第五十四屆聯校科學展覽

THE 54TH JOINT SCHOOL SCIENCE EXHIBITION

THE 54TH JOINT SCHOOL SCIENCE EXHIBITION PREPARATION COMMITTEE

The 54th Joint School Science
Exhibition Preparation Committee

PRESENTS

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EDITOR'S NOTE

This year has been hard and tough. Although there are lots of obstacles on the road to success, it is delightful that the Joint School Science Exhibition can still be held on schedule, so as to provide an extraordinary access for outstanding students to show their talents and swap their scientific ideas.

As the Publication Secretary, I am honoured to be a part of the 54th J.S.S.E.P.C.. Working with my Executive Committee members is definitely an unforgettable experience. I am so grateful to have been granted this opportunity, to learn new things, work with different people and gain valuable experiences which have made my life more colourful.

I would like to express my wholehearted gratitude to my fellow secretaries, Jenny and Rita, for cooperating with me to finish this piece of publication. Polishing and editing this piece of publication is not easy. There were times that I doubted my own ability. However, the Executive Committee members have encouraged and helped me a lot so I gained a lot of confidence as a Publication Secretary.

I sincerely hope that all of the participants enjoy the Exhibition this year. May this passion and spirit be inherited.

Yammy Wong
Publication Secretary
The 54th Joint School Science Exhibition Preparation Committee

FOREWORD

Mrs Fanny Law

GBM, GBS, JP

Fifty years have passed since I chaired the 4th Joint School Science Exhibition. During this period, advancement in science and technology has significantly changed the way we live, learn, work, play and communicate.

From the Internet to social media, data analytics to machine learning, augmented reality to extended reality, new technologies emerge at a mind-boggling rate. Gene-based medicines transform the lives of patients with serious diseases. The once fictional flying cars and roboscops have become prospective reality. From the Internet of things to the Internet of everything, we can barely imagine what an interconnected future would look like in another 50 years.

There are benefits and perils in the age of networked intelligence. Enhanced efficiency intensifies the pace of work and threatens quality of life. Human Relations are displaced by human-machine interaction. Privacy and security threats are growing concerns. Uneven access to technology has led to rising inequalities. The list goes on.

It is a timely and sobering call for the 54th Joint School Science Exhibition to seek "balance" between work and leisure, body and mind, man and nature. Avoid excess as the American philosopher, Ralph Waldo Emerson, said "Moderation in all things, especially moderation". Aristotle considered moderation a virtue and Plato described moderation as the harmony between reason, spirit and desire.

I wish the 54th Joint School Science Exhibition a great success, members of the Preparation Committee a memorable learning experience, and all participants as well as visitors, a balanced and happy life!

FOREWORD

Dr. Jimmy Wong

Executive Director
Hong Kong Academy for Gifted Education

The past 20 months or so has not been an easy time for us in Hong Kong nor for the entire human race. Breathing and talking are high risk activities, dining out or walking together in public with our family and friends could be criminal offences, flying on a plane is almost as remote as taking a spaceship to Mars!

COVID has hit us hard and unexpectedly, but as human beings, we are smart, wise and innovative, together we have tried hard to get along as "normal". We have taken previously unimaginable measures to continue our work, study and play. The 54th J.S.S.E.P.C. has taken all measures to bring our renowned J.S.S.E. to life and LIVE this year.

This year's theme, "Balance" is a very suitable theme for our students to think and reflect on what life has been like in Hong Kong for the past few years which has seriously been disrupted both socially and healthily. We need to regain and maintain our balance in life and society. Science and technology can be the solution to bring back this balance not just to nature but also to the way we interact and care about the needs in society.

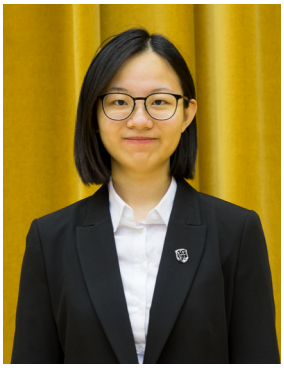
This year I am also very pleased to learn that our long-time overseas supporter of J.S.S.E., the Harmony School from Houston USA iscontinuing their participation in J.S.S.E. by sending their students to present their research online! I look forward to seeing their presentation but more so I hope to see them and other overseas teams face-to-face in J.S.S.E. next year and beyond.

This year, the J.S.S.E. team has decided to take on the challenge in organising the Exhibition among great difficulties and uncertainties, the students from the exhibiting schools have strived on with their research and innovations despite the disruption to school life. We are all very proud of your work and achievement and you should all be very proud of yourselves. I remember a few years ago when I took students to visit NASA in Houston, I saw a quote by the late US President John F. Kennedy (1961) printed on the wall of the exhibition hall which reads, "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win."

I wish the 54th J.S.S.E. a great success and may you all enjoy and treasure this great learning experience!

Good luck, good health and stay balanced!

FOREWORD



Ms Joey Yang

Chairperson
The 54th Joint School Science Exhibition Preparation Committee

Science brings convenience to our life, improves the quality of our living environment and helps us strike a balance between work and leisure, nature and urban development. Indeed, maintaining balance plays a crucial role in attaining a purposeful life. Hence, we, the 54th Joint School Science Exhibition Preparation Committee (the J.S.S.E.P.C.), would like to encourage all visitors and our members to maintain a work-life balance through the Exhibition.

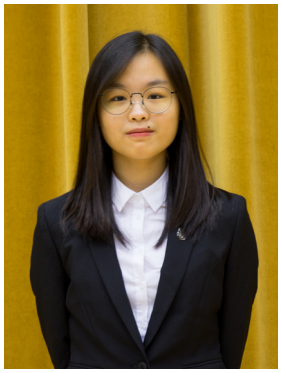
The Joint School Science Exhibition (the J.S.S.E.) was firstly introduced to me in 2017, when I was still a visitor at 51st J.S.S.E.. I can still vividly remember how amazed I was by the innovative designs and products made by different secondary schools students. I have never thought that the students could be so talented in making a new product within only around half a year.

This year, it is my greatest honour to be the Chairperson of the 54th J.S.S.E.P.C.. It has been a tough year for us due to the significant resurgence of COVID-19 when numerous activities were cancelled and a lot of rearrangements and contingencies were needed. With that being said, this made me realize how precious it is to have an opportunity to hold and participate in an event, and to interact with different stakeholders. Joining the J.S.S.E.P.C. family has really given me unprecedentedexperiences and strengthened my interpersonal skills.

I would like to take this opportunity to express my utmost gratitude to my Executive Committee members who have supported me through this arduous, yet valuable, Exhibition journey and have made every endeavor to organize and contribute to the Exhibition. My gratitude also goes out to our Preparation Committee members who have paid effort in various activities, our sponsors, advisors and all organisations who have supported or co-presented with us. The Exhibition will not have been successfully held without your tremendous support and connected effort.

I sincerely hope everyone enjoys this Exhibition and together treasure the efforts made by our Project Holders. I hope all of you have a memorable experience in the Exhibition and could lead a balanced and contented life!

FOREWORD



Ms Anny Hung

Vice Chairperson
The 54th Joint School Science Exhibition Preparation Committee

What is science? While some said that it is the basic law of our universe, others claimed that it is the only magic that works. In fact, science can be anything around us. It unfolds our mysteries , it solves our problems, it advances our life. As Robert A. Heinlein has stated "Everything is theoretically impossible, until it is done." Only with science and previous scientists' investment and perseverance, our contemporary world can be convenient and prosperous.

A year with the pandemic was a hard time for us, the public and the global. Most of us are restricted from normal socializing, not to mention practicing preventative measures to protect ourselves and people around us. The 54th Joint School Science Exhibition Preparation Committee (the J.S.S.E.P.C.) is no exception, fighting against the exploitative virus by cancelling some of our scheduled events. Nonetheless, we are grateful that numerous activities could be successfully held online with the advent of technology, another form of science.

Representing the J.S.S.E.P.C. as the Vice Chairperson, it is my deepest honour to join the big family, collaborating with other students with common grounds. While the J.S.S.E.P.C. gathers senior students who are passionate about science, science connects us as a team and leaves us with unforgettable memories.

Moreover, it has given me profound experiences such as practical skills to communicate with different stakeholders, opportunities to organize events and leadership skills, which will not be acquired from textbook learning. Hereby, I would like to express my sincerest gratitude to our Project Holders' for their contributions, our Preparation Committee members for their participation and my Executive Committee members for their devotions and endeavors. With our collaborative efforts and seamless coordination, we made it through this tough year and established an extraordinary clip of our life which has imprinted in my mind and is worth relishing.

Despite all the challenges and obstacles we faced this year, The 54th J.S.S.E. was fervently held. From my bottom of heart, I genuinely hope that the J.S.S.E.P.C. can consistently present our rationales, act as a platform for our future pillars to invest more on science while promoting science and its values to our public. Though it is never easy to bear the fruit, we should constantly attempt, explore and practice science in our life. Ultimately, I wish the best for the 55th J.S.S.E.P.C. for their foreseeable future.

INTRODUCTION OF THE J.S.S.E.P.C.

The annual Joint School Science Exhibition (hereinafter the J.S.S.E. or the Exhibition) is organised by the Joint School Science Exhibition Preparation Committee (hereinafter the J.S.S.E.P.C.) is a registered (in accordance with the provisions of Section 5A of the Societies Ordinance) and charitable organisation in Hong Kong. It solely comprises students from more than 150 local secondary schools who are passionate for science. It aims at arousing the public's interest in science, encouraging scientific research, promoting cooperation among secondary schools and fostering the exchange of scientific knowledge. For the past years, the Joint School Science Exhibition has been held successively and successfully, where participating schools have showcased their innovative inventions.

The J.S.S.E. was founded by Professor Payne, Dean of Department of Chemistry of the University of Hong Kong in 1968. It was a pioneer of joint school events in Hong Kong, with ten participating schools at first. At its 10th anniversary, the J.S.S.E.P.C. was officially registered as a non-profit making organisation and the number of member schools exceeded twenty. Furthermore, Governor Sir Maclehose was invited as the Guest of Honour at the opening ceremony of that year's exhibition. These achievements made the 10th J.S.S.E. one of the most memorable exhibitions in our history. In addition, since the 23rd J.S.S.E., delegates from overseas institutions and local universities have been invited to participate in the Exhibition so as to promote academic and cultural exchange between students from different nations.

With the unfailing support of sponsors, corporate partners, member schools, supporting bodies in the education sector and the public, the J.S.S.E. continues to attract a great number of visitors every year with its achievements widely recognised in the society. Stepped into its 54th anniversary, the J.S.S.E.P.C. will continue to adhere to the four major aims, to work together with each supporting unit and forge ahead.

一年一度的聯校科學展覽由聯校科學展覽籌備委員會舉辦。它是個經政府註冊（根據香港社團條例第 5A 條註冊）的慈善組織。它是由來自全港多於一百五十間中學、並對科學有熱誠的學 生所組成，旨在引起大眾對科學的興趣、鼓勵科學研究、提倡學校之間的合作和促進科學知識交流。在過去的五十幾年，聯校科學展覽已經連續成功舉辦多屆聯校科學展覽， 展出了無數具有創意的科學產品。

聯校科學展覽由時任香港大學化學系的彭德勵教授於一九六八年創辦，是香港聯校活動的先驅。第一屆科學展覽由十間中學聯合舉辦。直到第十屆，聯校科學展覽籌備委員會正式註冊成 為非牟利團體，而主辦學校躍升至二十餘間。當年更有幸邀請到時任港督麥理浩爵士為該屆展 覽主持開幕儀式。自第二十三屆聯校科展，籌委會每年都會邀請外地院校及本地大專院校的代表參展，以推動不同國家的學術及文化交流。

有賴贊助商、各合作單位、會員學校教育界和大眾的鼎力支持，聯校科學展覽每年都吸引了大量參觀者，而其成就亦得到廣泛認同。踏入第五十四個年頭，聯校科學展覽籌備委員會將繼續堅守四大宗旨，與各單位攜手合作，向前邁進。

THEME OF THE YEAR

Balance
平衡

Inspiring in Science, Seeking for Balance
啟發科學潛能，尋找生活平衡

In recent years, the rapid development of science and technology has boosted the economy of our society. Behind the rapid growth, people's daily hard work has contributed a lot to our society. However, because of their hectic lifestyle, it is often difficult for people to manage their time and establish an equilibrium in their lives. On the other hand, rapid urbanization has aggravated pollution and has brought a heavy burden to our environment.

Hence, the 54th Joint School Science Exhibition Preparation Committee has decided to use "Balance" as the theme of the year, hoping that science is utilized to help people strike a balance. Students are expected to probe into three aspects to design their innovative inventions: nature and urban development, life balance and personal comfort. Since maintaining a balance between work and leisure is the key to a purposeful life, we believe that these inventive ideas can help the public improve the quality of their living environment.

