Ministry of Education
SINGAPORE

SCIENCE CENTRE
singapore

NATIONAL STEM TALENT SEARCH AND SINGAPORE SCIENCE & ENGINEERING FAIR

AWARDS PRESENTATION CEREMONY

2024



PROGRAMME

Date 30 April 2024, Tuesday
Venue Auditorium, National Gallery Singapore

TIME	PROGRAMME
1:30pm	Arrival of guests
2:00pm	Welcome by Master of Ceremony
2:10pm	Welcome Address by **Associate Professor Lim Tit Meng** *SSEF Co-chairperson*
2:20pm	Address by Guest-of-Honour for NSTS 2024 **Professor Ng Huck Hui**
2:30pm	SSEF 2024 Video Highlights Singapore Science & Engineering Fair 2024 Awards Presentation
3:20pm	NSTS 2024 Video Highlights
3:30pm	National STEM Talent Search 2024 Awards Presentation
4:00pm	Tour of Finalists' Exhibition and Tea Reception
5:00pm	End of Programme

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Chairperson
Singapore Science & Engineering Fair Working Committee 2024
Director, Sciences Branch,
Curriculum Planning and Development Division,
Ministry of Education

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Co-Chairperson & Fair Director
Singapore Science & Engineering Fair Working Committee 2024
Chief Executive, Science Centre Singapore

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Chairperson, National STEM Talent Search 2024 Awards Committee
Provost, Singapore University of Technology and Design

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2024 Finalists

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SINGAPORE SCIENCE & ENGINEERING FAIR (SSEF)

BACKGROUND

The Singapore Science & Engineering Fair (SSEF) is a national competition organised by the Ministry of Education (MOE) 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. At the project exhibition in the fair, participants are interviewed by judges from organisations and institutions including 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.

SSEF 2024

2024 marks the 24th year of the Singapore Science and Engineering Fair (SSEF). SSEF 2024 continues to see high levels of participation with 550 projects registered for the Main Category. 319 of these projects were shortlisted for Final Judging in March 2024. A total of 117 Main Category awards were given out, comprising 27 Gold, 28 Silver, 36 Bronze and 26 Merit. This year, thirteen organisations (Amgen; ARTC-SIMTech; Institute of Chemical Engineers, Singapore; James Dyson Foundation; L'Oréal Groupé; NUS Chemistry; Singapore Association for the Advancement of Science; Singapore Mathematical Society; Singapore Society for Microbiology and Biotechnology; Singapore University of Technology and Design; The Electrochemical Society, Singapore Chapter; Institute of Engineers, Singapore; Yale-NUS college) sponsored 18 Special Awards, which were awarded to 76 projects.

In the Junior Scientist category (for students under 15 years of age at the period of experimentation), 67 projects were registered, and 31 projects were shortlisted for Final Judging. Five projects were awarded Distinction and three were awarded Merit for overall content and poster presentation. All 67 projects were eligible to participate in the Junior Scientist Video Contest out of which three were awarded Distinction and another three were awarded Merit for their videos.

FOREWORD



Mr Teo Kok Hong

CHAIRPERSON, *Singapore Science & Engineering Fair Working Committee 2024*

DIRECTOR, *Sciences Branch, Curriculum Planning and Development Division, Ministry of Education*

The Singapore Science and Engineering Fair (SSEF) continues to gather traction since returning to an in-person format in 2023. SSEF has grown stronger with an increasing number of schools and organisations participating over the years. Representatives from various organisations, ranging from research institutions to industry partners and the general public had the opportunity to engage students and learn more about these budding scientists' research innovations. Students, judges and visitors absorbed in scientific discourse was a sight to behold at every SSEF. We look forward to this continued zest and interest in STEM and research, and hope to celebrate the good effort by all present and past students with the upcoming SSEF Silver Jubilee in 2025.

SSEF is an important platform that brings together students, educators, researchers and industry professionals to learn about, share and collaborate on STEM research. We see our students developing into adaptive thinkers and creative problem-solvers as they learn new skills, sharpen their thinking and enrich their perspectives of STEM-related fields. We are confident that our students will be able to anticipate and address future challenges, and are motivated to make positive changes to society for a better future.

This year, 1399 students from 51 schools submitted 617 research projects for the fair. A total of 117 projects received Gold, Silver, Bronze and Merit Awards. To all student participants, we are proud of what you have accomplished! With the positive feedback received for past years' fringe activities offered by our partner organisations, SSEF has continued to expand the variety of activities this year. This year's SSEF Public Day comprised ten unique hands-on activities by valued partners and four STEM talks offered by our sponsor organisations, alongside the showcase of research projects by student finalists. The interest and response from schools and the public continues to be strong with at least 2000 visitors on SSEF Public Day this year. We were heartened by the strong show of support for our student finalists and the increasing interest in STEM from our schools and the public.

SSEF 2024 would not be possible without the invaluable support from the various members of our STEM community. I would like to express my deepest gratitude to the teachers, research mentors and judges for your valuable time, effort and expertise in developing our young talents. I would also like to thank our partner organisations for sponsoring the Special Awards to recognise our students' efforts to advance research. The 13 organisations are Amgen, ARTC-SIMTech, Institute of Chemical Engineers, Singapore, James Dyson Foundation, L'Oréal Groupé, NUS Chemistry, Singapore Association for the Advancement of Science, Singapore Mathematical Society, Singapore Society for Microbiology and Biotechnology, Singapore University of Technology and Design, The Electrochemical Society, Singapore Chapter, Institute of Engineers, Singapore and Yale-NUS college. Finally, I would like to thank our sponsors, A*STAR Graduate Academy, Defence Science and Technology Agency (DSTA), DSO National Laboratories, and Home Team Science and Technology Agency (HTX), and our longstanding co-organiser, Science Centre Singapore for the support and dedication in ensuring an enriched STEM learning experience for our students.

We look forward to your support for the upcoming SSEF Silver Jubilee in 2025. Let us ride on the wave of change and continue to be Curious, be Creative and be a positive agent of Change!

Mr Teo Kok Hong
CHAIRPERSON, *Singapore Science & Engineering Fair Working Committee 2024*
DIRECTOR, *Sciences Branch, Curriculum Planning and Development Division, Ministry of Education*

FOREWORD



Associate Professor Lim Tit Meng
FAIR DIRECTOR
CO-CHAIRPERSON, *Singapore Science Engineering Fair Working Committee 2024*
CHIEF EXECUTIVE, *Science Centre Board*

This year marks the 24th anniversary of the Singapore Science & Engineering Fair (SSEF), jointly organised by the Ministry of Education (MOE) and Science Centre Singapore (SCS). SSEF provides an excellent platform to showcase the passion of our budding scientists and engineers to industry experts. The winners will have the opportunity to represent Singapore at the prestigious International Science and Engineering Fair (ISEF), considered the Olympics of science competitions.

Candidates with outstanding research projects from SSEF 2024 can further compete in the National STEM Talent Search (NSTS), an annual competition designed to motivate and accord national recognition to students who excel in STEM. Following a rigorous selection process, only the best nine progress to the final round. They will be evaluated by an esteemed panel of judges chaired by Professor Phoon Kok Kwang, Provost of Singapore University of Technology and Design (SUTD), and together with Chief Judge Professor Ng Huck Hui, Assistant Chief Executive for Research and Talent Development, and Chief Scientific Advisor of the Institute of Molecular and Cell Biology (IMCB), under the Agency for Science, Technology and Research (A*STAR).

Competitions such as SSEF & NSTS provide a platform for youth to showcase their projects and an opportunity to work with professional mentors on their research. This immersive learning opportunity offers excellent insights for our youth and helps ignite their passion to pursue a career in STEM.

SSEF continues to draw strong interest from students in Singapore with more than 1000 students submitting 617 research projects this year. Of these, 69 projects were submitted for NSTS 2024 and competed for the top nine positions. I am extremely heartened by the enthusiasm and determination of the students and look forward to seeing their projects showcased at the awards ceremony on 30 April.

My sincere gratitude to all judges, mentors, trainers, teachers, parents and officials involved in this meaningful journey. On behalf of the Centre, I would especially like to thank MOE for their support, our sponsors and partners. Together through this initiative, we will continue to nurture the scientists of tomorrow.

