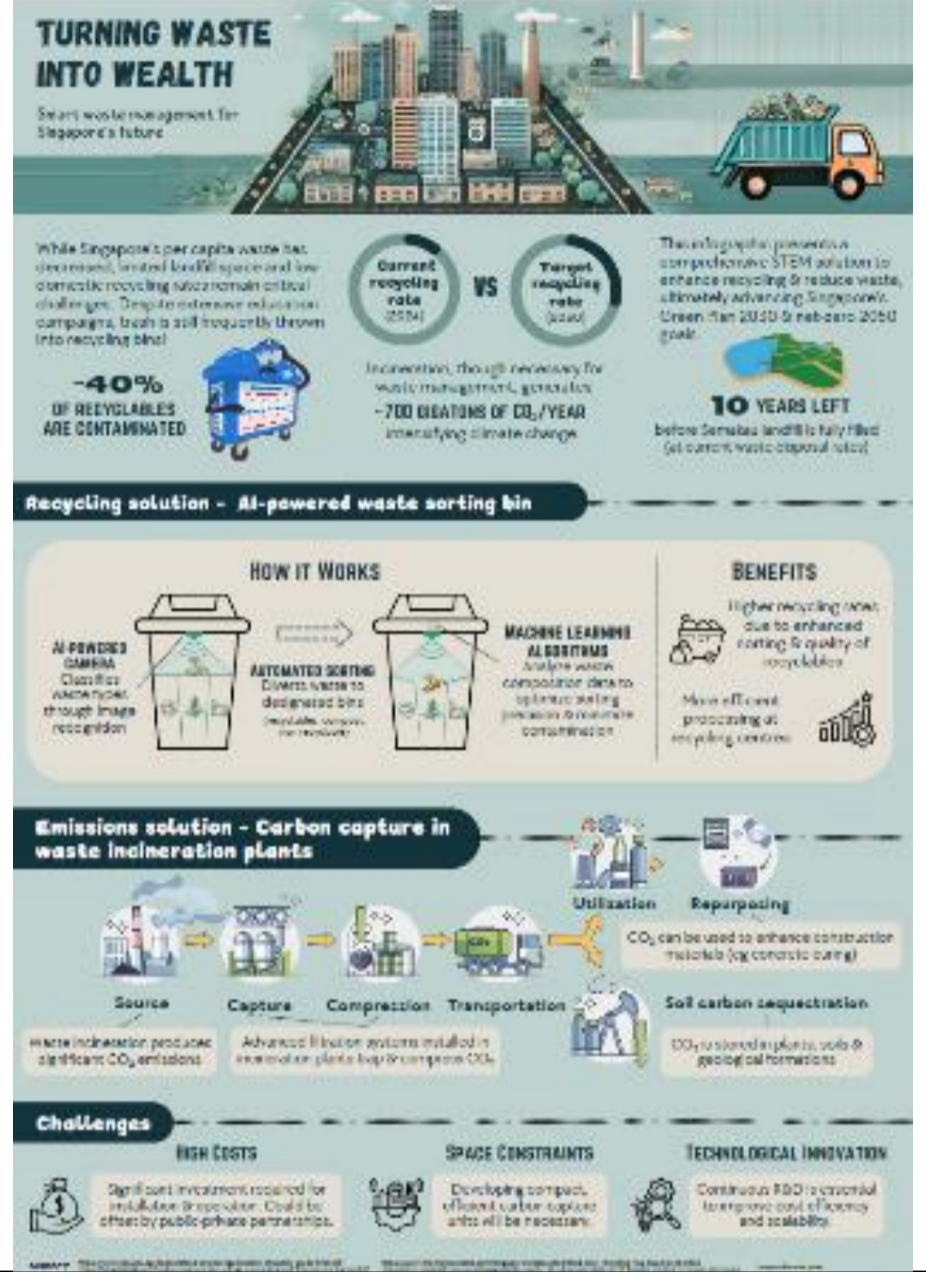



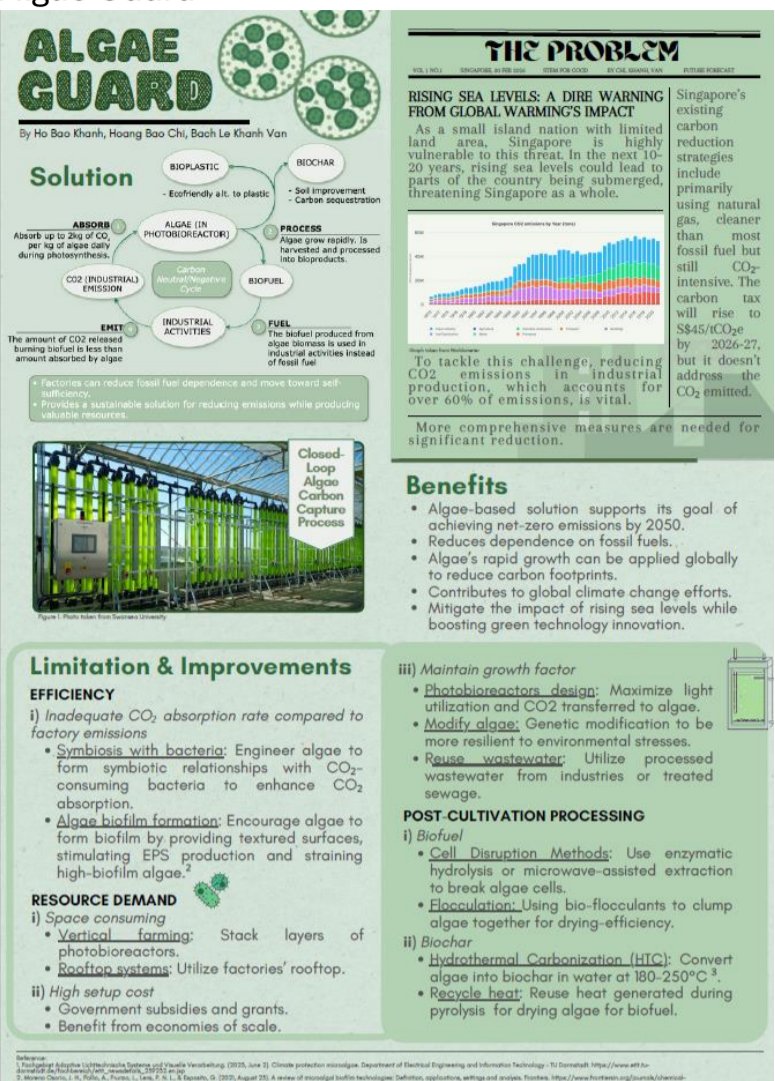
SSEF2025: STEM for Good! Contest

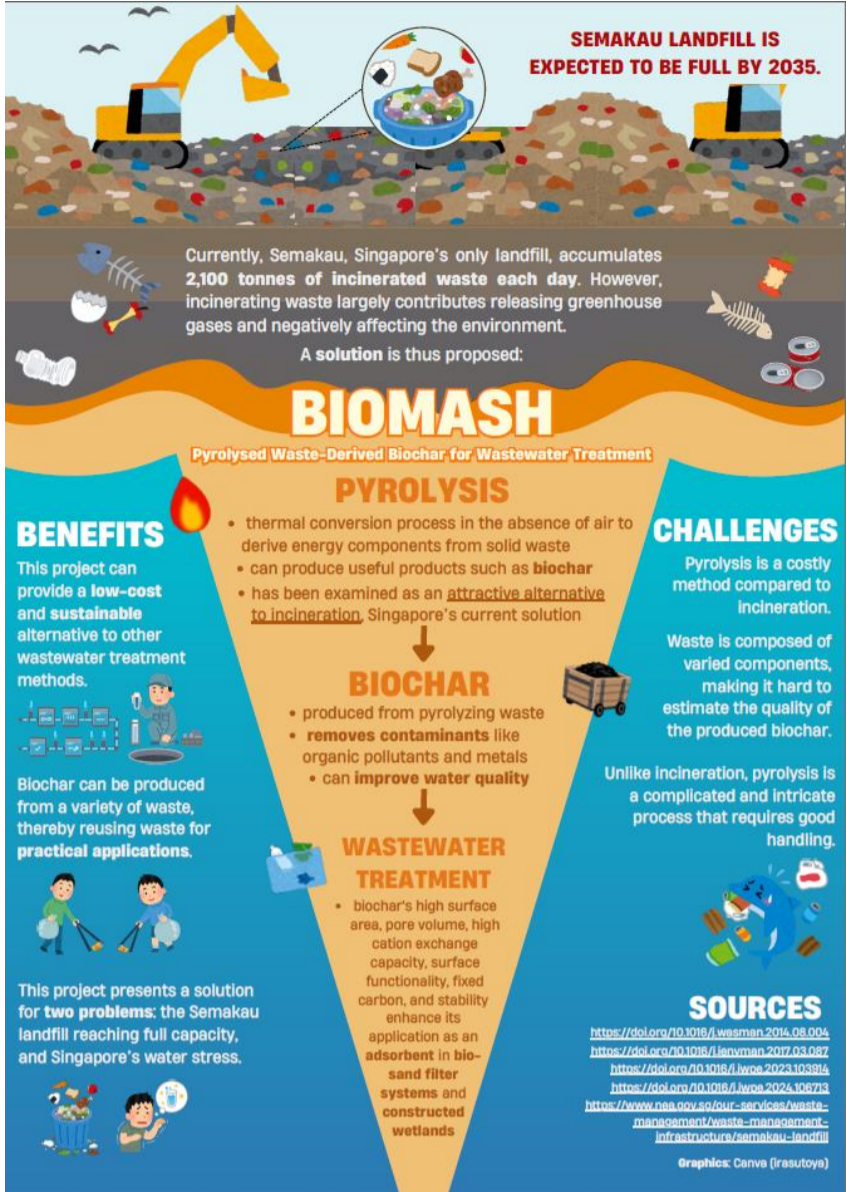
The following entries have been identified as the top 3 entries in their respective categories.

The entries are presented here in no order of merit.

Pre-University

Title	School	Names of Students
<p>Turning Waste into Wealth</p>  <p>TURNING WASTE INTO WEALTH Smart waste management for Singapore's future</p> <p>While Singapore's per capita waste has decreased, limited landfill space and low domestic recycling rates remain critical challenges. Despite extensive education campaigns, trash is still frequently thrown into recycling bins!</p> <p>Current recycling rate (2024) VS Target recycling rate (2030)</p> <p>Incineration, though necessary for waste management, generates -700 CREATIONS OF CO₂/YEAR intensifying climate change.</p> <p>The infographic presents a comprehensive STEM solution to enhance recycling & reduce waste, ultimately advancing Singapore's Green Plan 2030 & net-zero 2050 goals.