近年來，科學技術急速發展促進了社會的經濟，而於繁榮背後，全賴人們每天辛勞的工作，為社會貢獻。由於人們的生活忙碌，只有很少時間來管理自己的生活，難以在生活中找到平衡。 另一方面，急速的城市化加劇了污染，為我們的環境帶來了沉重的負擔。

有鑑於此，第五十四屆聯校科學展覽籌備委員會決定以「平衡」作為本年度的主題，希望大眾能夠通過運用科學來達到平衡， 並且以維持生活平衡、提高個人舒適度及平衡環境與社會發展為切入點，從而設計革新的發明。由於在工作與休息之間尋求平衡是實現理想生活的關鍵，因此我們相信這些創新的想法可以幫助大眾改善其生活環境的質素。

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Dr. LO Fai Hang
Professor TSANG Ling Ming
Professor ZHENG Bo

The Hong Kong Polytechnic University
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Dr. BU Siqi
Dr. Changyuan YU
Dr. LAM Kwok-ho
Dr. NG Vincent
Dr. Yang CHAI
Professor HUANG Haitao
Professor LAU Shu Ping, Daniel
Professor LU Qin
Professor Keith K.C. CHAN

The University of Hong Kong
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Dr. CHAN, Wing Tat
Dr. LEE, Jetty Chung Yung
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Professor Wing Sum CHEUNG
Professor GUO, Zheng Xiao

The Hong Kong University of Science and Technology
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Hong Kong Observatory

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BUDDHIST SUM HEUNG LAM MEMORIAL COLLEGE
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CANOSSA COLLEGE
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DIOCESAN GIRLS' SCHOOL
DMHC SIU MING CATHOLIC SECONDARY SCHOOL
ELCHK LUTHERAN SECONDARY SCHOOL
EVANGEL COLLEGE
FUKIEN SECONDARY SCHOOL (KWUN TONG)
FUKIEN SECONDARY SCHOOL (SIU SAI WAN)
GOOD HOPE SCHOOL
GT (ELLEN YEUNG) COLLEGE
HEEP YUNN SCHOOL
HK & KLN CCPA MA CHUNG SUM SECONDARY SCHOOL
HKMLC QUEEN MAUD SECONDARY SCHOOL
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HONG KONG TANG KING PO COLLEGE
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KING'S COLLEGE
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LEUNG SHEK CHEE COLLEGE
LI PO CHUN UNITED WORLD COLLEGE OF HONG KONG
LIONS COLLEGE
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迦密主恩中學
迦密聖道中學
迦密柏雨中學
中華基督教會全完中學
中華基督教會協和書院
中華基督教會銘基書院
中華基督教會蒙民偉書院
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張振興伉儷書院
宣道會鄭榮之中學
金文泰中學
廠商會中學
中華傳道會安柱中學
中華傳道會劉永生中學
文理書院（香港）
孔聖堂中學
香港中文大學校友會聯會陳震夏中學
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拔萃女書院
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福建中學
福建中學（小西灣）
德望學校
優才（楊殷有娣）書院
協恩中學
港九潮州公會馬松深中學
港澳信義會慕德中學
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香港道教聯合會圓玄學院第三中學
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可風中學（嗇色園主辦）
可立中學（嗇色園主辦）
旅港開平商會中學
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潔心林炳炎中學
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SHUN TAK FRATERNAL ASSOCIATION YUNG YAU COLLEGE	順德聯誼總會翁祐中學
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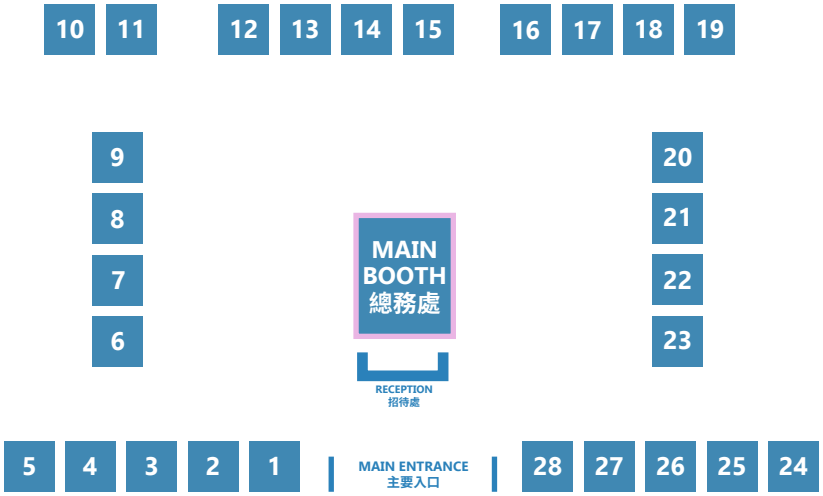
ST. CATHARINE'S SCHOOL FOR GIRLS, KWUN TONG	聖傑靈女子中學
ST. FRANCIS' CANOSSIAN COLLEGE	嘉諾撒聖方濟各書院
ST. FRANCIS XAVIER'S COLLEGE	聖芳濟書院
ST. FRANCIS XAVIER'S SCHOOL, TSUEN WAN	荃灣聖芳濟中學
ST. JOAN OF ARC SECONDARY SCHOOL	聖貞德中學
ST. JOSEPH'S ANGLO-CHINESE SCHOOL	聖若瑟英文中學
ST. JOSEPH'S COLLEGE	聖若瑟書院
ST. LOUIS SCHOOL	聖類斯中學
ST. MARK'S SCHOOL	聖馬可中學
ST. MARY'S CANOSSIAN COLLEGE	嘉諾撒聖瑪利書院
ST. PAUL'S CO-EDUCATIONAL COLLEGE	聖保羅男女中學
ST. PAUL'S COLLEGE	聖保羅書院
ST. PAUL'S CONVENT SCHOOL	聖保祿學校
ST. PAUL'S SCHOOL (LAM TIN)	藍田聖保祿中學
ST. PAUL'S SECONDARY SCHOOL	聖保祿中學
ST. ROSE OF LIMA'S COLLEGE	聖羅撒書院
ST. STEPHEN'S COLLEGE	聖士提反書院
ST. STEPHEN'S GIRLS' COLLEGE	聖士提反女子中學
ST. TERESA SECONDARY SCHOOL	德蘭中學
STEWARDS POOI KEI COLLEGE	香港神託會培基書院
TACK CHING GIRLS' SECONDARY SCHOOL	德貞女子中學
TAI PO SAM YUK SECONDARY SCHOOL	大埔三育中學
TOI SHAN ASSOCIATION COLLEGE	台山商會中學
THE Y.W.C.A. HIOE TJO YOENG COLLEGE	基督教女青年會丘佐榮中學
TRUE LIGHT GIRLS' COLLEGE	真光女書院
TRUE LIGHT MIDDLE SCHOOL OF HONG KONG	香港真光中學
TSANG PIK SHAN SECONDARY SCHOOL	曾璧山中學
TSUEN WAN PUBLIC HO CHUEN YIU MEMORIAL COLLEGE	荃灣公立何傳耀紀念中學
TSUNG TSIN COLLEGE	崇真書院
TUNG CHUNG CATHOLIC SECONDARY SCHOOL	東涌天主教學校
TWGHS LO KON TING MEMORIAL COLLEGE	東華三院盧幹庭紀念中學
TWGHS SUN HOI DIRECTORS' COLLEGE	東華三院辛亥年總理中學
TWGHS WONG FUT NAM COLLEGE	東華三院黃笏南中學
WA YING COLLEGE	華英中學
WAH YAN COLLEGE, HONG KONG	香港華仁書院
WAH YAN COLLEGE, KOWLOON	九龍華仁書院
WEST ISLAND SCHOOL	西島中學
YCH LAW CHAN CHOR SI COLLEGE	仁濟醫院羅陳楚思中學
YCH LAN CHI PAT MEMORIAL SECONDARY SCHOOL	仁濟醫院靚次伯紀念中學
YEW CHUNG INTERNATIONAL SCHOOL	耀中國際學校
YING WA GIRLS' SCHOOL	英華女學校
YLPMSAA TANG SIU TONG SECONDARY SCHOOL	元朗公立中學校友會鄧兆棠中學
YUEN LONG PUBLIC SECONDARY SCHOOL	元朗公立中學

FLOOR PLAN

平面圖



1 PH08 Homantin Government Secondary School 何文田官立中學

2 PH07 HKFYG Lee Shau Kee College 香港青年協會李兆基書院

3 PH17 PLK Vicwood K.T. Chong Sixth Form College 保良局莊啟程預科書院

4 PH25 St. Mark's School 聖馬可中學

5 PH09 Hong Kong Tang King Po College 香港鄧鏡波書院

6 PH16 Munsang College 民生書院

7 PH11 Kiangsu-Chekiang College (Shatin) 沙田蘇浙公學

8 PH27 Tsuen Wan Government Secondary School 荃灣官立中學

9 PH18 Po Leung Kuk Tong Nai Kan Junior Secondary College 保良局唐乃勤初中書院

10 PH19 Queen's College Old Boys' Association Secondary School 皇仁舊生會中學

11 PH12 Kwun Tong Government Secondary School 觀塘官立中學

12 PH24 St. Joseph's College 聖若瑟書院

13 PH26 St. Paul's College 聖保羅書院

14 PH10 Hong Kong Teachers' Association Lee Heng Kwei Secondary School 香港教師會李興貴中學

15 PH01 Belilios Public School 庇理羅士女子中學

16 PH20 Salesian English School 慈幼英文學校

17 PH15 Maryknoll Convent School (Secondary Section) 瑪利諾修院學校 (中學部)

18 PH28 Tsuen Wan Public Ho Chuen Yiu Memorial College 荃灣公立何傳耀紀念中學

19 Innovation and Technology Commission 創新科技署

20 PH21 S.K.H. Lam Kau Mow Secondary School 聖公會林裘謀中學

21 PH04 CCC Tam Lee Lai Fun Memorial Secondary School 中華基督教會譚李麗芬紀念中學

22 UD01 Electrical Engineering Department, City University of Hong Kong

23 UD02 HKU iGem Team 2021

24 SB01 Souvenir Booth 紀念品售賣處

25 GB01 Game Booth 遊戲攤位

26 GB02 Game Booth 遊戲攤位

27 ST01 Science Theatre 科學劇場

28 ST02 Science Theatre 科學劇場

VOTING METHOD

You can now take part in deciding the Most Popular Booth as well as the Best Presenter by voting for the one that you appreciate the most! Your vote is no doubt a token of gratitude for the hard work of all our Project Holders.

公眾現可投票選出最受歡迎隊伍及最佳介紹員，以表達對不同隊伍和參賽者的支持和鼓勵！

Voting Procedure

1. Write down your English full name (as shown in identity document) on the voting sheet.

2. Mark down the number (/ name) of your favourite booth and presenter.

3. Hand in voting sheet to Main Booth.

*Please be noted that you need to show the required document of identification when voting to prevent situations of repeated voting and thus ensure the fairness of the vote.

Thank you for your participation!

投票程序

1. 在選票上寫上英文全名 (需與身分證明文件所顯示的資料一致) 。

2. 在選票上填妥心儀的參賽隊伍和介紹員的所屬編號 (或姓名) 。

3. 把選票交回總務處。

＊請注意遞交選票時需出示身分證明文件來防止重複投票的情況和確保其公正性。

感謝你的熱心參與！

INTRODUCTION OF PROJECTS

展品介紹

UD01

香港城市大學
City University of Hong Kong

An Innovative App to Motivate Young Children to Overcome Phone Addiction

DEPARTMENT OF ELECTRICAL ENGINEERING, CITY UNIVERSITY OF HONG KONG

香港城市大學電機工程學系

Category: Mobile Application

類別：手機應用程式

Person in charge: Lee Hung Hin

Teacher advisor: Dr. Ray Cheung

A recent study has discovered that excessive use of smartphones increases the risk of Attention-Deficit Hyperactivity Disorder (ADHD) among school children. "Focus Beetle" is developed to motivate young children to develop the self-discipline to overcome the distraction of smartphones, reduce the time spent on the smartphone, stay focused, and concentrate in real life to improve productivity. It is a gamified habit-building application written in Swift and available on the iOS platform.

The application consists of five functions:
a) "Focus Timer" for monitoring and reminding the child not to be distracted by smartphone during "Focus Time".
b) "Beetle Nurturing" for awarding the child who can stay focused. The beetle will grow from egg to adult when the focus challenge is completed. More beetles will be available when the child spends less time on the smartphone.
c) "Tasks" for the child to develop good habits. It has notification features to remind him to complete the task on time.
d) "Statistic and Timeline system" for visualizing the focus records and analyzing personal time distribution.
e)" Cloud-server-based data storage" for keeping user data across multiple devices.
"Focus Beetle" is a fun way to help the young child overcome smartphone addiction.