Associate Professor Lim Tit Meng
FAIR DIRECTOR
CO-CHAIRPERSON, *Singapore Science Engineering Fair Working Committee 2024*
CHIEF EXECUTIVE, *Science Centre Board*

SSEF 2024 WINNERS

GOLD

Aaron Jacob, Possaweekrish Wipasstharitsakul
VICTORIA JUNIOR COLLEGE, HWA CHONG INSTITUTION
Analysis and Modelling of Eutrophication using System Dynamics

Akshat Vijoy
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Comprehensive Modelling and Dynamical Analysis of Magnetic Braking in Rotating Conductive Spheres for Space Debris Mitigation

Ang Gedeon Kusuma
RAFFLES INSTITUTION
SMART (Sustainable, Modular, Additively-manufactured, Robust, Tower-style) Urban Farming

Anselmo Klement Chua
RAFFLES INSTITUTION
Glycolysis and DNA Repair: Novel Roles of Pyruvate Kinase in the DNA Damage Response

Boyce Ang Kok Hong (Hong Guo Feng), Ng Yu Heng, Sun Zizhuo
HWA CHONG INSTITUTION
Optimised Numerical Methods for the Computation of Particles in Fusion Hotspots and Particle Interactions in Magnetised Liner Inertial Fusion (MagLIF)

Cai Junxiang, Aidan Ong
NATIONAL JUNIOR COLLEGE, HWA CHONG INSTITUTION
State Space Models Are All You Need

Chen Qingyuan, Ling Jun Quan
RIVER VALLEY HIGH SCHOOL, HWA CHONG INSTITUTION
Investigating the Effects of pH in the Rejection of Boron in Reverse Osmosis for Seawater Desalination

Galen Gay
NATIONAL JUNIOR COLLEGE
Assessment of the Umami Flavour of Commercial Meat and Plant-based Meat Analogues

Gan Kah Shuen
RAFFLES INSTITUTION
Yeast-based High-throughput Screening of Plasmodium falciparum Phosphodiesterase Beta (PDEβ) for Malaria Drug Discovery

Gan Mingle Chloe
ANGLO CHINESE JUNIOR COLLEGE
Analysis of Differentially Expressed Genes in Sapotaceae Ripening

Ivan Joel You Wen Jie
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Synergistic Combination of $Sb_2Si_2Te_6$ Additives in $Bi_{0.4}Sb_{1.6}Te_3$ for Enhanced Thermoelectric Waste Heat Harvesting

SSEF 2024 WINNERS

GOLD

Jack Low Ee Jin, Jiang Ruiyang
HWA CHONG INSTITUTION
Engineering Phase Transformation Behaviour in the 4D Printing of Ni-Ti Shape Memory Alloys

Jamie Wen
DUNMAN HIGH SCHOOL
Novel Next-gen Engineered Phage-photosensitisers: A Golden Opportunity against Multi-drug Resistant Pseudomonas Aeruginosa

Kabir Jain, Shah Mahir Hitesh
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Words that Heal: Retrieval-Augmented Large Language Models for Enhanced Medical Report Generation

Lim Wan Qin
HWA CHONG INSTITUTION
Fighting Future Pandemics: A Novel Approach to In Silico Drug Discovery for Global Health Priority Pathogen Nipah Henipavirus

Lv Jindong, Kang Taeyoung
RAFFLES INSTITUTION
Developing Novel Phase Retrieval Algorithms and Fourier Ring Analysis of Accuracy Limitations under Imaging and Propagation Errors

Martin Koh Zhen Xuan
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Precession, Nutation and Dynamic Trajectory of a Magnetic Rod in an Axisymmetric Magnetic Field

Mazereeuw Luc Martin Linus
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Patterns of Floating Droplets Excited with Faraday Waves

Michael Ho Kok Hou
HWA CHONG INSTITUTION
High Efficiency Polymer Solar Cells

Ng Le Xi, Khoo Jun Xin, Lee Hayoung
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Synthesis of Novel and Sustainable Biosorbents for Water Purification from Bread Waste

Nguyen Duc Minh Anh, Nguyen Thien Minh Tuan
HWA CHONG INSTITUTION
Investigating the Effects of Microclimate on Students' Stress and Emotions using Electrodermal Activity in Quasi-formal Academic Contexts in Singapore

SSEF 2024 WINNERS

GOLD

Ong Jiunn Xiang
RAFFLES INSTITUTION
Acoustic Analysis of the Pitch and Timbre of the Sound Produced by a Siren Disk

Prabakaran Sahana
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Utilising Thermostable Binders for Point-of-care Detection of African Swine Fever Virus

Saw Ze Dong, Ethan Wang Jun Qi
DUNMAN HIGH SCHOOL
MOTRIT-GPT: LLMs-based Interactive Tool for Multilayer Optical Thin-films Research

Wang Yunze
RAFFLES INSTITUTION
Modal Frequencies in a Nonlinear Beam-magnet Coupled Oscillator System

Wu Jiaqi
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Self-Powered Triboelectric Nanogenerator for Dynamic Multidirectional Pressure Sensing

Yin Yue, Aseera Jannath
RAFFLES INSTITUTION
Haema-Lights: Laser Initiated Site-selective Formation of Ag-Fe_2O_3 Composites for Electron Detection

SILVER

Ang Chong Zhe, Wong Wei Zhi, Neo Jun Zhi
DUNMAN HIGH SCHOOL
The Aggregation Behaviour of Staphylococcus Aureus Phenol-Soluble Modulins (PSMas) in Different Physiological Conditions: Exploring Novel Agents for Modulating Biofilm Formation

Ang Jun Ray
RAFFLES INSTITUTION
EDMaL - Enhanced Detection of AI Generated Text using Machine learning

Benedict Choo Jing Kai, Lim Yong Da
NATIONAL JUNIOR COLLEGE, EUNOIA JUNIOR COLLEGE
Magneto-impedance Spectroscopy of Liquids and Gels

Charmaine Goh
NATIONAL JUNIOR COLLEGE
Surface Plasmon Resonance (SPR) Sensor for Hydrogen Leakage Detection

Choo Ying Ern, Liew Yue Yu
NATIONAL JUNIOR COLLEGE, COMMONWEALTH SECONDARY SCHOOL
Effect of Different LED Lights Colour Combinations on β-Carotene Content and Antioxidant Activity of Red Spinach

SSEF 2024 WINNERS

SILVER

Chua Zi En, Tan Yu Ning, Isaac Teo Ler Xin
SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE
Converting Food Waste into Wood Paste for Additive and Subtractive Manufacturing

Felicia Tan Ee Shan, Goh Rou Hui Ashley
RAFFLES GIRLS' SCHOOL (SECONDARY), RIVER VALLEY HIGH SCHOOL
Chat, is this Real? Mm-Double Confirm! : A Multimodal Network for Singapore-context Misinformation Detection

Hoe Jun Wei
NATIONAL JUNIOR COLLEGE
Machine Learning Optimisation in a Novel High Numerical Aperture Quantum Interferometer

Hong Yanheng Zavier, Ho Yong Yi Jayden
RAFFLES INSTITUTION
Utilising Chaotropic Hofmeister Ionic Effect to Achieve High Precision 3D Printing of High-content Gelatin Bio-ink

Javier Ng Wei Quan, Caelen Chang Kai Mun, Ng Kai Jiun Ian
HWA CHONG INSTITUTION
Exploring the Anticancer Potential of Phytochemicals using Yeast as a Model Organism

Koh Zhi Hong Jonathan, Benz Chong Tze Jun, Tang Xuyuan
HWA CHONG INSTITUTION
Artificial Intelligence for Student's Self-Directed Learning of Titration Experiments

Lam Chi Ki Daisy
DUNMAN HIGH SCHOOL
Light Pollution and Changes in the Eyes of Beetles

Lee Chen Hui, Yeo Jun Ting
HWA CHONG INSTITUTION
Development of an Electrochemical Reactor with an Iron Modified Cathode for Wastewater Treatment through the Continuous Adsorption and Electro-regeneration of Activated Carbon

Lee Huan Yu, Gerrard Teo Kai Xiang
NATIONAL JUNIOR COLLEGE
Increasing the Efficiency of the Savonius Type Turbine with a Combined Design

Liu Yiming
RAFFLES INSTITUTION
Dysregulation of Myelin-related Genes in NOTCH2NLC-associated Neurodegenerative Diseases

Ma Zhiyu
ANGLO-CHINESE SCHOOL (INDEPENDENT)
Using the Particle Swarm Optimisation Algorithm for the Travelling Salesman Problem & its Application in Routing Optimisation for E-waste Collection

SSEF 2024 WINNERS

SILVER

Michelle Chen Dan Hua, Eunice Chua Kai En, Lo Sze Ee, Josher
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Optimising In Vitro Generation and Characterisation of Stem Cell Derived Photoreceptor Cells For Retinal Therapeutics

Pak Tze Bin Bryan
RAFFLES INSTITUTION
What's Under The Hood? Root Cause and Patch Analyses of Elevation of Privilege Vulnerabilities in the Windows Operating System

Selvakumar Vigneshwaran
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Novel Blood Biomarkers Identified for Early Alzheimer's Disease Intervention using Machine Learning Models

Siak Jing Yuan, Tiffany Wong Ying Qi
KRANJI SECONDARY SCHOOL
Investigation of the Effect of Natural Electron Mediators on the Performance of Microbial Fuel Cells

Tan Yong Le Timothy, Elliott Elijah Yeo Shao Ern, Jonathan Chan Jian Yao
ANGLO-CHINESE SCHOOL (INDEPENDENT)
AlGrow: A Homemade Seaweed-Based Biostimulant

Teng Jia Yu, Chng Choon Hoe Hugh
CLEMENTI TOWN SECONDARY SCHOOL
Spike Damages Mitochondria to Switch Cells to Aerobic Glycolysis

Vanisha Agrawal, Lim Yu Tong
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Investigating the Potential of NO_3^- as the Interlayer Anion in LiAl-LDH for Lithium Recycling

Wang Chen, Tan Heng Yi
DUNMAN HIGH SCHOOL
ZnO Nano-Spiky Balls for Antifouling: The Morphology Dependent Antifouling Activity of ZnO Nanoparticles

Wong Jia Le, Kristin Ting Kai Xin, Aidan Ruben Mohan
SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE
Upcycling of Soiled Diapers by Zophobas Morio (Superworms) into Ammonia and Fertiliser Products

