYSS has indeed grown from the seed of an ambitious idea into what it is today: a prestigious fixture on the conference calendar that reliably attracts top scientists and young researchers each year.

Despite the challenges posed by an ever-changing world, the summit continues to go strong in its mission to excite, engage and enable the next generation of scientific talent.

GYSS IN NUMBERS

3,774

Registered participants
(from 2013–2022)

465

Academic partners
(from 2013–2022)

514

Number of registered participants in first virtual edition of GYSS in 2021

480

Number of additional viewers in first virtual edition of GYSS in 2021

88
SPEAKERS

Total number of eminent speakers that have participated in GYSS since 2013

52

Nobel Prize laureates

5

Turing Award recipients

12

Fields Medal recipients

3

IEEE Medal of Honor recipients

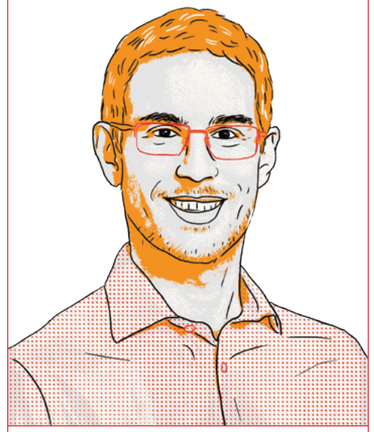
13

Millennium Technology Prize recipients

Youngest and oldest speaker

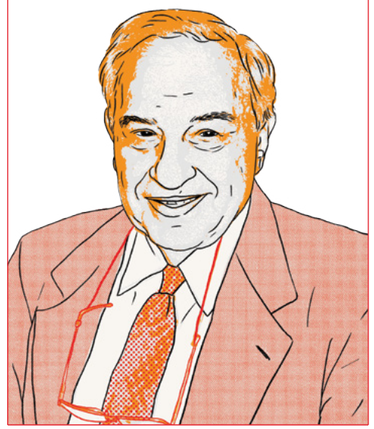
37 Age of youngest speaker at GYSS (2021)

PROF ALESSIO FIGALLI



92 Age of oldest speaker at GYSS (2015)

PROF RUDOLPH MARCUS



WHERE INGENUITY AND INSPIRATION INTERTWINE

The GYSS has staged prominent researchers who have left indelible marks in their respective fields. As GYSS celebrates its 10th anniversary, meet some of these speakers, and learn about their research and their hopes for the next generation of scientific leaders.

PROFESSOR SYDNEY BRENNER

Nobel Prize in Physiology or Medicine (2002)

Among his many prolific contributions to biomedical science, Professor Sydney Brenner discovered the messenger RNA (mRNA) and cracked the code of life, garnering the Albert Lasker Award in 1971. The South Africa-born biologist then won the Nobel Prize in Physiology or Medicine in 2002, alongside Professors John Sulston and Robert Horvitz.

For his pioneering discovery, Prof Brenner found that three DNA bases corresponded to one amino acid, the building blocks of proteins, and pinpointed mRNA as the missing link between genes and proteins. In the 1970s, the Nobel laureate then studied the genetics of the roundworm *Caenorhabditis elegans*. Prof Brenner deciphered how these molecular instructions regulate fundamental biological functions like cell death and organ formation, and crucially established *C. elegans* as a model system to better understand the life sciences.

Through his work with the Singapore government and R&D sector, he also helped catapult the city-state as a leading hub for scientific discovery, including advising the rise of the Institute of Molecular and Cell Biology (IMCB) at the Agency of Science, Technology and Research (A*STAR).

At the inaugural GYSS in 2013, Prof Brenner bared his vision for the future of regenerative medicine, just as stem cell technologies began to gain ground in the scientific world. By inducing these stem cells to specialise into any cell type in the lab, researchers could better understand human health and disease.

Prof Brenner passed away in April 2019, but his legacy continues to shine through the rapidly evolving field of molecular biology.

PROFESSOR THOMAS CECH

Nobel Prize in Chemistry (1989)

"The way that GYSS brings together young scientists from around the world is rather special."

Professor Thomas Cech's love for science began with a fascination with rocks and geology, which turned into a keen interest in physical chemistry, and finally culminated in a pivot to biological experimentation. Dedicated to understanding the chemical reactions essential to life, he uncovered how RNA molecules can act as enzymes—biological catalysts that speed up reactions. Accordingly, Prof Cech and Professor Sidney Altman were jointly awarded the Nobel Prize in Chemistry in 1989.

Before Prof Cech's radical discovery in 1982, scientists thought that such catalytic activity was exclusive to proteins. The prevailing dogma viewed RNA as passengers in the molecular information flow, serving as copies of genetic instructions that cells' machinery interpret to synthesise proteins. He unveiled RNA's ability to cut RNA strands and enzymatic functions to facilitate DNA replication, framing these molecules' importance to the origins of life.

As GYSS marks a decade of bringing eminent and budding scientists together, Prof Cech believes that a spirit of cooperation and mentorship will drive science forward, highlighting how collaboration played a significant role to address the COVID-19 pandemic. He also recounted his experience talking to several students from all over the world at previous GYSS editions.

"The way that GYSS brings together young scientists from around the world is rather special," Prof Cech said. "I was amazed last year (2021). The students had the same questions, the same concerns and the same desire to be able to contribute to the scientific process."

PROFESSOR AARON CIECHANOVER

Nobel Prize in Chemistry (2004)

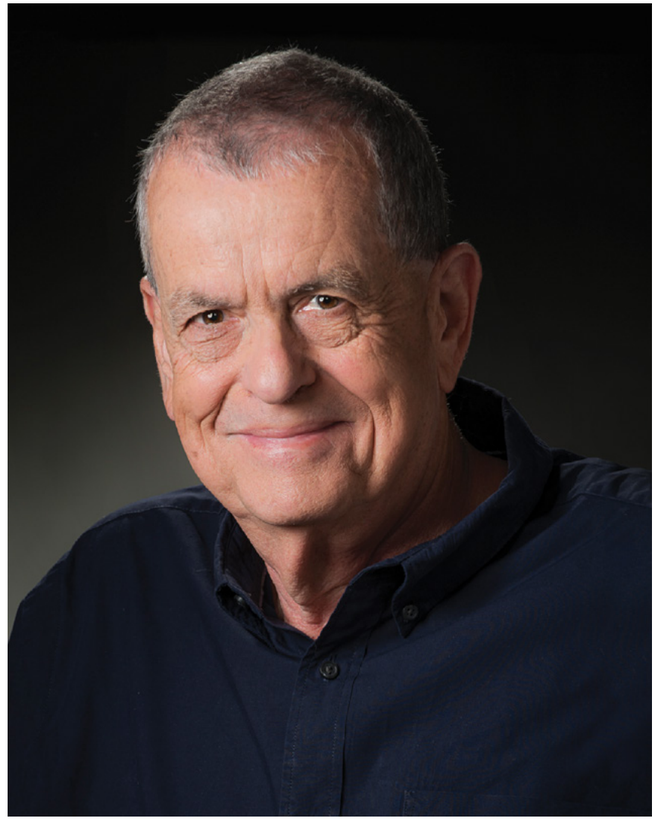
Professor Aaron Ciechanover was pursuing clinical training at the Technion-Israel Institute of Technology before his fascination with biochemistry led him to a research career. In collaboration with Professors Avram Hershko and Irwin Rose, Prof Ciechanover was awarded the Nobel Prize in Chemistry in 2004 for determining how a tiny molecule called ubiquitin regulates protein degradation.

Also called proteolysis, protein degradation is key to regulating numerous cellular functions, including cell division and intercellular communication. Prof Ciechanover and colleagues discovered that ubiquitin molecules attach to unneeded or damaged proteins, signaling complexes to break down the target proteins. Uncovering this mechanism also sparked drug discovery and development for diseases like cancer and neurodegenerative conditions.

Prof Ciechanover also served on the National Research Foundation's Scientific Advisory Board for three years, beginning in 2009 and even witnessed the birth of GYSS. Ahead of GYSS' 10th anniversary and his eighth appearance at the event, he highlighted that the platform is not limited to Nobel laureates, but is uniquely enriched by other major prize winners such as Turing Award recipients in Computer Science and Fields Medallists in Mathematics.

"It's an excellent idea to help young people realise achievements are not made by magicians," he shared. "I'm a human being. If I could do it, you can do it—not by getting the Nobel Prize, but by making a dent and leaving an achievement behind that is beneficial to society."

"I'm a human being. If I could do it, you can do it—not by getting the Nobel Prize, but by making a dent and leaving an achievement behind that is beneficial to society."



SIR ANTHONY LEGGETT

Nobel Prize in Physics (2003)

"GYSS has done an enormous service over the last 10 years by encouraging the best and brightest young people to pursue basic science."

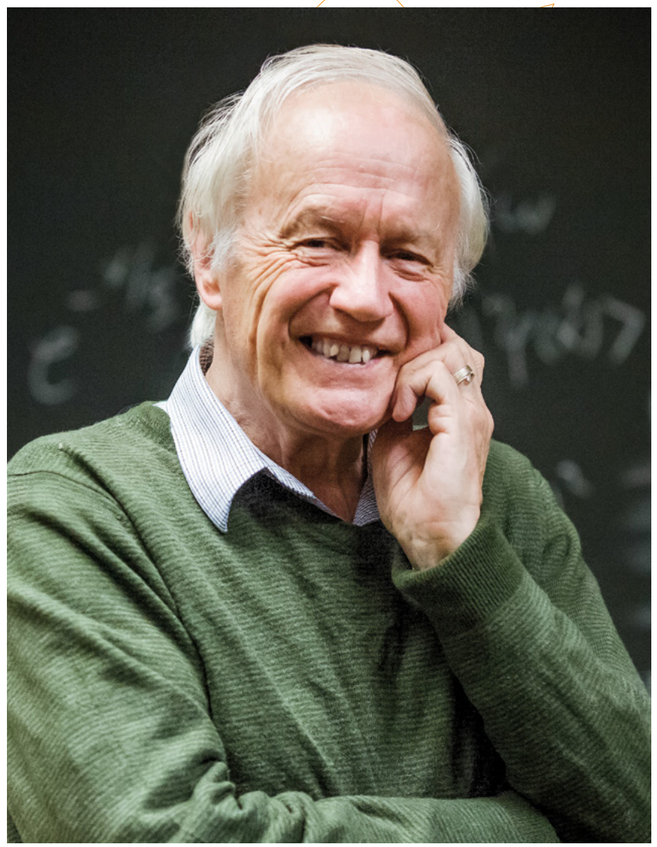


Photo by L. Brian Stauffer, courtesy of the Department of Physics, University of Illinois Urbana-Champaign.

