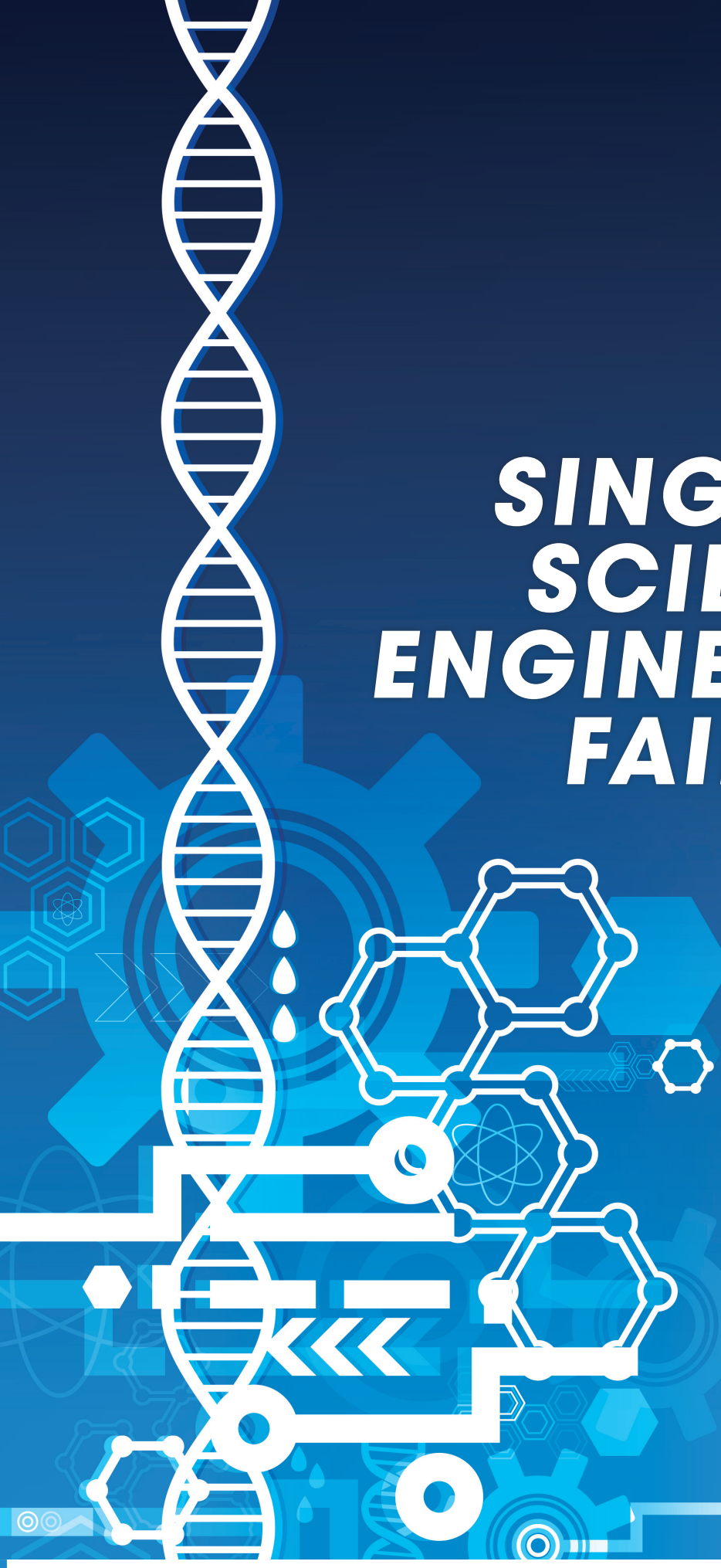
21st SINGAPORE SCIENCE & ENGINEERING FAIR 2021



ORGANISED BY

Ministry of Education SINGAPORE

Agency for Science, Technology and Research SINGAPORE

Science Centre singapore

AFFILIATED WITH

REGENERON ISEF A PROGRAM OF SOCIETY FOR SCIENCE & THE PUBLIC

SUPPORTED BY

YDSP Young Defence Scientists Programme

DSTA Defence Science & Technology Agency

DSO NATIONAL LABORATORIES

HTX

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BACKGROUND

The Singapore Science & Engineering Fair (SSEF) is a national competition organised by the Ministry of Education (MOE), the Agency for Science, Technology and Research (A*STAR) and Science Centre Singapore. The fair is open to all secondary and pre-university students between 15 and 20 years of age. Participants submit research projects on science, technology, mathematics and engineering. Shortlisted finalists exhibit their projects at the fair where they will be interviewed by judges from local universities, polytechnics and research institutes.

The SSEF is affiliated to the highly prestigious Regeneron International Science and Engineering Fair (Regeneron ISEF), which is regarded as the Olympics of science competitions.

21st SINGAPORE SCIENCE & ENGINEERING FAIR 2021

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FOREWORD

MDM LEE LIN YEE

CHAIRPERSON
Singapore Science & Engineering Fair Working Committee 2021

Director, Sciences Branch
Curriculum Planning & Development Division
Ministry of Education

2021 marks the 21st Anniversary of the Singapore Science and Engineering Fair (SSEF). True to the spirit of SSEF, the event has continuously evolved and matured over the years. 2021 is nothing short of another remarkable year of progress and innovation.

If we had to choose one word to describe SSEF 2021, it will be 'adaptability'. With crisis comes new opportunities. Despite the uncertain changing outlook that COVID-19 brought about, the organising committee was agile in re-formatting the event, presenting new opportunities to engage a wider audience and breaking down the physical walls. For the first time in SSEF history, live judging interviews were held virtually via a video conferencing platform. Fringe activities, such as talks on the latest STEM developments by industry experts and "A Hundred Hows" virtual learning journeys, were held entirely online. This expanded the reach of SSEF to viewers from Singapore and beyond, allowing them to experience interesting places and the relevance of classroom STEM learning to everyday life.

We witness the spirit of resilience from the students who persevered and overcame challenges independently. They adapted to the new format of the fair and adjusted their presentation skills to share their research findings with judges in an equally effective manner via video conferencing. This year, 1,128 students from 29 schools submitted 465 research projects for the fair. A total of 126 projects received Gold, Silver, Bronze or Merit Awards. The numbers, being comparable to previous years, showed that participation and performance of students remained strong and is a clear indication of the students' determination to pursue their interest and development in STEM research despite the challenges that the COVID-19 situation brought on.

To all student participants, great job and well done!

SSEF provides an important platform for students to further their interests and competencies in STEM research through interaction with like-minded peers and working alongside industry experts. Through this experience, their curiosity is piqued as they apply creativity in generating solutions, allowing them to be agents of positive change. Once again, we are impressed by the high-quality projects submitted this year, a testament to our students' potential in innovating and formulating practical solutions to challenges our world currently faces. We look forward to many more years of SSEF and good work from our students.

I would like to express my deepest appreciation to our teachers, mentors and judges, for working wholeheartedly with the organising committee to adjust to the virtual format of SSEF 2021. The fair would not have been possible without the strong commitment from all of you in guiding our young STEM talents. I would also like to thank our sponsor organisations for giving out the SSEF 2021 Special Awards to recognise our students' contributions. The seven organisations are The Electrochemical Society, Singapore Chapter (ECS), Institution of Chemical Engineers Singapore (IChemE), Singapore Association for the Advancement of Science (SAAS), Singapore Mathematical Society (SMS), Singapore Society for Microbiology and Biotechnology (SSMB), Singapore University of Technology & Design (SUTD) and Yale-NUS College.

Finally, I thank our longstanding partners, A*STAR and Science Centre Singapore, for their dedication to SSEF and for their passion in promoting STEM education to our future generations. Without this strong partnership, SSEF would not have attained the same level of success that we see today.

We look forward to continued support from everyone for future editions of SSEF. Continue to be curious, be creative, and be a positive change agent through STEM!

With crisis comes new opportunities.

FOREWORD

ASSOCIATE PROFESSOR LIM TIT MENG

CO-CHAIRPERSON AND FAIR DIRECTOR
Singapore Science & Engineering Fair Working Committee 2021
Chief Executive, Science Centre Board

Into its 21st year, the Singapore Science and Engineering Fair (SSEF) continues to serve as an educationally enriching platform for secondary and pre-university students to share, learn and showcase their research work in the respective fields of Science & Engineering. The national competition is also affiliated to the prestigious International Science and Engineering Fair (ISEF), which is regarded as the Olympics of science competitions. With sheer determination and tenacity, the student participants engaged in a year-long research project on Science & Engineering. During the online final judging round, they impressed the judges with their high-quality projects and depth of scientific knowledge. This good work was continued on at ISEF, and we could not have been prouder of our ISEF participants for holding the Singapore flag high on a global platform.