Yaw Chur Zhe
HWA CHONG INSTITUTION
Smart Car Sharing in On-Demand Mobility

Zhu Yancun
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
iCellSight: An Interactive Visualization Tool for In-Situ Cellular Insights in Hyper-plex Immunofluorescence Images

SSEF 2024 WINNERS

SILVER

Zou Jiaxin, Zhang Songyang, Zhang Bo
HWA CHONG INSTITUTION
Investigating the Potential of Diruthenium Carbonyl Complexes as DNA Binders

BRONZE

Abhimongkol Teeraphapphun, Nguyen Chi Kien, Nguyen Dai Duong
CLEMENTI TOWN SECONDARY SCHOOL
Enhancing Judgement Accuracy in Tchoukball through Real-time Ball Detection

Camilla Zheng Wan Qi, Mah Hoy Ee, Genevieve
HWA CHONG INSTITUTION
Development of a Machine Learning Intelligent System of Nystagmus Detection for Parkinson's Disease Screening

Cayden Chik Yong Jun
HWA CHONG INSTITUTION
Advancing Global Climate Prediction: Next-Generation Cryospheric Modelling with Jacobian-Free Newton-Krylov ILU-Preconditioned CGS

Chan Xing Yu, James, Chan Si Yu, David
RIVER VALLEY HIGH SCHOOL
Can LLMs Have a Fever? Investigating the Effects of Temperature on LLM Security

Chen Rui An, Niken Toh Teng Rui
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Elegant Results Involving Chebyshev's Polynomials

Chew Xin Kai, Seth Loo, Clement Low Hong Yi
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Concocting Effective Phage Cocktails against Acinetobacter Baumannii from Singapore's Sewage

Chloe Liow Yi Yin, Neo Joe Ern
RAFFLES INSTITUTION
Development of Insect Protein Formulations for 3D Printing and Casting of Dysphagia-Friendly Food Products

Chong Rei Eyan Glenda, Liang Zhiying
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Multinary Metal Chalcogenide Nanostructures for Thermoelectric Applications

Chua Ke Yue, Teoh En Rou, Yao Jingwen
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Developing Vegan-based Beef Flavourings through Rational Chemical Analysis and Design Methodologies

SSEF 2024 WINNERS

BRONZE

Jemma Lee Miin Yee, Sheng Yu Fei Carol, Cadence Wern Sea Loh
RAFFLES INSTITUTION
Volume-Hiding Dictionary Encryption: New Schemes and Benchmarking Results

Kan Yuhui, Thondaiman Ramprabhu
NATIONAL JUNIOR COLLEGE
Characterisation and Optimization of Extraction Methods to Extract Polyhydroxyalkanoate from Spirulina(Arthrospira)

Krishna Bhatia, Chua Yi Xi, Leroy, Nguyen Quang Nhat
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Generalising Reflection of Functions about Lines, Curves and Surfaces

Lee Care Greene, Huang Yuebin
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Chronocrop: Monitoring Crop Growth Using A.I.

Luo Chang
NATIONAL JUNIOR COLLEGE
Improved Drug Discovery using Existing Computational Models

Maharshi Mukherjee, Ngiam Lihong, Chik Yan Kit David
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Cancer Therapeutics: In silico Screening of Potential UBR5 Protein Inhibitors

Melody Cho Thansin Kyaw, Vivienne Chua Xuan Yu, Sumi Lin Zi Qing
CLEMENTI TOWN SECONDARY SCHOOL
How Metabolic Enzymes TPI and GAPDH link Glycolysis and Cancer

Nainika Gupta, Abhineshwari Narayanan, Rachel Goh Rui En
RAFFLES GIRLS' SCHOOL (SECONDARY)
Leaving No Crumbs: Laser-Enabled Upcycling of Silica in Rice Husk Ash for Novel Applications in Chemical Sensing and Photonic Circuitry

Ng Shi Qing Eugenia, Vera Ong Liwen
RIVER VALLEY HIGH SCHOOL, RAFFLES INSTITUTION
Data-Driven Drones: An Analysis of Large Language Models in Reinforcement Learning for Drones

Ong Crystal, Damien Cheng Yi Kiun, Oh Ren Kai, Jayden
RAFFLES INSTITUTION
Investigating the Human Longevity Properties of Human Umbilical Cord Tissue in the Prevention and Cure of Age-Related Diseases

Ong Zhi Xuan, Wee Su-Rei
TEMASEK JUNIOR COLLEGE (Integrated Programme), DUNMAN HIGH SCHOOL
A Tuneable Waveguide Reflectarray for Radiation & Scattering Experiments

SSEF 2024 WINNERS

BRONZE

Peh Yew Kee, Neo Wee Zen
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
DeVS: Zero-shot AI-Generated Text Detection Via Summarisation

S M Mohamed Arshath
ANGLO-CHINESE SCHOOL (INDEPENDENT)
How does Cyanidin, Obtained through Anthocyanin Extract from Aronia Melanocarpa, when Exposed to Different pH Levels (4,5,6,7,8,9&10) Affect its Efficiency as a Dye in a Dye Sensitized Solar Cell?

Shannon Yip Ying En, Kwan Qiao Le, Akhilesh Karthikeyan
VICTORIA JUNIOR COLLEGE, NANYANG GIRLS' HIGH SCHOOL, ANDERSON-SERANGOON JUNIOR COLLEGE
Design and Development of Delta Wing with Loitering Capability

Stephanie Teo Hui Wen, Li Jiayi, Lim Huang Pheng Gwendolin
HWA CHONG INSTITUTION
Beyond Pixels: Enhancing Image Inpainting Through Multi-Resolution Processing with Selective Scaling and Advanced Blending Approaches

Surya Padmanathan
ANGLO-CHINESE SCHOOL (INDEPENDENT)
Anthocyanin and Chlorophyllin Photosensitizers with Green Tea Extract Synthesized Silver Nanoparticles on Dye-Sensitized Solar Cell (DSSC) Efficiency as Quantified through Output Voltage

Tan Sze Qi, Adele Lim Yu Qing
RAFFLES INSTITUTION
Design of Stronger and More Durable Limestone-calcined Clay Cement (LC3) using Nano-additives

Tessa Yap, Yong Qing Ya Ranice, Lim Si En Alvena
RAFFLES GIRLS' SCHOOL (SECONDARY)
Simultaneous Bioremediation of Wastewater and Generation of Electricity using Laccase enzyme from Trametes versicolor

Tharini D/O Ramesh
VICTORIA JUNIOR COLLEGE
Photoinduced Late-Stage Functionalization of Sulfonamides via Smiles Rearrangement

Thongthornpatch Chamadol
VICTORIA JUNIOR COLLEGE
Quantifying and Correcting Spherical Aberrations for Deep Imaging of Cleared Tissue

Vivekraj Sekhar, Liu Wenkai
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
VisionVoyage: A Low-cost Reliable AI Integrated Smart Cane

Wang Xinning, Poh Qi Zhen
RAFFLES INSTITUTION
Nanoparticle Formulation for Inflammation Control and Skin Regeneration for Eczema Treatment

SSEF 2024 WINNERS

BRONZE

Xiang Siyue, Li Xinghe, Hasini Senthilnathan
RAFFLES GIRLS' SCHOOL (SECONDARY)
Development of an Intelligent System for Monitoring Bird's Health in the new Mandai Bird Paradise

Xu Kangyou, Amethyst Nguyen Xin Ai
HWA CHONG INSTITUTION
Investigating Tannin and Gelatin Multilayers and Microcapsules

Xu Qian, Er Sean Wee
HWA CHONG INSTITUTION
In-house Production and Modification of Biocellulose

Zannatun Naeim
VICTORIA JUNIOR COLLEGE
Role of β-cat-TCF transcription in Antigen Presentation and Processing in Colorectal Cancer

Zannatun Noor, Akila Rajesh
NANYANG JUNIOR COLLEGE
Investigating the Role of Branched-Chain Keto Acids as Signalling Molecules in Hepatocellular Carcinoma

MERIT

Aathmika Viju-Pany, Quek Tian Yin Esther
RAFFLES GIRLS' SCHOOL (SECONDARY)
Neoantigens in Immunotherapy: From Theory to Practice

Apicha Maneerat, Dolot Shine Mikaela Maminta, Papangkorn Wangchochedkun
VICTORIA JUNIOR COLLEGE
Investigating the Use of a Stylometry-Based Alternative to Detect AI-Generated & AI-Paraphrased Text

Austin Liu Zi Rui, Koh Jing Shan, Jasper Chow Wei Jie
RAFFLES INSTITUTION
Factors affecting Hermetia Illucens (Black Soldier Fly) in Digesting Certain Types of Food Waste and Quality of Frass produced

Caleb Seow, Sng Yi Xin, Tan Ee Hsuen, Conan
EUNOIA JUNIOR COLLEGE, NATIONAL JUNIOR COLLEGE
Quantum Computing in Chemistry: Benchmarking the Performance of Various Ansatzes with the Variational Quantum Eigensolver

SSEF 2024 WINNERS

MERIT

Chan Haowei, Yeo Zhen Ze
RAFFLES INSTITUTION
Inhibition of Gene F1 in MM Cells using ASOs: A Potential Therapeutic Strategy

Dylan Gan Kai Jie, Raghav Kumar, Tan Yong Tat
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Development of an Intelligent System for Glaucoma and Eye Testing using Virtual Reality and Data Analytics