As a Professor at the University of Illinois in the US, Sir Anthony Leggett built his expertise in low-temperature physics and quantum mechanics. Together with Professors Alexei Abrikosov and Vitaly Ginzburg, Sir Anthony was recognised with the Nobel Prize in Physics in 2003 for shaping the theoretical understanding of superfluid matter.

Sir Anthony's prize-winning work details the superfluidity of helium-3, describing how it flows without friction or viscosity at extremely cold temperatures. Similar to electricity passing through superconductive metals without resistance, superfluids move indefinitely over any obstruction and intriguingly run up the sides and flow right out of containers.

By digging into atomic interactions, Sir Anthony pieced together the quantum rules underlying helium-3's superfluidity. The helium atoms' identical half spins or orientations formed pairs of electrical charges to allow resistance-less flow. This fundamental insight has formed the basis for several applications, from cosmology to modern computers' superconductors.

For Sir Anthony, both basic and applied sciences are essential to addressing the pressing societal issues of our time. While attending multiple GYSS events, he has witnessed Singapore's steadfast dedication to fundamental and translational research and has shared his passion for theoretical physics with scientists from around the globe.

"GYSS has done an enormous service over the last 10 years by encouraging the best and brightest young people to pursue basic science, and I extend my very best wishes for its success in the future," he concluded.

PROFESSOR TAKAAKI KAJITA

Nobel Prize in Physics (2005)

As a graduate student at the University of Tokyo, Professor Takaaki Kajita spent much time on the Kamiokande-II experiment to detect chargeless particles called neutrinos, originally thought to have no mass. He then led the successor Super-Kamiokande project, providing astounding evidence that neutrinos had mass and later earning the 2005 Nobel Prize in Physics.

Neutrinos come in three types—electron, muon and tau neutrinos—so named for the kind of charged particle they specifically interact with. Based on extensive data from the Kamiokande experiments, Prof Kajita and colleagues found only two-thirds of the expected number of muon neutrinos, hypothesising that the missing particles may have changed to tau neutrinos. The team also recorded fewer muon neutrinos coming up through Earth than those coming down from the atmosphere.

But such events would have only been possible if neutrinos had mass. Prof Kajita's revolutionary discovery helped situate the particles' role as important building blocks in nature, born from astrophysical events like exploding stars and nuclear reactions.

In his unwavering quest to unlock the mysteries of the universe, Prof Kajita believes science will continue to decide the direction of society. Through meeting scientists and students at GYSS events, he has passionately highlighted the value of basic research into the origins of matter to better understand the cosmos and manipulate fundamental particles for applications like technology.

"Science is the key to our future and GYSS is playing a major role in encouraging the next generation of top scientists," Prof Kajita said.

"Science is the key to our future and GYSS is playing a major role in encouraging the next generation of top scientists."

PROFESSOR CÉDRIC VILLANI

Fields Medal (2010)

For Professor Cédric Villani, the lens of mathematics can reveal order and reason amidst uncertainty and counterintuitive phenomena. During his tenure as a Professor at the Ecole Normale Superiore in Lyon, France, he deduced the mathematics underlying a physics concept called entropy. For enriching both mathematics and physics, Prof Villani was awarded the Fields Medal in 2010. From his researcher roots, he has since pivoted to public service at the helm of the France artificial intelligence governance framework.

Entropy measures the amount of randomness in a system, tending to increase until the system reaches equilibrium or a state of balance—akin to moving from disorder to order. In 2009, Prof Villani and fellow French mathematician Professor Clément Mouhot finally formulated the mathematical proof for Soviet physicist and Nobel laureate Lev Landau's theory that plasma could reach equilibrium without increasing its entropy. The work also revealed unexpected connections between entropy and other areas of mathematics such as differential geometry and transport theory.

Prof Villani has actively participated in conferences and summits around the world, including at GYSS, sharing both mathematical knowledge and his experiences wrestling with equations leading up to his award-winning solution. Ahead of the GYSS' 10th edition, Prof Villani considers the summit as a platform for recognising the power of science and the challenges that lay ahead for the broader community to confront.

"In the wake of the pandemic, science has led to extraordinary achievements, including new vaccines," he said. "The challenge now is for science to redefine its practice to meet the social and ecological demands of our world."

> "The challenge now is for science to redefine its practice to meet the social and ecological demands of our world."

PROFESSOR ADA YONATH

Nobel Prize in Chemistry (2009)

> "I have always enjoyed attending GYSS, as a teacher and as a listener, and I wish that it continues for many more years."

Professor Ada Yonath nurtured her curiosity about science at an early age, dabbling in experiments while cleaning labs in high school. She went on to become a chemist at Israel's Weizmann Institute of Science, undertaking groundbreaking work to elucidate the structure and functions of ribosomes, the cell's protein-producing components. Prof Yonath was honored with the Nobel Prize in Chemistry in 2009—becoming the first woman to receive the award in 45 years—alongside Professors Venkatraman Ramakrishnan and Thomas Steitz.

Prof Yonath and colleagues discovered that ribosome crystals could not survive a process called X-irradiation, which resolves 3D crystal structures by measuring how the crystal scatters light waves, making studying ribosomes impossible in the laboratory. After 25,000 attempts, Prof Yonath's team finally saw their efforts bear fruit, successfully crystallising ribosomes via a novel technique called cryo-bio-crystallography that rapidly cools the crystals to encase them in a protective glass and reduce radiation damage.

Mapping the structure of ribosomes has proven instrumental in the development of life-saving antibiotics, which latch onto and disrupt bacterial ribosomes to effectively treat disease.

Beyond the lab, Prof Yonath encourages all youth to pursue their curiosities and passions, having supported all 10 GYSS editions since 2013. "Students and young scientists can learn a lot and broaden their knowledge through GYSS meetings," she expressed. "I have always enjoyed attending GYSS, as a teacher and as a listener, and I wish that it continues for many more years."

THE EVOLUTION CONTINUUM OF SCIENCE

Through the decade, GYSS has kept its fingers on the pulse of the global challenges facing humanity as it continues to gather the brightest scientific minds in Singapore to spark new ideas and inspirations for a better future.

Since its inception in 2013, GYSS participants have gathered annually to explore novel approaches to fixing some of the most pressing global issues of our time. The GYSS' core motif, *Advancing Science, Creating Technologies for a Better Tomorrow*, has brought scores of innovators from diverse domains together and created the space for lively, engaging discussions.

The last decade has seen several distinct themes emerge from GYSS presentations that span both local and global perspectives on opportunities for change. Unsurprisingly, these align with important focus areas for Singapore—human health and potential; urban solutions and sustainability; manufacturing, trade and connectivity; and smart nation and digital economy—as the country navigates an increasingly complex modern world.

Tracing the focal points of GYSS presentations over the years reveals an interesting trend. Earlier topics were more philosophical and aspirational, asking questions such as "What will the world be like in 50 years?" and "Why can't time run backwards?". More recently, speakers have been taking a deep dive into solutions for dilemmas we are facing today, journeying into the science of antibiotic-resistant bacteria, data storage shortages and the snowballing effects of climate change.

SUSTAINABILITY TAKES A LEAF OUT OF NATURE'S BOOK

The world has changed tremendously since the first GYSS, with the emergence of a new wave of uncertainties about the future. We are hurtling towards a world of nearly ten billion people by 2050, with the majority of these people residing in high-density urban areas[1,2]. According to experts, that is cause for concern—this growth is accompanied by steadily diminishing resources. Unsurprisingly, sustainability has been a central, long-standing theme at GYSS.

One of the key takeaways from the sessions is that to be truly sustainable, we have to first wean ourselves off our dependency on fossil fuels. Clean, renewable alternatives to coal and natural gas are urgently needed to slow the bulldozing impacts of climate change and meet our ever-growing resource needs.

Professor Michael Grätzel, Millennium Technology Prize winner and an active member of the GYSS community, described how he found inspiration for his work on renewable energy from a surprising source: plants. In his captivating series of lectures, *Energy Beyond Oil* (GYSS 2014–2018), Prof Grätzel described how the latest advances in solar energy technology leverage principles used in photosynthesis, or how plants use sunlight, water and carbon dioxide to make food.

↑ Professor Michael Grätzel, GYSS 2017

Solar energy has long been hailed as a viable solution to global sustainable energy woes. The promise of an emission-free energy source has seen many countries make a conscious shift towards solar. China, the world's largest producer of solar energy, has seen a sharp uptick in its solar power output capacities over the past decade.

However, solar energy is still far from perfect, holding back its widespread adoption. The infrastructure and processes required to harvest energy from the sun are too inefficient and too expensive. Photovoltaic converters, which are devices that convert optical radiation to electric energy, can be very costly. This often means that solar energy is not the first choice, especially in resource-limited settings.

Prof Grätzel has dedicated much of his research career to a singular cause: making solar energy more accessible and widely adopted through next-generation photovoltaic converters. Amongst his research achievements is developing third-generation photovoltaic converters that use low-cost dyes and pigments to extract energy, much like plants use chlorophyll.

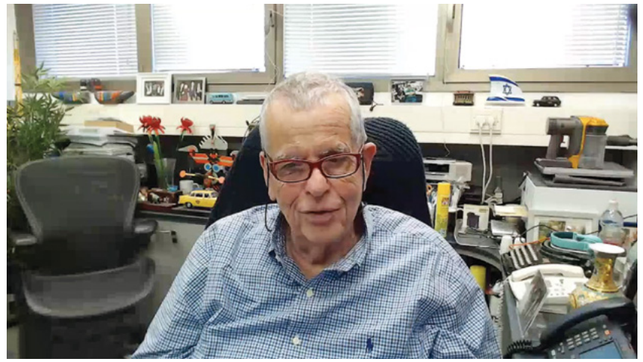
Through the years, Prof Grätzel has made remarkable progress in developing specialised perovskite photovoltaic cells. Since their discovery in 2009, the team has propelled perovskite photovoltaic cells forward as serious contenders against traditional solar cells. Prof Grätzel's perovskite cells now trump the efficiency of the current gold standard, polycrystalline silicon. Most commercially available silicon-based cells have an energy conversion efficiency of between 14 and 19 per cent, which pale compared to the perovskite cells' efficiency of 25.2 per cent.