Despite the challenges posed by the COVID-19 pandemic, our students displayed admirable resilience and flexibility, adapting to the changes that the organising committee had to make, working tirelessly behind the scenes. This underpinned the importance of STEM education in nurturing critical thinking, problem-solving and creativity skills among students. It also played a pivotal role in empowering them to be innovative thinkers capable of developing scientific and technological innovations to address global issues and challenges, such as public health and climate change.

To this end, SSEF not only provides students the opportunity to showcase their STEM research efforts but deepen their STEM learning through scientific communication with industry experts, distinguished scientists, and ▶

like-minded youths. The interaction with experts in the fields of Science & Engineering offered valuable insights and learnings about the STEM research landscape, as well as inspired them to pursue their passion to explore a career in STEM-related fields.

Thus, the whole scientific community must work together to nurture future STEM practitioners and ensure Singapore's good progress in STEM education. My heartfelt gratitude to

- the participating schools for their concerted efforts to encourage students to participate.
- our dedicated teachers, mentors, and partners from IHLs and research institutes for guiding our students and helping them develop 21st Century Competencies on top of scientific research skills.
- the judges for devoting their valuable time and effort shortlisting the projects during the preliminary judging round, interacting, and offering valuable feedback to students during the online final judging round; and
- our sponsors and partners, Defence Science and Technology Agency (DSTA), DSO National Laboratories and Home Team Science & Technology Agency (HTX) for their strong support and contribution in making this initiative a success.

Despite the challenges posed by the COVID-19 pandemic, our students displayed admirable resilience and flexibility.

Finally, I would like to express my earnest appreciation to the Ministry of Education (MOE) and Agency for Science, Technology and Research (A*STAR) for the longstanding partnership and collaboration. Their support is pivotal in ensuring SSEF continues to be a rewarding and meaningful journey of scientific inquiry and discovery for the future budding scientists and researchers.

A WORD FROM OUR SPONSORS

HTX (HOME TEAM SCIENCE & TECHNOLOGY AGENCY)

HTX believes that a strong foundation in Science and Engineering empowers our youth to create technologies and solutions that will positively impact Singapore and the world. We are pleased to partner SSEF to provide a platform for our young innovators to showcase their inventions, meet industry experts and participate in various enriching activities to inspire them to make a difference to the society through STEM.

DEFENCE SCIENCE AND TECHNOLOGY AGENCY (DSTA)

SSEF offers many opportunities for students to gain insights and first-hand experiences through a series of STEM-related activities that cover curriculum outside of the classroom. With DSTA as a partner, SSEF continues to nurture, spur and enhance students' interest in STEM. See possibilities with SSEF & DSTA today!

DSO NATIONAL LABORATORIES (DSO)

SSEF is a great platform for students to have a glimpse into the real world and the current research problems. They will be exposed to readings, discussions and topics that are outside of their curriculum. It will broaden their breadth and depth of knowledge, which will be crucial for innovative thinking in their future work.

INTRODUCTION

SSEF 2021 marked the 21st anniversary of the fair and was the first time that it was held completely virtually due to the COVID-19 situation. Despite the challenging circumstances, 465 projects registered for the Main Category and 320 of these projects were shortlisted for final judging in April 2021. A total of 126 awards were awarded, encompassing 27 Gold, 29 Silver, 34 Bronze and 36 Merit awards. This year, seven organisations (Institution of Chemical Engineers Singapore, Singapore University of Technology and Design, Singapore Society for Microbiology and Biotechnology, Yale-NUS College, The Electrochemical Society, Singapore Association for the Advancement of Science, and Singapore Mathematical Society) sponsored Special Awards, which were awarded to 42 projects.

In the Junior Scientist Category (for students under 15 years of age), 32 projects were shortlisted for final judging. Four projects were awarded the Distinction award and two projects were awarded the Merit award for their projects, while one project was awarded the Distinction award and six projects were awarded the Merit award for their videos.

THE SSEF 2021 EXPERIENCE: STUDENTS

- **YAN JUN JIE**
- **MERWIN THAM WEHN YANG**
- **ZHANG KAIWEN**

SCHOOL

HWA CHONG INSTITUTION

PROJECT TITLE

Fabrication of eco-friendly cellulose reduced graphene oxide hybrid aerogel from various fruit wastes for water purification

Our study utilised fruit wastes to synthesise a novel hybrid reduced graphene oxide aerogel which is reusable and effective in removing several types of pollutants including metal ions, dye and oil from water. SSEF was an excellent opportunity for us to hone our communication skills, especially with the enriching feedback we received from the judges. Being held online, learning from our peers was made even more convenient. Although the COVID-19 pandemic presented several challenges for us such as restricting the time we had in data collection, we managed to pull through with our determination and advice from our mentor.

- **CLAIRE SZE WEI ROBERTS**
- **EMMA GAN LI ANN**
- **AVELYN YAP EN**

SCHOOL

METHODIST GIRLS' SCHOOL

PROJECT TITLE

Artificial Intelligence Models for Predicting Statin-Induced Myalgia using Clinical and Genetic Factors

SSEF was a mind-opening experience! One challenge we faced was learning the R language, which we used to train AI models for prediction. We had no prior knowledge of the R language but our mentors patiently taught us. Something we learnt through SSEF was the importance of machine learning as it is the key to future discoveries. Our knowledge of machine learning can be applied to different fields in the future, potentially contributing to the scientific community. We are grateful for our teacher, Mrs Lam, and our NUS mentors, Dr Lee Jin and Prof Lee, for their guidance.

LEE RUI XUAN

SCHOOL

SWISS COTTAGE SECONDARY SCHOOL (currently studying in Nanyang Junior College)

PROJECT TITLE

Flora-scence: Graphene oxide-Blue Butterfly Pea Flower Composite

Presenting scientific research and data was something new to me, so I found it challenging to come up with an engaging, informative, yet concise presentation, especially with the amount of data I had to present. Participating in SSEF 2021 has taught me spontaneity as the professionals whom I interacted with kept me on my toes with refreshing questions. I was surprised at the ease at which the event proceeded, despite being held online.

I feel that future participants should not only see SSEF as a competition, but also a way to enjoy the process of scientific research.

TAN CHIEN HAO

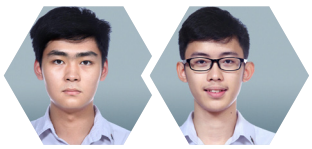
SCHOOL

RAFFLES INSTITUTION

PROJECT TITLE

Topology and Geometry of 3-Band Models

For most days that I spent doing research, it felt like my efforts were wasted, as I did not manage to obtain data or results that could lead me further or seem to contribute to science. Well, that's perfectly fine too, as this is part of the research process and the key is to improve and hone my research skills! Having taken four projects since Year 3, I found that choosing a field that I am genuinely curious about makes the whole process less painful, because research is not just a chance to get an academic award, it's a rabbit hole that can expand one's breadth of knowledge!



WANG ZIXUN
JONATHAN CHEW JIAN PIN

SCHOOL

RIVER VALLEY HIGH SCHOOL

PROJECT TITLE

Design & Testing of a Novel Single-Rotor Tailsitter

SSEF 2021 has been a truly enjoyable experience. We get to learn knowledge beyond the school science syllabus and hone our scientific communication skills. SSEF has also allowed us to receive invaluable feedback from judges about how we could improve our project, and it could be extended in real-world contexts.

Research is all about seeking answers to the unknown. Identifying and closing gaps are important processes in research methodology, so it is natural for scientists to say "I don't know.". Hence we hope all future SSEF participants would ask bold questions and not be afraid to say "I don't know.".

- **N D DURGHADEVE**
- **LIM AINSLEY**
- **BRYAN LEE JIA CHENG**

SCHOOL

CLEMENTI TOWN SECONDARY SCHOOL

PROJECT TITLE

Host Target Proteins of Spike Protein of SARS-CoV-2

SSEF 2021 was an exciting experience. At the beginning, we were surprised by how exhausted we were after each laboratory session. We also had to face the challenge of SSEF being held online for the very first time. To overcome this, we practised hard and adapted to the new format. We are glad that we could work together as a team effectively. The entire experience helped to boost our confidence and strengthened our willpower, allowing us to emerge as better and more confident individuals. We thank the SSEF organisers and we wish the very best to future participants!

- **LIM DONGGEON**
- **MARVYN CHIA**
- **CLARISSA KOH**

SCHOOL

ANDERSON SERANGOON JUNIOR COLLEGE

PROJECT TITLE

Detection and Removal of Obstructions in Still Images Utilising Machine Learning

Our project was about removing common obstructions in photos, such as lamp posts or chain fences. By harnessing the power of machine learning, we were able to create a sophisticated product to create seamless images.

SSEF was a sterling experience for us. To future participants, we would like to share that the beauty of watching your project evolve is not something you would typically find in day-to-day lessons. Commitment and perseverance are invaluable attributes to have, for rushing your project only slows down your progress. Find your pace, work hard, and you can flourish in the world of scientific research.

