

A Letter on the International Science Youth Forum: Celebrating a Community of Young Science Talents that Connects, Collaborates and Communicates

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The nurturing of top young science talents remains vital in helping to mitigate current and future global challenges. Written in the form of a letter, this paper chronicles the major activities of the International Science Youth Forum, an annual event held in Singapore where top young science talents from across the world have the opportunity to interact with Nobel Laureates and other eminent scientists. Reflections of the student and educators who participated in this event are also documented, and it is hoped that their experiences can pave the way for other similar activities to be organized worldwide.

Keywords: High school students; science education; science communication.

Dear Professor Tiang,

Greetings! I trust that you and your family have been well. Thank you for being a wonderful friend and mentor all these years, and I truly appreciate the insightful conversations that we continue to have. I am delighted to hear that you have recently taken on the challenging but fulfilling role of overseeing the nurturing of STEM (Science, Technology, Engineering and Mathematics) talents for a number of high schools in your country. You also mentioned that the United Nations member states adopted the 17 Sustainable Development Goals (SDGs) in 2015 as part of the 2030 Agenda for Sustainable Development.¹ The world is just emerging from the aftermath of a pandemic and continues the struggle to deal with extreme weather and climate change, which underscores the importance of international cooperation and collaboration to

reinvigorate efforts and expedite progress on the SDGs. I am in full agreement with you that it is our mission as educators to prepare students to thrive in a highly technologically advanced society and be part of an innovative workforce in the global economy. Hence, we need to ensure that they cultivate effective communication, creative thinking and problem solving skills, in order for them to grow into adaptive, creative and caring citizens of the world. To continue nurturing and strengthening the pipeline for STEM talent development, there must be opportunities for students to congregate, connect with one another and be inspired by the best in the world. You asked for more information about the International Science Youth Forum (ISYF) that is being held annually in Singapore. I have the privilege to be involved in the organization of the Forum for a number of years and it is my great pleasure to share more with you.

1. Beginnings

The concept of ISYF was modeled after the annual Lindau Nobel Laureate Meetings, where young researchers from universities all over the world gather together to attend Nobel Laureate lectures and engage in discussions.² These meetings encourage dialogue between science and society, thus contributing to a general understanding of science in a humanistic way that is of increasing importance to the society. It also served the function of creating networks of scientific cooperation among delegates worldwide. In March 2008, Ms Ho Peng, then Director-General of Education at the Ministry of Education (MOE), Singapore, together with Professor Phua Kok Khoo, then Director of the Institute of Advanced Studies (IAS), Nanyang Technological University (NTU) mooted the idea of ISYF. The Forum would promote a better understanding of science for students and its impact on humanity. As senior high school students were still considering their career choices, it was postulated that the interactions with Nobel Laureates and

other eminent scientists would inspire them to pursue a career in science, as well as provide a valuable perspective for them on current and future issues in science. The objectives of ISYF are to: (a) Inspire Passion for Science Amongst Youth; (b) Establish Cooperation and Friendship amongst Young Science Talents; and (c) Build Capacities of Science Educators. The inaugural ISYF was held in January 2009, jointly organized by Hwa Chong Institution (HCI) and IAS, NTU, with support from MOE and Temasek Foundation. A total of 82 high school students and 28 science educators from schools across Asia participated in the five-day residential program (Appendix A) with accommodation provided by HCI Boarding School.

2. Evolution

In designating 2022 as the International Year of Basic Sciences for Sustainable Development (IYB-SSD), the United Nations recognized the salient role played by the various scientific disciplines in



Fig. 1. Group photograph of ISYF 2018 student delegates and educators, with school leaders and the student organizing team from Hwa Chong Institution (HCI), in front of the iconic HCI Clock Tower Building.

creating solutions for a more sustainable world.³ Many of the themes adopted by ISYF in the past 15 years (Appendix B) have reflected this important aspect. Cultivating scientific curiosity and innovation, communicating scientific ideas effectively and promoting sustainable practices have been constant motifs for ISYF over the years, laying strong foundations for the topics covered by the Masterclass and Dialogue speakers in engaging the participants as well as promoting conversations between the delegates. Since its inception, the ISYF program for student delegates has expanded to include hands-on activities in the laboratory, the Team Project Challenge, as well as excursions to Science Centre Singapore and the Sustainable Singapore Gallery. Concurrently, the program for educators has been enhanced to incorporate learning journeys to the National Institute of Education, Singapore, where the latest in education technologies and teaching pedagogies are showcased. From the early 2010s, delegates from the American, European and Oceania continents were invited to ISYF, complementing the delegations from Asia and leading to an increase in the number of participants overall. A total of 120 students and 45 educators attended the tenth edition of ISYF in 2018 (Fig. 1). During the recent pandemic, both ISYF *digital* 2021 and ISYF *digital* 2022 were held online in view of travel restrictions and social distancing measures. By harnessing technology effectively, the student delegates, educators and speakers were able to connect and communicate on virtual platforms. The 15th edition of ISYF in 2023 resumed a physical format, and ISYF continues to be a signature event for many top high school students and educators from Singapore and overseas.