最近的一項研究發現，過度使用智能手機會增加學童患注意力缺陷多動障礙 (ADHD) 的風險。《集中甲蟲》旨在激勵兒童培養自律，不受智能手機的干擾，減少花在智能手機上的時間，保持專注，專注於現實生活，提高生產力。它是一個用 Swift 編寫的有助養成好習慣的應用程式，可在 iOS 平台上使用。

此應用程式包含五個功能：
a) “Focus Timer”，用於監控和提醒孩子在“Focus Time”期間不要被智能手機分心。
b) 「培育甲蟲」，獎勵能夠保持專注的孩子。完成集中挑戰後，甲蟲將從卵長成成蟲。當孩子花在智能手機上的時間更少時，就會有更多的甲蟲可用。
c) 讓孩子養成良好習慣的「任務」。它具有通知功能，提醒孩子按時完成任務。
d) 用於把焦點記錄形象化和分析個人時間分佈的「統計和時間線系統」。
e) 「雲端服務器的數據存儲」，用於保存跨多個設備的用戶數據。 “Focus Beetle”是一種幫助幼兒避免智能手機成癮的有趣方式。

Self-sustaining PET Plastic Degradation System

THE UNIVERSITY OF HONG KONG
香港大學

Category: Physics, Chemistry, Biology

類別：物理、化學、生物

Person in charge: Kenneth Ng Tsz Chun

Teacher Advisor: Kenneth Ng Tsz Chun

HKU iGEM is working on a self-sustaining PET plastic degradation system through a symbiosis of E. coli and a cyanobacteria, S. elongatus. E. coli is engineered to produce two plastic-degrading enzymes, PETase and MHETase. The E. coli is additionally engineered to take in sucrose to be used as an additional energy source, with an additional output of bicarbonate. An engineered S. elongatus produces the sucrose from photosynthesis. The bicarbonate aids in S. elongatus' photosynthetic efficiency.

香港大學 iGEM 正致力於通過大腸桿菌和藍細菌 S. elongatus 的共生來開發自我維持的 PET 塑料降解系統。大腸桿菌經過工程改造可產生兩種塑料降解酶 —PETase 和 MHETase。 大腸桿菌將被額外設計，用來吸收作為額外能源的蔗糖，並額外輸出碳酸氫鹽。一種工程化的 S. elongatus 通過光合作用產生蔗糖。碳酸氫鹽有助提升 S. elongatus 進行光合作用的效率。

OD01

Analysis of the Exoplanet HD 189733b to Confirm its Existence

HARMONY SCHOOL OF ENDEAVOR, AUSTIN, TEXAS

Category: Physics, Engineering

Project Holders: Pratham Babarian & Ethan Chandra

In this study, we examined the orbital periods, photometry, and radial velocity of one exoplanet in the HD star system: 189733 b. We constructed a high caliber exoplanet transit detection tracker that acts as a means to analyze the data constituted of the Raw Science images that we obtained from a DSLR camera. We used the BATMAN Python programming package to convert our data to light curves and a radial-velocity model. The radial velocity data was taken from multiple high precision research studies, which were then converted to a sinusoidal graph portraying the radial velocity with respect to time. Chi-square tests were performed on the data in order to examine the likelihood that observation was due to mere chance. We hypothesized that the creation of a DSLR camera star tracker would produce results that support previously established studies. The results of our studies were statistically significant and supported our hypothesis and previous studies. This study demonstrates the importance of accurately using the radial velocity and photometry data from high-precision research studies.

Exoplanets are planets that orbit stars other than the Sun. In this study, we aimed to detect exoplanets around the HD 189733 b star system using the transit method of planet detection. We built upon an existing methodology that will make exoplanet detection easier and much more efficient for astronomers. By doing so, we can exponentially increase the rate at which we discover exoplanets andmake it much faster and simpler. By making equipment that is fast, economical, and usable, civilian scientists will also be able to access this technology. This would not only make exoplanet detection far faster but would also result in increased engagement with exoplanetary science for people of all ages.

The technology we employ is known as a barn door model star tracker. A barn door star tracker is an economical exoplanet detector that relies on an Arduino Uno and a bipolar stepper motor to control the platform where a camera rests. Between these two platforms there is a threaded rod that is spun by the motor. Additionally, using the Arduino IDE software application, we are able to program the motor to move at an identical rate that opposes the rotation of the Earth, resulting in a raw image without motion blur. Here, we show that the barn door star tracker produces results remarkably similar to advanced space and ground based telescopes, such as the Hubble Space Telescope, Kepler Space telescope, or the Gemini Planet Imager. These research surveys of our universe require significant expertise to operate and use, which make these methods of exoplanet detection out of reach for aspiring scientists and the general populace. Even though these telescopes undoubtedly have better quality and pictures, we hypothesized that our star tracker would produce transit curves similar to those of professional scientific research studies.

To conclude, we found that it is feasible to detect exoplanets using inexpensive and readily available technology. Therefore, our studies show that it is possible for exoplanets within 100 light years from earth to be detected using a barn door star tracker. The radial velocity and photometric analysis surveys that we conducted on the exoplanets supported the existence of hot Jupiters. The data presented here produced a cyclical photometry graph in agreement with the results of previous studies.

在這項研究中，我們檢查了 HD 恆星系統中顆系外行星的軌道周期、光度測量和徑向速度：189733 b。我們構建了一個高水準的系外行星凌日檢測跟踪器，作為分析我們從數碼單反相機獲得的原始科學圖像組成的數據的一種方法。我們使用 BATMAN Python 編程包將我們的數據轉換為光曲線和徑向速度模型。徑向速度數據取自多項高精度研究，然後將其轉換為描繪相對於時間的徑向速度的正弦圖。我們對數據進行了卡方檢驗，以檢查觀察結果純屬偶然的可能性，並假設創建 DSLR 相機星跟踪器會產生支持先前建立的研究的結果。我們的研究結果具有統計學意義，支持我們的假設和之前的研究。這項研究證明了準確使用來自高精度研究的徑向速度和光度數據的重要性。

系外行星是圍繞太陽以外的恆星運行的行星。在這項研究中，我們旨在使用行星探測的凌日方法探測 HD 189733 b 恆星系統周圍的系外行星。我們建立在現有方法的基礎上，該方法將使天文學家更容易、更高效地探測系外行星。通過這樣做，我們可以成倍地增加發現系外行星的速度，並使其更快、更簡單。通過製造快速、經濟和可用的設備，平民科學家也將能夠使用這項技術。這不僅會使系外行星探測變得更遠更快，但也會令更多來自不同年齡層的人參與系外行星科學的研究。

我們採用的技術被稱為旋門星體追蹤器。旋門星體追蹤器是一種經濟型系外行星探測器，它依靠 Arduino Uno 和雙極步進電機來控制相機所在的平台。在這兩個平台之間有一個由電機旋轉的螺紋桿。此外，使用 Arduino IDE 軟件應用程序，我們能夠對電機進行編程，使其以與地球自轉相反的相同速率移動，從而生成沒有運動模糊的原始圖像。在這裡，我們展示了旋門星體追蹤器產生的結果與先進的太空和地面望遠鏡非常相似，例如哈勃太空望遠鏡、開普勒太空望遠鏡或雙子行星成像儀。這些對我們宇宙的研究調查需要大量的專業知識來操作和使用，這使得這些系外行星探測方法對於有抱負的科學家和普通民眾來說遙不可及。儘管這些望遠鏡無疑具有更好的質量和圖像，但我們假設我們的恆星跟踪器會產生類似於專業科學研究的凌日曲線。

總而言之，我們發現使用低成本且現成的技術探測系外行星是可行的。因此，我們的研究顯示，使用旋門星體追蹤器可以探測到距地球 100 光年以內的系外行星。我們在系外行星上進行的徑向速度和光度分析調查支持熱木星的存在。此處提供的數據產生了與先前研究結果一致的循環光度圖。

SS Carpet
SS 地毯

BELILIOS PUBLIC SCHOOL
庇理羅士女子中學

Lau Yan Ting 劉欣庭
Chan Ching Wah Betty 陳菁華
Yung Ka Hei 翁家希
Gloria Lee Ying Hei 李瀅希

In modern society, the main sources of electricity generation are fossil fuels and nuclear energy which release a large amount of pollutants and radioactive waste. On the contrary, renewable energy is still not widely used, which occupies only 5% of the global energy production.

Our team hopes to alleviate this problem, so we are promoting the application of piezoelectricity which does not cause pollution during the electricity generating process. With the aim of reducing the environmental burden, our product is designed to produce electricity by exploiting the wasted mechanical energy in daily life.

In addition, our product can maintain hygiene in indoor areas. We make use of the electricity produced to illuminate the UV light for sterilization of the carpet. For this reason, the name of our product is "SS Carpet", which stands for Self-sterilization Carpet.

The principle behind the SS Carpet is the Piezoelectric Effect. When mechanical pressure is applied to quartz or certain crystals, the atomic structure inside is deformed, resulting in the presence of net charge. The method of disinfection used is Ultraviolet Germicidal Irradiation (UVGI), which uses short-wavelength UVC to inactivate or kill microorganisms, such as bacteria and viruses.

We have every confidence that our product, the SS Carpet, will provide satisfactory user experience and make contributions to environmental protection.

在現代社會，我們主要依靠燃燒化石燃料和核能發電。這些發電方法會產生大量污染物和高放射性廢物，對人類和環境造成巨大的傷害。至於較環保的可再生能源，卻沒有被廣泛應用，只佔全球能源生產的百分之五。

我們的團隊希望能改善和紓緩這個問題，因此我們決定推廣一種生電過程中沒有污染的能源壓電。為了減低對環境的污染，我們設計的產品會通過利用日常浪費的機械能去發電。

除此以外，我們的產品能幫助用戶保持室內衛生。 我們利用壓電產生的電力來點亮紫外光燈，以對地毯進行滅菌。因此，我們產品的名字是「SS 地毯」，「自我消毒地毯」的簡寫。

SS 地毯背後發電的原理是壓電效應：當特定晶體受到外機械能作用，壓電片中的電荷平衡會被破壞，晶體的原子結構因此發生變形，從而產生淨電荷。至於消毒地毯的方式，我們會使用紫外線殺菌輻射。這個技術運用短波紫外線去抑壓或消滅細菌和病毒等微生物。

我們有十足的信心，SS 地毯能為用户提供良好的使用體驗，以及能為保護環境出一分力。

PH04

River Cleaning System
河道清潔系統

CCC TAM LEE LAI FUN MEMORIAL SECONDARY SCHOOL

中華基督教會譚李麗芬紀念中學

Fung Tsz Ming Jermone 馮梓銘
Ma Kim Hang 馬儉恆
Wong Siu Fung 王笑風
Lai Chi Yung 黎志勇

According to the data on river water quality in Hong Kong in 2016 from the Environmental Protection Department, The average amount of Escherichia coli per 100 ml per year exceeds 1,000. The smell of Tuen Mun River which is next to our school is always awful. Also, we find that there is a lot of floating rubbish in the river.

This project aims to clean the floating rubbish from the river. This project aims to improve the River Filtration System from the previous version of an RC Cleaning Boat. It aims to increase the efficiency of collecting floating rubbish. The previous version faced the problem of water resistance generated by the collected garbage due to the garbage storage being underwater. To handle this problem, the storage is attached to the top of the boat, and a conveyor belt which is used to deliver floating garbage from the water surface to the storage is attached to the front. The propeller which produces thrust for the boat keeps being attached on the top because it can prevent the propeller from hitting the river bed when the boat is in the shallow area.

The material of the bowls is fiber-reinforced plastic which is lightweight and strong to produce buoyancy. Aluminum is used to be the lightweight and strong structure of the boat. A used Barbeque grid is reused as garbage storage. 3D printing material is used in some parts of the conveyor belt. A 3S LiPo battery can provide about 30 min sailing.

This new version of RC Cleaning Boat in this project can significantly increase the efficiency of cleaning float garbage in the river. But there are still some further improvements or modifications that can be made. First of all, the conveyor belt will be deployed and retracted to reduce water resistance. Second, a solar-powered version of the boat will be invented to increase cruising endurance. Last but not least, apart from cleaning floating garbage, oil and smell should be handled as well. A water filtration version of the RC boat will be invented to absorb oil and remove the smell of the river.