- **WOON ZEE NING**
- **VICKY ANG**
- **LIM ZHI YAN**

SCHOOL

DUNMAN HIGH SCHOOL

PROJECT TITLE

Potential of Acid and Alkali chemical activators of Biochar for the Effective Removal of Ibuprofen

One takeaway from SSEF was that scientific research comes with open-mindedness. During SSEF, we got the chance to discuss our project with many different people, who provided many new viewpoints and inspired us to improve the project in other ways. We found communication a huge obstacle when preparing for SSEF. With the safe management measures, we were only able to discuss and complete our report online, which often caused miscommunication of ideas we had. It was surprising how smoothly the competition flowed as well as how friendly and light-hearted the judges were.

- **DOLOT SHINE MIKAELA MAMINTA**
- **MAGBITANG CALLISTA YSABELLE ACUNA**
- **HO KE YING**

SCHOOL

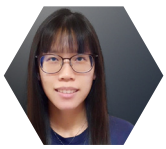
NGEE ANN SECONDARY SCHOOL

PROJECT TITLE

Investigation of the effectiveness of different plain weave structures on the tensile strength of rope bridges

SSEF was an enriching experience that taught us the rigour of scientific research. A challenge that we faced was the lack of necessary materials. Thus, we had to improvise the experimental procedures. As we thought that the weave structures of rope bridges may not be the most interesting subject to investigate, we were surprised that our project entered final judging round and even won the distinction award. We are glad that our hard work paid off, which goes to show that anyone can be a scientist if you put your heart and mind to it!

THE SSEF 2021 EXPERIENCE: TEACHER MENTORS



MS TAN JIEYING

TEACHER

SCHOOL

ANG MO KIO
SECONDARY SCHOOL

My mentoring journey has been a rewarding one as I got to witness the growth of my students. I am proud to see them take ownership of their research projects, collaborate with one another and work towards a common goal. I believe in giving students the autonomy in decision-making and the space to explore, problem solve and test out their ideas. The challenges that they faced were good opportunities to develop resilience and flexible thinking. My favourite part of being a teacher mentor would be when I see my students' faces light up with a sense of accomplishment.

MISS ESTHER ZHENG

TEACHER

SCHOOL

KRANJI
SECONDARY SCHOOL

I have been mentoring student research projects for ten years. My favourite part of being a teacher mentor is the development of trust in the relationship between me and my students as they develop skills in collaboration, communication, and research.

A highlight of my mentoring journey is experiencing how reflective thinking in research can develop students' scientific interest and innovation.

One pro-tip I have for future SSEF student participants is to be open and observant to the possible areas of needs that needs to be addressed to generate their research ideas.

DR CHIAM SHER-YI

HEAD OF RESEARCH, INNOVATION AND ENTERPRISE

SCHOOL

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

I have been mentoring research at NUS High for a decade, and I suppose, been in science and research all my working life. Research in itself is rewarding for me. It is even more so when I get to guide my students in their research. I enjoy the process of helping them to ask the right questions, then how to go about to answer it. Remember, research is about uncovering new knowledge, so the question is key. My favourite part about mentoring research is the same as when I am doing my own research – learning new things.

DR YAP ANN TECK

HEAD OF DEPARTMENT, SCIENCE

SCHOOL

ST. ANTHONY'S CANOSSIAN SECONDARY SCHOOL

I started the Science Research Programme in 2013 when I first joined the school, with an aim to train the students beyond the Science syllabus and to expose them to the world of Scientific Research.

Over the years, I have mentored many teams of students in Life Science Projects and most of which have participated in the SSEF. My mentoring journey had led me to venture into unfamiliar grounds and to unravel new knowledge.

I felt that the most important value to conduct a research study, for both future SSEF student participants and mentors is to have full commitment and to sustain that passion in the project to see to its completion. My greatest contentment is to witness the growth and development of students in the process, becoming more mature and skillful at the end.

MRS LYDIAWATI WONG

TEACHER

SCHOOL

ST. JOSEPH'S INSTITUTION

The 5-month journey of my team of three students towards SSEF was challenging and rewarding. Students learned to become extremely creative to overcome lack of sophisticated equipment in the school laboratory. It is only through their perseverance and determination that the project was completed, and I enjoyed immensely exchanging ideas and journeying along with them. The most memorable moment of the competition for them was their project presentation to SSEF judges. My advice to future SSEF participants is to never give up and to seek inspiration from others who have gone before them, so they know what to expect during SSEF.

MS LUO HUILIN MICHELLE

TEACHER

SCHOOL

TEMASEK SECONDARY SCHOOL

My journey as a teacher mentor started 3.5 years ago and my favourite part is being able to encourage inquisitive minds to research on creative scientific solutions for everyday problems. From creating bioplastics to using waste products to clean up oil spills; I will never forget the time when my students faced an issue with processing one of the waste products. It was heartening to see them step out of their comfort zone to seek help from others as they realised that the scientific endeavour is not a lonely one. We can all contribute to science and the society!

MDM CHIN SIEW MEE

TEACHER

SCHOOL

VICTORIA JUNIOR COLLEGE

I first joined VJC as a practicum student from NIE and shadowed a teacher for science research in 1996 and since then, I have been mentoring students in research projects. One of the most rewarding experiences is when students found their passion in research and decided to take up the A*STAR scholarships and have a career in research. Being a teacher mentor has kept me abreast with current research. It is not possible to guide research students if you don't know a little about their field of research.

THE SSEF 2021 EXPERIENCE: JUDGES

MR TAN TECK CHUAN

DIRECTOR (PLATFORM SYSTEMS)

Home Team Science & Technology Agency

I am honoured to be invited as one of the SSEF judges for the last 5 years. I have been very amazed and impressed with the engineering projects and research done by the students. The competition has become more intense in recent years and the submitted projects/reports have gotten more complex and higher in standard as well.

DR CHARLES ONG BAN CHOON

HEAD OF SCHOOL

PSB Academy

I have been a judge in the SSEF for more than 10 years and have always looked forward to interacting with passionate participants who are ever so keen to share their ideas and their work. It is amazing how the quality of projects has improved over the years and I am very proud of our outstanding young talents who showcase their projects each year. While I know that everyone has done their utmost in the SSEF, I hope that all participants and judges also had fun participating. The competition continues to be a platform to fuel students' interest in STEM education and career.

MR WINSTON HO

DEPUTY DIRECTOR (MECHANICAL & ELECTRICAL ENGINEERING DEPARTMENT 2)

JTC Corporation

As a first-time SSEF judge, I was very excited to be involved. Despite the judging process being conducted entirely online, the passion and drive of each group still shone through. It brought me great joy to be a judge. Kudos to all projects that have participated.

DR BUI VIET PHUONG

GROUP MANAGER / SENIOR SCIENTIST

A*STAR Institute of High Performance Computing

Being an SSEF judge provides me with great opportunities to meet many bright and enthusiastic students and gain my trust in our young generations. It is truly inspiring and fulfilling to observe many high-quality and user-inspired projects with a good application of science. For future judges: stay curious and enjoy the journey!

DR STEPHEN CHUA

RESEARCH FELLOW

Earth Observatory of Singapore, Nanyang Technological University

I joined SSEF 2021 hoping to spark the joy of science in students. Judges automatically critique and point out limitations, but we often forget they are still young! This must be paired with building up ideas and praising effort. Budding scientists need a lot of careful pruning and watering to flourish.

MS WHISTINE CHAI XIAU TING

FORENSIC PSYCHOLOGIST

Home Team Behavioural Sciences Centre, Ministry of Home Affairs

This was my first time being a judge in SSEF and I truly enjoyed the judging experience. It was a privilege for me to be part of this event, where I had the opportunity to talk to budding scientists/researchers and help nurture their research strengths and interests, particularly in the domain of psychology. I was not only impressed with the submissions by these young students, but also amazed with how the SSEF organisers manage to pull all these together!

ASSOCIATE PROFESSOR MANOJIT PRAMANIK

ASSOCIATE PROFESSOR

Nanyang Technological University

Its been a pleasure to serve as the SSEF judge for the past five years. Every time I interact with the young students during their presentations, I am glad to see that the future generation is on the right track for developing a creative, inquisitive, scientific mindset, which will benefit the country in the long run. The quality of the projects also have improved over the years significantly.

ASSOCIATE PROFESSOR NIKOLAI YAKOVLEV

ASSOCIATE PROFESSOR (ADJUNCT)

National University of Singapore

I have been judging SSEF since 2014, while my students have participated in SSEF since 2004. Every year, I taught them how to do science, write about it and give good presentations at SSEF. So when SSEF invited me to be a judge, I immediately agreed. I believe that my interaction with the students helps them to understand good science.