Ernest Ng
HWA CHONG INSTITUTION
Wearable Tech

Hew Zhi Xin, Lim Suang Kee, Namasya Holla
CEDAR GIRLS' SECONDARY SCHOOL
Investigating Koolfever as an Alternative Heat Sink to Optimise Thermoelectric Technology to Power Wearable Devices

Ho Le Qi, Chen Yan Tong, Esther Suraya Puk Rui En
RAFFLES INSTITUTION
Tackling Pharmaceutical Pollution: Jackfruit Derived Biochar-Alginate Composite Hydrogel Beads as a Novel Approach for Ofloxacin Removal

Isabelle Ang En Yi, Lim Wan Ying, Qiang Kaixin
NATIONAL JUNIOR COLLEGE
Phytoremediation of Zinc in Sunflowers

Joanne Tan Kai Xin, Koh Ying Min Bernice
HWA CHONG INSTITUTION
Investigating Changes in EEG during Cognitive Tasks in the Presence of One's Smartphone

Kaung Htet Zar Nie
NATIONAL JUNIOR COLLEGE
Modelling of Plasma Sheaths and Ion Flux Distortion at an Insulator-conductor Interface

Khow Willard, Li Hanyu, Chua Jia Rong
RIVER VALLEY HIGH SCHOOL
Validation of Novel Analogues of an FDA-approved Anti-cancer Molecule to Alleviate the Burden of Atopic Dermatitis

Lee Kuo Rei, Lim Jin Wei Isaac
HWA CHONG INSTITUTION
Synthesis, Characterisation, and DNA Binding Studies of Ruthenium(II) Arene Complexes with Amino Acid-derived Reduced Schiff Base Ligands

SSEF 2024 WINNERS

MERIT

Lee Yian Jana
TEMASEK JUNIOR COLLEGE (Integrated Programme)
Biovalorisation of Leftover Rice for Development of a Probiotic Fermented Beverage

Leow Xin Xiang Dionysius, Wang Chen
HWA CHONG INSTITUTION
Effect of Selected Herbs on Reducing Motor Dysfunction in a Caenorhabditis Elegans Model of Amyotrophic Lateral Sclerosis

Li Lingbo, Nicole Khor Qiao Wen
HWA CHONG INSTITUTION, RAFFLES INSTITUTION
Lateral Flow Assays for the Rapid Detection of Viruses

Lim Yann Ting, Jireh John Kwek, Hor Hong Ming
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
A Study of Attention in Adolescents Using Functional Near Infrared Spectroscopy

Liu Linxi
NATIONAL JUNIOR COLLEGE
Qubit Dynamics Simulation and Optimal Control

Narella Widjaja
ANGLO-CHINESE SCHOOL (INDEPENDENT)
IOT System For Efficient Hydroponics Maintenance With Adaptive RGB Lighting System

Neo Hao Jun, Isaac Tan Jia Le, Kuai Yi Zhuang, Ezann
HWA CHONG INSTITUTION
Development Of A Low-Cost Robust Autonomous Approach To Modern Campus Security

Qiu RuoLin, Huang Yijia
HWA CHONG INSTITUTION
Understanding the Mechanisms of PARP Inhibitor (PARPi) Resistance

Seah Yuheng, Chng Ming Cong Jerrell
HWA CHONG INSTITUTION
Investigating the Use of Eggshells as an Antibacterial Agent and in the Removal of Heavy Metal Ions in Water

Toh Si Ting, Annabelle, Lim Jun Yao Brian, Ramanathan Vijay
VICTORIA JUNIOR COLLEGE
Investigating the Effects of Ingestion of Different Sugars and Substitutes on Cardiovascular Health in Larval Zebrafish for Application in Humans

Valerie Chia Boon Hwan, Chong Chee Wen, Joslyn Yap Qian Ting
RIVER VALLEY HIGH SCHOOL
The Mechanics of Swirling Granular Matter

SSEF 2024 WINNERS

MERIT

Yang Zirui, Lau Yi Xuan
HWA CHONG INSTITUTION
Development of New CRISPR Tools for More Efficient Transcriptome Engineering

JUNIOR SCIENTIST CATEGORY PROJECT AWARDS

DISTINCTION

Hannah Sin, Tong Rui Sze Clara, Zhiyan Eva Jin
RAFFLES GIRLS' SCHOOL (SECONDARY)
Investigating the Bioactive Compounds Present in Lion's Mane Mushroom

Joshua Lew Yi Le, Kiefer Owen Tanya Young, Chen Ruilin
RAFFLES INSTITUTION
Investigating the Number and Configuration of Man-made Structure on the Effectiveness of Ecological Seawalls

Lee Chong Jin, Ian
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Glyoxalase Rescues Cells from Spike-induced Death

Lim Jye Ern Javen
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Powered Cycle Subtraction

Ying Liqian
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Make24: Bounding the Generalised Form of a Numbers Game

MERIT

Chai Chang Xuan Cheryl, Soh Kit Ann, Pandian Mallikasree
RAFFLES GIRLS' SCHOOL (SECONDARY)
Development of Bioplastics Supplemented with Natural Products as Alternatives to Synthetic Plastics

Chia Xuan Ye
CLEMENTI TOWN SECONDARY SCHOOL
The Curious Case of Biofluorescence in Pineapples

Loi Zi Wei Ariel, Rivika Chandra, Loo Xin Ni Bernice
CEDAR GIRLS' SECONDARY SCHOOL
An Investigation on the Effectiveness of Used Cosmetic Sheet Masks as a Reusable Whiteboard Duster

SSEF 2024 WINNERS

JUNIOR SCIENTIST CATEGORY VIDEO AWARDS

DISTINCTION

Frank Alexander Sharpe, Jason Timothy Hartanto, Wang Hong En
YIO CHU KANG SECONDARY SCHOOL
Terracoolta Tech

Lee Chong Jin, Ian
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Glyoxalase Rescues Cells from Spike-induced Death

Loi Zi Wei Ariel, Rivika Chandra, Loo Xin Ni Bernice
CEDAR GIRLS' SECONDARY SCHOOL
An Investigation on the Effectiveness of Used Cosmetic Sheet Masks as a Reusable Whiteboard Duster

MERIT

Chee Junxiang Gerald, Josiah Tay Eng Kiam (Zheng Yinqian), Pon Yue En Jewelle
NORTHBROOKS SECONDARY SCHOOL
Investigation of How pH and Moisture Content Affects the Performance of the Microbial Fuel Cell

Chong Yu Teng Aden, Teo Ming Yang
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Expanding on the Collatz Conjecture

Low Zhi Yu Chloe, Lucy Tan Ying
NGEE ANN SECONDARY SCHOOL
Investigating the Feasibility of SCOBY Leather as a Sustainable Leather Alternative

SSEF SPECIAL AWARDS

Amgen Ampower Special Awards for Science and Technology

Chan Haowei, Yeo Zhen Ze
RAFFLES INSTITUTION
Inhibition of Gene F1 in MM Cells using ASOs: A Potential Therapeutic Strategy

Ng Le Xi, Khoo Jun Xin, Lee Hayoung
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Synthesis of Novel and Sustainable Biosorbents for Water Purification from Bread Waste

Qiu RuoLin, Huang Yijia
HWA CHONG INSTITUTION
Understanding the Mechanisms of PARP inhibitor (PARPi) Resistance

Siak Jing Yuan, Tiffany Wong Ying Qi
KRANJI SECONDARY SCHOOL
Investigation of the Effect of Natural Electron Mediators on the Performance of Microbial Fuel Cells

Tan Jie Min, Koo Xin Xuan, Sonia Pho
NANYANG GIRLS' HIGH SCHOOL
Neuronal and Vascular Decoupling in the Eye

SSEF SPECIAL AWARDS

ECS Special Awards

Michael Ho Kok Hou
HWA CHONG INSTITUTION
High Efficiency Polymer Solar Cells

Serene Song, Tan Yu
NATIONAL JUNIOR COLLEGE
Development of "Green" Microbial Fuel Cell with Iron-based Mediator

Ivan Joel You Wen Jie
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Synergistic Combination of $Sb_2Si_2Te_6$ Additives in $Bi_{0.4}Sb_{1.6}Te_3$ for Enhanced Thermoelectric Waste Heat Harvesting

IChemE Singapore Awards

Michael Ho Kok Hou
HWA CHONG INSTITUTION
High Efficiency Polymer Solar Cells

Tessa Yap, Yong Qing Ya Ranice, Lim Si En Alvena
RAFFLES GIRLS' SCHOOL (SECONDARY)
Simultaneous Bioremediation of Wastewater and Generation of Electricity using Laccase Enzyme from Trametes Versicolor

IES Special Awards

Ang Gedeon Kusuma
RAFFLES INSTITUTION
SMART (Sustainable, Modular, Additively-manufactured, Robust, Tower-style) Urban Farming

Lee Chen Hui, Yeo Jun Ting
HWA CHONG INSTITUTION
Development of an Electrochemical Reactor with an Iron Modified Cathode for Wastewater Treatment through the Continuous Adsorption and Electro-regeneration of Activated Carbon

SSEF SPECIAL AWARDS

James Dyson Foundation Design Engineering Awards

Jack Low Ee Jin, Jiang Ruiyang
HWA CHONG INSTITUTION
Engineering Phase Transformation Behaviour in the 4D Printing of Ni-Ti Shape Memory Alloys