根據環境保護署的 2016 年河道水質年報，屯門河中的大腸肝菌全年幾何平均值達至每 100 毫升 1000 個，導致在我們學校經常嗅到嗅味。另外，我們也發現有很多飄浮拉圾飄浮在屯門河上。這計劃的目的是為了清理屯門河裏的飄浮垃圾。

在計劃中，改良河流過濾系統的舊版本遙控清潔船。改良版本目的是提高收集漂浮垃圾的效率。之前的版本面對垃圾儲存在水下導致收集的垃圾收集間產生水阻問題。為了解決這個問題，我們把收集間由船下改為船的頂部，在船的前方安裝了用於將漂浮的垃圾從水面運送到存儲庫的運輸帶。為船隻產生推力的螺旋槳一樣固定在頂部，因為這可以防止船隻在淺水區時撞到河床。

船身的材料是玻璃纖維，重量輕，強度高，可以產生足夠浮力。鋁角條經被用作船身的輕巧而堅固的結構，使用過的燒烤網格被重新用作垃圾存儲。運輸帶的一些部件使用了 3D 打印材料。3S 的鋰電池可以提供大約 30 分鐘的航行時間。

計劃中的這款新版遙控清潔船，可以顯著提高清潔河道漂浮垃圾的效率。但仍有一些改進或修改的地方。首先，運輸帶將可展開和收納以減少水阻力。其次，將發明一款太陽能供電的船，以增加巡航能力。最後，除了清理漂浮的垃圾外，還應處理油污和異味。水過濾版本的遙控清潔船將被發明用來吸收油和去除河流的氣味。

CO_2 Car Converter
二氧化碳轉化器

HKFYG LEE SHAU KEE COLLEGE
香港青年協會李兆基書院

Tang Calvin 鄧卓謙
Fung Yu Ching 馮諭正
Wan Hiu Yau Yuko 温曉悠
Yip Chak Sum 葉澤琛

In light of rapid urban development, driving is inevitable and extremely common nowadays, which leads to an increase in carbon dioxide emissions in most of the cities. Eventually, it will also intensify global warming. Therefore, we created the CO_2 Car Converter to help reduce CO_2 emissions by road vehicles to alleviate the current unideal atmospheric situation. In such a circumstance, the world can develop as usual while the negative impacts on the environment can be reduced, which helps achieve sustainable development.

In terms of the scientific principles, the convertor works mainly based on the following two chemical equations:

1. $NaOH(aq) + CO_2(g) \rightarrow Na_2CO_3(aq) + H_2O(l)$
2. $2Na_2CO_3(aq) + Ca(OH)_2(s) \rightarrow 2NaOH(aq) + CaCO_3(s)$

By using the alkaline principle of sodium hydroxide (NaOH) and calcium hydroxide ($Ca(OH)_2$), carbon dioxide (CO_2) can first react with NaOH to form sodium carbonate (Na_2CO_3). The Na_2CO_3 can then react with $Ca(OH)_2$ to form NaOH(aq) again. This is effective in extending the lifespan of the converter and reducing the times of replacing it.

Design-wise, the chemicals were wrapped up with pieces of filter paper and some tea bags to prevent leakage. The chemical bags were then put tilted in our device wrapped in aluminium foil. The tilting increases the contacting surface area between the exhausted gas and the chemicals, as well as reduces the air pressure inside the converter.

在城市化的發展趨勢下，駕駛已成為了日常生活中不可分離的一部份。但是，此行為無形地排放大量二氧化碳，對環境造成極大破壞。有見及此，我們研發出一個能透過轉換二氧化碳為其它較無害化學物質以減低汽車二氧化碳排放量的轉化器，藉以減輕環境的負擔，舒緩正在加劇的温室效應，並希望能進一步達至可持續發展。

從科學原理方面而言，以下兩條化學式為使轉化器運作的主要反應：

1. $NaOH(aq) + CO_2(g) \rightarrow Na_2CO_3(aq) + H_2O(l)$
2. $2Na_2CO_3(aq) + Ca(OH)_2(s) \rightarrow 2NaOH(aq) + CaCO_3(s)$

根據第一條化學式，氫氧化鈉會與二氧化碳發生反應，形成對環境有較少危傷害的碳酸鈉。而根據第二條化學式，碳酸鈉和氫氧化鈣的反應會再次形成氫氧化鈉，從而增加轉化器的壽命及減少更換轉化器的次數。

在設計方面，為了避免泄漏，我們以多層濾紙和茶包包裹轉化器內的化學物。然後，茶包傾斜地擺放在由多層錫箔紙組成的轉化器裏，藉此增加可以促使反應的接觸面，而更重要的是，這樣的設計可以確保氣體暢順流通，避免爆炸發生。

PH08

Kart Home
卡丁車之家

HOMANTIN GOVERNMENT SECONDARY SCHOOL
何文田官立中學

Wong Kin Fung 黃鍵鋒
Yeung Ka Wai 楊嘉偉
Ho Cheuk Yin 何卓言
So Yuk Kwan 蘇鈺琨

'This year, the global temperature has reached a new high again. The culprit is the use of non-renewable energy vehicles such as diesel...'

Nowadays, people have begun to pay more and more attention to their quality of life. Because of the epidemic, they also began to focus on personal health, and even began to pay attention to environmental protection, such as global warming, air pollution, and sustainable development factors. Many people hope to strike a balance between personal interests and the environment, so that the interests of both parties will not be harmed, and the future development will not be affected whereas the balance can be maintained.

As the theme of the 54th Joint School Science Exhibition --- Balance, we focus on paying attention to the quality of life of urbanites without harming the environment. Therefore, we learn from the idea of shared bicycles in mainland China and the well-known multinational company 'Tesla' about solar power. The employment of renewable energy aims to reduce the air pollutants emitted by vehicles, and with the additional functions of our products, a balance between personal interests and the environment can be achieved.

The concept of this product is a combination of solar charging stations and electric vehicles manufactured by us. The vehicle itself is driven by renewable energy, and connected with the GPS system on the car, to find solar charging stations. It runs on replaceable solar-charged batteries, thereby achieving no emissions of any pollution. At the same time, there is also our own software on the electric car, which is used to remind users about life needs and achieve sustainable development, just like the way they are staying at home.

「今年全球溫度又再次創新高，其罪魁禍首莫過於使用柴油等不可再生能源的交通工具……」

現時愈來愈多人開始著重於個人的生活質素，因為疫情而開始著重於個人健康，甚至開始注意有關環保的議題，如：全球暖化、空氣污染、可持續發展方面的因素，導致有很多人希望於個人利益及環境中取得平衡，在不傷害兩方利益的情況下，達到平衡而同時不影響未來發展。

為配合本年度科展的主題——平衡 ，我們著力於關注都市人的生活質素及城市發展，同時又不損害環境，故此我們借鑒中國大陸的共享單車，及知名跨國企業 Tesla 有關太陽能驅動方面的發展，以可再生能源驅動單車，從而希望減少交通工具所排出的空氣污染物，配合上我們的產品的其他功能，達致個人利益及環境的平衡。

本產品概念由太陽能充電站及我們製造的電動車結合，以可再生能源驅動電動車，配合車上的 GPS 系統，去尋找太陽能充電站，以太陽能充電的電池去替換車上的電池，從而達到不排放任何污染物。同時電動車上亦有我們自創的軟件，用於提醒用戶有關生活方面的問題，使用戶猶如在家一般的體驗。

Cussed cushion
頑固的枕頭

HONG KONG TANG KING PO COLLEGE
香港鄧鏡波書院

Ip Chak Sang 葉澤生
Feng Tianzhu 馮天鑄
Chui Chi Yin 徐志賢
Wong Kwok Lam Oswald 黃國臨

Cussed cushion, as you can tell by the name, it is a cushion. However it is not any cushion, it is a cushion that brings balance to your life, balance between your work and your sleep, to be more specific.

Sleep is important as lack of sleep not only affects your physical health, causing you to feel fatigued and possibly leading to cardiovascular diseases such as heart attacks, but it also harms your mental and social health, causing you to feel lonely, less sociable and stressed.

Though the facts mentioned above are already quite commonly known among people, they still don't sleep for various reasons such as work, entertainment and social purposes, which is why they need this pillow. The pillow works somewhat like a reverse alarm clock attached to your pillow, one that won't stop chirping until you go by the rules and sleep. And once you lay on the pillow, it plays soothing sounds and music that is scientifically proven to be beneficial to increase your deep sleep. The way it works is that there is a laser pointer shooting a laser which reflects throughout the pillow. When a head is sleeping on the pillow, the light is blocked. Then there is a light detection system attached to both the alarm and the speaker. The alarm will activate and go off when light is sensed. The speaker will activate once the alarm is turned off. There are also some durable rechargeable batteries attached onto the pillow and circuit boards to provide power.

Now here are some questions you may be wondering about, "why can't I just put an alarm on my phone to make myself sleep?" Attaching the alarm directly onto the pillow ensures that the user is actually sleeping rather than just turning off the alarm and continuing doing whatever he or she was doing, which increases the chances that they would actually sleep. "why can't I just play the soothing sounds with my phone while I sleep?" Using your phone during sleep time could hinder the quality of your sleep, the blue light makes you feel awake, charging while sleeping reduces battery life and attaching it onto the pillow allows the sound to feel as if it's right next to you. "What sounds can be soothing, don't sounds disrupt sleep?" Sounds that are not too loud and regular such as ocean waves, white noise and heartbeats will not hinder your sleep. Instead, it actually helps you concentrate and lower your anxiety levels, allowing you to gain quicker sleep.

「頑固的枕頭」，從它的名字可以知道它是一個枕頭。然而，它與普通的枕頭有分別，它為您帶來平衡，具體地平衡您的工作和您的睡眠。

睡眠很重要，因為睡眠不足不僅會影響您的身體健康，導致您感到疲勞，還可能導致心血管疾病：如心臟病；睡眠不足也會損害您的心理健康和社會健康，導致您感到孤獨，不太善於交際和感到有壓力。

雖然上述情況已經很普遍，但仍然因為工作、娛樂和社會等各種原因而無法入睡。這就是為什麼您需要這個枕頭。枕頭的原理就像依附在枕頭上的反向鬧鐘，在你睡覺之前不停鳴叫；但是一旦您躺在枕頭上，它便會播放舒緩的聲音或音樂，科學證明那些聲音是有益的，可增加你睡眠的深度。它運作的原理是，有一枝鐳射筆發射鐳射，利用全內反射將雷射反射到整個枕頭。當頭部睡在枕頭上時，光線會被阻擋。然後，警報器和揚聲器上都連接有一個光檢測系統。當感應到光時，警報器啟動並開始鳴叫；揚聲器在警報器關閉時啟動。枕頭和電路板上還配有一些可充電電池，以提供動力。

現在，你可能會想問一些問題：「為什麼我不能在手機上放一個鬧鐘，提醒自己睡覺？」其實，將鬧鐘直接連接到枕頭上，可確保使用者實際上正在睡覺，而不只是關閉手機上的鬧鐘，並繼續做他正在做的事。「為什麼我不能在睡覺的時候用手機播放舒緩的聲音？」其實，在睡眠時間使用手機會妨礙你的睡眠品質，藍光會讓你感覺清醒，在睡覺時充電會縮短電池壽命。但將它連接到枕頭上，可以讓聲音感覺好像就在你旁邊。「什麼聲音可以舒緩，並且不擾亂睡眠？」其實，不太響亮和經常的聲音：如海浪、白噪音和心跳不會妨礙你的睡眠；相反，它可以幫你集中注意力，降低你的焦慮水準，讓你更快地睡眠。

PH10

The supermarket "smart shopping trolley"
超市「智能購物手推車」

HONG KONG TEACHERS' ASSOCIATION LEE HENG KWEI SECONDARY SCHOOL
香港教師會李興貴中學

Hui Ka Ying 許嘉鎣
Chan Yeung 陳陽
Leung Yiu Tung 梁耀東
Pang Nap Shan 彭納姍

This is a trolley modified by us and is used in the supermarket, with a built-in micro-tablet computer, smart reader, electric motor and charger. We named it the supermarket "smart shopping trolley". It has a lot of functional characteristics. Not only can it detect the barcodes on the goods and be controlled via mobile apps, but it also has the navigation function and can be paid with an electronic wallet. Moreover, when the customer pushes the machine, the engine will be activated to convert the kinetic energy into electrical energy, so as to charge the battery.

The purpose of creating this machine is to reduce the busyness and pressure of cashiers, ease overcrowding of customers in the supermarkets, and reduce the waiting time for payment. After payment, the trolley can automatically return to its original position, and it can also quickly find goods and guide the users to the location of the goods via the tablet, thereby enhancing the customer experience and improving the quality of life of users. We hope the invention can benefit and contribute to society.

這是一台被我們改裝過且在超市用的手推車，並且裝有微型平板電腦、智能讀取器、電動機以及充電器，我們為它取名為超市「智能購物手推車」。它的功能特點是可讀取商品條碼，亦可透過手機程式控制。這手推車也有導航功能，還可用電子錢包支付，而且當顧客推動這台機器時會啟動發動機，將動能轉為電能，為電池充電。

我們創造這台機器目的是減輕收銀員的忙碌和壓力，讓超市人擠人現象緩解，減少付款等待排隊的時間，付款後手推車可自動回到原位，也可透過平板電腦快速尋找貨品並指引貨品的位置，從而提高顧客的體驗和改善用戶生活質素，更希望能夠造福社會，為社會做出貢獻。

Blue Dilemma
藍的疑惑

KIANGSU-CHEKIANG COLLEGE (SHATIN)
沙田蘇浙公學

Chen Ying Qiao 陳英喬
Zhang Jason Zhishen 張智燊
Chan Wing Sum 陳穎心
Zhu Wing Lam 朱穎琳

With the improvement of technology, electronic devices become a necessity in daily life. During the epidemic, people are suggested to stay at home to attend online classes and telecommute and thus electronic devices are used more frequently than ever.