MR CHOI KUAN MENG

LECTURER

Republic Polytechnic

For me, doing judging work for SSEF is always one of the highlights of the year. The students' passion inspires me and they have worked hard to achieve technical findings that could help shape the future. See you next year!

MS SIM GIA WEN

SENIOR LECTURER

Nanyang Polytechnic

It was my first time as a SSEF judge and my privilege to witness the students' interesting projects. One thing I enjoyed the most was hearing from the students and giving my inputs to them. Apart from the competition, I think this event was a platform to nurture young and aspiring scientist/engineer.

PROFESSOR YU HAO

PROVOST CHAIR PROFESSOR AND DEPARTMENT HEAD

Department of Biological Sciences, National University of Singapore

I have been serving as an SSEF judge since 2005, and always relish the multiple roles I have played in the process as an evaluator, a motivator for inspiring young children to enjoy science, and a role model to pursue STEM careers.

DR TAN YEN KHENG

INDUSTRY CHAIR

Institute of Electrical and Electronics Engineering (USA) Singapore Section

I am glad to be part of the SSEF family to provide my technical expertise as well as my passion to learn and nurture with the students. The SSEF team did wonderful works for many years and looking forward for more ahead. Join us with a heart to serve!

DR PETER LEE

LECTURER

National Institute of Education, Nanyang Technological University

I have been an SSEF judge since 2005. Being a judge, I especially enjoyed all the passionate discussions with the students. I find their enthusiasms refreshing and uplifting. I also believe that it is my mission to encourage these students to become the future science and engineering leaders of tomorrow.

REGENERON INTERNATIONAL SCIENCE AND ENGINEERING FAIR 2021

INTRODUCTION

Regeneron International Science and Engineering Fair (Regeneron ISEF), organised by the Society for Science & the Public in the United States of America, is one of the world's largest annual pre-college science fairs that provides a platform for top STEM talents to showcase their projects.

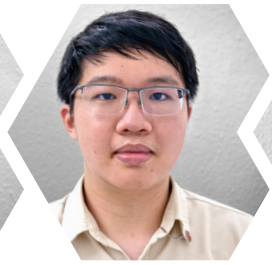
The fair was conducted virtually in 2021 and comprised two components. The competition segment was held from 3 to 6 May, while the official Regeneron ISEF events, such as panel discussions with experts and a STEM career hall, were conducted from 16 to 21 May. Ten Singapore students who performed well at SSEF 2021 were selected to compete against more than 1,800 youths from over 75 countries, regions and territories at the fair. They submitted four individual projects and two team projects and bagged a total of seven awards.

STUDENTS FROM TEAM SINGAPORE 2021

Lim Dillion

Bryan Lee

Ho Shanley



Huang Huiyan

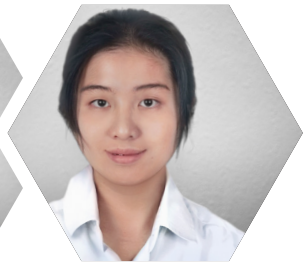
Shen Lingbo

Jishnu Talukdar

Nathaniel Tan

Low Ing

Tay Li Ann



Celyn Chng

MESSAGE BY DR FANNON LIM

I enjoy judging as I get to query students who think critically before giving their answers.

DR FANNON LIM

GRAND AWARD JUDGE

Regeneron International Science and Engineering Fair 2021

Deputy Director, Public Sectors
Singapore Institute of Manufacturing Technology (A*STAR)

Having been an SSEF judge for the past 16 years, it was a great experience to be this year's ISEF Grand Award Judge. As ISEF was held virtually for the first time, Team Singapore had to participate in the late evening and wee hours of the morning from the Little Red Dot. Despite the challenges presented by the ongoing pandemic, the results were remarkable, with Singapore bagging seven awards!
I enjoy judging as I get to query students who think critically before giving their answers. Some of their answers exceeded my expectations!

Through this competition, students will be able to hone their research, science communications, critical thinking and independent learning skills. These competencies are relevant and important for both their professional and personal lives.

One takeaway for students is to link their work to practical applications and emphasise on how it can be world-changing. In this way, judges will be able to determine how well students are able to understand and apply their findings.

TEAM SINGAPORE'S REGENERON ISEF DELEGATES

- **LOW IING**
- **TAY LI ANN**
- **CELYN CHNG**

SCHOOL

RAFFLES INSTITUTION
(RAFFLES GIRLS' SCHOOL)

"SSEF and ISEF 2021 showed us that science communication is critical to STEM research. We would like to thank the judges for their enlightening comments during judging interviews."

PROJECT TITLE

Supplementation of Lactobacillus casei reduces ß-amyloid accumulation in Alzheimer Drosophila melanogaster

Celyn, Li Ann, and Low Iing were inspired to discover new treatments for Alzheimer's disease when they chanced upon Lactobacillus casei (L. casei). Based on their research, L. casei, which is low in cost, has the possibility to treat the root cause of Alzheimer's disease. Hence, it is a potentially promising method to treat patients suffering from this disease.

Through the project, they learned of the importance of teamwork and trust. It was through their teammates' support and encouragement that they managed to step out of their comfort zones when doing the research project.

Celyn, Li Ann and Low Iing did their project in Raffles Girls' School and are currently studying in Raffles Institution.

- **LIM DILLION**
- **BRYAN LEE CHONG HAN**
- **HO SHANLEY**

SCHOOL

HWA CHONG INSTITUTION

"While in-person interaction is always more personable, having SSEF and ISEF held online afforded greater convenience of learning more about our peers' projects."

PROJECT TITLE

Intricate Study of Hydrothermally-Synthesised Hexagonal $K_2W_4O_{13}$ Nanowires for the Adsorption and Photodegradation of Organic Dyes and Heavy Metal Ions

Dillion, Bryan, and Shanley's project involved the synthesis of Potassium Tungstate Nanowires to remove water pollutants. Their one-pot and hydrothermal synthesis technique is environmentally-friendly, cheap, and fast.

The breakthrough of this project was the discovery that the Potassium Tungstate Nanowires had dual properties — the ability to adsorb pollutants and photodegrade dyes.

Their research journey had been an exciting one. While they struggled with the research during the COVID-19 pandemic, they managed to overcome the odds in completing the research project. They are especially thankful to their mentor, Mrs Sow-Peh Yoke Keow, for her constant support and guidance, acknowledging that they would not have come this far without her.

JISHNU TALUKDAR

SCHOOL

ANGLO-CHINESE SCHOOL (INDEPENDENT)

"The online format of SSEF and ISEF 2021 allowed me to meet many like-minded people and share my project findings."

PROJECT TITLE

Novel Open Time to Event model for low-cost and long-term marine population abundance estimates from remote underwater video stations.

Having observed a lack of marine population size and distribution data to come up with efficient conservation strategies, Jishnu developed a low-cost method to obtain full open fish population estimates using only cameras and his probability model.

Jishnu described his experience participating in the ISEF 2021 as "beyond thrilling". Apart from having the opportunity to speak to experienced scientists and entrepreneurs, he also enjoyed interacting with like-minded individuals who were passionate in science.

SHEN LINGBO

SCHOOL

NATIONAL JUNIOR COLLEGE

"While judging for both SSEF and ISEF were conducted live via video conferencing this year, the interactions I had with judges were equally effective and inspiring. I enjoyed sharing my research findings with peers and experts of the STEM community."

PROJECT TITLE

Novel Coating of Porous Cu as Heat Pipe for Thermal Management

Lingbo's project deals with the problem of overheating in electronic devices which could potentially cause damage to fragile electrical components. For the first time through this project, a multilayered porous copper structure was synthesised by electrodeposition, functioning as capillary wicks in heat pipes. This material demonstrates superior characteristics including high porosity, great capillarity and structural integrity which can greatly facilitate cooling actions. Its fabrication method, electroplating, is environmentallyfriendly, time-efficient, and cost-effective, and hence will be promising in industrial settings.

From the research journey, Lingbo learned the importance of several transferable skills, especially communication skills which are crucial for the delivery of scientific findings. She also learnt the value of adaptability, open-mindedness and perseverance when conducting scientific research.

TEAM SINGAPORE'S REGENERON ISEF DELEGATES

HUANG HUIYAN

SCHOOL

HWA CHONG INSTITUTION

"Presenting at SSEF 2021 has helped me hone my science communication skills. The online format was a unique experience for us to share our research projects with others."

PROJECT TITLE

Wearable Strain Sensors with Silver Nanowires for Health Monitoring

Huiyan's project aims to fabricate kirigami-patterned wearable strain sensors for long-term human health monitoring. He systematically optimised the silver nanowire synthesis process, producing long silver nanowires to create strain sensors with high stretch ability, stability, and sensitivity. These strain sensors have been applied on the human hand, and have been proven to allow muscle rehabilitation and wound healing.

Through the project, Huiyan learned the importance of resilience in bouncing back from setbacks.