Nonetheless, hurdles still stand in the way of perovskite photovoltaic cells' widespread use. Lingering manufacturing hurdles and concerns around the long-term stability of these solar energy components have yet to be addressed[3, 4]. But where there's a will, there's a way, noted Prof Grätzel optimistically, adding that progress can be fast-tracked to address pressing and formidable global sustainability issues.

Echoing these sentiments was Professor Hartmut Michel, 1988 winner of the Nobel Prize in Chemistry. In his GYSS 2018 lecture, *The Nonsense of Biofuels*, Prof Michel said that we need to take a closer look at what we have deemed to be sustainable. Biofuels, for example, are unlikely to live up to their promise as the answer to diverting our reliance on fossil fuels. This alternative energy source was born out of a desperate need: the volatile and staggeringly high oil prices, which began in the late 2010s[5]. This price spike ignited a concerted global effort to develop biofuels derived from plant or animal matter.

However, this led to a crossroad between prioritising crops for food or for fuel. Diverting agricultural output to be used as biofuel feedstock created a tug-of-war between food supplies and energy production[6], one that Prof Michel remarked has a clear winner. According to the Nobel laureate, using plant-based biomass as biofuels is exceptionally inefficient. Photosynthesis has a relatively low energy conversion rate, ultimately resulting in low energy yields.

While it is possible to hack nature to enhance photosynthesis—research for which Prof Michel won the Nobel Prize in Chemistry—he believes that advanced solar cell technology is the way to go. Prof Michel supports using photovoltaic cells, which he estimated are around 500 times more energy-efficient than biofuels burnt in combustion engines.



Professor Aaron Ciechanover, GYSS 2021

A MULTI-DIMENSIONAL VIEW OF PRECISION MEDICINE

Human health and potential has been another core area of interest at the GYSS. Numerous prominent Nobel Prize winners in Chemistry and Physiology or Medicine have taken to the stage, sharing insights on how recent research breakthroughs could transform how we enhance human health and wellness.

Of these developments is precision medicine, a new healthcare paradigm that offers a tailored, customised approach to patient care. The process of integrating technologies that enable precision medicine is a critical strategic area for Singapore. The 10 year National Precision Medicine (NPM) programme, launched in 2017 is now in phase two of its journey.

Precision medicine, also known as personalised medicine, promises safer, more effective and less costly clinical care, which translates to the easing of pressure on already over-burdened healthcare resources. However, experts say ethical considerations first need to be ironed out before we can fully enjoy all of precision medicine's benefits.

Professor Aaron Ciechanover won the Nobel Prize in Chemistry in 2004 for his extensive biochemical research characterising the cellular protein degradation and recycling pathway. At the GYSS, Prof Ciechanover tackled the hard-hitting questions on the bioethics behind precision medicine in *The Revolution of Personalised Medicine—Are we going to cure all diseases and at what price?*

Safer, more targeted therapies are the hallmark of personalised medicine, said Prof Ciechanover, adding that this is a departure from today's one-size-fits-all administration of therapies. However, this represents a massive systemic change, a shift that will undoubtedly face growing pains in the early years. Prof Ciechanover foresees the need to redesign several established systems such as R&D, public policies and education to make room for this new paradigm.

In addition, there are many grey zones surrounding the bioethics of personalised medicine. Once mapped, an individual's genetics and accompanying disease risk factors may elicit socio-economic ramifications if not properly safeguarded. One of the primary solutions to these pertinent issues is open, transparent communication between administrators, recipients and regulators of precision medicine, asserted Prof Ciechanover.

At GYSS 2021, Prof Ciechanover illustrated the importance of open lines of communication in the context of the COVID-19 pandemic, highlighting issues such as treatment inclusion or exclusion criteria, vaccine skepticism and objection as well as the plethora of fake news that made rounds on social media over the past year. Many of Prof Ciechanover's insights already have a real-world impact, with his ideas already being integrated in NPM's workstreams.

EXPANDING THE GENETIC TOOLKIT

The pandemic has also spurred the immense growth and proliferation of new health technologies. We now have two approved mRNA vaccines against COVID-19 on the market. However, the idea of mRNA vaccines that trigger immune responses is not exactly a new one. The concept has, at least theoretically, been around for some time with roots in earlier attempts to create vaccines against cancer.

Professor Harald zur Hausen, 2008 Nobel Prize winner in Physiology or Medicine, is among the group of scientists that spearheaded the notion of using vaccines to stimulate the immune system to combat cancer. Specifically, Prof zur Hausen is known for elucidating the role of human papilloma viruses (HPV) in the development of cervical cancer.

Strikingly, in *Potential Pathogenicity of Single-Stranded DNA in Cancer and Chronic Diseases* (GYSS 2015), Prof zur Hausen said that over a fifth of all cancer incidences are linked to infectious events. Viruses are to blame for around 64 per cent of the cancers triggered by infections.

His discoveries enabled subsequent work on developing a cervical cancer vaccine, which was approved in 2006. The commercialisation of this vaccine followed that of the hepatitis B virus (HBV) vaccine, a similar anticancer vaccine approved in 1981[7]. These milestones spurred the race to develop more anticancer vaccines. The approval of the Pfizer/BioNTech and Moderna COVID-19 mRNA vaccines, built on ideas from decades ago, has renewed hope that more cancer vaccines using mRNA technology could be a reality in the near future.

One of the hottest discoveries of the past decade is the emergence of CRISPR. This breakthrough gene editing technology allows scientists to tweak genomes with greater precision and efficiency than ever before. In 2021, GYSS had the honor of hosting Professor Jennifer Doudna, CRISPR pioneer and the 2020 Nobel Prize winner in Chemistry.

Since its discovery, CRISPR has given rise to a new wave of biotech companies empowered with new tools to fix long-standing problems in medicine, food security and many other industries. CRISPR has reinvigorated the field of gene therapy, affording a seemingly endless array of therapeutic possibilities. We may soon be able to reap CRISPR's benefits—some CRISPR-based therapies have entered clinical testing, with promising data further bolstering the innovation's utility to treat disease safely.

Also in 2021, gene editing was the theme of 1989 Chemistry Nobel laureate Professor Thomas Cech's GYSS lecture, *CRISPR Revolutionises Research*. Prof Cech, who won the Prize for his work on the catalytic properties of RNA, discussed how CRISPR had expanded the molecular biologist's toolbox. Scientists can now tag individual molecules and track them in living cells, providing never-before-seen glimpses into protein dynamics and function.

SHIFTING PERSPECTIVES ON GENETICALLY MODIFIED ORGANISMS

What if we had the key to solving looming food security threats at our fingertips? According to genetically modified organisms (GMO) expert Professor Richard Roberts, 1993 winner of the Nobel Prize in Physiology or Medicine, we do. However, Prof Roberts said in his GYSS 2016 lecture, *A Crime against Humanity*, misinformation and misplaced fear has left a dark mark on the future of GMO foods.

Prof Roberts, famed for his discovery of gene splicing mechanisms, is a strong proponent for GMO adoption. He described how global anti-GMO sentiments sprouted from European Green parties and their political allies, who feared that agribusiness giants offering GMO crops such as Monsanto would dominate food supply chains. Unfortunately, due to the unyielding smear campaign against GMOs, the world has lost one of the most promising technologies for solving the food crisis faced by under-resourced nations, said Prof Roberts.

Professor Harald zur Hausen, GYSS 2015

Take the example of Golden Rice, a GMO crop originally developed to address vitamin A deficiencies that still cripple many communities worldwide. In the Philippines, Golden Rice became a political target, resulting in the destruction of agricultural test sites for the crop by anti-GMO activists. We need to put GMOs back in the good books, said Prof Roberts. These genetically engineered crops have the potential to address malnutrition and maximise food production to meet increasing global food demands as arable land and other resources become increasingly scarce. In addition, Prof Roberts, along with other Nobel laureates, penned the *Laureates Letter Supporting Precision Agriculture (GMO)* in 2016, addressing leaders of Greenpeace, the United Nations and global governments in full support of the adoption of GMOs.

GAINING NEW GROUND IN ARTIFICAL INTELLIGENCE

The past decade has seen rapid innovation and growth in the computing and digital space especially in areas such as artificial intelligence (AI), cybersecurity, quantum technologies and communications. The COVID-19 pandemic has caused the demand for digital services to skyrocket, driving the need for more robust IT and computing solutions. Accordingly, GYSS has provided a platform for digital innovators to share their ideas on advancing the capabilities of our digital economy.

AI and machine learning have become buzzwords of late. Most of the digital solutions that we use in our daily lives are powered by supercomputing—from algorithms that recommend what movies to stream, to service chatbots deployed to ease the workloads of human operators. However, AI's reach is slowly stretching far beyond these realms. Companies have begun leaning on machines to help maximise resources, keep complex systems running smoothly and even revolutionise transport.

Once the stuff of science fiction, the idea of self-driving cars is slowly being realised thanks to giant leaps forward in AI—albeit slowly.

↓ Professor John Hopcroft, GYSS 2020

↑ GYSS 2016

For Professor Joseph Sifakis, 2007 Turing Award winner, cruising around in cars and buses that drive themselves is easier said than done. He highlighted some of these obstacles in his GYSS 2021 address: *Why is it so hard to make self-driving cars? (Trustworthy autonomous systems).*

Prof Sifakis explained that there are two distinct classes of AI: one that can navigate computing systems independently and another significantly more sophisticated technology designed to replace human operators in unpredictable, dynamic environments. The latter is at the heart of a self-driving car, which would need to manage many different, potentially conflicting goals and initiate actions accordingly. In addition, the systems must also be able to respond to cues from human operators as needed. Given this tough ask, Prof Sifakis said that developing these platforms require all-new scientific and engineering foundations outside the scope of what current AI can manage.

Better AI is just one side of the coin. Machine learning platforms also need a revamp, said Italian mathematician and Fields Medallist Professor Alessio Figalli in *Optimal Transport: From Nature to Machine Learning* (GYSS 2021). Prof Figalli's work focuses on the bleeding edge of machine learning applications, drawing inspiration from nature to lay the foundations of future cities. In GYSS 2020, Professor John Hopcroft, who won the Turing Award in 1986, provided an overview of the machine learning landscape in *An Introduction to AI and Deep Learning*, calling on the young scientists in attendance to get curious about the fundamentals of big data analytics and supercomputing.