Electronic devices can emit visible blue light with high energy and high frequency. It ranges in wavelength from approximately 380nm (3.8×10^{-7}m, which is violet) to 500 nm (5×10^{-7}m, which is blue) in the visible spectrum. Direct exposure to blue light at night can deteriorate one's sleep quality and circadian rhythm. However, blue light is essential to physiological responses and visual processes. Memory, alertness, attention span, reaction times, learning ability and cognitive performance do better under blue light.

Blue light can be both beneficial and harmful to health. As we are living in the age of electronic devices, we should monitor the absorption of blue light carefully. In this project, we are attempting to help people to avoid excess exposure to blue light and maintain the balance between absorption of blue light with wavelength: 415nm and 455nm by human eyes with working with light emitting diodes (LED)-based electronic devices that have adverse effects on sleep quality .We hope our users can achieve a healthier lifestyle.

The multi-spectral digital sensor attached to the glass can detect and record the intensity of lights and the data is sent to Jetson nano to do AI analysis and corresponding responses will be given to the users when they have absorbed too much blue light.

隨著科技的進步，電子設備成為日常生活中的必需品。疫情期間，人們在家裏上網課和遠程辦公，因此電子設備的使用比以往任何時候都更頻繁。

電子設備會發出高能量、高頻率的可見藍光。它的波長範圍大約在可見光譜中的 380 納米（3.8×10^{-7} 米；紫色）至 500 納米（5×10^{-7} 米；藍色）之間。人在夜間直接暴露在藍光下會降低睡眠質量和干擾晝夜節律。然而，藍光對生理反應和視覺過程至關重要。記憶力、警覺性、注意長度、反應時間、學習能力和認知能力在藍光下都會表現得更好。

藍光對健康既有益又有害。由於我們生活在電子設備廣泛應用的時代，我們應該仔細監測藍光的吸收情況。在這個計劃中，我們希望用戶避免過度暴露在藍光下，並幫助用戶在使用以發光二極管為基礎的電子設備時，平衡人眼對波長 415 納米至 455 納米藍光的吸收，減少對睡眠質素的不良影響。我們希望用戶能擁有更健康的生活方式。

貼在眼鏡框上的多光譜數字傳感器可以監測和記錄藍光的強度，然後將數據發送到 Jetson nano 進行人工智能分析，當用戶吸收過多藍光時會給予相應的反饋。

PH12

Biodegradable Soap
可生物降解肥皂

KWUN TONG GOVERNMENT SECONDARY SCHOOL
觀塘官立中學

Yeung Kei Shing 楊旗成
Leung Ka Ho 梁家浩
Law Tsz Sum 羅子琛
Liang Wing Hei 梁穎熙

Principle:
Heat an alkali (sodium hydroxide) and a mixture of oil separately until 70°C and mix them with continuous stirring at high temperature for at least 15 minutes. There will be a process called alkaline hydrolysis of oil (or saponification) occurring and soap without substances harming the environment will form.

Details of products:
In some of the soap, we will also add some additives without harmful substances such as coffee grounds and green tea leaves. Some of them are proven to be beneficial to our body. For instance, coffee grounds are the exfoliating component to remove dead skin and dirt from pores.

The existing soap nowadays is not biodegradable and environmentally friendly. They are usually synthetic, man-made derivatives and contain phosphates, nitrates and ammonium compounds which may cause harm to the environment. For example, the compounds in the soap may cause eutrophication and algal bloom.

But our product is made from fats or oils. Therefore, our soap is biodegradable and more environmentally-friendly as these non-toxic and natural ingredients (fats and oils) can be broken down by microorganisms like bacteria easily.

We hope to raise awareness towards the detrimental impacts to the environment caused by using common soap sold.

We will prepare some funny activities at our booth such as games, video-playing and experimental demonstrations.

原理：
分別加熱油和鹼（氫氧化鈉）至大約 70° C。將它們倒在一起並持續攪拌十五分鐘以充分混合它們。油鹼性水解將發生並會形成不含危害環境物質的肥皂。

展品詳情：
在一些肥皂中，我們還會添加一些不含有害物質的添加劑，如咖啡渣和綠茶葉等。 其中一些被證明對我們的身體有益。例如，咖啡渣是去角質成分，可洗淨毛孔污垢及老廢角質。

現時在市面上販售的肥皂都是不可生物降解且不環保。它們通常是人造的合成品，並含有可能危害環境的磷酸鹽、硝酸鹽和銨化合物。例如，肥皂中的化合物可能導致富營養化和藻華。

然而，我們的產品是由脂肪或油製成的。因此，我們的肥皂是可生物降解的，並且更環保，因為這些無毒的天然成分（脂肪和油）很容易被細菌等微生物分解。

我們希望增加人們對使用市面上的普通肥皂對環境所造成的不利影響的認識。

我們會在攤位上準備一些有趣的活動，例如游戲、視頻播放和實驗示範。

Magic Mirror
魔鏡

MARYKNOLL CONVENT SCHOOL (SECONDARY SECTION)
瑪利諾修院學校 (中學部)

Chan Tsz Yu Ines 陳子如
Auyang Hayley Hay Ching 歐陽曦晴
Kwan Tsz Ka Michelle 關紫嘉
Ngan Sze Tung Gloria 顏詩炯

Achieving productivity at home is a big challenge as there are a lot of distractions, our phone going off every two seconds and making us lose focus or moving to social media apps whenever we want to check our phones. However, a study from Stanford shows that working remotely can actually bring more productivity if done right. Turns out, discipline and micromanagement is the key factor in determining whether you will perform better or not.

With this goal in mind, we designed the magic mirror. By using the magic mirror, we can organise and check our to-do list everyday, lowering our reliance on phones. Unlike conventional iPads and computers, the coding for it is set so we can only view what we are supposed to do that day, and things that can help with making our daily life better like weather reports and time. This can help us achieve work life balance.

The materials used to build our mirror include a two way mirror and a raspberry pi. By programming the raspberry pi, information related to productivity will show on the two way mirror.

The mirror can be put anywhere inside the house whether it's the bathroom, so you can check the to-do list every morning when you wake up, or in the study room where it can bring natural light in as well as showing you the schedule for the day.

The magic mirror is versatile and simple to use. We hope to change the way people work by something as simple as organising their day using the magic mirror.

在家裡有效率地工作是一個巨大的挑戰，我們會遇到很多干擾因素和誘惑，例如手機不時就會響一次，這讓我們失去注意力。然而，斯坦福大學的一項研究表明，如果做得對，在家工作實際上可以帶來更高的生產力。這能證明，紀律和微觀管理是決定你是否會表現更好的關鍵因素。

帶著這個目標，我們設計了「魔鏡」。通過魔鏡，我們可以每天整理和查看待辦事項清單，減少對手機的依賴。與傳統的平板電腦和不同，它的編碼設置為我們只能查看當天應該做的事情，以及可以幫助我們改善日常生活的事情，例如天氣報告和時間。這可以幫助我們實現工作與生活的平衡。

用於構建鏡子的材料包括雙向鏡子和迷你電腦。通過對迷你電腦進行編程，可把提高工作效率相關的信息將顯示在雙向鏡像上。

鏡子可以放在家裡的任何地方，無論是浴室，這樣你每天早上醒來都可以查看待辦事項清單，或者放在書房裡，不單帶來自然光也可以顯示你的日程安排那天。

魔鏡用途廣泛，使用簡單。希望魔鏡可以為人類加強工作效率以及人們的生活方式。

PH16

ABAP: Algae-based Air Purifier

空氣「從藻」

MUNSANG COLLEGE
民生書院

Ng Ho Wang 吳皓弘
Wang Luyi 王鷺怡
Chan Cine Wah 陳羨樺
Lam Tsing Cherry 藍晴

In the metropolis in which we reside, air pollution is as inevitable as breathing. Even in our own homes with closed windows sheltering us from the vehicle exhaust gas and secondhand smoke, we are still exposed to the dangers of indoor air pollution.

It is commonly known that formaldehyde released by furniture can cause various health problems, including dizziness, irritation of the breathing tract, triggering of asthma and increased risk for cancer. As for the high indoor carbon dioxide level caused by continuous exhalation by humans, its negative impacts can vary from moderate, temporary issues like headache, breathing difficulty and reduced concentration ability, to severe health conditions such as permanent damage to the cardiovascular, breathing and nervous system. We can therefore see that the problem of indoor air pollution is one that must be addressed. The Algae-based Air Purifier (ABAP) designed by us is capable of removing formaldehyde, carbon dioxide and other air pollutants from the atmosphere, achieving a balance between urban development and personal well-being.

Once air enters the ABAP, it passes through a mixture of chemicals, which will remove the formaldehyde from air. Then, the activated carbon in the second layer will absorb and filter out dust, odour and other harmful gases, further cleansing the air. Next, the spirulina, a kind of algae, in the third layer, will photosynthesise under the illumination of the LED light in order to grow, absorbing carbon dioxide while releasing oxygen in the process. Spirulina has a wide range of uses and great nutritional value, allowing it to be used as an organic plant fertiliser and even consumed by humans.

We hope that with the ABAP, citizens will be empowered to recycle the carbon dioxide they breathe out into spirulina, a valuable superfood, while air quality will be improved, thereby giving urban residents the safe, comfortable living environment they deserve.

空氣污染，是都市人難以逃離的無形殺手。即使身在家中，把車輛廢氣、二手煙隔絕於窗外，依然難逃吸入室內空氣污染物的命運。

家具釋放出的甲醛，可令人頭暈、呼吸道敏感、哮喘發作，甚至致癌，而室內二氧化碳濃度隨著人的呼吸不斷升高，輕則可導致頭痛、呼吸困難、專注力下降，重則可對心肺及神經系統造成永久性損害。由此可見，室內空氣污染對市民身心的影響不容小覷。而我們所設計的空氣淨化機 ABAP 便能移除空氣中的甲醛、二氧化碳及其他污染物，在城市發展和個人健康中取得平衡。

空氣進入 ABAP 後，首先會經過一層化學混合物，這些化學物會將甲醛從空氣中移除。然後，ABAP 第二層中的活性碳能夠吸收並過濾空氣中的微塵、異味及其他有害氣體，進一步淨化空氣。而 ABAP 第三層的螺旋藻則能在 LED 燈照明下進行光合作用，吸取空氣中的二氧化碳供其生長，同時釋放氧氣。螺旋藻的用途廣泛，營養豐富，可作有機植物肥料，甚至供人類食用。

我們希望透過 ABAP，化腐朽為神奇，把人體呼出的二氧化碳回收成為甚具營養價值的螺旋藻，並改善室內空氣質素，還都市人一個安全舒適的生活環境。

Cane Of Balance
平衡杖

PO LEUNG KUK VICWOOD K.T.CHONG SIXTH FORM COLLEGE
保良局莊啟程預科書院

Lai Paak Hei 黎珀熙
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Chan Chung Hin Anthony 陳琮憲
Chin Chue Fung 錢鑄峰

Since the roads and walkways in the mountain are narrow. It is quite dangerous for hikers who do not pay any attention to the rocky terrain, chatting with their close friends or watching the stunning scenery. If they are walking on some narrow roads without paying attention, they could slip or fall and get injured easily. And the worst case scenario is that the hikers may become unconscious while falling down a mountain, rescue teams have to waste a lot of time looking for hiker's last location, and wasting the golden hour for saving their lives.

Our invention is Cane of Balance (also named as C.O.B.) The cane is extendable and its height is around 100 to 150 cm. The Balance Stick's shaft is made of aluminum because aluminum is a light material and it is cheap. Also, a water-proof box is installed at the upper part of the shaft in order to protect the electronic part from water and dust which includes an accelerometer, a buzzer and a LED light for lighting up a dark area.

The cane will keep sending the user's location to the cloud database. When the accelerometer detects unusual acceleration, the accelerometer will give out a signal to the processor. After a while, if the user did not respond, the processor will send the information to the mobile app through the Bluetooth. At the same time. It will switch on the buzzer producing a warning sound. The app will get the coordinates from the GPS board and send it to the cloud server. Finally the cloud server will send an email or SMS to inform the user's relatives that the user is in danger. In case the user is in a place without network connection, the cloud server will get the user's last known location from the cloud database and inform the user's relatives.