NATHANIEL TAN XIN RUI

SCHOOL

RAFFLES INSTITUTION

"SSEF 2021 was very well organised. I enjoyed discussing ideas and concepts with judges even though it was via video conferencing."

PROJECT TITLE

Liar Liar Pants on Fire: A Computer Vision Approach to Deception Detection

Lie detection has been a subject of interest of late due to the potentially severe repercussions that false statements have on society. For example, the harm from a false testimony can be significant and potentially lead to an innocent person being convicted and incarcerated, while allowing a guilty person to be freed. Nathaniel's project uses computer vision and machine learning to detect deception in high-stakes situations, such as testifying in court and during police investigations, through the facial characteristics of the subject.

Through this journey, Nathaniel learned the importance of independence and perseverance when facing challenges. At the ISEF 2021, Nathaniel enjoyed meeting people from all over the world, who shared similar interests in wanting to improve the world through science.

SSEF 2021 MAIN CATEGORY AWARD WINNERS

GOLD

Celyn Chng **Tay Li Ann** **Low Ling**
RAFFLES GIRLS' SCHOOL (SECONDARY)
Supplementation of Lactobacillus casei reduces ß-amyloid accumulation in Alzheimer Drosophila melanogaster

Huang Huiyan
HWA CHONG INSTITUTION
Wearable Strain Sensors with Silver Nanowires for Health Monitoring

Nallapuraju Ananya **Ye Chen Rui**
Prannaya Gupta
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Gait Monitoring and Analysis of Parkinson's Disease Patients

Zhang Lanyu **Du Yu**
VICTORIA JUNIOR COLLEGE, RAFFLES INSTITUTION
The Use of Digital Aids in the Learning of Geometry and Its Effects in the Home-Based Learning Setting

Praakhar Agrawal **Anika Lee W Xuen**
Venkatesan Subasriram
RAFFLES INSTITUTION
Transcriptional Candidates as Biomarkers for Allergic Rhinitis

Mahendran S/O Ravindran
Kuan Ming Jie **Ethan Lim Herng Rwei**
HWA CHONG INSTITUTION
Antimicrobial, Antioxidant, Toxicity and Phytochemical screening of Dieffenbachia camilla and the synthesis of a novel and green topical delivery method for it

Kuok Ray Ann **Chew Kuan Yu Ervin**
Lim Jun Teck Bryan
CLEMENTI TOWN SECONDARY SCHOOL
Isolation and Characterisation of Human Proteins that interact with the Orf10 Protein of Sars-CoV-2

Lim Ainsley **Bryan Lee Jia Cheng**
N D Durghadeve
CLEMENTI TOWN SECONDARY SCHOOL
Host Target Proteins for the Spike protein of Sars-Cov-2

Shen Lingbo
NATIONAL JUNIOR COLLEGE
Novel Coating of Porous Cu as Heat Pipe for Thermal Management

Jishnu Talukdar
ANGLO-CHINESE SCHOOL (INDEPENDENT)
Novel Open Time to Event model for low-cost and long-term marine population abundance estimates from remote underwater video stations

Lim Sing Wei
RIVER VALLEY HIGH SCHOOL
A Differential Gene Expression Analysis of Alzheimer's Disease Single-Cell RNA-Seq Transcriptomes

GOLD

Lim Dillion **Bryan Lee Chong Han**
Ho Shanley
HWA CHONG INSTITUTION
Intricate Study of Hydrothermally-Synthesised Hexagonal $K_2W_4O_{13}$ Nanowires for the Adsorption and Photodegradation of Organic Dyes and Heavy Metal Ions

Yu Zhenning **Fu Wenbo**
Ethan John Lim
HWA CHONG INSTITUTION
Synthesis of magnetic chitosan hydrogel from crab shells as an environmentally-friendly adsorbent for water purifcation

Liao Xinyan **Tan Jiecong**
HWA CHONG INSTITUTION
Treatment of Effluent With Azo Dyes and Heavy Metals by Electrochemical Advanced Oxidation Processes (EAOPs) Using Graphene-Coated Electrodes

Sheng Jiarui
DUNMAN HIGH SCHOOL
Optical Technique for Rapid and Quantitative Bacteria Detection

Yan Jun Jie **Merwin Tham Weng Yahn**
Zhang Kaiwen
HWA CHONG INSTITUTION
Fabrication of eco-friendly cellulose-reduced graphene oxide hybrid aerogel from various fruit wastes for water purification

Jonathan Chew Jian Pin **Wang Zixun**
RIVER VALLEY HIGH SCHOOL
Design and Testing of a Novel Single-Rotor Tailsitter

Tay Kar Ray **Yong Ming Le, Ethan**
RAFFLES INSTITUTION
Designing a Low-cost and Compact Circuit to Effectively Perform Nuclear Quadrupole Resonance (NQR) Spectroscopy on Medical Pills Containing N-14 Nuclei

Tan Jo Shin **Eishwar Ravichandran**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Deep-Learning Driven IoT System for Noise Pollution Analysis on Marine Biodiversity

Xu Yifan **Deng Chunyi**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Investigation of the Shoelace Method in Higher Dimensions

Chelsea Chan Li Xin
RIVER VALLEY HIGH SCHOOL
Potentiation of Antibiotic Activity by Cationic Cyclic Peptides on Gram-Negative Bacteria

GOLD

Tan Chien Hao
RAFFLES INSTITUTION
Topology and Geometry of 3-Band Models

Trivikram Mohan **Omkar Mahadevan**
Tang Kean Seng
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Heterologous Expression of a Mangrove K^+ Transporter, AoHKTI increases salt tolerance of Arabidopsis Thaliana

Glenda Tan Hui En **Goh Xin Ru Karin**
RAFFLES GIRLS' SCHOOL (SECONDARY)
Stool Recognition for Colorectal Cancer Detection through Deep Learning

Nathaniel Tan Xin Rui
RAFFLES INSTITUTION
Liar Liar Pants on Fire: A Computer Vision Approach to Deception Detection

Jiang Zhiheng
HWA CHONG INSTITUTION
Unveiling music genre structure through common-interest communities

Tew Ci Heng Nathan
Jotham Lim Jia Liang
RAFFLES INSTITUTION
Improved graphical user interface for interactive pixel tight segmentation

SILVER

Lee Yuan Xi **Zoey Lau,**
Ess Alexander Jones Shijie
RAFFLES INSTITUTION,
RAFFLES INSTITUTION,
TEMASEK JUNIOR COLLEGE
The Evolution of Colours in Butterflies

Senthil Kumar Harsha **R Shahana**
RAFFLES INSTITUTION
Impact of Social Jet lag (SJL) on Depressive Symptoms of Adolescents

Huang Yimin
RAFFLES INSTITUTION
Linguistic Indicators of Success in Aviation Emergencies: A Cockpit Voice Recorder (CVR) Investigation

Elamperuvaluthi Alexander **Pu Yinghao**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Rapid Ligand Binding Assay of Zika Virus NS2B-NS3p for Drug Development using 19F-NMR Spectroscopy

SILVER

Pl Sriram
ANGLO-CHINESE SCHOOL (INDEPENDENT)
Investigating the antioxidant potential of berries namely Blueberry (Vaccinium corymbosum), Blackberry (Rubus fruticosus), Raspberry (Rubus idaeus), Cranberry (Vaccinium subg. Oxycoccus), and Strawberry (Fragaria ananassa) through a mung bean shoot (Vigna radiata) bioassay and Onion root (Allium Cepa) bioassay

Maggie Yao Chai Yinzhi **Aw Si Yu**
RAFFLES GIRLS' SCHOOL (SECONDARY)
Supplementary DHA ameliorates motor and cognitive dysfunction in Drosophila melanogaster model of Alzheimer's Disease

Teng Jia Jun, Zen
Chiow Yan Cheng Steve
HWA CHONG INSTITUTION
Synthesis and Intercalating Abilities of Ruthenium-Arene Complexes with Chalcone and Bidentate Ligand

Claire Sze Wei Roberts **Avelyn Yap En**
Emma Gan Li Ann
METHODIST GIRLS' SCHOOL
Artificial Intelligence Models for Predicting Statin-Induced Myalgia using Clinical and Genetic Factors

Kiefer Ong Xian Yao **Ng See Jay**
Pierre Yeap Yu Song
HWA CHONG INSTITUTION
Synthesis of an Eco-friendly and Reusable Magnetic Ferrofluid using Orange Peel Extract for Oil Spill Cleanup

Jonathan Lee Beng Fong **Lu Zihan**
Lok Peng Yee
HWA CHONG INSTITUTION
Green synthesis of calcium hydroxyapatite using eggshells for the removal of heavy metal ions and fluoride ions

Woon Zee Ning **Lim Zhi Yan** **Vicky Ang**
DUNMAN HIGH SCHOOL
Potential of Acid and Alkali chemical activators of Biochar for the Effective Removal of Ibuprofen