Le Xuan Hai, Nueng Ang Zhi Min, Chee Xin Min Josephine
NATIONAL JUNIOR COLLEGE, GEYLANG METHODIST SCHOOL
Phase Changing the World: Using Beeswax-Corn Oil Mixtures as a Phase Change Material for Indoor Thermal Regulation

Veniko Borislavov Belinski
VICTORIA JUNIOR COLLEGE
Computational Energy Modelling for Optimisation of HVAC Systems in Singapore Climate

Wu Jiaqi
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Self-Powered Triboelectric Nanogenerator for Dynamic Multidirectional Pressure Sensing

L'Oréal Special Awards for Innovation in Sustainability

Ang Gedeon Kusuma
RAFFLES INSTITUTION
SMART (Sustainable, Modular, Additively-manufactured, Robust, Tower-style) Urban Farming

Seah Yuheng, Chng Ming Cong Jerrell
HWA CHONG INSTITUTION
Investigating the Use of Eggshells as an Antibacterial Agent and in the Removal of Heavy Metal Ions in Water

Wong Jia Le, Kristin Ting Kai Xin, Aidan Ruben Mohan
SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE
Upcycling of Soiled Diapers by Zophobas Morio (Superworms) into Ammonia and Fertiliser Products

SSEF SPECIAL AWARDS

NUS Chemistry Special Awards

Chan Min, Chen Siqin
EUNOIA JUNIOR COLLEGE
Investigation of Protein Crystallisation using Precision Ellipsometry

Chan Yee Yong, Tan Jun Jie Xavier
HWA CHONG INSTITUTION
Investigation on Eggshell Powder as an Inorganic Filler in Polyethylene Composites

Chong Rei Eyan Glenda, Liang Zhiying
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Multinary Metal Chalcogenide Nanostructures for Thermoelectric Applications

Teo Jia Xuan Rylie, Kwek Yee Shong, Sagiv Seah Jia En (Xie Jia'En)
HWA CHONG INSTITUTION
Extraction of Phenolic Compounds from Citrus Fruit Peels to Investigate its Antioxidative Properties

Vanisha Agrawal, Lim Yu Tong
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Investigating the Potential of NO_3^- as the Interlayer Anion in LiAl-LDH for Lithium Recycling

Yan Yu En, Zhang Youxin, Chong Chloe Nouf
RAFFLES GIRLS' SCHOOL (SECONDARY)
Synthesis of Magnetic Iron Oxide and its Applications toward Methylene Blue Removal

SAAS Special Awards - Poster Awards for Science Communication

Ang Gedeon Kusuma
RAFFLES INSTITUTION
SMART (Sustainable, Modular, Additively-manufactured, Robust, Tower-style) Urban Farming

Anselmo Klement Chua
RAFFLES INSTITUTION
Glycolysis and DNA Repair: Novel Roles of Pyruvate Kinase in the DNA Damage Response

Boyce Ang Kok Hong (Hong Guo Feng), Ng Yu Heng, Sun Zizhuo
HWA CHONG INSTITUTION
Optimised Numerical Methods for the Computation of Particles in Fusion Hotspots and Particle Interactions in Magnetised Liner Inertial Fusion (MagLIF)

Chew Xin Kai, Seth Loo, Clement Low Hong Yi
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Concocting Effective Phage Cocktails Against Acinetobacter Baumannii from Singapore's Sewage

SSEF SPECIAL AWARDS

SAAS Special Awards - Poster Awards for Science Communication

Felicia Tan Ee Shan, Goh Rou Hui Ashley
RAFFLES GIRLS' SCHOOL (SECONDARY), RIVER VALLEY HIGH SCHOOL
Chat, is this Real? Mm-Double Confirm! : A Multimodal Network for Singapore-context Misinformation Detection

Foo Loke Zen, Koh Wen Yu
HWA CHONG INSTITUTION
Investigating Changes in EEG while Performing Different Cognitive Tasks

Hew Zhi Xin, Lim Suang Kee, Namasya Holla
CEDAR GIRLS' SECONDARY SCHOOL
Investigating Koolfever as an Alternative Heat Sink to Optimise Thermoelectric Technology to Power Wearable Devices

Huang Yining
RAFFLES INSTITUTION
Detecting Microplastic Particles In Dried Apricot Packets

Hugo Maximus Lim, Ian Wang
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Algebraic Solutions to Extensions of Apollonius' Problem in 3D

Kiana Loh Kai Wei, Lim Sin Yu, Tey Yu Xin Richelle
RIVER VALLEY HIGH SCHOOL
Effects of Common Sugars on the Antioxidant Activity in Green Tea (Camellia sinensis)

Le Trung Kien
ST. JOSEPH'S INSTITUTION
Machine Learning to Extract Plasma Emission Spectrum Data from Laser Fusion in Metal 3D Printers

Nguyen Phuc Chuong, Hoang Nguyen Khanh Linh, Chong Kai Xin
ANDERSON-SERANGOON JUNIOR COLLEGE
Investigation on the Optimal Light Condition for Plant Growth and Energy Efficiency in Vertical Farming

Prabakaran Sahana
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Utilising thermostable binders for point-of-care detection of African Swine Fever Virus

Saw Ze Dong, Ethan Wang Jun Qi
DUNMAN HIGH SCHOOL
MOTRIT-GPT: LLMs-based Interactive Tool for Multilayer Optical Thin-films Research

SSEF SPECIAL AWARDS

SAAS Special Awards - Poster Awards for Science Communication

Teo Shen Han, Lim En Qi, Christine Chuah Hui Qi
RIVER VALLEY HIGH SCHOOL
Ink-r-edible crickets: Effect of Air-frying Treatment on the Properties of Direct Ink Writing 3D Printed Cricket Products

Wang Hongyu, Mao Tianze
HWA CHONG INSTITUTION
Investigating the Effects of Plant Extracts on Alzheimer's Disease

Wong Jia Le, Kristin Ting Kai Xin, Aidan Ruben Mohan
SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE
Upcycling of Soiled Diapers by Zophobas Morio (Superworms) into Ammonia and Fertiliser Products

Wu Jiaqi
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Self-Powered Triboelectric Nanogenerator for Dynamic Multidirectional Pressure Sensing

Xiang Siyue, Li Xinghe, Hasini Senthilnathan
RAFFLES GIRLS' SCHOOL (SECONDARY)
Development of an Intelligent System for Monitoring Bird's Health in the new Mandai Bird Paradise

Zou Jiaxin, Zhang Songyang, Zhang Bo
HWA CHONG INSTITUTION
Investigating the Potential of Diruthenium Carbonyl Complexes as DNA Binders

Singapore Mathematical Society Awards for Ingenuity

Ang Wei Bin
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Expressing the √p in Terms of a Sum of Trigonometric Functions=

Chen Rui An, Niken Toh Teng Rui
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Elegant Results Involving Chebyshev's Polynomials

Krishna Bhatia, Chua Yi Xi, Leroy, Nguyen Quang Nhat
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Generalising Reflection of Functions about Lines, Curves and Surfaces

Puah Xuan Ying, Vera, Arnab Mishra
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Optimizing Natural Number Representation via Pan Balance Mechanisms

SSEF SPECIAL AWARDS

A*STAR SIMTech & ARTC Science and Engineering Excellence Award

Camilla Zheng Wan Qi, Mah Hoy Ee, Genevieve
HWA CHONG INSTITUTION
Development of a Machine Learning Intelligent System of Nystagmus Detection for Parkinson's Disease Screening

Lee Huan Yu, Gerrard Teo Kai Xiang
NATIONAL JUNIOR COLLEGE
Increasing the Efficiency of the Savonius Type Turbine with a Combined Design

Rae Tang
NATIONAL JUNIOR COLLEGE
Investigation of Plant Health in Agritech and Green Spaces via Image Processing

Sanvi Gupta, Iniyaa Srinivasan
RAFFLES GIRLS' SCHOOL (SECONDARY)
Deep Learning based Algorithm for Frequency Estimation of Noisy Signals

Seah Jia Ying
NATIONAL JUNIOR COLLEGE
Perching Mechanism for Drones

Siak Jing Yuan, Tiffany Wong Ying Qi
KRANJI SECONDARY SCHOOL
Investigation of the Effect of Natural Electron Mediators on the Performance of Microbial Fuel Cells

Wong Jia Le, Kristin Ting Kai Xin, Aidan Ruben Mohan
SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE
Upcycling of Soiled Diapers by Zophobas Morio (Superworms) into Ammonia and Fertiliser Products

Wu Jiaqi
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Self-Powered Triboelectric Nanogenerator for Dynamic Multidirectional Pressure Sensing

SSMB Special Awards

Jamie Wen
DUNMAN HIGH SCHOOL
Novel Next-gen Engineered Phage-photosensitisers: A Golden Opportunity against Multi-drug Resistant Pseudomonas Aeruginosa

SSEF SPECIAL AWARDS

SUTD Research and Innovation Awards: Artificial Intelligence

Cai Junxiang, Aidan Ong
NATIONAL JUNIOR COLLEGE, HWA CHONG INSTITUTION
State Space Models Are All You Need

Le Trung Kien
ST. JOSEPH'S INSTITUTION
Machine Learning to Extract Plasma Emission Spectrum Data from Laser Fusion in Metal 3D Printers

SUTD Research and Innovation Awards: Aviation

Ng Yu Feng, Pham Le Viet Hoang
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Vortex Surfing Effects (Positional Parameters) on Aerodynamic Performance and Stability of Conventional Aircraft in Formation