Likewise, Professor Leslie Valiant highlighted the growing prominence of these technologies in the GYSS 2020 lecture, *How to Increase the Reach of Machine Learning*. Prof Valiant put forward that it would be possible to build upon current successes in machine learning to solve more ambitious AI goals. To do that, we need to tack on additional components to existing machine learning frameworks, unify learning and reasoning into a single framework as well as create tests to validate new platform iterations.

SAFELY NAVIGATING THE ONLINE UNIVERSE

Safeguarding information online is paramount to consumers and organisations; without solid cybersecurity infrastructure, the internet would be the wild, wild West. As more global systems move online, building more robust cybersecurity safety nets has become an urgent priority.

In GYSS 2015, Turing Award winner Professor Shafi Goldwasser shared *The Cryptographic Lens*, a peek into how secure information transfer and communication forms the cornerstone of cybersecurity. Prof Goldwasser highlighted some of the vulnerabilities of online data transfer and how cryptography advances would support a new era in global computation. A year later, fellow Turing Award winner Professor Andrew Yao shared how blending mathematics, physics and computer science is pivotal to the further development of cryptography in *The Magic of Modern Cryptography* (GYSS 2016).

In 2019, blockchain exploded onto the scene. Professor Silvio Micali, Turing Award recipient, discussed thorns in current blockchain technologies or digital ledgers of transactions distributed on vast computer networks. In his GYSS 2019 opening plenary, *Distributed Ledgers and Blockchain*, Prof Micali said most existing blockchains could only fulfill two out the three ideal properties of an optimal system: security, scalability, and decentralisation. His team has created a potential solution that utilises a Verifiable Random Function (VRF) to solve some of the persistent blockchain bottlenecks.

Besides security, there has been growing concern about the management of online digital data. Professor Butler Lampson, the 1992 Turing Award recipient, took a closer look at this issue in his GYSS 2017 presentation, *Personal Control of Digital Data*. The public, he said, has an understandable concern: that their personal online data can easily be tapped into and collected. Moreover, many would perceive data protection as a fundamental human right. Prof Lampson noted that while regulators are slowly starting to respond to the public's concern, there is no one perfect solution. It would be impossible to establish a single regulatory framework given the diversity of legislation, government policies and cultural norms across the globe. Consequently, the regulation of data privacy is likely to remain an ongoing debate in the foreseeable future.

Professor Jennifer Doudna and Professor Thomas Cech at a virtual panel discussion, GYSS 2021 →

SOWING THE SEEDS OF FUTURE INNOVATION

GYSS provides a platform to drive and inspire the next generation of scientists while simultaneously providing a forum to deliberate some of the greatest obstacles facing the modern world and how we can leverage science and technology to tackle them. GYSS has kept its finger on the pulse of current issues throughout its ten-year history, bringing together eminent researchers to share their insights and research progress. The future lies in the hands of the eager young innovators in the GYSS audience, who are likely to face even more significant challenges in time. The GYSS is a unique think tank with expert mentors at the helm, sowing the seeds of future innovation towards a greener, healthier and more efficient tomorrow.

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THE 10TH ANNIVERSARY

The annual Global Young Scientists Summit marked 10 years of attracting top scientific minds and nurturing young researchers.

Call it a special meeting of the minds. In January this year, young researchers and top scientists from around the world gathered online for the Global Young Scientists Summit (GYSS) 2022, and became part of history: the Summit's 10th anniversary of bringing together aspiring researchers and luminaries across the fields of science, technology and engineering.

Over the past decade, nearly 4,000 scientists and researchers from over 40 countries have attended the Summit. Many bright-eyed participants who were at the start of their careers have become trailblazers in their fields, doing their part to create a better future for the world.

Mr Heng Swee Keat, Deputy Prime Minister and Coordinating Minister for Economic Policies, who kicked off the GYSS 2022, said that the event is more important than ever. He noted: "As the world around us becomes more interconnected, interdependent and uncertain, the solutions to our challenges will also increasingly be more interdisciplinary, inter-institutional and cross-border."

"The GYSS is an important initiative to foster global partnership."

Dr Tony Tan and Deputy Prime Minister of Singapore and Chairman of NRF, Heng Sweet Keat, GYSS 2022

Prof Ada Yonath, Prof Aaron Ciechanover, Prof Benjamin List and Prof Cédric Villani, GYSS 2022

A LANDMARK IN THE MAKING

With a decade of the GYSS to celebrate, the National Research Foundation, Singapore (NRF), which organises the annual event, marked the occasion by launching this commemorative publication titled "Where Great Minds Meet: 10 Years of the Global Young Scientists Summit."

Some of the Summit's 88 distinguished speakers and the young researchers who attended the Summit shared their experiences of being part of its growth.

Dr Andy Tay, Presidential Young Professor (Assistant Professor) at the National University of Singapore's Department of Biomedical Engineering, recalled how Nobel Laureates who gave talks at the GYSS 2016 spoke about rejections in their careers, and how they persevered to achieve their breakthroughs.

"Whenever I meet with challenges in my experiments or manuscript or grant submissions, I remind myself of their stories, and motivate myself to continue working on impactful research projects," he said.

As part of the celebrations, an anniversary dinner was held on the Summit's first day too. At the event, DPM Heng presented former President of Singapore, Dr Tony Tan, who conceived of the GYSS and is its patron, with the commemorative publication.

Dr Tan said: "I am heartened by the progress that GYSS has made in exciting public interest in science since its inaugural edition. When it started in 2013, it had 260 participants. This year, we had over 1,600 people register for the Summit."

LIGHTING-UP THE STAGE AT GYSS 2022

Those who joined the GYSS 2022 were treated to five days of plenary lectures, panel discussions and more. These featured a constellation of scientific superstars as speakers. The 21 speakers ran the gamut from Nobel Laureates and Fields Medallists to Millennium Technology Prize, Turing Award and IEEE Medal of Honour recipients.

Four were taking the GYSS stage for the first time. Prof Benjamin List won the Nobel Prize in Chemistry in 2021 for developing asymmetric organocatalysis, while Prof Stefan Hell received the Nobel Prize in Chemistry in 2014 for pioneering a super-resolved fluorescent microscopy technique.

The other two were Prof Barry Marshall, recipient of the Nobel Prize in Physiology or Medicine in 2005 for discovering the *Helicobacter pylori* bacterium and its role in gastritis and peptic ulcer disease; and engineer Prof B. Jayant Baliga, who was awarded the IEEE Medal of Honour in 2014 for creating the energy-saving and now ubiquitous 'insulated-gated bipolar transistor' (IGBT), which is reducing our global carbon footprint.

Some of the speakers this year are regular supporters of the event. One of them was Prof Ciechanover, who explained: "Science education is very important for people and countries. The GYSS is an excellent tool to disseminate this spirit of education, attract young people to science and increase the spread of knowledge in society."

With the Summit held online this year due to the COVID-19 pandemic, the speakers delivered 20 plenary lectures and six panel discussions that were broadcast live on YouTube. They also took part in virtual networking sessions with young researchers.

Prof Baliga, whose lecture recounted how he developed the IGBT, noted: "A single technology can have a huge impact on humanity, improve the quality of life and play a part in saving the environment. With the GYSS, I think young people will be inspired to do great things and make big contributions."

The panel discussions not only spanned a wide range of topics but had their eye on the future. The lively conversations explored the possibilities of next-generation power grids, the ethics and governance of artificial intelligence (AI), start-up opportunities for young scientists, and how to prepare for the next pandemic.

Prof Lim Tit Meng, Dr Li Jingmei, Prof Stuart Parkin, Prof Yvonne Gao and Prof Ho Teck Hua, GYSS 2022

Co-Chair of the GYSS Organising Committee and Senior Advisor to NRF, Prof Bertil Andersson and Senior Minister of Singapore and Former Chairman of NRF, Teo Chee Hean, GYSS 2022

YOUTH TAKING CHARGE

To increase the opportunity for (online) interaction, 19 young scientists stepped up to present their research and work to their peers too, through virtual presentation sessions. Their varied and inventive projects included an innovation to generate electricity by harvesting fog, an analysis of how sleep disturbances affect adolescents' psychopathology, and a method to use AI to identify potential cases of renal cell carcinoma.

The returning GYSS Video Challenge also sparked an outpouring of creativity. Three young researchers won awards for their most engaging videos. Mr Riccardo Rizzo from ETH Zürich secured the Panel's Choice Award for his video that shed light on his research in 3D bio-printing.

The two People's Choice Awards went to Ms Rebecca Chakram from the University of London for her video that captured her work to improve the vision of children with special needs; and Ms Noora Almarri from University College London for her video that covered her research on battery-less implantable medical devices.

At the end of the five days, Prof Bertil Andersson, Co-Chair of the GYSS Organising Committee and Senior Advisor to NRF, closed the GYSS 2022, thanking all the speakers who shared their insights at the Summit. He added: "Science is not only the cornerstone of great advances of the past. It is even more important today to solve global challenges and meet societal needs."