Selina Peh Yuet Ning
RAFFLES INSTITUTION
Wideband Sinuous Antenna Design

Paul Seow Jian Hao **Akshat Chaudhary**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Brannan's conjecture and trigonometric polynomials: the case strictly between 0.5 and 1

Wong Yin Leng Angelina
Ethan Kuai En Kai
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Investigating the Effectiveness of Non-pharmaceutical Interventions on COVID-19

Dhanabalan Jeevakaarthik
Siddharth S Arumuganainar
Krishnan Nithesh
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Riemann Zeta Function: A Real Analytic Approach

SILVER

Oh Chin Aik **Tai Zi Xiang**
HWA CHONG INSTITUTION
Characterisation of Quantum Walk with Cross-Entropy

Yap Yu Ting **Austin Huang Deyu**
RAFFLES INSTITUTION
Synthesis of Novel Silica Aerogel Composites

Malcolm Sow Miao Geng
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Emergence of Fluorescence Properties in Human Hair tailored by Focused Laser Beam

Vannessa Toh Hui Ying **Chan Dong Jun**
HWA CHONG INSTITUTION
Formation and stability of tannic acid and gelatin multi-layers

Wang Yiqin **Chen Shuheng**
HWA CHONG INSTITUTION
Automatic diagnosis of Coronary Artery Disease through multi-vessel analysis of coronary angiograms with a novel AI approach

Tham Yun Xin
RAFFLES GIRLS' SCHOOL (SECONDARY)
Quantification of Kinetic Friction Coefficient with Timoshenko Oscillator

Yang Jingxiang **Gan Chee Joon**
Lee Rui Kai
RIVER VALLEY HIGH SCHOOL, RIVER VALLEY HIGH SCHOOL, ST. JOSEPH'S INSTITUTION
2D Moire Heterostructure

Alysa Lee Mynn
RAFFLES GIRLS' SCHOOL (SECONDARY)
Cross-lingual Information Retrieval

Lim Sui Ron
VICTORIA JUNIOR COLLEGE
Machine Learning/Deep Learning Techniques for Advanced Image Inference Tasks

Teng Yee Shin
RIVER VALLEY HIGH SCHOOL
Data-Driven Method for Li-Ion Battery Health Monitoring

Narayanan Aravind **Kane Ng Zheng Kang**
Shriniket Subramanian
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
EMG Signals Decoding

Lek Wing Chung, Eugene
ANGLO-CHINESE JUNIOR COLLEGE
VAE-U-nets: Addressing the weaknesses of GANs used for image resolution enhancement

Tang Guang Xiang **Choong Kai Zhe**
Isaac Yang Xue Yan
RAFFLES INSTITUTION
Developing Suspect Detection Systems using Machine Learning

Clarissa Koh Shi Qi **Lim Donggeon**
Marvyn Chia Kai Liang
ANDERSON SERANGOON JUNIOR COLLEGE
Detection and Removal of Obstructions in Still Images Utilising Machine Learning

BRONZE

Zhou Xinyan
RAFFLES INSTITUTION
Electrocardiogram-based Arrhythmia Classification using Machine Learning and Complexity Analysis Techniques

Tia Shi Ting **Angelica Lee**
EUNOIA JUNIOR COLLEGE
Limb Hypothermia for Preventing Chemotherapy Induced Peripheral Neuropathy: Effects of Different Limb Hypothermia Modalities on Motor Nerve Functions

Medha Shridharan
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Development of a Paper-based Test for the Detection of IL-6

Hong Wan Jing **Teo Jin Yin Yvette**
Bay Kai Fen, Kylie
RAFFLES GIRLS' SCHOOL (SECONDARY)
Investigation of Lactobacillus casei in the Treatment of Parkinson's Disease in the Nematode Model Caenorhabditis elegans

Lu Shiyi Rachel **Sheryl Tay Ke Ying**
RAFFLES GIRLS' SCHOOL (SECONDARY)
Elucidating the role of MAMDC2 in head and neck squamous cancer

Allysa Tan Li Ying
NATIONAL JUNIOR COLLEGE
A Computational Model of Microtubule Dynamics for Multi-Nuclei Positioning in Myotubes

Ayyappan Lakshmanan **Luo Zhongyi**
Kyi Cin Thet
RAFFLES INSTITUTION
Effectiveness of Non-defatted _Carica_ Papaya Seed Powder as a Low-cost Biosorbent in the Removal of Wastewater Pollutants

Choy Yeung Yi, Josher **Soh Swee Min**
Tey Yee Xin, Sheryl
TEMASEK SECONDARY SCHOOL
Investigating the effectiveness of common biodegradable waste products in Singapore in cleaning up oil spills

Low Jeen Liang **Yiu Yi Hin Kinsey**
Tan Wei An
HWA CHONG INSTITUTION
Electrochemical Enhancement of Activated Carbon Fibre for the Purification of Solvent Contaminated Pharmaceutical Effluents

Yong Rei En **Kera Ruth**
Mak Zhan Rui Jovan
NATIONAL JUNIOR COLLEGE
Design of Underground Structure to Mitigate Effects of Soil Liquefaction

Sruthi Muralikrishna
RAFFLES INSTITUTION
Interfacial Engineering for High Efficiency Perovskite Solar Cells

BRONZE

Ryan Wong Wern Jieh
Gabriel Goh Hao Xiang
Brandon Ong Jing Jie
HWA CHONG INSTITUTION
The Math Behind Scaffolding

Zhou Kangyun **Sun Yuang** **Liu Lekuan**
HWA CHONG INSTITUTION
Plague Inc: Mathematical Model of Contagions

Guo Lukang **Gao Jiquan**
HWA CHONG INSTITUTION
The study of epidemic model in the context of Singapore

Lim See Min **Li Yuanfei** **Ho Kai Ting**
HWA CHONG INSTITUTION
Spectral Analysis of Public Transport Networks

Lim Sue Han Justin
Edden Chew Keyn-Hantz
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Analysis of a Pseudorandom Bit Generator Based on Elliptic Curves

Lok Ting Yuan **Wong Kai Ray** **Yap Jia Le**
HWA CHONG INSTITUTION
Investigating the effects of sugarcane and lotus root extracts on the growth of Lactobacillus sp. and its effects on microbial antagonism.

Oh Shuyi
DUNMAN HIGH SCHOOL
Coloured Carbon Black: A Laser Initiation

Tsai King Ron **Yang Dexin**
Vishal Vijay Kumar
RAFFLES INSTITUTION
Investigating how the microbial community in the soil changes when Food Waste Anaerobic Digestate is used as fertiliser for the cultivation of the vegetables Bayam (Amaranthus dubius) and Chinese Cabbage (Brassica rapa) and its implications on growth

Tahamina Abdul **Isaiah Lee Boon Eng**
Ganesh Giri
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Isolation & Characterisation of Salmonella Phages

Tan Ren Ying **Ramachandran Mehal**
Caleb Koh Chao Yang
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Isolation and Characterisation of Acinetobacter Baumannii Phages from the Environment

Lee Rui Xuan
SWISS COTTAGE SECONDARY SCHOOL
Flora-scence: Graphene oxide-Blue Butterfly Pea Flower Composite

Sankar Jaikumar
RAFFLES INSTITUTION
A quasi-static approach to calculating the sinking time of damaged floaters and verification of model's predictive power with motion path analysis

BRONZE

Foo Lyn-Li, Kimberly **Ang Jan Syi**
Tan Yun Xuan
METHODIST GIRLS' SCHOOL
In-vitro propagation of Tillandsia bulbosa

Ethan Koh Hao **Goh Kai Meng**
Timothy Luke
ANGLO-CHINESE SCHOOL (INDEPENDENT)
investigating how charcoal to soil ratio aids in remediating allelopathy

He Yida
RAFFLES INSTITUTION
COVID-19 fake news detection using deep learning

Lu Haomeng **Zhu Jiabao**
NATIONAL JUNIOR COLLEGE
Evaluation of a new multivariate uniformity metric based on information entropy for efficiently accessing the uniformity of a meta-dataset based on an expertise space

Law Rui Xi **Yen Jun Hung**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Automating the playtesting of turn based strategy games using AI

Tan Yi Kai **Low Wei Sheng**
HWA CHONG INSTITUTION
Document Layout Analysis via Machine Learning

Alistair Cheong Liang Chuen
Beh Chuen Yang **Wu Jiayang**
HWA CHONG INSTITUTION
Explaining Adversarial Vulnerability with a Data Sparsity Hypothesis

Navaneethan Sanjai
Nachiappan Hari Subramanian
Sri Naren Omprakash
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Evaluation of divided attention performance using overt and covert SSVEP with different visual angles

Tan Shannon **Amy Ling Yuhui**
Natasha Yeo Ting Yu
RAFFLES INSTITUTION
Human Movement Analysis using Handphone IMU sensors