3. Growth

By describing some highlights of the ISYF program below — some from the point of view of the delegates themselves — I hope that you will be able to better perceive the experiences and reflections from student delegates and educators.

3.1. *Masterclass and dialogue sessions*

With four to five concurrent Masterclass and Dialogue sessions held almost daily throughout the ISYF program, the delegates have multiple opportunities to interact with many distinguished



Fig. 2. A delegate engaging in conversation with Professor Klaus von Klitzing (Nobel Laureate in Physics, 1985) during a Masterclass and Dialogue session.

speakers (Appendix C). About thirty delegates and educators attend each concurrent session, which are held in classrooms. The speakers begin each session by sharing their research journey, infused with fascinating anecdotes and compelling life stories; after a short break, the session resumes with a dialogue between the speaker and the delegates, moderated by a member of the student organizing team (Fig. 2). The narratives by the speakers impart many important life lessons for the attentive youth present — for example, Professor Dan Shetchman (Nobel Laureate in Chemistry, 2011) shared about how the scientific community remained sceptical about his discovery of quasicrystals for many years, despite his own persistence and tenacious belief that he was correct in his experiments and observations. Professor Ada Yonath (Nobel Laureate in Chemistry, 2009) recounted her humble background and gradual recognition in a male-dominated field for her dedication and diligent work in ribosomal crystallography. Professor Jerome Friedman (Nobel Laureate in Physics, 1990), himself an established artist, encouraged delegates to continue pursuing their passion not only in science but in other fields as well; he believes that in doing so, delegates would develop into better human beings who would appreciate the finer things in life. After every session, the delegates come to realize that all of the speakers are driven by an innate sense of scientific curiosity, dedicating themselves to lifelong learning. Many years of hard work and perseverance precede recognition by their peers, with all of the speakers emphasizing the need to keep an open mind and have fun while making discoveries.

The focus dialogues enabled me to examine various science issues from different perspectives and gave me deeper insights as to how one should solve the problems and issues we currently face... The Nobel Laureates have inspired me immensely about my future career and my attitude towards science research.

— Delegate from Thailand (2010)

We can be inspired by the Nobel Laureate's passion for science as well as the far-reaching impacts of their dedicated efforts. Many of them do not pursue science with an end goal in mind. There are no lofty or selfish ambitions (besides that of feeding their own curiosity and passion) but only the love of science and the willingness to dedicate their lives to it. This is something in the scientists that I have yet to discover in myself. They have a rooted passion, that tempered with mental discipline, gives them great power to strive for what they believe in despite the challenges they may face. I think this in itself is very inspiring.

— Delegate from Singapore (2012)

It exposed me to many of the fields of science which could lead to potential career possibilities. It also reinforced the importance of pursuing science to satisfy my curiosity.

— Delegate from Japan (2013)

I am certain I will pursue a science related career. I am inspired by the research around me and the dialogues that included Nobel Laureates and eminent scientists.

— Delegate from Vietnam (2015)

I understood more about research. It made me consider research as a future career path. It also made me realize failure in research isn't that scary as even the top scientists experience that countless times.

— Delegate from Hong Kong SAR (2017)

Science is a lot more than studies and endless research. It's about passion and curiosity for the subject. To achieve my aspirations, I have to follow what I want to do, and not what other people tell me to do.

— Delegate from Canada (2018)

Science is a rather complex but interesting field of study. There is a deep sense of satisfaction associated with this subject. A simple concept is much

more complex than it seems. It can be a part of a much bigger application in the real world.

— Delegate from the Philippines (2019)

Science is about a constant journey of exploring, research work is tedious and sometimes even if the results don't match up, you should not sweep it under the carpet just yet. Lastly is keeping trust in science because it takes many years of work and research before an application.

— Delegate from Australia (2020)

It's okay if we still don't know what specific field we want to do, keep options open, and never stop learning.