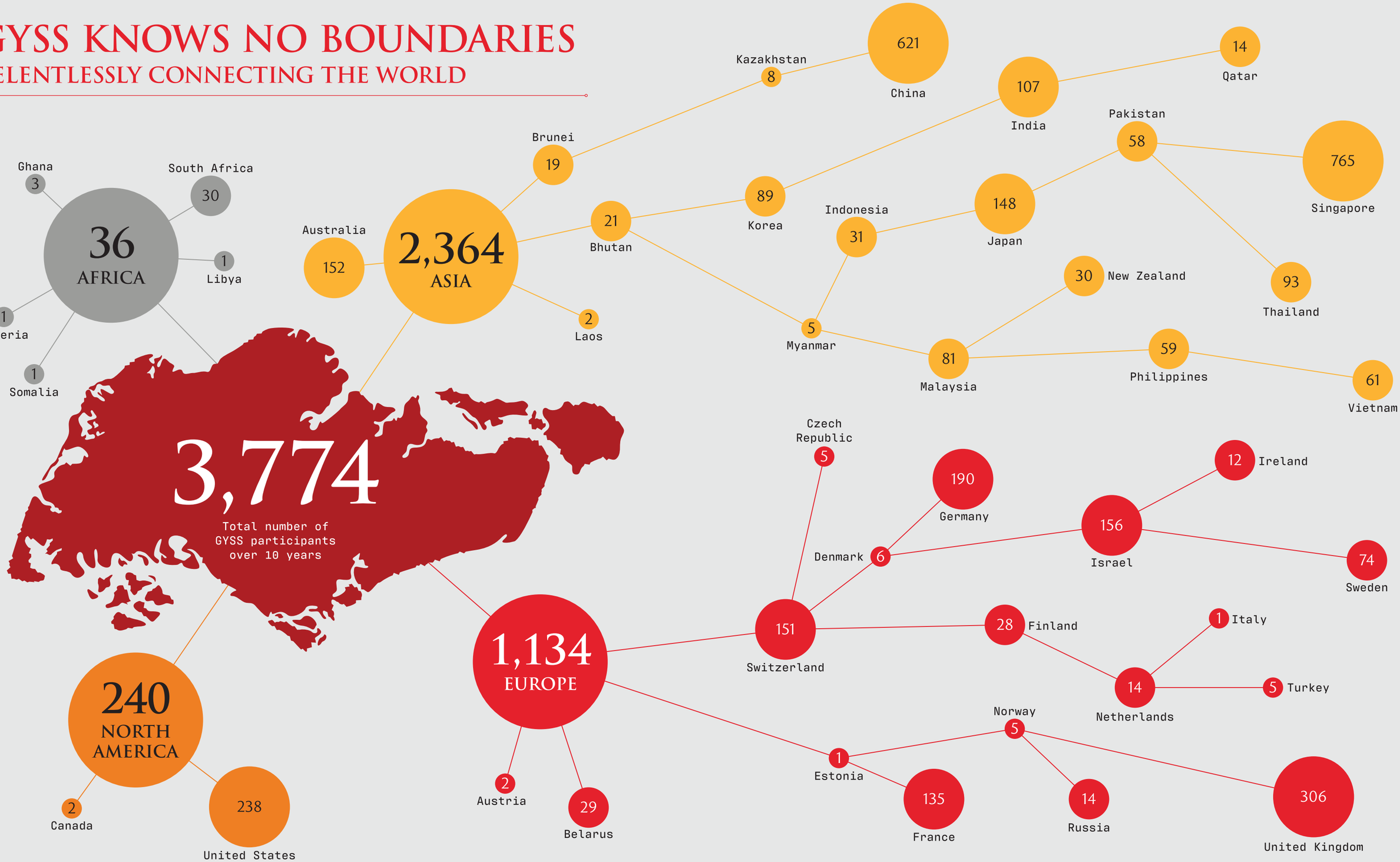
Prof Low Teck Seng, NRF Chief Executive Officer and Co-Chair of the GYSS Organising Committee reminisced in his own closing remarks: "We started the Summit a decade ago with the belief that interactions among promising young scientists and illustrious scientists will provide fresh perspective and collaboration opportunities that are key to scientific progress."

With this belief borne out over the past 10 years, he concluded: "The Global Young Scientists Summit will remain committed to exciting, engaging and enabling the next generation of scientific leaders."

Mr Chen Siteng, Dr Michele Nyugen, Mr Andrea Luppi and Ms Anne-Marlene Ruëde, GYSS 2022

GYSS KNOWS NO BOUNDARIES

RELENTLESSLY CONNECTING THE WORLD



THE JOURNEY TO SCIENTIFIC EXCELLENCE

Ten young researchers reflect on their experiences as participants of the GYSS—a platform rich in learning, mentorship and opportunities.

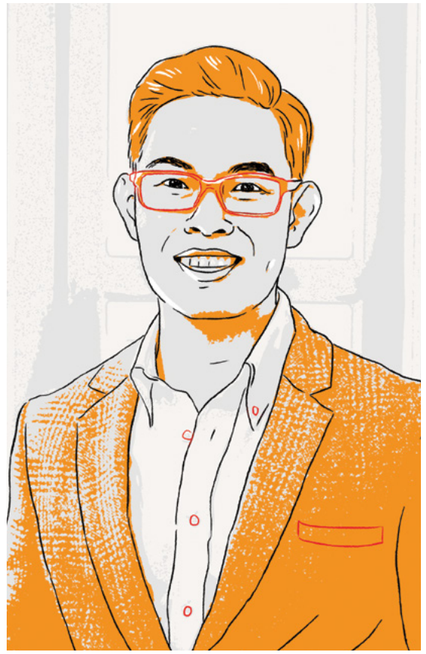
Ironically, the secret to Singapore's success is really no secret at all. With a heavy emphasis on education, the 'little red dot' nurtures local talent and works to provide tomorrow's changemakers with every opportunity to grow.

Sharing this vision with the world, the Global Young Scientists Summit (GYSS) gathers bright young scientists and the best veteran researchers from across the globe to share ideas and discuss how research can address major global challenges. Launched in 2013 and organised by the National Research Foundation, GYSS provides a platform for big conversations on even bigger topics spanning science, research, technology, innovation and society.

From ecological engineers and educators to PhD candidates and Nobel laureates, the summit has seen the world's best and brightest minds participating in lectures, plenary sessions and panel discussions. We spoke to 10 GYSS participants to find out how the conference broadened their perspectives and impacted their careers.

ANDY TAY KAH PING

Assistant Professor, Department of Biomedical Engineering
Presidential Young Professor
National University of Singapore



In his excitement to attend his first international conference as a first-year PhD candidate, Assistant Professor Andy Tay arrived at the GYSS venue the night before to ensure he would not be late the next day. Now a Presidential Young Professor and Assistant Professor at the National University of Singapore, his knack for being prepared pays off as he works to engineer materials and technologies that combat cancer. He develops methods that can identify more specific cancer marker proteins in solid tumours, improve cell manufacturing and modulate tumour microenvironments.

"Participants can expect to learn about the latest advances in different disciplines and be inspired by the career trajectories of top scientists."

How have GYSS' mentorship opportunities impacted your career?

GYSS is not a technical conference so participants should not go in wanting to learn deeply about a specific field. Rather, they can expect to learn about the latest advances in different disciplines and be inspired by the career trajectories of top scientists.

During GYSS, the Nobel laureates shared their stories of rejection and how they persevered and eventually got to where they are now. These stories were meaningful because I think all scientists who wish to continue in this industry need to learn to cope with failure. Whenever I face challenges such as those in manuscript and grant submissions or experimental difficulties, I remind myself of these stories and it motivates me to continue working on impactful research projects.

What can be done to facilitate mentorships for aspiring scientists from less privileged backgrounds?

As a child from a low-income family, I never had a role model who was a scientist and never knew what a scientist was until I had my first research attachment. If I could change something, I would introduce a structured national programme for students from less privileged backgrounds to train them in basic scientific literacy and give them an opportunity to spend time in labs.

The goal is for them to interact with research students and staff, receive informal mentorship and experience what life is like as a scientist. This can hopefully boost interest and retention among STEM students in Singapore.

Why it is important to build a pipeline of local research talent?

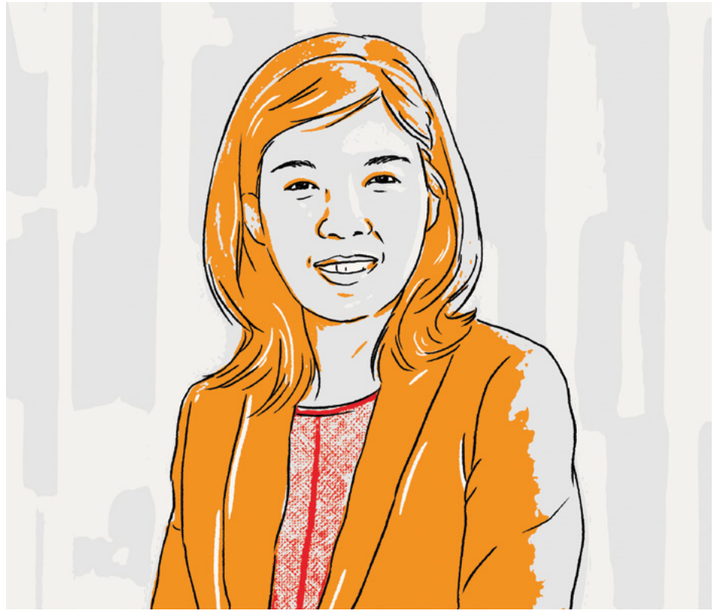
Singapore faces unique challenges and it's important to nurture local talent that understands the nation and can come up with the best solutions to solve its problems.

For example, I know a colleague from overseas who applied to Singapore as faculty, and despite having been published in a leading journal, he was unsuccessful. This was probably because his research is focused on a rare disease that affects just one in a million people, which is not considered pragmatic by funders in Singapore.

Singapore is a small country and unlike large countries like the US and China, we need to invest in strategic areas of science like food security, climate resilience, digital health and advanced manufacturing. We therefore need talented local researchers who can identify the country's needs and are committed to championing innovation in Singapore.

LYNETTE CHEAH

Associate Professor, Engineering Systems and Design
Singapore University of Technology and Design
Associate Editor, Journal of Industrial Ecology



Eight years ago, Associate Professor Lynette Cheah attended GYSS as a postdoctoral research associate at the Massachusetts Institute of Technology (MIT). In the early years of her career, the Summit allowed her the opportunity to network with research peers, potential sponsors and eminent scientists. As she grew as a scientist, her work shifted from developing cleaner vehicles like lightweight cars and alternative powertrains to improving mobility across the board by studying how vehicles are used as a part of transport systems.

Can you share about your experience winning the first Singapore Challenge at GYSS 2013?

I participated in the Singapore Challenge with my former lab mates from MIT. We were elated to win the prize! It was a great honour to personally receive the award from the President of Singapore.

The winning proposal was about adaptive and demand-responsive urban mobility systems. Back then, the proposal gained quite a bit of interest, and opened doors to other research grants and collaboration opportunities.

What is the main transport challenge you are addressing with your research and how?

My focus has been on developing low-impact, sustainable transport systems in cities. Lately, I've been studying urban freight transport and how to move goods more efficiently. With the rise in e-commerce, there has been a growing need to address the impact of home deliveries. My research team models and simulates different urban freight solutions like consolidation schemes and the use of low-emission vehicles.