Chen Yijia
NATIONAL JUNIOR COLLEGE
Assessment of highly sensitive surface plasmon resonance biosensors for the SARS-CoV-2 virus detection by computational modeling & simulation

Lucia Li **Tanya Tan Xin Yu**
Gwen Yeo Wenning
RAFFLES INSTITUTION
Automatic Classification of Tau-PET images using Deep Learning

MERIT

Quah You Chen Roy
HWA CHONG INSTITUTION
Epigenetic modifications of fruitless in mushroom bodies influence male Drosophila courtship behaviour

Lye Yu Xuan **Lee Kia En**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
An Ex Vivo Beating Heart Study Model

Lau Wan Sin **Claudia Lai**
Jane Sim Jia Zhen
NATIONAL JUNIOR COLLEGE
Effects of listening to motivational high and low tempo music on 400m sprint performance in female youths

Jin Xiaoxuan **Lee Wai Yee**
HWA CHONG INSTITUTION
Personalized Guided Perceptual Learning

Chen Xinpeng **Li Yee Shin Carlyne**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Asymmetric remote functionalization for enantioselective synthesis of pharmaceutical molecules

Yap Vit Chun **May Phu Pwint**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Metal Ion Release Assembly (MIRA): A Novel Approach to Ultrafast Deposition of Conformal Two-Dimensional Material Multilayers on Arbitrary Substrates

Joon Kew Cheng **Tan Qi Xuan**
HWA CHONG INSTITUTION
Investigating the application of the separation capabilities of a Zirconium MOF B-oriented MFI zeolite membrane

Paige Soh Si Ying
Arunasalam S/O Senkuttuvan
RAFFLES INSTITUTION
Chitosan-modified rice husk biochar and its effects on heavy metal ion sorbency

Han Yijia **Delfina Poernomo**
Nico Tan Jing Ya
NATIONAL JUNIOR COLLEGE
Crude Oil Reclamation from polluted waters using Nets and Blowers

Ho Xu Ying Nicole **Pok Yuen Xuan**
DUNMAN HIGH SCHOOL
Study of the properties of fruit seed starch bioplastics and the effects of gelatin and used coffee grounds on it

Fei Yaowei **Xiong Hongrui**
Justin Low Renkai
RAFFLES INSTITUTION
Effectiveness of Canards Compared to Strakes as High Lift Devices

Reuben Ong **Ng Si Han**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Traffic Strategy for Mixed Traffic in Container Terminals

MERIT

Phoebe Wee ◦ **Sarah Wong Ee Min**
RAFFLES GIRLS' SCHOOL (SECONDARY)
Where Does the Signal Come From

Yap Jun Yan ◦ **Chan Kin Chung Ravan** ◦ **Yu Fei**
HWA CHONG INSTITUTION
Investigation and Construction of a Hot Wire Anemometer

Liang Yusen ◦ **Lee Jia Qing**
ANGLO-CHINESE JUNIOR COLLEGE
Future of solar energy: Global optimisation of all perovskite tandem solar cells through artificial intelligence

Tey Yi Fan ◦ **He Donghang** ◦ **Chow Guan Ze**
HWA CHONG INSTITUTION
Functional Equations with Permutations of Finite Order

Chua Rui Hong ◦ **Ooi Xuan Shan** ◦ **Javier Chan Yan Kai**
HWA CHONG INSTITUTION
Optimisation of Water Systems

Le Viet Hung ◦ **Xu Yu**
RAFFLES INSTITUTION, VICTORIA JUNIOR COLLEGE
Variants of the Gale-Berlekamp Switching Game and their Solutions: Balancing the Rectangle and the Cube

Jiang Kai Jie ◦ **Leroy Wong Yan Zhe** ◦ **Zachary Loh Zi-Yang**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Investigating Number of 5G Small Cells Required in Singapore

Jay Tai Kin Heng ◦ **Sim Hui Xiang** ◦ **Gabriel Tan Jiaxu**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Brannan's conjecture and trigonometric polynomials

Tan Jia Jun Shaun ◦ **Phua Jia Yang**
HWA CHONG INSTITUTION
Comparison of Microbial Safety and Quality Indicators in Spontaneous v.s. Probiotic-Controlled Fermentation of Carrots in a Home Fermentation Setting

Jennifer Goh Zhen Ni ◦ **Christophyr Yeoh Kai Xiang**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
The Combinatory Effects of Microplastics and Emerging Contaminants on model green alga Chlamydomonas Reinhardtii

Liang Ying Hao Matthew
NATIONAL JUNIOR COLLEGE
Winding-less magnetometer to measure permeability and core losses

MERIT

Chua Yao Xuan
RIVER VALLEY HIGH SCHOOL
A Numerical Simulation Study on Opinion Evolution in Complex Social Networks

Li Xinrui **Tee Ren Jie**
HWA CHONG INSTITUTION
Dynamics of a bouncing rigid capsule

Tan Jun Wei **Mikail Firas Abdul Jabbar**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE, RAFFLES INSTITUTION
A Comprehensive Study into the Magnetic Levitation of a Magnetic Stirrer

Sun Xiaoqing
RAFFLES GIRLS' SCHOOL (SECONDARY)
Viscous flow around a bottle

Matthew Yar Kwok Jway
RAFFLES INSTITUTION
An aeroacoustic study of the swinging sound tube

Low Ta Ken **Samantha Suchita Wibawa**
NATIONAL JUNIOR COLLEGE
Effects of UV Light on Plant Development

Glenda Chong Rui Ting
Chin Ling Xing, Lance
RIVER VALLEY HIGH SCHOOL
Into the Online World: Human or Bot?

Komati Reddy Nikhita
RAFFLES GIRLS' SCHOOL (SECONDARY)
Determining feasibility of mixed integer linear programming problem by machine learning

Lim Yi Dawn Adele
HWA CHONG INSTITUTION
AI Panorama Art of Proteins with Image Blending Deep Learning

Sean Lim Shi-An **Karis Yuen Xin Er**
Ryan Nathaniel Thesman
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
AI-driven data sentiment analysis

Ang Yan Lin **Chen Peiran**
HWA CHONG INSTITUTION
Finding Nemo: a fish-inspired soft robotic drone

Jovern Teo, Lyon Toh
Akhil Chandran Nair
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Motion Tracking for Fingers

Tan Huan Xi Gregory **Neo Souw Chuan**
HWA CHONG INSTITUTION
Self-supervised Learning with Deep Neural Networks for Computer Vision

SPECIAL AWARD

ECS SPECIAL AWARD

Sruthi Muralikrishna
RAFFLES INSTITUTION
Interfacial Engineering for High Efficiency Perovskite Solar Cells

Liang Yusen **Lee Jia Qing**
ANGLO-CHINESE JUNIOR COLLEGE
Future of solar energy: Global optimisation of all perovskite tandem solar cells through artificial intelligence

Wong Yu Zhen **Ooi Xin Yien**
Chloe Young
NATIONAL JUNIOR COLLEGE
Electricity Generation from Quercetin and Anthocyanin using Microbial Fuel Cell

ICHEME SINGAPORE AWARD

Balakrishnan Naveen Mani Kumar
Mothiki Eswara Anirudh
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Thermal Signature Analysis of Singapore's Housing Infrastructure

Wong Yu Zhen **Ooi Xin Yien**
Chloe Young
NATIONAL JUNIOR COLLEGE
Electricity Generation from Quercetin and Anthocyanin using Microbial Fuel Cell

SAAS SPECIAL AWARD

Lee Yuan Xi **Zoey Lau**
Ess Alexander Jones Shijie
RAFFLES INSTITUTION, TEMASEK JUNIOR COLLEGE
The Evolution of Colours in Butterflies

Lee Zhi Yan, Natalie
Aurelia Azifa Chelfannisa
CEDAR GIRLS' SECONDARY SCHOOL
SORBET Project

Eddula Jyotsna Reddy **Adeena Ansari**
Aina Afrina Bte Mohd Faizal
RAFFLES GIRLS' SCHOOL (SECONDARY)
Investigating Methods of Producing Bioplastics and its Physical Properties with Different Amounts of HCl

SPECIAL AWARD

SAAS SPECIAL AWARD

Lim Ainsley **Bryan Lee Jia Cheng**
N D Durghadeve
CLEMENTI TOWN SECONDARY SCHOOL
Host Target Proteins for the Spike protein of Sars-Cov-2

Allysa Tan Li Ying
NATIONAL JUNIOR COLLEGE
A Computational Model of Microtubule Dynamics for Multi-Nuclei Positioning in Myotubes

Kiefer Ong Xian Yao **Ng See Jay**
Pierre Yeap Yu Song
HWA CHONG INSTITUTION
Synthesis of an Eco-friendly and Reusable Magnetic Ferrofluid using Orange Peel Extract for Oil Spill Cleanup