— Delegate from Indonesia (2021)

Firstly, I was inspired by lots of the scientists and also by my friends in my group. Both the scientists and my friends gave me lots of advice and inspiring words. To be honest, at first I was not someone that was really interested in the field of science, but after ISYF, I am quite interested in the field of science now. Secondly, I pushed or forced myself to explore more about science. Before ISYF, I started to do some research on the topics you all called us to do research in. It gives me an opportunity to explore more in the science field. Thirdly, ISYF gives me an unforgettable experience, probably an experience that I won't forget. The activities were mesmerizing and I really enjoy in this event.

— Delegate from Malaysia (2021)

I am beginning to think more positively towards science as a more fun and explorative subject.

— Delegate from Brunei Darussalam (2022)

ISYF has made me reconsider how I view science, not as ternary but a spectral whole, in which cross-disciplinary studies are the norm.

— Delegate from the United Kingdom (2023)

3.2. Project poster exhibition

“Standing in front of the booth where the A0-sized poster of my research project is displayed, I feel a little nervous as I watch the crowd move towards me. Will I be able to present my project rationale and objectives, processes and outcomes succinctly to other ISYF delegates, senior high students from the host school, educators, as well as Nobel Laureates and other eminent scientists during this Project

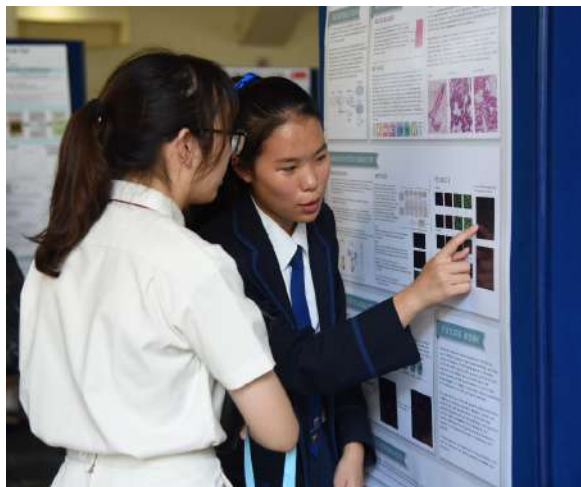


Fig. 3. A delegate presenting her research project during the Poster Exhibition.

Poster Exhibition? I exchange smiles with a group of fellow delegates who gather in front of my poster, and I start to engage in conversation with a captive audience (Fig. 3). I present my project to an eminent scientist, whose words of encouragement make me more determined to continue and improve on my work. As more groups stop by my poster booth, I continue to hone my communication skills and my confidence grows, fuelled by the constructive feedback and support given to me by an appreciative audience. The allocated timing for my presentation session ends and it is now my turn to roam around and view the other attractively designed posters. While the challenges addressed by the projects may be unique to the diverse cultures and respective communities, I notice that these overcoming challenges rely on a strong foundation in universal scientific principles. Inspired by the hard work and passion shown by my fellow presenters, I am filled with renewed hope that whatever global challenges may come our way, we will be able to solve them as a united scientific community.”

Never in my wildest dreams did I think that I would get to see a Nobel Laureate much less actually talk to one, show my poster and explain it to him. It was the most amazing thing in my life!

— Delegate from India (2012)

I really gained enthusiasm to learn more about science and do more about science. I want to do breakthrough research and find something interesting like my friends.

— Delegate from Indonesia (2014)

My biggest takeaway from talking to other Delegates is to find my passion and to be curious and passionate, don't be afraid of failure and don't be afraid to ask what you don't know.

— Delegate from Japan (2017)

I have learnt that many aspects of science are interdisciplinary; the lines separating the subjects of physics, chemistry and biology are almost indistinguishable.

— Delegate from Mexico (2018)

I learnt that the starting point of research should always be for the betterment of the world.

— Delegate from Thailand (2018)

Science should originate from passion, and when and if we choose to do Science, determination, creativity, imagination, and the willingness to work hard are all essential.

— Delegate from the United Kingdom (2021)

There is a whole society of students like me all over the world with similar interests and passion for science! I got to interact with many amazing students and made many new friends.