</p> <p>-40% OF RECYCLABLES ARE CONTAMINATED</p> <p>10 YEARS LEFT before Semakau landfill is fully filled (at current waste disposal rates)</p> <p>Recycling solution - AI-powered waste sorting bin</p> <p>HOW IT WORKS</p> <p>AI-POWERED CAMERA Classifies waste types through image recognition</p> <p>AUTOMATED SORTING Diverts waste to designated bins (recyclables, organics, non-recyclables)</p> <p>MACHINE LEARNING ALGORITHMS Analyze waste composition data to optimize sorting precision & minimize contamination</p> <p>BENEFITS</p> <p>Higher recycling rates due to enhanced sorting & quality of recyclables</p> <p>More efficient processing at recycling centers</p> <p>Emissions solution - Carbon capture in waste incineration plants</p> <p>Waste incineration produces significant CO₂ emissions</p> <p>Advanced filtration systems installed in incineration plants help to capture CO₂</p> <p>Utilisation CO₂ can be used to enhance construction materials (eg concrete curing)</p> <p>Repurposing CO₂ stored in plants, soils & geological formations</p> <p>Soil carbon sequestration</p> <p>Challenges</p> <p>HIGH COSTS Significant investment required for installation & operation. Could be offset by public-private partnerships.</p> <p>SPACE CONSTRAINTS Developing compact, efficient capture systems will be necessary.</p> <p>TECHNOLOGICAL INNOVATION Continuous R&D is crucial to improve cost efficiency and scalability.</p>	<p>HWA CHONG INSTITUTION</p>	<p>Kaela Gan Shao Yi</p>
<p>Extending Semakau Landfill Vertical Expansion for Sustainable Waste Management</p> <p>EXTENDING SEMAKAU LANDFILL: VERTICAL EXPANSION FOR SUSTAINABLE WASTE MANAGEMENT</p>  <p>URGENCY OF EXPANSION</p> <ul style="list-style-type: none"> SEMAKAU LANDFILL IS EXPECTED TO REACH FULL CAPACITY IN 12 YEARS THE RATE AT WHICH WASTE IS DISPOSED OF AT SEMAKAU LANDFILL SIGNIFICANTLY EXCEEDS THE RATE AT WHICH IT BREAKS DOWN. WITHOUT IMMEDIATE ACTION, SINGAPORE WILL FACE A CRITICAL WASTE CRISIS <p>BACKGROUND</p> <p>SEMAKAU LANDFILL SPANS ~350 HECTARES (15 SQUARE KILOMETERS) AND IS ENCLOSED BY A 7-KILOMETER PERIMETER ROCK BUND.</p> <p>CONSTRAINTS ON HORIZONTAL EXPANSION:</p> <ul style="list-style-type: none"> RISK OF DAMAGING SENSITIVE MARINE HABITATS, SUCH AS CORAL, SEEP AND MANDRAVES PROXIMITY TO OTHER ISLANDS, SUCH AS PELAIU JUNG, CREATES COMPLOTS WITH EXISTING LAND USES AND ECOLOGICAL PRESERVATION