What is the significance of young scientists to the Singaporean research landscape?

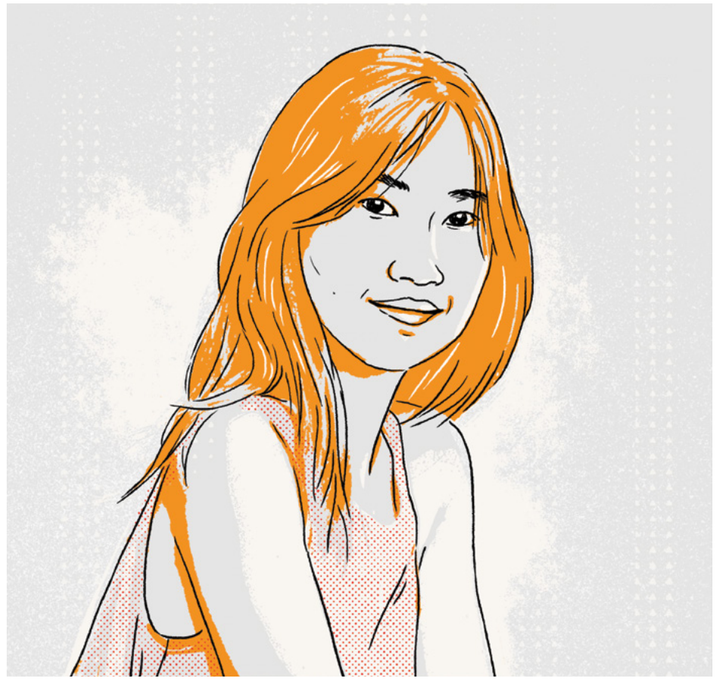
We need scientific talent, both young and old, to bring ideas and energy into their domains of expertise. There are many challenges that need technical and social skills as well as knowledge. With open minds and the right motivations, scientists can work alongside stakeholders like policy makers and corporations to do meaningful and impactful work.

"We need scientific talent, both young and old, to bring ideas and energy into their domains of expertise."

LI JINGMEI

Group Leader and NRF Fellow, Women's Health and Genetics
Genome Institute of Singapore (GIS)
Agency for Science, Technology and Research (A*STAR)

"There are over a thousand reasons every year that remind me my work is important."



For Dr Li Jingmei, GYSS was a community of curious minds that nurtured her attraction to outrageous ideas. As she listened to her scientific heroes discuss ideas that seemed straight out of science fiction, she was inspired to continue on her research journey with new vigour. Combining genetic and non-genetic factors, Dr Li and her team aim to transform breast cancer risk management and communicate their findings effectively with the public.

What made you decide to focus on breast cancer research?

A shining example of a role model in breast cancer research is Professor Per Hall at the Karolinska Institutet, Stockholm, Sweden. He was my PhD supervisor. I didn't choose breast cancer as a research focus, I chose him. He used to be a radiation oncologist with decades of clinical brilliance. However, he pursued epidemiology.

He decided to study ways of reducing the number of new breast cancer cases diagnosed every year. When asked why he gave up medicine for research, his reply was simple. "When I was a doctor, I helped one patient at a time. I want to help more patients and breast cancer research makes it possible," he said.

Prof Hall inspired me and crystalised my calling for breast cancer research. He is ambitious, persistent and respected, yet approachable and fun at the same time.

What can be done to inspire the next generation of scientists?

Science must be seen and heard! The GYSS is a great example of how science and passion can be shared. I especially like how the audience mix transcends cultures, nations, expertise and seniority. Over the three days, it takes just one moment, one conversation or one talk that resonates with a young scientist to spark a fire that lights the way for the rest of their career.

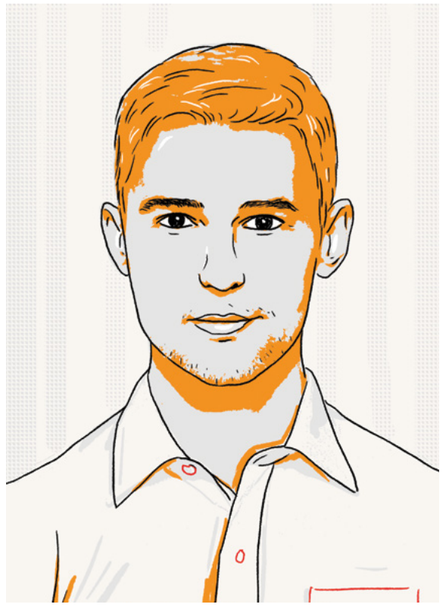
What keeps you inspired in your research today?

There are over a thousand reasons every year that remind me my work is important. Two thousand new breast cancer patients are diagnosed each year in Singapore. Every patient is a reason for me to carry on.

TOMASZ TRZCINSKI

Associate Professor
The Faculty of Electronics and Information Technology
Warsaw University of Technology

"My best memories of GYSS are linked to the incredible people I met during the event."



At the Warsaw University of Technology, Associate Professor Tomasz Trzcinski leads a group of researchers at the Computer Vision Lab. At a multitude of software development companies like Tooploox, comixify.ai and MicroscopeIT, Assoc Prof Trzcinski wears a slightly different hat as an entrepreneur, angel investor, partner as well as chief scientist. Interested in all aspects of his field, Assoc Prof Trzcinski was inspired by the industry leaders and scientists he met at GYSS who allowed him to see the value of computer science within a broader scope of scientific disciplines and industry applications.

What do you remember most from your time at GYSS?

My best memories of GYSS are linked to the incredible people I met during the event—my fellow young researchers as well as distinguished lecturers. I remember very well the talks given by Nobel Prize laureates, such as Professor Aaron Ciechanover, the informal gatherings with fellow young researchers and the exciting trips around stunning Singapore.

The most memorable moment was the dinner with Professor Cédric Villani and other GYSS attendants in one of Singapore's skyscrapers. Not only were we impressed by the city skyline, but also by the incredible insights into the world of science, humanity and politics shared by Prof Villani.

How does machine learning assist the software you have developed?

Machine learning models are now ubiquitous across fields and applications. One of the main projects I am working on right now is set to increase the efficiency of modelling high-energy physics interactions at the European Council of Nuclear Research (CERN).

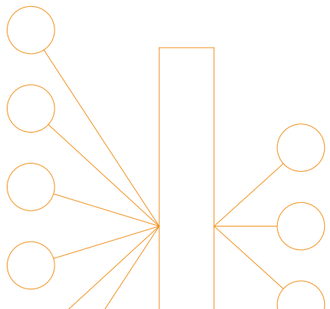
This project leverages novel generative machine learning models to increase the speed at which we simulate interactions between heavy particles. As a result, we can get much faster results from physical experiments, and in the meantime save on computing costs, ultimately reducing the carbon footprint of CERN's scientific experiments.

Another area of my research where machine learning becomes indispensable is medical data processing. We launched a joint project with researchers from New York University (NYU) on training artificial neural networks to share information between multiple medical facilities. Since each facility collects different data samples and sharing the data is impossible due to privacy concerns, we developed a continual learning model that combines the general model with facility-specific data samples.

How important is collaboration to the research you do?

I am involved in multiple collaborations worldwide, including those with CERN, NYU and several industrial partners like Microsoft Research which funded fellowships for my students. For me, these international collaborations are instrumental in advancing science. We learn how to communicate ideas across languages and cultures, while benefitting from the different viewpoints and scientific experiences of all participants.

Nowadays, no scientific discovery is made in isolation—we live in a connected world where scientific collaborations thrive and extend the impact of our work. I believe that collaborations are the cornerstones of contemporary science and that those that do not acknowledge this now will soon lag behind mainstream computer science.



DINA TSYBULSKY

Assistant Professor
Head of the Biology Education research group
Faculty of Education in Science and Technology
Technion Israel Institute of Technology

"GYSS is an opportunity to look at innovative trends in science education."

As science education changes in the digital age, educators like Assistant Professor Dina Tsybulsky must likewise adjust with new teaching and assessment methods. For such a shift to take place on a global scale, Asst Prof Tsybulsky believes that events like GYSS can serve as a platform to exchange breakthrough ideas and discussions that can later be implemented to improve communication and raise the authority of scientific research in society.

What role do events like GYSS play in science education?

GYSS is an opportunity to look at innovative trends in science education. Young scientists are encouraged to share their research programmes and can benefit from highly professional feedback from experts in their fields. Such events can also inspire participants personally, especially female researchers who face various obstacles and challenges in pursuing their careers as scientists. Scientific forums like GYSS provide an opportunity to foster the participants' understanding of the socio-cultural aspects of scientific endeavours.

How has education adapted to the COVID-19 pandemic?

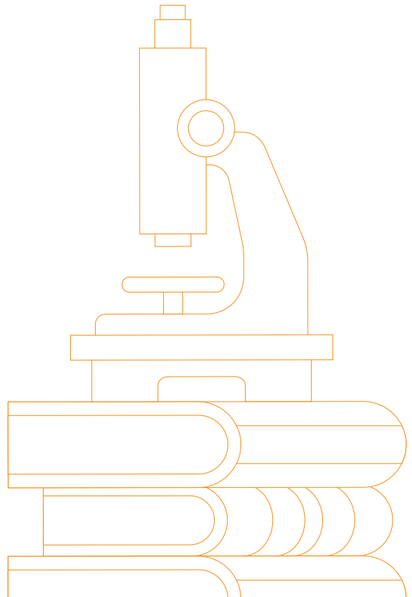
The consequences of the COVID-19 pandemic remain to be assessed, but it is already clear that studies must focus on changing the attitudes of students, teachers and parents rather than on technological or economic phenomena.

What sparked your passion to become a science educator?

At the beginning of my career as a science educator, I was enchanted by the opportunity to share my passion for scientific inquiry with my students. I could see that my constant search for the most beneficial teaching approaches and their successful implementation positively and profoundly affected my students' vision of science and themselves.

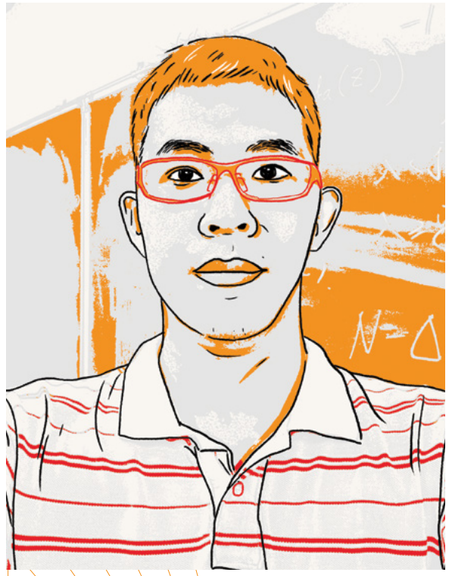
How would you like to inspire the next generation of scientists?