— Delegate from Singapore (2023)

3.3. Team project challenge

The inclusion of the Team Project Challenge in the ISYF program from 2019 enabled the delegates to deepen their understanding of STEM concepts by applying their knowledge to novel scenarios. For this activity, delegates were assigned to teams of ten to twelve members each. For ISYF 2019 and ISYF 2023, the teams had to apply STEM concepts to build a Rube Goldberg machine utilizing recyclable everyday objects such as wooden chopsticks and paper cups, to fulfil the task of either flipping a page of a book or throwing a ball into a box (Fig. 4).⁴ The version for ISYF 2020 required teams to envision an innovative solution to meet sea or land transportation needs in the future, followed by building a prototype to highlight the scientific concepts, efficiency and sustainability of their proposed design. Collaborative discussions among the delegates of ISYF *digital* 2021 and ISYF *digital* 2022 took place via online platforms due to the pandemic, with the students presenting their proposals through slides and videos. For these two years, the delegates roleplayed teams of scientists and engineers tasked by the government of a fictitious island nation to devise



Fig. 4. Delegates prototyping their Rube Goldberg machine (with the objective of throwing a ball into a box) for the Team Project Challenge.

scientific solutions to challenges brought about by urbanization and climate change, such as water pollution and food shortage. Through the Challenge, the teams engaged in friendly competition with one another to come up with innovative and feasible solutions to the prescribed challenges, motivating the students to master new concepts and skills as well as overcome their differences to work collaboratively.

I learnt how to communicate and work together with people from different backgrounds and cultures.

— Delegate from Chinese Taipei (2019)

The opportunity to do 3D modelling, and to exchange ideas with various group members while exploring all sorts of solutions!

— Delegate from South Korea (2021)

I enjoyed meeting new friends and trying to solve a prevalent problem. In fact, through TPC, I have met a new friend, which is something I have honestly not considered to be possible.

— Delegate from Vietnam (2021)

Science is founded on the basis of collaboration, as we are gathered from different parts of the world to solve pertinent global issues on sustainability.

— Delegate from Malaysia (2022)

The fact that we got to know each other better through working together, and also I like the fact that everyone's working on a different problem so we can learn from each other's research and ideas while helping Astrum (the fictitious island nation) all together, the storyline/background planning was really good! It was interesting to research and ideate for solutions to solve the problems with consideration of the context of Astrum.

— Delegate from Singapore (2022)

I have made new friends and I feel that it is an excellent opportunity to learn about different scientific concepts from others.

— Delegate from Australia (2023)

There were many commonalities and similar traits which exist amongst individuals from different schools. These traits allowed communication and bonding to be smoother.

— Delegate from the United States of America (2023)

3.4. Cultural exchange

“All the ISYF delegates and educators as well as students and staff of the host school attended the Cultural Exhibition. The delegates really understood the assignment and came dressed in their traditional or national costumes, including those from Japan wearing their *yukatas*, from Thailand attired in their *chut thai*, the female delegate from Mexico in her *huipil* and the male delegate in his *charro* suit (he kindly let me try on his *sombrero*, no cap ☺). More than just introducing their schools and culture, many of my friends from across the world put up entertaining cultural performances that really slaps. I replied “Slay!” when the delegates from Bali, Indonesia, asked if we enjoyed their *Legong* dance (in full traditional costume, fr). The *lokum* and *gotgamssam* sweets offered to me by the Turkish and South Korean delegates respectively at their booths were bussin’. ngl the foodie in me can’t wait to visit these places to taste more delicacies (drool. . .). ijbol every time I recollect the scene where my friends from the United States, Japan, United Kingdom, China and myself stood in a circle kicking the *chatek* to one another! All of us laughed and bonded together, forging friendships that will last a lifetime (Fig. 5). I really had the vibes interacting with all of them, and have come to realize that despite being from all over the world, we have



Fig. 5. Delegates sharing and learning from one another at the Cultural Exhibition.

very similar dreams and hopes for the future. We ate and left no crumbs!”

It enabled me to broaden my horizons and meet new people. I now have connections all over the world, rather than just in a small area. This is invaluable. I also learnt that people in other countries are not that different from myself, despite differences in culture. We after all do share our humanity.

— Delegate from Australia (2014)

I was able to learn about the food, culture, and fun of a country I can't actually visit, which made me feel as if I was participating in a sightseeing tour.

— Delegate from Japan (2015)

I was excited by the exchange of cultures in ISYF, and how the different personalities of my group-mates made the ISYF experience more fun.

— Delegate from Hong Kong SAR (2016)

I learnt the importance of accepting everybody. Everybody is from different cultures, and if nobody compromises, then nobody is going to end up as friends.