Besides, we created an app for our Cane of Balance. It is created by App Inventor. It has a built-in weather report so that the users can know the latest weather conditions to plan their routes. Furthermore the app is responsible for sending the cane's information such as, user's location, user's status to the cloud database.

For our booth setup, we will set up a few iPads to show videos of our experiment conducted with the C.O.B. and our practical demonstration videos of us attempting to use the C.O.B. on surfaces such as sand, wet rocks and slope. Also, we will show the instructions for using C.O.B..

由於山上很多的道路有很多都是凹凸不平的，而有很多人在行山的過程中只顧看風景或跟朋友聊天等等，並沒有專心看清楚道路的路況。而當他們遇到凹凸不平的路時，很容易踩空而導致扭傷。另外在發生意外的時候，救援人員多數會在人們失蹤前的位置附近搜索，而範圍都比較大，從而導致救緩受到延遲。

當加速器感應到數據異常，會發出一個信號傳送到 Arduino 處理器，Arduino 處理器透過藍牙傳送資料到電話應用程式，並且同時啟動蜂鳴器發出聲音警告，最後 GPS 發送位置到電話應用程式。電話應用程式會判定使用者遇險，系統能自動通知親友，增加使用者的獲救機率。
而我們在攤位展示是「平衡仗」和電話應用程式。平衡杖是一支智能杖，是大概 100 厘米至 150 厘米高。而杖的材料將由鋁製成，降低平衡仗的重量。另外防水箱裏面包括 GPS，加速計，蜂鳴器。

除此之外，我們還研發了一個電話應用程式。電話應用程式是由 app inventor 設計，裏面包含了地圖，和天氣等等，能夠清楚目前的狀態而選擇適合自己的路線。當使用者遇險的時候，系統能自動通知親友，增加使用者的獲救機率。

最後，我們攤位設有幾部平板電腦，能夠展示我們在山上拍下的測試影片，而我們在不同路面下測試，包括沙地，樓梯，斜路。而我們也會在現場實際展示平衡仗的運用和使用方法。

PH18

Superworm Decompose Plastic Box
蟲塑世界之盒

PO LEUNG KUK TONG NAI KAN JUNIOR SECONDARY COLLEGE
保良局唐乃勤初中書院

Chan Wai Sum 陳煒森
Lam Tsz Kit 林子杰
Fung Wing To 馮永濤
Ng Ho Him 吳灝謙

In recent years, the world's population is generating more plastic waste than ever. Plastics and their by-products form a high percentage of solid waste in our cities, oceans and waterways. According to the Environmental Protection Department (EPD), Hong Kong landfills are taking in on average over 10,000 tonnes of municipal solid waste daily. More than 20% is plastic waste, weighing as much as 90 double-decker buses.

Plastic products need a lot of time to decompose, for example, plastic needs 20 years to decompose, plastic straws need 200 years and plastic bottles need 450 years. The estimated time to naturally decompose polystyrene is about 500 years. Each person in Hong Kong produces 300g of plastic waste per day. Getting rid of polystyrene by burning can release a large amount of carbon monoxide along with styrene and other toxic chemical compounds causing damage to the environment and hazard to our health.

As plastic contains harmful chemicals, plastic waste has the greatest potential to harm the environment, wildlife and human beings. The solution to solve this problem is to use less, recycle and reduce. But is there another way to solve this problem? So we decided to investigate ways to tackle this environmental problem and see whether they can decompose plastic successfully. Based on a review of relevant literature, we decided to investigate the possibility of using worms to biodegrade plastic.

一次性塑膠廢物被人類長期大量使用，讓全球塑膠垃圾劇增，因為塑膠需要長時間才能自然降解 (膠袋需要 20 年，膠吸管需要 200 年，膠樽和膠杯需要 450 年)，所以將它們掩埋在堆填區中是最常見且最普遍的處置方法。根據《2015 香港固體廢物監察報告》: 塑膠廢物佔全港都市固體廢物總 量的 21%。每日有 158 噸塑膠瓶 (PET 瓶) 被棄置於堆填區，約等於 832 萬枝膠樽飲品 (一個 PET 瓶 約重 19 克)。由此可見堆填區的可用空間很快就會被用盡。人們有時候也會選擇將塑膠棄置於海洋 (會造成海洋污染和海洋生物誤食等問題。研究指出，現時約有 700 種海洋生物備受 5.25 萬億件塑膠垃圾威脅) 或者焚燒 (燃燒過程中會釋放有毒氣體，如二噁英、呋喃、汞和多氯聯苯，造成空 氣污染)，這都會對地球環境造成污染。近年新冠肺炎大流行，人們對一次性塑膠的使用大增，這 更加劇了塑膠對全世界造成的問題。

在這種背景下，我們想到了一個解決塑膠廢物並減輕堆填區負擔的實用方法——就是用超級蠕蟲來分解塑膠。我們期望可以在未來讓人們在家中飼養超級蠕蟲，來達到到分解家庭日常生活所產生的塑膠垃圾，並且預期這種方法對環境的影響，將遠低於焚燒、掩埋以及棄置於海洋對生態環境所造成的影響。

QC Paradise
QC 天地

QUEEN'S COLLEGE OLD BOYS' ASSOCIATION SECONDARY SCHOOL
皇仁舊生會中學

Chan Chi Wai 陳志威
Chu Chung Ho 朱重豪
Cheung Hoi Ching 張海澄
Xie Kwok Cheung 謝國祥

Microbes oxidize organic compound in polluted water to produce energy which transfers electrons to the final electrons acceptor, there are various kinds of microbes e.g. genus Geobacter、Enterobacter、Shewanella and Bacillus, can produce electrons and protons to form current in our set-up. Making use of Escherichia coli to carry out cellular respiration, the chemical ($C_6H_{12}O_6$) is transformed to $24H^+$ and $24e^-$. In our set-up it contains anode, cathode and semi-permeable membrane. $C_6H_{12}O_6$ solution is poured into the system at the anode side, it provides substrates to undergo cellular respiration. However during the final step of the oxidative phosphorylation, enzymes Cytochrome C Oxidase will turn e^-, H^+ and O_2 into water. Adding cyanide can inhibit its catalysis effectively. Then, e^- will flow from the anode through the wire to the cathode. Eventually H^+ will pass through the membrane and react with e^-, O_2 to form H_2O.

微生物藉氧化污水內的有機化合物氧化產生能，使電子轉移至最終的電子受體產生電流，菌種如：Genus Geobacter、Enterobacter、Shewanella 和 Bacillus 均能夠在下列實驗中產生電流。我們利用生物例如細菌 Escherichia coli 進行需氧呼吸，將化學物 ($C_6H_{12}O_6$) 轉化為 $24H^+$ $24e^-$ 即是電子及質子。而我們的系統包含陽極、陰極及半滲透膜，$C_6H_{12}O_6$ 溶液灌入陽極槽中，當中的大腸桿菌，進行需氧呼吸，將葡萄糖分解為：二氧化碳、質子及電子，而氧化磷酸化的過程中，氧是電子傳遞鏈的最終電子受體，為了防止氧、電子、質子重新反應為水，我們會使用氰化物抑制電子傳遞鏈內的細胞色素 C 氧化酶。因為細胞色素 C 氧化酶是電子傳遞鏈的終點的催化劑，氧氣在此被還原生成水。

PH20

Talorie
幫謹里

SALESIAN ENGLISH SCHOOL
慈幼英文學校

Li Lok Hang 李洛桁
Tam Kwan Yu Anson 譚鈞羽
Ng Ka Kui 吳珈駒
Shiu Pak Nam 蕭栢南

In Hong Kong, many people are too busy to maintain a good balance between work and life. Most people in Hong Kong work for about eight hours or even overnight every day. As a result, They might have to resort to an unhealthy diet to reduce stress due to its convenience. It is especially common for people who are living in a fast-paced city who have only little time for healthy diet selection during working hours. This may lead to malnutrition and deficiency diseases. In addition, the lack of physical activities among citizens even aggravate the situation. These problems will increase their risk of suffering from chronic diseases.

We aim at helping users to plan a healthy eating habit through our app "Talorie". By scanning a QR code printed on the receipt of the meal they have ordered at restaurants, users will receive a report with their dietary data with the amount of calories, fats and proteins consumed. Then with the data across time, the app will integrate the information of all the food you have eaten, and visualize the data for users to take reference from. The app will also give users some diet suggestions and sport advice according to their users' profiles and food consumption. Users can then monitor their planned eating habits and make necessary interventions conveniently.

在香港，人們總因事忙而未能保持工作與生活間的平衡，大多數香港人每天工作約八小時或總是在辦公室熬夜。他們或需依賴不健康的飲食來減輕壓力。對於生活在節奏急速的城市人來說，在工作的午餐時段缺乏充裕時間選擇健康飲食，或會引起營養不良和營養缺乏病。加上都市人普遍缺乏體育鍛煉，這也增加市民患上慢性病的機會。

透過我們的應用程式「幫謹里」，我們希望幫助用戶規劃健康的飲食習慣。用家可通過掃描他們在餐廳點餐時收據上列印的二維碼，用戶將收到一份包含他們飲食數據的報告，其中包含他們當餐攝取的卡路里、脂肪和蛋白質的份量。經過一天、一周及一個月後，該應用程式將整合用戶攝取過的所有食物的資訊，並以圖表顯示以供用戶參考。 該應用程式還會根據用戶的個人資料和食物攝取量，為用戶提供一些飲食和運動建議。這可方便用戶監察他們計劃的飲食習慣，並進行生活習慣上的必要改變。

ECO-heater
環保集能熱水器

S.K.H. LAM KAU MOW SECONDARY SCHOOL
聖公會林裘謀中學

Lau Kin Lun 劉建麟
Wong Sun Yuen 黃新源
Ho Shan Shan 何姍姍
Wong Wai Yi 黃蔚宜

Have you ever thought of reducing energy consumption by recycling heat energy from the environment?

In Hong Kong, about 12% of electricity consumption in the residential sector is used for water heating. If we can save part of the electricity spent on water heating, it would mean a huge reduction of electricity consumption and the city's carbon footprint. This helps balance the city's development by nature conservation.

Eco-heater is an energy-saving shower heater. It has a coefficient of performance, COP greater than 1, which conventional heaters cannot achieve.

The heater consists of two main parts--the heat recovery system and the thermoelectric heating unit. The heat recovery system brings the residual heat from the used bath water to the cold side of the thermoelectric heating unit. The unit then makes use of the Peltier effect to 'pump' the heat from the heat recovered to its hot side at where the bath water is heated. By doing this, the energy output of the heater can be 34% larger than the electrical energy consumed (COP = 1.34). Given this chance, our Eco-heater can definitely make a significant contribution to environmental protection!

Save our Earth, use an ECO-heater!

你可有想過透過回收環境中的熱能，減少能源消耗嗎？

現時，香港有高達 12% 的住宅電能耗用於加熱熱水，僅次於煮食與空調。而我們的設計——環保集能熱水器，就可以透過回收環境中的熱能，用於加熱洗澡用的水，從而減少能源消耗及香港家庭的碳足印，使城市發展與生態保育獲得平衡。

環保集能熱水器由兩個主要部分組成，分別是半導體加熱模組和廢熱能回收系統。

廢熱能回收系統能收集洗澡廢水中剩餘的熱能 （根據測試，洗澡後廢水中的溫度仍高達 34°C），把它帶到半導體加熱模組的一面，而半導體加熱模組則能利用半導體的熱泵原理，把所收集的廢熱推到另一邊，加熱家庭的用水。

利用這些技術後，環保集能熱水器可以省卻 34% 用於加熱洗澡水的能源。環保集能熱水器能改善洗澡時熱能浪費的情況。 因此，請給我們一個機會，在社會中推廣環保集能熱水器，拯救地球！

PH24

DeGarNO$_x$ 氮平衡

ST. JOSEPH'S COLLEGE
聖若瑟書院

Fung Pak Chuen 馮百川
Chan Ho Tak 陳灝德
Lau King Lung 劉璟龍
To Chun Fung 杜俊鋒

Nitrogen oxides (NO_x) are a major component of car exhaust gas. As a prominent urban air pollutant, many adverse effects on human health are brought on by nitrogen oxides. This is especially true for garage workers, who spend a considerable amount of time in enclosed garages working with cars.

Hong Kong has a lot of old vehicles that need repair every so often. These old vehicles usually have less efficient catalytic converters that are less able to remove NO_x from the exhaust. During repair, repairmen have to constantly idle the engine for repairs, leading to the build-up of NO_x in garages with less efficient ventilation systems. Further complicating this fact is that the freshly started engine emits much more NO_x than during usual operation, as the catalytic converter has not kicked in yet.

Our bioreactor, named DeGarNO$_x$, is designed to absorb and break down nitrogen oxides to harmless nitrogen at relatively low temperatures. The usage of an iron-based complex to absorb NO_x, and also denitrifying bacteria to reduce the absorbed NO_x to nitrogen, can help reach the near complete reduction of NO_x emissions.