I believe emerging research paradigms are going to enrich the field of scientific research and raise the prestige of scientific researchers in society.



FU-TSUN WEI

Professor
Department of Mathematics
National Tsing Hua University



As he taught and supervised graduate students at National Tsing Hua University, Professor Fu-Tsun Wei found that discussing material with his students helped him review theories he learned in the past and apply them to his work with number theory. Specifically, Prof Wei studies the arithmetic of the Eisenstein series in positive characteristic. Despite facing roadblocks in a field with a reputation for being extremely challenging, Prof Wei finds inspiration in the perseverance and passion of fellow researchers and well-known scientists he meets at conferences like GYSS.

What was your most memorable GYSS experience?

GYSS in 2015 was the first event that gave me the chance to meet so many people from various fields and listen to so many wonderful talks by the world's top experts.

There are two specific memories that inspired me. The first was advice given by 2010 Fields Medallist Professor Ngô Bảo Châu during the small group session. "What we do is to invent languages to explain or describe the things we discovered," he said.

Using the right language is very important. Sometimes difficult problems are solved naturally when you find the right language. This philosophy changed the way I thought about mathematics and helped me see the bigger picture when it comes to mathematical problems and theories in my research.

The second significant memory is a question I asked during a discussion section, and the responses I received from Professor Shafi Goldwasser, 2012 Turing Award winner, and the other Nobel Prize winners. I asked about finding a balance between our own research and communicating with colleagues from other research areas. The speakers had a wealth of experience in collaborating with researchers from different fields and encouraged us to stay focused on our own interests. Pure science is always at the heart of their research work and becoming an expert in our chosen fields is the first thing they suggested. Their comments inspired me to keep concentrating on my unpopular research problem at the time, and I eventually made progress.

How does meeting and interacting with other researchers at events like GYSS help in your research?

Although my research is an uncommon topic in pure mathematics, communication with other researchers at events like GYSS still helps me implicitly in my research. It gives me the chance to know how other people see the world, and what people think about mathematics.

How would you inspire the next generation to pursue research in mathematics?

When I was a PhD student, my advisor told me that mathematics is an art. Some people say that the development of pure mathematics is disconnected from the real world, however, we are actually doing the same thing—exploring where we are by explaining the rules we discovered. I would tell the next generation not to be afraid. Keep your mind open and be passionate when pursuing what fascinates you in mathematics.

"Keep your mind open and be passionate when pursuing what fascinates you in mathematics."

ALIREZA JAVADIAN

Co-founder and CEO
Widuz
Head of Research
Faculty of Architecture, Sustainable Construction
Kalrsruhe Institute of Technology (KIT)

"The way trees grow or how leaves repel water can teach us how to design with creativity and practicality in mind."

At Singapore-based startup Widuz, Co-founder and CEO Dr Alireza Javadian and his team develop engineered bamboo composite materials strong enough for construction and five times more renewable than traditional materials like timber. The company is a result of his PhD research in Singapore and Zurich—research that he eagerly discussed, shared and received feedback for while attending GYSS. In fact, Dr Javadian kept in touch and continues to collaborate with several researchers he met from various countries at GYSS.

Why are sustainable materials important for future cities?

For 200 years, we have enjoyed an industrial era built on a fossil-based, linear economy. This industrial era has delivered economic and demographic growth as well as social and technological progress. However, economic acceleration has resulted in an increasing rate of environmental degradation. In fact, emissions from the production of materials as a share of global greenhouse gases (GHG) increased from 15 per cent in 1995 to nearly 23 percent in 2015.

While more than 40 percent of emissions from material production and use are associated with the construction industry, the sector lags behind other industries in tackling its share of GHG emissions.

As industries become more aware of the impact of fossil-fuel based synthetic materials on our environment, the demand for sustainable materials will increase. The Paris Agreement's target of limiting global warming to below 2°C and possibly to just 1.5°C above pre-industrial levels, requires us to substantially reduce GHG emissions globally.

What inspires your search for sustainable materials?

I believe we can learn many things from nature. The way trees grow or how leaves repel water can teach us how to design with creativity and practicality in mind. I like to spend an hour or so every day in nature, even on my way to the office and when heading back home. That is why in my research I mainly focus on design philosophies that are based on the use of renewable materials and circular economy models.

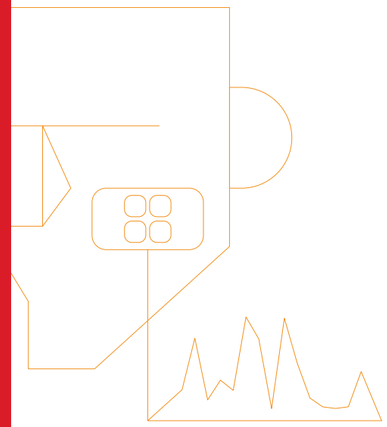
How does collaboration contribute to your work and what is your advice on building a strong global research network?

I think working in a team with members from different disciplines allows for great discussion. This leads to fruitful results that can complement the role of each discipline. The COVID-19 pandemic has shown us how important collaborative research and sharing really is. I have worked with material scientists, chemists, sociologists and even business development leads in my career so far.

I believe making the right connections is very important in one's professional life. While creating new connections can be difficult for young researchers, I strongly believe that being connected to leading researchers can be pivotal for a successful career in academia and industry. I highly recommend attending workshops and conferences in order to meet people and share contacts.

CANAN DAĞDEVIREN

Assistant Professor
MIT Media Lab
Massachusetts Institute of Technology

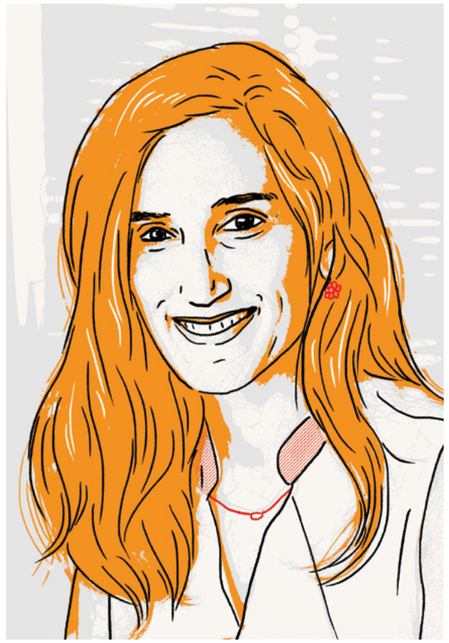


Dedicated to improving diagnosis and care, Assistant Professor Canan Dağdeviren works to develop user-friendly sensing technologies that are miniaturised and conformable to soft tissue. Asst Prof Dağdeviren's work is particularly relevant when it comes to assisting patients with long-term conditions like amyotrophic lateral sclerosis (ALS), where her recent study on facial code extrapolation sensors can make communication easier for patients by tracking their facial and eye movements.

What do you remember most from your time at GYSS?

My time at GYSS was simply mind-blowing! It was packed with enlightening talks, conversation, networking opportunities and delicious food.

"My time at GYSS was simply mind-blowing! It was packed with enlightening talks, conversation, networking opportunities and delicious food."



How does your research leverage the vital information from nature that is 'coded' in physical patterns?

Soft tissue throughout the human body creates an ocean of unique physical patterns, including heartbeats, muscle movements and neural activity. Today's biosensing technologies, however, still face fundamental obstacles that prevent them from seamlessly integrating with these soft tissues to effectively and accurately access, evaluate and alter such patterns. The goal of my research is to pioneer sensing technologies that are user-friendly, target-specific, miniaturised and mechanically conformable to soft tissue. This aims to enable a precise and comprehensive understanding of the human body.

Mechanical and biochemical mismatches between rigid and inorganic electronics and soft and organic human tissue can lead to skin irritation, tissue damage, compromised signal-to-noise ratios and limited service time.

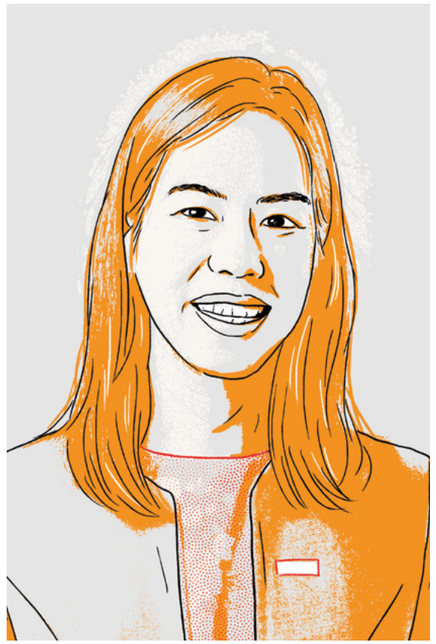
To address these challenges, I have been working on developing conformable and target-specific electronic systems that overcome contact interface, efficacy and data collection issues and seek to provide a holistic understanding of the dynamic changes of the human body. This will allow us to perform early diagnosis, assess disease progression and provide customisable treatment for a wide range of conditions. Harnessing this ability to communicate with the body with such precision across soft, curvilinear interfaces could be a scientific gamechanger that promises to meet some of today's difficult challenges in healthcare delivery.

How would you personally inspire the next generation of scientists?

By sharing the ups and downs of my academic journey via short videos. Recently, I have become very interested in creating short content to increase global outreach in STEAMD (science, technology, engineering, arts, maths and design). We also published a YouTube video outlining our research journey.

MARY KAN

Programme Director
Singapore Biodesign
Agency for Science, Technology and Research (A*STAR)



"The Singapore Biodesign programme taught me the importance of needs-centric research."

As an avid water polo athlete, Dr Mary Kan brings determination, good time management and a healthy competitive spirit to Singapore's healthcare innovation sector. Besides cultural differences, Asians also differ from Western populations in genetics and their physical manifestations, dictating the way healthcare is developed and provided. To address such differences, Dr Kan works to support local innovators in the medtech community as they search for solutions to Asia's biggest medical challenges.