— Delegate from Malaysia (2017)

I think it's a good thing to include cultivate cross-cultural understanding, I liked it as a way to expand my horizon and see things from perspectives of different nationalities.

— Delegate from China (2019)

ISYF was not so much about learning scientific theories and knowledge but is more of exposure to

scientific culture as well as exchange of cultures between delegates and I enjoyed the event a lot.

— Delegate from Vietnam (2019)

I learned that culture is one of the richest values that humans have. The memories we share along with the exchange in information and experiences was truly a magical and extraordinary experience. My time in Singapore was as incredible as it was unparalleled.

— Delegate from Poland (2020)

I have realized that although my peers from other countries may speak a different language and come from a different culture and background, the goals that we share are very similar. We all want to study well, pursue our interests in Science and technology and contribute back to society in one way or another. As a result, language didn't seem to be a barrier to our communication at all. We were sensitive to each others' beliefs and shared our thoughts, views and questions we had in the realm of science and sustainable development. I think I have truly benefited from this experience and have learnt more about their different ways of thinking about a problem.

— Delegate from Singapore (2022)

3.5. Educators' networking and sharing

On the first day of the ISYF program, all the educators embark on a sightseeing tour of several local attractions, hosted by their Singapore counterparts. Strong ties are forged between local educators and their overseas colleagues, setting the stage for more in-depth sharing of experiences and ideas over the remaining days of the program. In addition to attending the Masterclass and Dialogue sessions with their students, the ISYF program incorporates numerous opportunities for the educators to exchange ideas on pedagogical approaches and share best teaching practices. Through informal conversations during meals and formal sharing sessions, the bonds within the fraternity are strengthened and capacities enhanced (Fig. 6). Discussion and sharing topics include how to design and implement an interdisciplinary STEM curriculum, initiatives to encourage more students to embark on scientific research, using Infocomm Technology and Data Analytics to inform teaching practices, as well as the impact of generative Artificial Intelligence



Fig. 6. Educators sharing and learning best practices and innovative teaching pedagogies.

on the writing of student research reports. The program for educators also include discussions with international renowned science educators, school leaders and education policy makers from the Singapore Ministry of Education, covering science curriculum design and implementation as well as assessment standards and benchmarking. Educators are given time to reflect and consolidate their learning; many of the educators show their commitment to enhance their craft by drafting action plans outlining how these newly minted teaching ideas could be adopted back in their schools.

It is a very enriching experience to have the opportunity to interact and learn from international educators.

— Educator from Japan (2014)

The educators' program gave me an opportunity to learn from and interact with educators from all over the world instead of just being a teacher chaperone.

— Educator from Canada (2016)

The STEM journal shared by one of the educators was a good idea to motivate students to engage into scientific writing & research.

— Educator from Brunei Darussalam (2017)

From the educator sharing, I observed how other teachers used real-life examples, practical activities and media, such as photography... I am planning to implement a co-curricular science club where

students can research, investigate and communicate science topics that interest them.

— Educator from Australia (2018)

Cross-curriculum collaboration between different subject areas is an important tool we have as educators. Finding a balance between subject-specific learning and cross-curricular learning needs to be a question that we constantly ask ourselves.

— Educator from Singapore (2019)

In the educator sessions, I learnt a great deal about how different international schools develop the science talents of their students.

— Educator from Estonia (2020)

The challenges faced by the teachers and students due to the pandemic — teachers need to adopt new strategies to ensure the students continue to learn remotely and students becomes more persistent in their learning. Important to tap on technology to enhance students' learning, e.g. use technology in gathering feedback and assessment.

— Educator from the Philippines (2022)

There are common challenges faced by the educators across the world, it was really interesting to listen to the different solutions that educators have come up with. Particularly on making a vast impactful decision to teach powerful knowledge such as skill sets as opposed to teaching just to cover the syllabus when faced with limited time.

— Educator from the United States of America (2023)