Shannon Yip Ying En, Kwan Qiao Le, Akhilesh Karthikeyan
VICTORIA JUNIOR COLLEGE, NANYANG GIRLS' HIGH SCHOOL, ANDERSON-SERANGOON JUNIOR COLLEGE
Design and Development of Delta Wing with Loitering Capability

SUTD Research and Innovation Awards: Cities

Michael Ho Kok Hou
HWA CHONG INSTITUTION
High Efficiency Polymer Solar Cells

Ng Le Xi, Khoo Jun Xin, Lee Hayoung
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Synthesis of Novel and Sustainable Biosorbents for Water Purification from Bread Waste

SSEF SPECIAL AWARDS

SUTD Research and Innovation Awards: Healthcare

Esther Siak, Yap Li Ling, Jethro Liew Hng Kai
NATIONAL JUNIOR COLLEGE
Comparision of a 4-week Weights Training program versus a Sprint and Plyometric Programme on Long jump Distance

Kabir Jain, Shah Mahir Hitesh
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Words that Heal: Retrieval-Augmented Large Language Models for Enhanced Medical Report Generation

SUTD Research and Innovation Awards: Multi-Disciplinary

Felicia Tan Ee Shan, Goh Rou Hui Ashley
RAFFLES GIRLS' SCHOOL (SECONDARY), RIVER VALLEY HIGH SCHOOL
Chat, is this Real? Mm-Double Confirm! : A Multimodal Network for Singapore-context Misinformation Detection

Ling Keng-Hwee Carissa, Yeo Hui Yu
RAFFLES GIRLS' SCHOOL (SECONDARY)
Design of Flat Lens with Printed Circuit Board (PCB) Fabrication Technology

SUTD Research and Innovation Awards: Sustainability

Chan Yee Yong, Tan Jun Jie Xavier
HWA CHONG INSTITUTION
Investigation on Eggshell Powder as an Inorganic Filler in Polyethylene Composites

Wong Jia Le, Kristin Ting Kai Xin, Aidan Ruben Mohan
SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE
Upcycling of Soiled Diapers by Zophobas Morio (Superworms) into Ammonia and Fertiliser Products

SSEF SPECIAL AWARDS

Yale-NUS Special Awards

Felicia Tan Ee Shan, Goh Rou Hui Ashley
RAFFLES GIRLS' SCHOOL (SECONDARY), RIVER VALLEY HIGH SCHOOL
Chat, is this Real? Mm-Double Confirm! : A Multimodal Network for Singapore-context Misinformation Detection

Hugo Maximus Lim, Ian Wang
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Algebraic Solutions to Extensions of Apollonius' Problem in 3D

Lim Wan Qin
HWA CHONG INSTITUTION
Fighting Future Pandemics: A Novel Approach to In Silico Drug Discovery for Global Health Priority Pathogen Nipah Henipavirus

Martin Koh Zhen Xuan
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Precession, Nutation and Dynamic Trajectory of a Magnetic Rod in an Axisymmetric Magnetic Field

Mazereeuw Luc Martin Linus
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Patterns of Floating Droplets Excited with Faraday Waves

Puah Xuan Ying, Vera, Arnab Mishra
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
Optimizing Natural Number Representation via Pan Balance Mechanisms

Regeneron International Science & Engineering Fair

ISEF 2024

STUDENT DELEGATES



STEPs Ahead: Self-Powered Triboelectric Nanogenerator (TENG) for Dynamic Multidirectional Pressure Sensing

WU JIAQI
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

In this fast-paced world today, technologies such as human-machine interfaces and human motion monitoring are rapidly evolving. These advancements highlight the need for real-time pressure sensing technologies for accurate and interactive feedback systems. However, the challenge remains in mass-producibility due to the lack of a simple fabrication process, while still maintaining high sensitivity at the clinically relevant pressure range of 0 to 70 mmHg with real-time remote sensing capability.

To address these needs, we developed the self-powered triboelectric nanogenerator (TENG) based pressure sensor (STEPs). STEPs is meticulously designed as a three-layer sandwich structure, which can be easily made using solely parallel processes. By doping Carbon Black (CB) and Polyvinylpyrrolidone (PVP) at optimal percentages into the PDMS matrix, together with employing a unique three-dimensional morphology, we achieved an optimized surface charge density, leading to a high sensitivity of 2.61 ± 0.02 mV/mmHg with excellent linearity of R-square ≈ 0.996, outperforming previous works.

Additionally, we developed a STEPs array and equipped it with a wireless system for multidirectional pressure sensing and real-time remote display of pressure readings. STEPs had demonstrated great reliability and accuracy in simulated trials, and we believe that this highly sensitive pressure sensor meets the demand in a wide range of applications, offering significant commercial potential in fields including the Internet of Things (IoT) and advanced biomedical technologies.



SMART (Sustainable, Modular, Additively-manufactured, Robust, Tower-style) Urban Farming

ANG GEDEON KUSUMA
RAFFLES INSTITUTION

Singapore faces food security and sustainability issues due to low (<10%) local produce, increased demand for food (50% by 2050) and little (1%) land allocated for agriculture. Only a very small 3.9% of local vegetables consumption is produced locally. Nutrient Film Technique (NFT) hydroponics is practical, but current solutions are inadequate due to space and maintenance constraints. In this project, a novel design of tower-style NFT hydroponics, that focuses on space efficiency, multifunctionality, intelligence, energy efficiency and material efficiency, is developed. Complex internal and exterior geometry, structures inspired by aircraft semi-monocoque fuselage, which are optimised in their dimensions, and analysis by finite element analysis (FEA) ensures the design is space efficient, material saving and strong (safety factors > 6 across all 3 loading conditions). Selective Laser Sintering (SLS), a Laser Bed Powder Fusion (LPBF) Additive Manufacturing (AM) process, is used to fabricate these complex geometries without support structures, with high isotropy; and with glass-bead filled polypropylene (PPGB).

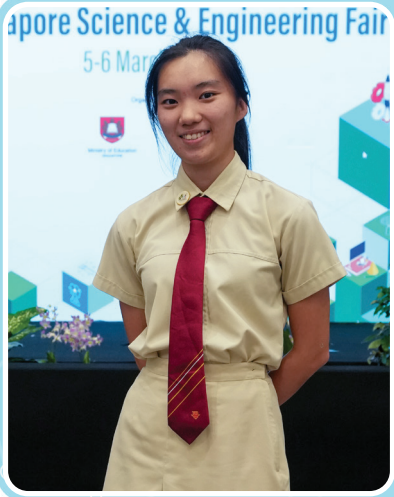
This system is 3.3 to 9.8 times more space efficient; and 3.4 to 4.7 times more material efficient than existing NFT hydroponics systems. A more energy-efficient full-spectrum LED lighting solution is also developed. This system's high modularity allows different sizes and types of plants to be grown together. A low-cost system monitors and maintains critical variables for the system's operation. A 2-week test growth period shows expected plant growth. Hence, this system can be practically installed in (especially) indoor settings such as homes and offices, bringing Singapore closer to the 30-by-30 plan.



Precession, Nutation and Dynamic Trajectory of a Magnetic Rod in an Axisymmetric Magnetic Field

MARTIN KOH ZHEN XUAN
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Precession and nutation in dynamical systems have been of long-standing research interest. Manifesting in systems as diverse as spinning tops to celestial bodies like planets, and understanding these motions offer a window into the intricate dance of forces governing such systems. One example of a previously unexplored system exhibiting precession and nutation is that of a magnetic rod in an axisymmetric magnetic field. This project aims to study this system through qualitative, quantitative, and experimental means. A theoretical model was formulated using Newton's Second Law and the torque equation, accounting for energy dissipation. One unique aspect of this system compared to other systems exhibiting precession and nutation is the presence of the non-linear magnetic force and torque, which were modelled by considering both magnets as current carrying cylinders. Experimentally, the dynamic trajectory and relevant degrees of freedom of the rod were measured using image binarization and ellipse fitting. This was used for a systematic investigation into how the nutation, precession and petaloid-like trajectories are affected by number of magnets, initial angular velocity and other relevant parameters. Theoretical predictions and experimental results show a good agreement. This work has various engineering applications such as centrifuge design, and could be used to introduce students to the concepts of precession, nutation and the magnetic force.



Atomically Yours: Novel DeepGraphDTI Takes Fight Against Future Pandemics to the Next Level

LIM WAN QIN
HWA CHONG INSTITUTION

The World Health Organisation's Blueprint Priority Disease Nipah Henipavirus' (NiV) deadly pandemic potential has been evidenced by outbreaks across the world. Its high mortality rates of up to 92% across Asia, South Pacific, and Australia renders it distressing as no approved vaccines and NiV-specific therapeutics exist to this date. Current in silico methods to discover a cure rely on molecular docking and dynamics which are computationally intensive and time-consuming. Hence, deep learning Drug-Target-Affinity (DTA) models, which are able to predict drug-target interactions within seconds, present an attractively accelerated approach to discover inhibitors, circumventing tedious protein and chemical environment preparations required for simulations. Present DTA architectures encode sequence-based protein residues for learning, often using Convolutional Neural Networks that neglect structural information. To greatly enhance the predictive prowess of DTA models, this study curates a novel Graph Neural Network model DeepGraphDTI, which builds graph representations of proteins from atomic-level properties, allowing high-resolution structural attributes to be extracted. Found to surpass the performances of existing state-of-the-art models, DeepGraphDTI proves itself a potent tool for diverse applications in drug discovery such as unearthing novel drugs against emerging pathogens. In this study, DeepGraphDTI was used to identify potential inhibitors against the NiV attachment and fusion glycoproteins from 1,040 drugs in the Global Health Priority Box, Pandemic Response Box and Pathogen Box, and molecular docking was carried out to further verify the predicted inhibitors. 7 promising drugs were thus selected for future in vitro and vivo experimental evaluation.