Yan Jun Jie **Merwin Tham Weng Yahn**
Zhang Kai Wen
HWA CHONG INSTITUTION
Fabrication of eco-friendly cellulose-reduced graphene oxide hybrid aerogel from various fruit wastes for water purification

Kevin Ong Gheng Seong
He Yue, Hu Buyan
HWA CHONG INSTITUTION
Investigating the effect of bacteria and its synergistic effect on biodegradation of plastic

Foo Lyn-Li, Kimberly **Ang Jan Syi**
Tan Yun Xuan
METHODIST GIRLS' SCHOOL
In-vitro propagation of Tillandsia bulbosa

Tan Jo Shin **Eishwar Ravichandran**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Deep-Learning Driven IoT System for Noise Pollution Analysis on Marine Biodiversity

Malcolm Sow Miao Geng
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Emergence of Fluorescence Properties in Human Hair tailored by Focused Laser Beam

Shua Yee En, Cheryl **Teo Zuo Rui**
DUNMAN HIGH SCHOOL
Don't Trash the Ash - Burning Characteristics of the Fluorescence and Conductivity of Bottom Ash

Ayyappan Lakshmanan **Luo Zhongyi**
Kyi Cin Thet
RAFFLES INSTITUTION
Effectiveness of Non-defatted Carica Papaya Seed Powder as a Low-cost Biosorbent in the Removal of Wastewater Pollutants

Nathaniel Tan Xin Rui
RAFFLES INSTITUTION
Liar Liar Pants on Fire: A Computer Vision Approach to Deception Detection

Tew Ci Heng Nathan
Jotham Lim Jia Liang
RAFFLES INSTITUTION
Improved graphical user interface for interactive pixel tight segmentation

SPECIAL AWARD

SMS AWARD FOR INGENUITY

Yin Junren, Ryan **Chow Xing Yu**
Wong Yee Hern
HWA CHONG INSTITUTION
The Wheels of Life

Tey Yi Fan **He Donghang**
Chow Guan Ze
HWA CHONG INSTITUTION
Functional Equations with Permutations of Finite Order

SSMB SPECIAL AWARD

Tsai King Ron **Yang Dexin**
Vishal Vijay Kumar
RAFFLES INSTITUTION
Investigating how the microbial community in the soil changes when Food Waste Anaerobic Digestate is used as fertiliser for the cultivation of the vegetables Bayam (Amaranthus dubius) and Chinese Cabbage (Brassica rapa) and its implications on growth and yield

SUTD R&I AWARD: ARTIFICIAL INTELLIGENCE

He Yida
RAFFLES INSTITUTION
COVID-19 fake news detection using deep learning

Toh Jing En Daniel
Kan Rui Xian Matthew
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Investigating James Stein paradox and applying James Stein estimation to machine learning problems

SPECIAL AWARD

SUTD R&I AWARD: AVIATION

Bernice Chong Boon Yen
RAFFLES GIRLS' SCHOOL (SECONDARY)
Reliability Design and the In-Orbit Lifetime of Satellites

Yu Shuhuai
HWA CHONG INSTITUTION
Airfoil shape optimization using machine learning techniques

SUTD R&I AWARD: CITIES

Senthilkumar Iniya **Adhvika Mohan** **Singaravelan Divyashree**
RAFFLES INSTITUTION
Synthesis of activated carbon from coconut endocarp for the adsorption of microplastics and heavy metal ions removal

Ho Xu Ying Nicole **Pok Yuen Xuan**
DUNMAN HIGH SCHOOL
Study of the properties of fruit seed starch bioplastics and the effects of gelatin and used coffee grounds on it

SUTD R&I AWARD: HEALTHCARE

Lu Shiyi Rachel **Sheryl Tay Ke Ying**
RAFFLES GIRLS' SCHOOL (SECONDARY)
Elucidating the role of MAMDC2 in head and neck squamous cancer

Glenda Tan Hui En **Goh Xin Ru Karin**
RAFFLES GIRLS' SCHOOL (SECONDARY)
Stool Recognition for Colorectal Cancer Detection through Deep Learning

SUTD R&I AWARD: MULTI-DISCIPLINARY

Zhou Xinyan
RAFFLES INSTITUTION
Electrocardiogram-based Arrhythmia Classification using Machine Learning and Complexity Analysis Techniques

Chua Yao Xuan
RIVER VALLEY HIGH SCHOOL
A Numerical Simulation Study on Opinion Evolution in Complex Social Networks

SPECIAL AWARD

YALE-NUS SPECIAL AWARD

Lim Yi Ting, Erica **Zhang Yu**
Gong Yong Jia
RIVER VALLEY HIGH SCHOOL
Investigating the effect of different types of vinegar as adjuvants on the toxicity of Radix Bupleuri (RB)

Paramasivam Shaveen Gajaananan
ANGLO-CHINESE SCHOOL (INDEPENDENT)
To investigate the effect of temperature on shrimp-shell derived chitosan's adsorption capacity onto cationic and anionic toxic dyes (Methylene Blue and Eriochrome Black T respectively)

Goh Si Hui, Angela **Tan Yen Lin, Alyssa**
Zhang Qi
NATIONAL JUNIOR COLLEGE
reDISHsign your bins

Paul Seow Jian Hao **Akshat Chaudhary**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Brannan's conjecture and trigonometric polynomials: the case strictly between 0.5 and 1

Jiang Kai Jie **Leroy Wong Yan Zhe**
Zachary Loh Zi-Yang
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Investigating Number of 5G Small Cells Required in Singapore

Dhanabalan Jeevakaarthik
Siddharth S Arumuganainar
Krishnan Nithesh
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Riemann Zeta Function: A Real Analytic Approach

Vannessa Toh Hui Ying **Chan Dong Jun**
HWA CHONG INSTITUTION
Formation and stability of tannic acid and gelatin multi-layers

Li Xinrui **Tee Ren Jie**
HWA CHONG INSTITUTION
Dynamics of a bouncing rigid capsule

Tan Jun Wei **Mikail Firas Abdul Jabbar**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE, RAFFLES INSTITUTION
A Comprehensive Study into the Magnetic Levitation of a Magnetic Stirrer

Li Yue Chen
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
A Novel and Lightweight Virtual Proctoring System for Online Assessments

SSEF 2021 JUNIOR SCIENTIST AWARD WINNERS

PROJECT AWARD

DISTINCTION AWARD

Zhang Haiyun **Hilary Chee Xin Yi**
Anastasiya Samushkova
RAFFLES GIRLS' SCHOOL (SECONDARY)
Constructing a Prototype of Air Filter out of Plant Materials

Natalie Ho Shu Yi **Swetha Sivakumar**
Phang Zhi Xuan Belle
METHODIST GIRLS' SCHOOL
In Vitro Propagation Of Chinese Kale And Chinese Cabbage As An Alternative Method Of Growing Food

Dolot Shine Mikaela Maminta
Magbitang Callista Ysabelle Acuna
Ho Ke Ying
NGEE ANN SECONDARY SCHOOL
Investigation of the effectiveness of different plain weave structures on the tensile strength of rope bridges

Lam Chi Ki Daisy **Zhang Songbo**
Jerald Yeo
DUNMAN HIGH SCHOOL
Investigation on the Effectiveness of Indoor Plants on Absorbing Volatile Organic Compounds

MERIT AWARD

Looi Zi Jenn **Cheah Zong Heng**
Krishang Joshi
RAFFLES INSTITUTION
Development and characterisation of a facile, environmentally-friendly aluminium-oxygen batteries using coffee capsules and common household gelling agents gelatin and agar agar

Selvakumar Vigneshwaran
Drew Michael Terren Ramirez
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Quoridor

VIDEO AWARD

DISTINCTION AWARD

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Phang Zhi Xuan Belle

METHODIST GIRLS' SCHOOL

In Vitro Propagation Of Chinese Kale And Chinese Cabbage As An Alternative Method Of Growing Food

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Anastasiya Samushkova

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Lam Chi Ki Daisy **Zhang Songbo**
Jerald Yeo

DUNMAN HIGH SCHOOL

Investigation on the Effectiveness of Indoor Plants on Absorbing Volatile Organic Compounds

Joella Hau Ryae Ning **Chan Kai Ling**
Isabel Kye Li Ho

RAFFLES GIRLS' SCHOOL (SECONDARY)

Prototyping Biodegradable Food Containers made from Durian Rind Material

Alex Teng Yi **Jaeden Soon Chuankai**
Favian Lim Wey Yee

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Testing the Strength of Pykrete

Teng Ywee See **Myat Noe Ein Chai**

NATIONAL JUNIOR COLLEGE

Effect of salinity stress on Plant Growth of Microgreen

Ang Chong Zhe **Chew Yu Heng**
Dong Huanran

DUNMAN HIGH SCHOOL

Biofuel production through transesterification of different plant oils

ACKNOWLEDGMENTS

THANK YOU

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