By attaching the bioreactor to the exhaust pipe of the car being repaired in the garage, the amount of NO_x released into the garage air can be significantly diminished, hence making the air fresher and safer for workers to breathe, while also reducing the adverse environmental effects brought on by NO_x air pollution.

Denitrify your garage with DeGarNO$_x$, beginning today.

氮氧化物（NO_x）是汽車排出的廢氣中主要的空氣污染物。香港有很多舊車需要恆常的保養和維修，維修期間引擎的怠速使氮氧化物排放量提升，可是舊車內置的催化轉化器效率較低，氮氧化物因而容易在通風系統較弱的車庫積聚。此外，在啟動引擎時，當內置的轉化器未能完全投入運作，汽車便會釋放出比平時更多的氮氧化物，使空氣污染問題愈趨惡化。作為一種空氣污染物，氮氧化物亦對人類呼吸系統健康構成嚴重威脅，而這些負面影響對長年累月在封閉的車庫中工作的汽車車庫工人來說，尤為明顯、嚴重。

為此，我們特意研製 DeGarNO$_x$ 生物反應器，冀望在溫度相對較低的環境下，在車庫中吸收氮氧化物，並將其分解為無害的氮氣。通過將生物反應器的接駁端連接到車庫汽車的排氣管，利用鐵基複合物作為螯合劑以吸收氮氧化物，同時又使用反硝化菌將其還原為氮，便可高效排除空氣中的氮氧化物，顯著降低車庫空氣中氮氧化物的含量。正所謂對症下藥，此舉相信不但能有效地使車庫工人建立健康屏障，還可減少氮氧化物對城市空氣質素的不良影響。

從今天開始，DeGarNO$_x$ 將是車庫脫硝工程的不二之選。

Dronba

ST. MARK'S SCHOOL
聖馬可中學

Cheng Sin Tung 鄭善桐
Wong Po Leung 黃步良
Lau Shun Hei 劉信希
Tsang Yi Tung 曾伊彤

Since the outbreak of the COVID-19 pandemic, hiking has become one of the most popular leisure activities in Hong Kong. It was a fantastic chance for Hong Kong people to escape from the concrete jungle and get close to mother nature. However, not all hikers are responsible, and some have left behind litter leading to solid waste problems in country parks. As a result, the natural environment is disturbed. This inspired us to find a solution to mitigate land pollution.

Our model "Dronba" utilises both a drone and a robot arm. We will use an existing drone on the market to capture images of suitable hiking trails. By allowing the drone to patrol and capture videos during off-peak hours, we can transmit the images to a computer and then process and analyse the images using pre-trained real-time object detection algorithm YOLO (You Only Look Once). Through this, we can detect unwanted objects on the ground with reasonable accuracy. After recognising objects such as plastic bottles, the location of litter can be mapped with the help of mapping software. This data provides invaluable information about where littering hotspots are. Necessary follow-up actions can be taken, such as increasing surveillance and increasing bin collection to prevent littering and further damaging of the environment. The data can also be used for future research.

With the rough location of the objects provided by the GPS of of the drone and mapping, we will use a robot arm that is attached separately to a vehicle to pick up the unwanted items. To do so, we will set up a stereo camera system capable of depth perception, which is similar to how humans judge the distance of a specific object with two eyes. Unwanted items can be removed from the environment and brought to nearby collection sites. This way, we can alleviate land pollution in country parks through remedial actions.

Litters made by plastics and other non-biodegradable materials left behind by humans may be fatal. When animals ingest the indigestible waste, they may suffocate and die. Even though we cannot ensure that every person will not litter in the country park, yet, through preventive and remedial actions, we can minimise the impact that we as humans have on the environment. Moreover, the result is a win-win situation, as humans can also benefit from less visual pollution while hiking. Hence, we can strike a balance between the environment and humans so that our actions are sustainable in the long term.

我們的模型 「Dronba」希望透過無人機和機械臂的組合，能夠幫助減少山上垃圾數量。無人機會首先將將相機影像傳送到電腦，然後利用圖像識別算法 YOLO 進行分析，再使用機械臂移除山上的垃圾。

為了能夠使用機械臂來撿起不需要的物品，我們亦需運用兩個鏡頭的數據去計算出個別物體的距離，然後將數據上傳至電腦運算，從而把被辨認為垃圾的物體撿起，再把分類的垃圾從環境中移動至附近的收集地點，把環境中的廢物垃圾重新集中至一個收集點，以便清潔公司等收集垃圾，減少人物質源之外，亦可以將垃圾從大自然不再四散。這不但可以令大自然環境改善減少廢物污染，同時亦可以平衡生態，減少對地球環境的傷害，使人民生活舒適質數提升。

另外，通過這種方式，在識別出塑料瓶等物體後，亦可以在地圖上記下垃圾的位置，以便採取其他後續行動，例如在垃圾丟棄熱點增加閉路電視和增加垃圾箱等措施，以減輕亂拋垃圾的問題。通過以上預防和補救措施，人類對環境的影響便可減少，並在環境和人類活動之間取得平衡。

PH26

Anti-Myopia Lamp

ST. PAUL'S COLLEGE
聖保羅書院

Mak Chun Lam 麥晉霖
Cheng Hong Kiu 鄭匡喬
Wong Kau Hei 黃教熙
Lee Man Wai Adrian 李文尉

Everyone needs lights, no matter at work, running errands, or during leisure time for illumination. However, as of what we have found, light from table lamps is usually either too bright or too dim, since the brightness of the environment varies with sunlight. In addition, light intensity required for different activities, such as reading, using electronic devices, are different. Unsuitable brightness of the environment might cause eye sore or other eye problems of the user, and such situations have to be improved.

At the same time, exposure to sunlight can also reduce risk of myopia (short sight), by regulating the length of the eyeball. However, due to the hectic school life of children in Hong Kong, they usually do not have sufficient time to play outdoors. Therefore, they have less exposure to sunlight compared with children of the previous generations and thus have higher risks of getting myopia.

The theme of the Exhibition this year is "Balance". In our project, not only do we want to balance the brightness of lights, but we also want to maintain people's health while they are working or studying, which is equivalent to striking a balance between work and health. We decided to design a table light, which can emit light with additional blue light, to produce a similar stimulating effect to the users. With such a function, the users can balance their time exposed to sunlight and normal light without going outdoors under their busy daily life and even during their work.

Therefore, we came up with this idea: making a table lamp that could emit more beneficial blue light. Intensity of specific wavelengths of light (455 - 500 nm) are strengthened. Light from the table lamp mainly consists of the conventional white light and supplementary bulbs to provide the extra aforementioned wavelengths of light. Light intensity can be adjusted manually according to the surrounding environment using an app. The users can choose whether to turn on the mode or not, so as to balance their time of exposure to sunlight and normal light.

In order to make our own lamp, we will do some research on the beneficial blue light, especially how it helps regulate the size of the eyeball by finding and filtering relevant information online. Beneficial blue light can stimulate the release of dopamine at the retina, which helps inhibit the extension of axial length of the eyeball. Besides, there are lots of collagenous fibres in the cornea and sclera. Collagenous fibres and also the eyeball will become stronger by the action of dopamine, thus the extension of axial length due to intraocular pressure will be reduced.

After investigation, we will try to make the table lamp by adding those components if possible. To better facilitate the production of the lamp, we are going to learn python, a prevalent programming language. Using python, we can write the app, as mentioned above, to allow users to control the table lamp effectively.

每個人都需要燈光，無論是在工作，還是在閒暇的時候，都可以用來照明。然而，正如我們發現，檯燈所發出的光通常不是太亮，便是太暗，而環境的亮度會隨著陽光的變化而改變。此外，不同活動（例如閱讀、使用電子設備）所需的光強度也不同。不適當的光度可能會導致用戶的眼睛疼痛或其他眼睛問題，因此這是一個需要糾正的問題。

同時，暴露在陽光下還可以通過調節眼球的長度來降低近視（近視）的風險。然而，由於香港學生們的生活忙碌，通常沒有足夠的時間到戶外玩耍。因此，與上一代的孩子相比，他們接觸陽光的次數較少，因而患近視的風險更高。

今年聯校科展的主題是「平衡」。在我們的研究和製作過程中，我們不僅要平衡燈光的亮度，還要在人們工作或學習的同時保持人們的健康，這相當於在工作和健康之間取得平衡。我們決定設計一種檯燈，它可以發出帶有額外藍光的光，以對用戶產生類似的刺激效果。有了這樣的功能，用戶可以在忙碌的日常生活中，甚至在工作中，不用去戶外便可以平衡暴露在陽光和普通光線下的時間。

因此，我們提出了這個想法：製作一種可以發出更有益藍光的檯燈，特定波長的光（455 - 500 nm）的強度會得到加強。檯燈發出的光主要由傳統的白光和輔助燈泡組成，以提供上述額外波長的光。用戶可以使用應用程序根據周圍環境手動將光強度調整為不同的亮度，亦可以選擇是否開啟該模式，以平衡他們暴露在陽光下和正常光線下的時間。

為了製作我們自己的燈，我們會對太陽光的成分進行一些研究，並通過在網上查找和過濾相關信息來確定太陽光的成分如何幫助調節眼球的大小。陽光可刺激視網膜釋放多巴胺，有助於抑制延長眼球的軸向長度。此外，角膜和鞏膜中含有大量膠原纖維。在陽光照射下，膠原纖維和眼球會變得更強，從而減少眼壓引起的眼軸延伸。

在資料搜集後，我們將嘗試通過添加以上組件來製作檯燈。為了製作這燈，我們亦會學習流行的編程語言 python。使用 python，我們可以編寫程式碼，令用家能以如上所述的應用程式來控制檯燈。

TimeTransduce

TSUEN WAN GOVERNMENT SECONDARY SCHOOL
荃灣官立中學

Tsui Wang Yue 徐宏瑜
Heung Lok Yiu 香樂瑤
Yu Kai Lam, Karl 虞啟林
Yung Kwok Wa 翁國樺

Our working efficiency is restricted by the human body's lack of an innate sense of time. Many of us still struggle with mismanaged time and disrupted circadian cycles despite an abundance of timekeeping means. To help users keep track of the flow of time is the rationale behind the smart wristband TimeTransduce and system eLapse, our solutions for inefficient usage of time and low productivity. They electronically assist the human body to transduce the elapse of time, hence the names of these components. The wristband operates with an Arduino microprocessor, and is intended for use on multiple occasions. Using a number of low-capacity electrodes, small, controlled and safe electric currents that have sweeping effects across the skin produce sensations of the passage of time to the user with minimal discomfort. As an interface for the wristband, there will be the mobile application eLapse for users to set alarms, timers and daily schedules. In practice, alarm signals will be as noticeable as possible strong, repetitive impulses; timer signals will start out weak but progressively strengthen; and daily scheduled signals will be weak ambience for the entirety of a scheduled event. TimeTransduce aims to utilize neuroplasticity, the ability of the human brain to grow and reorganize under external stimulus, for users to develop a subconscious sense of time. Our conscious efforts to keep track of time, such as counting seconds or referring to clocks, are time-consuming actions themselves. With TimeTransduce, we hope to see much improvement in users' time efficiency and productivity.

生活在這個時代，人們的生活節奏非常急速。在如此緊迫的時間之下，人們的工作效率及生活平衡因人體缺乏與生俱來的時間感而受影響。現今的設備如手錶、智能電話等，為人們目前用來讀取時間的主要工具，需要使用者有意識地留意，既不能收提升時間管理之效，更有機會使人分心，而視覺是連續的、集中的過程，不是持續讀取時間的最佳方法，但通過 TimeTransduce 上的 eLaspe 技術，用戶便能通過體感系統更有效地感知時間。TimeTransduce 目的是幫助用戶追蹤時間的流轉，從而達致工作生活的平衡。裝置使用 Arduino 作控制核心，並透過多個電極，在皮膚上具有掃掠效果的微小、可控且安全的電流產生時間流逝的感覺給用戶使用。裝置更可透過手機應用程式 eLapse 設置鬧鐘、定時器和日程安排。鬧鐘信號會盡可能地引起強烈的、重複的脈衝，時間信號開始時弱，但會逐漸增強，日程表信號相對鬧鐘信號較弱。因大腦具備的神經可塑性，人們經過一段短時間的學習後能感受到正確時間，就如發展出對時間感知的「第六感」。擁有了更良好的時間感知，人們對時間管理的觀念將大大提高，同時提升生產力，減少因時間管理不善而造成的工作生活不平衡現象。

PH28

ChromVolt
遮光變電

TSUEN WAN PUBLIC HO CHUEN YIU MEMORIAL COLLEGE
荃灣公立何傳耀紀念中學

Or Chung Hymn Daniel 柯頌謙
Leung Tsz Wang Raymond 梁子宏
Ho Kit Chun 何傑晉
Fan Cheuk Kiu 范焯橋

Nowadays, the sunlight from the windows indoors affect our working quality, especially offices in skyscrapers. Moreover, the dazzling lights and ultraviolet lights emitted from the sun may cause health problems such as skin cancer and discomfort of the eyes. On the other hand, the consumption of energy in the office is high as a lot of machines are operating at the same time and a cooling system is frequently used in high power, which can be quite expensive with high emission of greenhouse gases. That's when the photochromic windows can be a solution.