4. Horizons

We celebrated the 15th consecutive edition of ISYF in 2023, and are extremely grateful to the many individuals and organizations that have made all of this possible. Professor Phua Kok Khoo, who first mooted for ISYF, has been a constant pillar of strength and encouragement. We have been extremely fortunate to have strong support from the Ministry of Education (MOE), Singapore, as well as the National Research Foundation (NRF), the Agency for Science, Technology and Research (A*STAR) and Temasek Foundation. In addition, many renowned faculty members from our local universities — Nanyang Technological University (NTU), National University of Singapore (NUS) and the Singapore University of Technology and Design (SUTD) — continue to avail themselves to

share their experiences as speakers at the Masterclass and Dialogue sessions. It has been also my great honour to work with and learn alongside dedicated students and teacher colleagues (all of whom are volunteers) in the ISYF organizing team, with the school leaders at Hwa Chong Institution providing sound advice and support. Has our hard work been worthwhile? To answer that, I look towards the delegates who participated in the first few editions of ISYF; we see that they have grown to be STEM change-makers who are making a difference to our world. Some have become Principal Investigators of their own research groups in universities and research institutes, others are leading teams in government ministries to formulate national policies and improve communities through science and technology, while a handful have emerged as technopreneurs. In recent years, some of these STEM change-makers have been invited back as speakers to share their experiences with the delegates; I believe that we have indeed come full circle.

The United Nations has designated the years 2024 to 2033 as the International Decade of Sciences

for Sustainable Development (IDSSD).⁵ While the role played by sciences has never been more crucial, we must also acknowledge that there is a clear need to break the traditional silos of the scientific disciplines, in order to embrace the interdisciplinary and transdisciplinary approach in discovering solutions to the complex and intricate challenges facing us today and in the near future. ISYF will continue to grow from strength to strength and be an important avenue for students and educators to network, build strong relationships and be inspired by the best minds in STEM. I strongly believe that we are setting the stage and building the strong foundations required for our talented youths to create a better future for all of us through STEM. I hope that my sharing above serves as a source of motivation for you to consider initiating similar programs as part of your new role, and look forward to hearing about the wonderful ideas and plans from you soon. Take care and wishing you and your family good health!

Best,
Kelvin

Appendices

Appendix A. Program Highlights for ISYF

Day 1	Day 2	Day 3	Day 4	Day 5
Team Bonding	Masterclass & Dialogue session	Masterclass & Dialogue session	Team Project Challenge presentation	Masterclass & Dialogue session
Amazing Journey across Singapore	Excursions and Learning Journey	Cultural Exhibition	Educators' Sharing & Discussion session	Celebration Lunch
	Team Project Challenge preparation	Team Project Challenge preparation	Grand Ceremony & Poster Exhibition	
	Educators' Sharing & Discussion session	Educators' Learning Journey		

Appendix B. Themes for ISYF 2009–2023

Year/Theme

2009 "Science and the Ever-Changing Environment"
 2010 "Future Innovations and Science"
 2011 "Challenges for a Sustainable World"
 2012 "Nurturing the Scientific Mind"
 2013 "Breaking Through"
 2014 "Science for Humanity in the 21st Century"

(Continued)

Appendix B (*Continued*)

Year/Theme
2015 “Becoming a Modern Scientist”
2016 “Communicating Science”
2017 “Innovation for a Better Life”
2018 “Transcending Frontiers”
2019 “Science: A Common Language”
2020 “Evolving Aspirations: Divergent Pathways, Convergent Future”
2021 “Post-Pandemic Science: Navigating Uncharted Waters”
2022 “Sparking Innovation, Igniting Collaboration”
2023 “Reconnecting, Reimagining: Looking Ahead to a Better World”

Appendix C. Distinguished Speakers at ISYF 2009–2023

Nobel Prize in Physics	Sir Anthony Leggett Professor Douglas Osheroff Professor David Gross Professor Jerome Friedman Professor Claude Cohen-Tannoudji Professor Albert Fert Sir Andre Geim Professor Carlo Rubbia Professor Klaus von Klitzing Professor Francois Englert Professor Barry Barish Sir Konstantin Novoselev
Nobel Prize in Chemistry	Professor Aaron Ciechanover Professor Dan Shechtman Professor Kurt Wuthrich Professor Ada E. Yonath Professor Hartmut Michel Professor Martin L. Chalfie Professor Ei-ichi Negeshi Professor Arieh Warshel Professor Rudy Marcus Sir Fraser Stoddart Professor Michael Levitt Sir David MacMillan
Nobel Prize in Physiology/Medicine	Professor Sydney Brenner Sir Richard J. Roberts Professor Leland H. Hartwell Dr John Robin Warren Sir Tim Hunt
Fields Medal Winner	Professor Stephen Smale Professor Ngo Bao Chau Professor Vladimir A. Voevodsky Sir Michael Atiyah Professor Pierre-Louis Lions Professor Wendelin Werner
Turing Award Winner	Professor Barbara Viskov
Millennium Prize Winner	Professor Michael Gratzel Dr Tuomo Suntola Professor Stuart Parkin Sir David Klenerman

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