Why are the networking and mentorship opportunities provided by initiatives like GYSS important for young scientists?

GYSS presents an invaluable opportunity to develop a social network outside of your lab and to engage with like-minded people to explore and discuss interest areas in science and technology.

I was more of an introverted scientist then and did not leverage much on the networking and mentorship opportunities. A decade on, I regret not reaching out to my peers and the speakers more, and not following up to build lasting mentor-mentee relationships.

Could you tell us more about your journey from researcher to Programme Director at A*STAR?

As a researcher, I was always more motivated by the translational impact. My work at DSO National Laboratories and the National University of Singapore was focused on translational research and aimed to improve combat care and soldier performance, but there were limitations on market size and opportunities to create products.

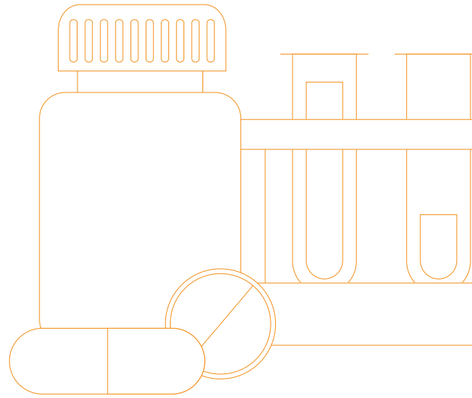
The Singapore Biodesign programme taught me the importance of needs-centric research. Although I am no longer active in research, I continue to give back by empowering innovators with the right mindset and tools to approach their research through biodesign. I also function as a matchmaker between research performers and industry with the hope of moving research to product.

Why it is important to provide a pipeline of local research talent?

Singapore Biodesign is committed to empowering innovators for Asia. There are a few drivers for the need to provide a critical mass to sustain this ecosystem.

Firstly, our ecosystem is seeing more health and medtech companies, with many starting to hit the growth stage and hiring more aggressively. Secondly, our research, innovation and enterprise population also requires upskilling in innovation on top of their technical or other specialist skills to be able to provide a sturdy project pipeline for translation.

Finally, the evolving healthcare needs of our aging population will bring about new problem statements for innovation and the healthcare system will require staff to be able to identify these needs and implement optimal solutions.



SEBASTIAN STEINHORST

Associate Professor
Department of Electrical and Computer Engineering
Technical University of Munich

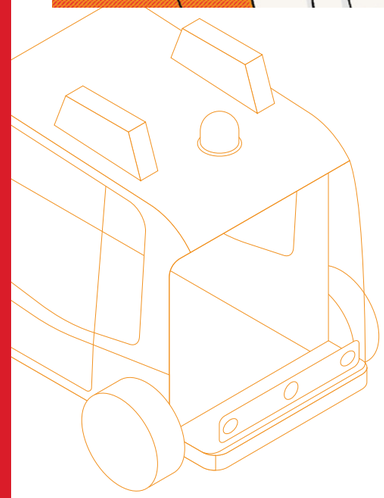
Fresh out of his PhD in 2013, Associate Professor Sebastian Steinhorst began his career as a research fellow at Singapore-based transport solution providers TUMCREATE. Not far from the research centre he worked in was GYSS—where Assoc Prof Steinhorst had the opportunity to meet Nobel laureates, Turing awardees and fellow young researchers committed to their work. Today, his work has shifted to focus on environmental sustainability issues and efficient computing at the Technical University of Munich, but he remains inspired by the global and interdisciplinary community of passionate scientists of all ages that he met at GYSS.

Scientists are typically very focused on solving their problems, but I think seeing that others have managed to even solve larger challenges, and that this is possible is very important. If you are young this is usually when you can engage the most because you typically have the least amount of constraints and can dedicate all your efforts to doing research.

What are your hopes for the future of science and GYSS?

I hope that GYSS and science itself can continue to contribute to solving the world's major challenges. Researchers need to understand that what they do is important and visible and if you work hard, you can make real progress.

GYSS definitely influenced me and I hope that it continues to inspire young researchers and give them a perspective on what is possible.



How are changes in research trends reflected at GYSS?

In general, I think it's a very competitive environment in science, and young researchers need passion and enthusiasm. I feel like this was totally reflected at the first GYSS. While I did not participate in further GYSS events, I could see that the selection of speakers and people engaging helps create generation after generation of young scientists, by giving them a platform to connect and motivating them.

What role can young scientists like yourself play in the world today?

Young scientists need to see that what they do can become really important. And I think that events such as GYSS contribute to shaping this perspective and show that if you work hard, you can accomplish significant achievements.

> "I hope that GYSS and science itself can continue to contribute to solving the world's major challenges."

USHERING IN THE NEXT 10 YEARS OF GYSS

Now a fully fledged gathering of science's foremost minds, GYSS has achieved its mission to excite, engage and enable scientific talent, and is set to continue to do so into the future.

As we close the summit's first chapter and look ahead to the next 10 years and beyond, it seems only fitting to hear from the young minds whose paths to scientific success have been shaped by the GYSS. Just as the Lindau Meeting struck a chord with the distinguished Dr Tony Tan years ago, the summit continues to excite, engage and enable both aspiring researchers and seasoned experts worldwide—sowing the seeds for a brighter future.

HEEDING THE CALL TO ADDRESS GLOBAL CHALLENGES

Though the COVID-19 pandemic may be top of mind at the moment, the climate crisis presents an ongoing challenge that requires not just a nationwide but a planet-wide effort.

"If you look at the trends, we are seeing an increasing focus on sustainability and the circular economy in multiple industries and contexts," comments GYSS 2016 participant, Dr Alireza Javadian, who admires the multidisciplinary collaboration that GYSS encourages. Through his company Widuz and research at the Singapore-ETH Centre, Javadian works to reduce the exploitation of natural resources and construction industry emissions by providing sustainable, renewable alternatives to the materials now in use.

Associate Professor Sebastian Steinhorst, who attended the very first edition of GYSS in 2013, is tackling sustainability from a different angle—he aims to usher in an era of efficient computing.

"The Internet of Things (IoT) is bringing computational capabilities to more and more devices, so you can imagine how much energy is needed to power them," Assoc Prof Steinhorst said. "By having more efficient algorithms and doing the same work with fewer resources, we can make an impact on IoT devices and contribute to environmental sustainability."

Beyond immediate issues like sustainability, the GYSS and its participants also have an eye on the future, as Turkish material scientist Canan Dağdeviren can testify. Currently an Assistant Professor at the Massachusetts Institute of Technology (MIT), Dağdeviren attended the summit in 2014.

"My postdoctoral mentor, Professor Robert Langer, was invited to join one of the panels, where he talked about drug infusions, polymeric capsules and dissolvable polymers among other things—all of which are hot topics in the field," she recalled. "I think GYSS is doing a great job in following the trends and making them available for younger generations to understand."

Since participating in the summit, Asst Prof Dağdeviren has followed in the footsteps of her mentor, one of medicine's most prolific inventors. At MIT, her team seeks to unlock the mysteries of the human body and advance personalised medicine through conformable biomedical devices. "If we can understand our own body, many complex problems can be solved in a more effective way," she shared.

CATALYSING COLLABORATION ACROSS BORDERS AND DISCIPLINES

For many budding researchers on the cusp of their careers, a key draw of the summit lies in the opportunity to interact with eminent scientists at the top of their game. "What I do remember most from my time are the fantabulous talks from the most distinguished scientists!" enthused Dr Li Jingmei, Group Leader of the Genome Institute of Singapore at the Agency for Science, Technology and Research (A*STAR), who attended GYSS in 2015.

But a passion for science is not the only factor binding the two groups together. With eating said to be Singapore's national pastime, Dr Li shares how casual conversations over dinner evolved into lasting friendships that transcended disciplines. "You have someone working on graphene, another in theoretical physics and myself tackling breast cancer. What do we talk about? Food of course!"

Finding common ground proved to be the key factor in breaking the ice among attendees, noted Assistant Professor Danna Gurari from the University of Colorado Boulder. When she attended GYSS in 2014, Asst Prof Gurari fondly remembers how sitting down with the distinguished speakers gave her the chance to learn about their day-to-day lives. "It makes you understand that they're just ordinary human beings," she said, adding that listening to the award winners share their unique career journeys made her realise the diversity of ways in which great ideas can be actualised.

According to Assistant Professor Andy Tay, now a Presidential Young Professor at the National University of Singapore, the social media-savvy aspiring researchers who attend the summit each year are perfectly positioned to catalyse collaboration. This is because these young scientists are so at ease with connecting with people around the world via technology. "If we can come together and be innovative, we have a much better chance of solving global challenges in healthcare and climate change," he noted.

Despite the disruptions caused by COVID-19, Asst Prof Tay also acknowledges that there is a silver lining. "The pandemic has shown that GYSS can be successful in a virtual format," he said. "I hope that in the future, the summit will no longer be limited to people who can attend in person, but that the content will also be available to people worldwide."

For Dr Hemu Xinya, currently a postdoctoral research fellow at Nanyang Technological University, Singapore, who attended GYSS 2021 virtually, shared that the increasing digitalisation of the post-pandemic normal provides a roadmap for GYSS to evolve in surprising ways. "Perhaps the summit could bridge academia and industry in a new, creative way, such as a virtual reality tour of pharmaceutical pipelines, so that young researchers can directly see how their research can contribute to society," she suggested.

With its track record of success and an infusion of fresh ideas each year, the memories of past GYSS participants prove that the summit has indeed achieved its goal to excite, engage and enable—and will continue to do so in the years to come.

GYSS 2020

ACKNOWLEDGEMENTS

We would like to extend our warmest thanks to the 88 speakers whose names are featured on our front and back covers.

Through imparting your knowledge and sharing on your life experiences at the GYSS, you have given the next generation precious opportunities and memories, encouraging them to use their passion in science and research to make the world a better place. Thank you for being an inspiration to the thousands of young scientists from around the world.

We would also like to extend our appreciation to the following for their invaluable support and friendship:

Her Royal Highness Princess Maha Chakri Sirindhorn of Thailand

Countess Bettina Bernadotte, President of the Council for Lindau Nobel Laureate Meetings

Minister Frederique Vidal, Minister for Higher Education, Research and Innovation, France

Academy of Singapore Teachers

Agency for Science and Technology (A*STAR)

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