By installing a solar panel system on top, the sunlight would come in use as a renewable energy source and help achieve an eco-friendly environment in the office. The photochromic glass panel on the front darkens when sunlight is shone in order for comfort of the eyes by making use of redox reactions. The double glazed windows system can reduce the conduction from the outside and such a narrow space inside prevents efficient convection, reducing the temperature gain inside and thus lower the reliance of air-conditioning.

For the limitations of the invention, the photochromic glass panels do not work well in cold environments and if the building has metal window frames the insulation would be less effective. And the generation of electricity would be limited by cloudy or dark sky and is dependent on when the sun shines.

室內窗戶的陽光會影響我們的工作質量，特別在高層數辦公室，直接受到陽光照射。此外，從太陽刺眼的燈光和紫外線會導致眼睛不適甚至引致皮膚癌等問題。另一方面，辦公室的能源消耗很高，因為許多機器需要同時工作，冷卻系統也大功率運作，導致溫室氣體排放量大。

通過在上面安裝太陽能電池系統，陽光將用作可再生能源，並有助於在辦公室實現生態友好型環境。當陽光照耀時，前面的光致色玻璃面板會變暗，以氧化還原反應來阻擋刺眼的太陽光。雙層玻璃窗系統可以減少熱傳導，內部狹窄的空間可以防止高效的對流，降低內部溫度增益，從而降低對空調的需要。

本發明的限制，在於玻璃面板在寒冷的環境中效果不佳，如果建築物有金屬窗框，絕緣效果會降低。發電將受到天色的限制，並取決於陽光陽光於何時照射以及照射的地方。

STRUCTURE

架構

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From left to right: Mimi Tsoi, Ashley Ngan, Michelle Chan, Oiki Zhu, Joey Yang, Anny Hung, Jenny Wang, Rita Cheng, Yammy Wong, Tracey Cheng

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PAST EVENTS

活動回顧

PROPOSAL COMPETITION

計劃書設計比賽

The Proposal Competition will start in January 2021. An adjudicating panel comprising professors and professionals from different fields will be invited to select no more than 30 teams to exhibit their products in the 54th J.S.S.E..

計劃書設計比賽在二零二一年一月舉行，由來自多個領域的教授和專業人士組成的評審團評分。評審團亦會從中選出不多於三十隊優秀隊伍，於第五十四屆聯校科學展覽展出其作品。

PROJECT HOLDERS' SEMINAR

展品負責人研討會

The Project Holders' Seminar was successfully held on 24 January 2021 on an online platform. During the Seminar, the J.S.S.E.P.C. and J.S.S.E. were introduced to the Project Holders from different participating schools. Details of the Proposal Competition such as regulations, marking criteria as well as guidance on the preparation work were also announced.

展品負責人研討會於二零二一年一月二十四日以網上形式舉行。講者向來自不同學校的展品負責人介紹聯校科學展覽籌備委員會及聯校科學展覽。此外，研討會中亦公佈了計劃書設計比賽的詳情，例如比賽規則、評分準則及準備工作的指引等。

PROPOSAL SUPERVISING SCHEME

計劃書指導計劃

The Proposal Supervising Scheme was successfully held in February 2021 on an online platform. A panel of supervisors consisting of numerous professors and lecturers from renowned local tertiary institutions met the Project Holders in person a few weeks before the deadline of submission of proposals. During the meeting, questions raised by Project Holders were answered so as to solve the problems encountered when working on the proposal. Advice was given so that Project Holders could refine their proposals before submission.

計劃書指導計劃於二零二一年二月舉行。由教授和大學講師組成的指導人員於提交計劃書截止日前數星期與展品負責人會面，解答他們在制訂計劃書時遇到的問題，並給予建議，藉以提高其計劃書水平。

JUNIOR SECONDARY SCHOOL ACTIVITY

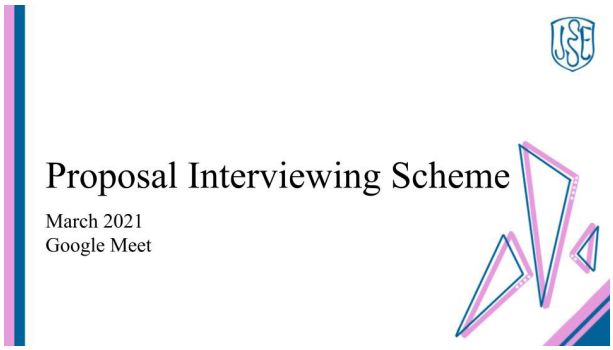
初中學生活動

The Junior Secondary School Activity is held on 13 March 2021. Through completing various games, they are able to learn a lot of scientific knowledge and also to show their talents in science.

初中學生活動於二零二一年三月十三日舉行。 透過參與各式各樣的遊戲，他們將學習到有關科學的知識，同時展示其科學才能，以及對科學的熱情。

PROPOSAL INTERVIEWING SCHEME

計劃書面試計劃



Project Holders were interviewed by adjudicators in March 2021. During the interview session, Project Holders were required to give a presentation on their proposals and to answer questions raised by the adjudicators. This offers the adjudicators an in-depth understanding of their proposals, ensuring objectiveness on the results of the Proposal Competition as well as the selection of teams for the 54th J.S.S.E.. Only those whose scores exceed a certain standard could be able to exhibit their products in the Exhibition.

展品負責人於二零二一年三月下旬與評判會面。在面試的過程中，展品負責人須向評判介紹其計劃書，並回答評判提出的問題。此計劃能使評判對計劃書的構思更為了解，並確保計劃書設計比賽的結果和隊伍選拔的客觀性。在計劃書面試計劃中得分超過一定標準者，方能得到參加第五十四屆聯校科學展覽的資格。

PRIMARY SCHOOL SCIENCE WORKSHOP

小學生科學工作坊

The Primary School Science Workshop was held on 4 July 2021 at Hong Kong Science Museum. We are more than delighted to see the participants from various primary schools getting along with one another, as well as cultivating their interest in science.

小學生科學工作坊在二零二一年七月四日舉行。我們很高興看見參加者之間相處融洽，並對科學有更深入的了解和興趣。

PRIMARY SCHOOL COLOURING COMPETITION

小學生填色比賽 --「科學描繪無限可能 達至生活理想平衡」

Junior Division Champion
初小組（小一至小三）冠軍

Senior Division Champion
高小組（小四至小六）冠軍

Bearing the annual theme "Balance", the Colouring Competition is held to encourage primary school students to express their passion for science through colouring and drawing. Participants are required to paint and decorate the sheet of sketch to bring out the theme "Inspiring in Science, Seeking for Balance".

是次比賽以小學生為對象，旨在配合本年度聯校科學展覽的主題「平衡」，鼓勵小學生以填色及繪畫表達對科學的熱誠。參賽者須在填色紙上添上色彩並加以任何裝飾，對應主題「啟發科學潛能，尋找生活平衡」。

ACKNOWLEDGEMENT

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City University of Hong Kong
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Carmel Bunnan Tong Memorial Secondary School
CCC Kei Yuen College
CCC Tam Lee Lai Fun Memorial Secondary School
Chiu Lut Sau Memorial Secondary School
Confucius Hall Secondary School
HKFYG Lee Shau Kee College
Homantin Government Secondary School
Hong Kong Teachers' Association Lee Heng Kwei Secondary School
Kiangsu-Chekiang College (Shatin)
Kwun Tong Government Secondary School
La Salle College
Lok Sin Tong Leung Chik Wai Memorial School
Maryknoll Convent School (Secondary Section)
Munsang College
PLK Vicwood K.T. Chong Sixth Form College
Po Leung Kuk Tong Nai Kan Junior Secondary College
Queen's College Old Boys' Association Secondary School
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S.K.H. Lam Kau Mow Secondary School
S.K.H. Li Ping Secondary School
St. Francis Xavier's School, Tsuen Wan
St. Joseph's College
St. Mark's School
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Tsuen Wan Government Secondary School
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創新科技署

香港特區政府創新科技署於2000年成立，肩負引領香港成為以知識為本的世界級經濟體的使命。創新科技署的工作重點包括提供基礎設施，發展人力資源；資助應用研發、支援創科企業；提倡創科文化，以及支援檢測和認證業的發展等。

Innovation and Technology Commission

Established in 2000, the Innovation and Technology Commission (ITC) of the HKSAR Government has been charged with the mission of spearheading Hong Kong's drive to become a world-class, knowledge-based economy. The ITC strives to enhance Hong Kong's competitiveness through providing infrastructure and developing human capital, funding applied research and development, supporting I&T ventures, fostering an I&T culture and supporting the development of Hong Kong's testing and certification industry.

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田家炳基金會成立於1982年，以「回饋社會、貢獻國家」為宗旨，致力推展社會慈善公益事業，運作資金全部來自創辦人田家炳博士及其家族公司之無私捐獻，受惠學校、機構遍佈全國。

秉持田家炳博士「中國的希望在教育」之信念，我們相信聚焦教育是提高國民素質、振興中華的關鍵。2010年基金會實行管治轉型，邀請本港九所大學校長/代表和多位社會俊彥加入諮議局及董事局，並更新使命為：「促進道德教育、弘揚中華文化、融合世界文明，以提升中國教育素質，貢獻國家。」

作為支持教育內涵發展的慈善團體，基金會的工作緊密配合國家政策及社會發展需求，近年來積極推動與中央及地方政府、教育行政部門、大學和教科研機構的深度合作，在學生培育、教師專業發展、學校文化建設等領域，尤其在青少年德育及中華文化傳承等範疇，開展特色項目。此外，基金會亦面向全國200余所田家炳學校，提供相應的資源傾斜，並推行扶貧獎優計劃。本會自2016年起連續多年資助聯校科展活動。

承蒙大眾的關愛與支持，基金會於2017年在廣州註冊成立代表處並獲國家教育部出任業務主管單位，2018年獲廣東省公安廳頒發優質代表機構獎，2020年獲教育部評為卓越合作夥伴。基金會同仁將一如既往竭盡棉力投身教育志業，不斷追求卓越，繼續造福社群，貢獻國家。

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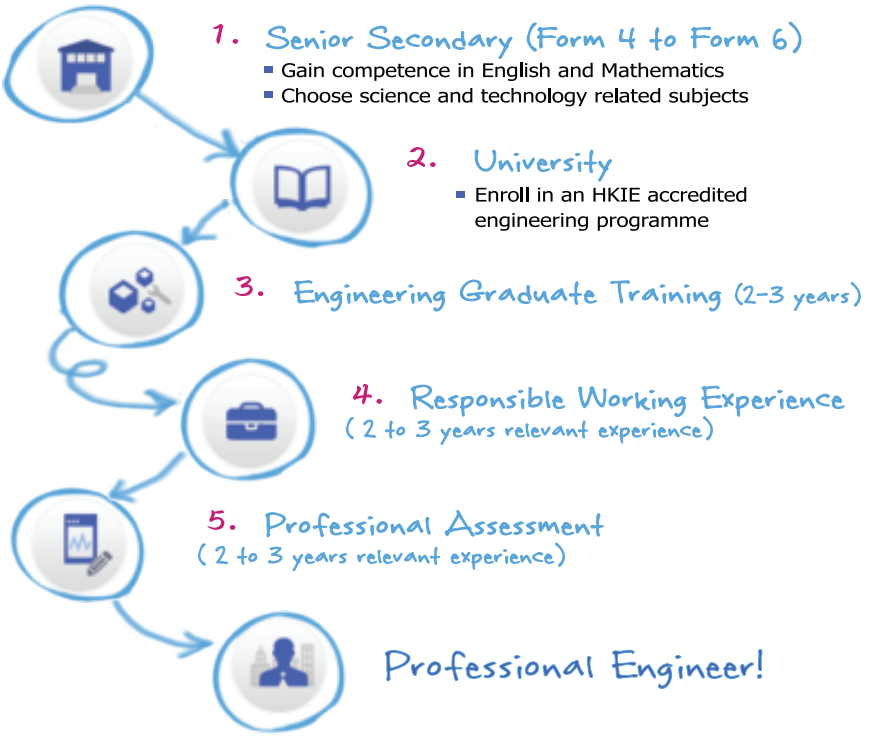

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鑒於科技發展一日千里，並對各地社會及文化影響深遠，為此，始創人籌集資金並創立"千里眼始創人慈善基金有限公司"，以推動、促進與普及科技教育。

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