Haema-Lights: Facile method of Site-selective Synthesis of Fluorescent Ag-Fe_2O_3 Nanocomposites for Optical Electron Detection

YIN YUE, ASEERA JANNATH
RAFFLES INSTITUTION

Ag-Fe_2O_3 nanocomposites are powerful catalysts for the photocatalytic degradation of toxic industrial dyes and effective antimicrobial agents against fungi and bacteria, making them the subject of much interest. However, currently the chemically intensive, pollutive, hazardous, and expensive synthesis processes of Ag-Fe_2O_3 nanocomposites stand as a barrier to application. Traditional physical and chemical methods involve the usage of chemical reducing agents, high temperatures and pressure, while newer biological methods utilising microorganisms as reducing agents pose safety challenges due to the toxic nature of certain microorganisms and difficulties with incubation.

The first part of our project involved exploring a simple yet effective method for synthesising Ag-Fe_2O_3 nanocomposites. We grew Fe_2O_3 nanoflakes by "cooking" iron foil on a hotplate and doped them with silver through laser modification under $AgNO_3$ solution, allowing the nanocomposite to be formed without the use of any chemical reducing agent. The formation process is precise and composite characteristics like size and uniformity can be easily tuned by varying laser parameters. We also conducted morphology and composition characterisation using Scanning Electron Microscopy (SEM), Electron Diffraction X-ray spectroscopy (EDX), Transmission Electron Microscopy (TEM), Raman Spectroscopy, X-ray Photoelectron Spectroscopy (XPS), and proposed and verified a potential formation mechanism.

We also discovered that the Ag-Fe_2O_3 nanocomposite has fluorescent properties where our sample glows red under yellow light. Not only that, the fluorescence intensity of our material responded linearly to electron exposure, leading us to investigate its capabilities as an electron detector. Characterisation using XPS and TEM techniques allowed us to propose the mechanism for the nanocomposite's fluorescence change - electron-induced reduction! Finally, we showed that the sensor is spatially highly precise - easily up to 5 μm. We hope that its micro-scale size and inexpensive synthesis can make it a valuable complement to existing sensors.



State Space Models Are All You Need

CAI JUNXIANG, AIDAN ONG
NATIONAL JUNIOR COLLEGE,
HWA CHONG INSTITUTION

Our primary goal for this project was to make AI models for sequence modelling more efficient and accurate. We hold the view that pursuing more efficient and accurate sequence modelling can allow AI to be used in a wider range of scenarios. There has been a significant amount of impressive effort in scaling Transformers to longer sequences, however, many of them seem to encounter a trade-off with accuracy. To enable more efficient and accurate sequence modelling, we introduced two State Space Model (SSM)-based architectures – Liquid-S5 and LiquidMamba that both scale linearly with sequence length, instead of quadratically, like the Transformer. Liquid-S5 sets a state-of-the-art (SOTA) score on the industry-standard Long Range Arena benchmark, while LiquidMamba sets another SOTA score on the WikiText-103 benchmark at the parameter count of 125 million. In particular, both architectures exceeded the performance of the Transformer architecture. Given that our emphasis revolves around modelling progressively longer sequences more efficiently and accurately, we are particularly driven by applications that could gain advantages from these extended-sequence models, including high-resolution imaging, extremely long genomic sequences, and language models capable of comprehending entire books. We are confident that our contributions enhance the overall cost efficiency and accuracy of sequence modelling, potentially offering valuable contributions to scientific exploration.

National STEM Talent Search

By Science Centre Singapore

NATIONAL STEM TALENT SEARCH (NSTS)

BACKGROUND

The National STEM Talent Search (NSTS) is an annual competition by Science Centre Singapore with support from the Ministry of Education. Previously known as the A*STAR Talent Search, the competition was inaugurated in 1995 and is based on a concept similar to the Regeneron Science Talent Search in the USA. NSTS is a prestigious annual competition that aims to motivate and accord national recognition on students who excel in science and technology. Through NSTS, Singaporean students aged 15 to 21 years old are given a platform to showcase their projects and are encouraged to further their interest in science, technology, engineering, and mathematics (STEM).

NSTS participants are evolved from the winners of the Singapore Science & Engineering Fair (SSEF) 2024 after the first round of judging on their presentation of their submitted research projects for SSEF. NSTS participants then undergo two more rounds of selection by a panel of judges consisting of scientists from A*STAR, NEA, NTU, NUS, SIT and SUTD and chaired by a renowned local scientist.

NSTS winners need to display resourcefulness, mastery of scientific concepts, as well as passion for scientific research.

There are four scientific categories for NSTS 2024:
- Biomedical Science
- Computer Science & Mathematics
- Engineering
- Material Science

FOREWORD



Professor Phoon Kok Kwang
CHAIRPERSON, *National STEM Talent Search 2024 Awards Committee*
PROVOST, *Singapore University of Technology and Design*

We are honoured to have the distinguished Professor Ng Huck Hui as the chief judge for NSTS this year. Prof Ng is the Assistant Chief Executive for Research and Talent Development, and Chief Scientific Advisor of the Institute of Molecular and Cell Biology (IMCB), under the Agency for Science, Technology and Research. Professor Ng is renowned in the field of stem cells, having spent more than a decade in research to understand and uncover the intricacies of gene regulation and how they relate to cell biology.

Being a scientist can be a tremendously fulfilling and enlightening experience, even though the path to scientific discovery is frequently challenging. The best scientists are motivated to make the world a better place. We hope that the NSTS will encourage the next generation to keep growing as researchers and to see science as a meaningful pursuit.

This year, 69 registered participants demonstrated a high level of interest in NSTS. The Committee and I find it encouraging that our young students have led the way in such enthusiastic engagement across a wide range of sciences. In addition to the novelty of this year's ideas, the NSTS exemplifies the spirit of passion that characterizes our next generation of aspiring scientists.

Students have shown perseverance and commitment by accepting this challenge, and I would like to thank each and every one of them for participating in NSTS 2024. To the nine finalists: we are incredibly proud of how far you have come and your outstanding performance. I have no doubt that everyone who has taken part has grown personally and acquired useful knowledge and skills. I hope that it has been a rewarding experience.

I would want to thank everyone who has helped make NSTS a success, especially the NSTS Awards Committee and the Science Centre Singapore. My sincere gratitude also extends to the judges, mentors, principals, teachers, and parents who have given so much of their time and energy to nurture our young talents and to make this annual apex event a success.

Thank you.

Professor Phoon Kok Kwang
CHAIRPERSON, *National STEM Talent Search 2024 Awards Committee*
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NSTS 2024
FINALISTS



SMART (Sustainable, Modular, Additively-manufactured, Robust, Tower-style) Urban Farming

ANG GEDEON KUSUMA
RAFFLES INSTITUTION

CATEGORY : ENGINEERING
MENTOR : PROFESSOR SING SWEE LEONG

Singapore faces food security and sustainability issues from low (<10%) local produce, and little (1%) land allocated for agriculture. This project outlines the development of a novel design of tower-style nutrient film technique (NFT) hydroponics that focuses on space-efficiency, modularity, intelligence, energy-efficiency, and material-efficiency. Complex internal and exterior geometry inspired by aircraft semi-monocoque fuselage; optimisation and analysis by finite element analysis (FEA) ensures the design is space-efficient, material-saving, and strong (all safety factors>6). Selective laser sintering (SLS) is used for fabrication without support structures, with high isotropy. This system is 3.3-9.8x more space-efficient; and 3.4-4.7x more material-efficient than existing NFT systems. A more energy-efficient full-spectrum LED lighting solution, and a low-cost monitoring, maintenance and alert system is also developed. This system's high modularity allows different-sized plants to be grown together. Hence, this system can be practically installed in indoor settings (homes and offices), bringing Singapore closer to the 30-by-30 plan.



Chat, is this real? mm-Double Confirm! : A Multimodal Network for Singapore-context Misinformation Detection

FELICIA TAN EE SHAN
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CATEGORY : COMPUTER SCIENCE & MATHEMATICS
MENTOR : MR ADRIEL KUEK YONG JIE

In today's digital age, misinformation demands innovative solutions. To address the lack of a fact-checking model for Singapore-specific multimodal misinformation (text and image), we propose a novel ensemble model that achieves strong performance across all functions. Our automated evidence retrieval framework, leveraging the H2-keywordextractor transformer and SBERT to query NewsAPI, ensures accuracy and practicality. Our CLIP Truthfulness Classifier, trained on a self-collected Singapore-context multimodal misinformation dataset, coupled with a parallel ChatGPT-4-32k system, achieves robust ~ 95% F1-scores. We developed an SBERT-based detector to evaluate satire based on language semantics, achieving a 93.2% F1-score. We verified that the COSMOS model is suitable for domain transfer. Lastly, we developed an explanation generation system by prompting optimised ChatGPT-4-32k, achieving high BLEU, METEOR and ROUGE scores of 0.841, 0.945 and 0.913 respectively. Our model addresses nuanced aspects of misinformation that are currently overlooked and achieves state-of-the-art performance for Singapore-specific multimodal misinformation.



Yeast-based High-throughput Screening of Plasmodium falciparum Phosphodiesterase Beta (PDEβ) for Malaria Drug Discovery

GAN KAH SHUEN
RAFFLES INSTITUTION

CATEGORY : BIOMEDICAL SCIENCE
MENTOR : PROFESSOR CHARLES HOFFMAN

The emergence of drug-resistant Plasmodium falciparum parasite, which causes the most lethal malaria, poses a significant challenge to disease eradication efforts and necessitates the discovery of new drug targets. This study focuses on the cyclic nucleotide signalling pathway in P. falciparum, specifically, the action of enzyme phosphodiesterase beta (PfPDEβ). PfPDEβ catalyses the hydrolysis of intracellular second messenger 3',5'-cyclic adenosine monophosphate (cAMP), a key regulator of P. falciparum asexual blood stage development. I successfully cloned the PfPDEβ gene and constructed Schizosaccharomyces pombe yeast strains expressing PfPDEβ. A yeast-based high-throughput screen (HTS) was developed and optimised to identify PfPDEβ inhibitors. 162 known mammalian phosphodiesterase (PDE) inhibitors were screened and the growth response of yeast strains expressing PfPDEβ was analysed. Six hit compounds were identified as PfPDEβ inhibitors. This study has successfully developed a chemical toolkit to assess the utility of PfPDEβ as a drug target, advancing ongoing efforts in antimalarial drug development.



Dysregulation of Myelin-related Genes in NOTCH2NLC-associated Neurodegenerative Diseases

LIU YIMING
RAFFLES INSTITUTION

CATEGORY : BIOMEDICAL SCIENCE
MENTOR : DR ZENG LI, DR TU HAITAO

NOTCH2NLC-associated neurodegenerative diseases are a novel disease entity with heterogeneous clinical manifestations. Abnormally-expanded GGC repeats within the NOTCH2NLC gene were recently identified as its genetic mechanism. However, its underlying molecular mechanism is unclear. This study identifies and investigates the involvement of downstream cellular components in the pathogenesis of NOTCH2NLC-related neurodegenerative diseases. Bulk RNA-seq revealed differential gene expression, highlighting the significance of the cellular component myelin sheath. qPCR validation was conducted for representative myelin-related genes using transgenic mice and patient samples. With their general down-regulation in diseased samples, the most significant gene, MBP, was co-expressed with NOTCH2NLC constructs in SH-SY5Y cells to simulate the disease genotype; coupled with our transgenic mouse model, we demonstrate dependence of MBP protein levels on pathogenic GGC repeat expansions. Overall, the identification and validation of myelin-related differentially expressed genes like MBP may serve as biomarkers for diagnosis or potential drug targets in treating NOTCH2NLC-associated neurodegenerative diseases.



Precession, Nutation, and Dynamic Trajectory of a Magnetic Rod in an Axisymmetric Magnetic Field

MARTIN KOH ZHEN XUAN
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

CATEGORY : ENGINEERING
MENTOR : DR BERNARD RICARDO

Precession and nutation have been of long-standing research interest. Manifesting in dynamical systems ranging from spinning tops to planets, understanding these motions offer a window into the intricate dance of forces governing such systems. One example of a previously unexplored system exhibiting precession and nutation is that of a magnetic rod in an axisymmetric magnetic field. This project aims to study this system theoretically and experimentally. We modelled the non-linear magnetic interaction by considering both magnets as current cylinders. This was used in conjunction with Newton's Second Law and the torque equation, accounting for energy dissipation. Experimentally, the rod's relevant degrees of freedom were measured using image binarization and ellipse fitting. A systematic investigation into how precession, nutation and the petaloid-like trajectories are affected by rod length and other parameters was conducted. Theoretical predictions and experimental results show good agreement. This work has various engineering applications such as centrifuge design.



What's Under The Hood? Root Cause and Patch Analyses of Elevation of Privilege Vulnerabilities in the Windows Operating System

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CATEGORY : COMPUTER SCIENCE & MATHEMATICS
MENTOR : MS YAP NI

The Windows operating system is highly vulnerable to improper privilege management. This project focuses on three elevation of privilege CVEs. The objective is to analyse whether the patches comprehensively address the root causes of the vulnerabilities or merely mitigate specific methods of replication. The methodology uses static analysis tools like Ghidra, IDA and BinDiff, as well as dynamic analysis tools like ProcMon and WinDbg. Firstly, for root cause analysis, each vulnerability was replicated on a virtual machine, and its driver or executable was statically analysed, to identify its root cause. Next, patch analysis was conducted on the "patched" driver or executable and its virtual machine to evaluate if the patches are sufficient at fully mitigating the root cause of the vulnerability. The patches for CVE-2020-1170 and CVE-2021-21551 are unsuccessful as there are ways that attackers can bypass them. In contrast, CVE-2023-21768 exhibits successful patching that prevents elevation of privilege.



How Metabolic Enzymes TPI and GAPDH link Glycolysis and Cancer

VIVIENNE CHUA XUAN YU
CLEMENTI TOWN SECONDARY SCHOOL

CATEGORY : BIOMEDICAL SCIENCE
MENTOR : A/P NORBERT LEHMING

Human cancer cells, like yeast, ferment glucose to lactate (alcohol in yeast) generating energy, despite the presence of oxygen, or aerobic glycolysis. The Warburg effect correlates a cancer's aggressiveness with the ratio of aerobic glycolysis to respiration, oxidising glucose to CO2. Aerobic glycolysis maintains most C-C bonds of glucose, but generates less energy, requiring it to operate at a higher frequency. Methylglyoxal, a toxic by-product of glycolysis, damages DNA. Cancer cells, like yeast, repair damaged DNA efficiently, making them resistant to radiotherapy. More research linking glycolysis and cancer can further develop chemotherapy which inhibits DNA repair using drugs. Modelling with yeast, DNA repair factor Rad9 was discovered to interact with TPI1 and GAPDH. We isolated DNA repair deficient TPI1 and GAPDH mutant strains. The TPI1 mutant lowered TPI enzymatic activity, suggesting methylglyoxal accumulation, while the GAPDH mutants' enzymatic activity remained normal, indicating that GAPDH moonlights in the DNA Damage Response.

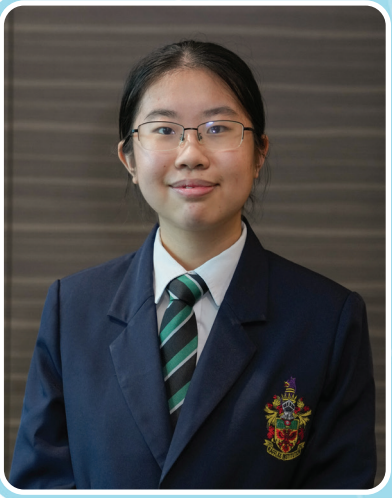


Self-Powered Triboelectric Nanogenerator (TENG) for Dynamic Multidirectional Pressure Sensing

WU JIAQI
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

CATEGORY : ENGINEERING
MENTOR : DR ZHENG XINTING

Advancements in biomedical treatments and technological systems require effective real-time pressure sensing to provide smart feedback. However, developing a sensor that combines mass reproducibility and high sensitivity at clinically relevant pressure range has remained a significant obstacle. Herein, a self-powered triboelectric nanogenerator (TENG) based pressure sensor (STEPs) is proposed to meet these critical demands. STEPs introduces an innovative composite material, homogeneously blending Carbon Black (CB) and Polyvinylpyrrolidone (PVP) in Polydimethylsiloxane (PDMS) at optimal content ratio. Together with the unique three-dimensional structure, STEPs achieved enhanced surface charge density, leading to a high sensitivity of 2.61 mV/mmHg while following a much simpler fabrication process compared with previous works. A wireless system, established between a STEPs array and a readout device, further enables real-time remote display of multidirectional pressure readings. It is envisioned that STEPs is broadly applicable to many fields, with significant potential for commercialization in both human-machine interface and biomedical applications.



Haema-Lights: Laser Initiated Site-selective Formation of Ag-Fe2O3 Composites for Electron Detection

YIN YUE

RAFFLES INSTITUTION

CATEGORY : MATERIAL SCIENCE
MENTOR : PROFESSOR SOW CHORNG HAUR, DR SHARON LIM

Ag-Fe_2O_3 nanocomposites are valued as powerful catalysts for the degradation of toxic industrial dyes and effective antimicrobial agents. However, the chemically intensive, pollutive, hazardous, and expensive synthesis processes of Ag-Fe2O3 nanocomposites stand as a barrier to application. This work first demonstrates a cheap, facile, yet effective method for synthesising Ag-Fe_2O_3 using a low-cost hotplate method of Fe_2O_3 nanoflake growth and incorporating Ag via laser modification under $AgNO_3$ solution, without the use of any chemical reducing agents. It is shown that the formation process is precise and composite characteristics laser tunable. Morphology and composition characterisation were conducted and we proposed and verified a potential formation mechanism. Further, the Ag-Fe2O3 nanocomposite has fluorescent properties which respond linearly to electron exposure. An electron-reduction based mechanism was proposed and verified for its fluorescence change. The sensor is spatially highly precise and may be applied in micro precision sensing and as an affordable wearable patch.

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