EFFORTS <p>GUIDELINES FOR COMPLIANCE AND SUSTAINABILITY</p> <ul style="list-style-type: none"> ENSURE ENVIRONMENTAL PROTECTION MAINTAIN ECO-FRIENDLY AND FLOURISH FLORA AND FAUNA SAFEGUARD WATER SOURCES: IMPERMEABLE LINERS, LEACHATE TREATMENT MINIMIZE ASH DISPERSION: COMPACT INCINERATION ASH, COVERED BARRELS FOR TRANSPORT <p>VERTICAL EXPANSION: FURTHER UTILISATION OF FILLED CELLS AND EXTEND LIFESPAN OF LANDFILL BY 10-15 YEARS</p> <p>INTEGRATION OF PIGGYBACK CONCEPT WITH REINFORCED TERRACING SOLUTIONS</p> <p>SINCE SEMAKAU ALREADY HAS ENGINEERED SLOPES, EXPANSION CAN BE ACHIEVED BY REINFORCING, STEEPENING AND TERRACING THEM</p> <p>OPERATIONS</p> <ul style="list-style-type: none"> SOIL SLOPE PROTECTIVE STRATEGIES WILL INVOLVE REGRASSING THE FILLED CELL SLOPES (EG. FROM 1V:4H TO 1V:3H) THROUGH COMPACTION AND GEO-SYNTHETIC REINFORCEMENT OF INCINERATION ASH AND SOIL. MAINTAINED SURFACE AND CAPACITY OF LANDFILL WHILE REDUCING HEIGHT-RELATED INSTABILITY RISKS WASTE CELLS WILL THEN BE TERRACED WITH PROGRESSIVELY GENTLER SLOPES AT EACH LEVEL. SPRING PLAYINGFIELDS CAN BE REIMPOSED FOR FUTURE VEGETATION, PROMOVING NATURE RESTORATION (E.G. SOIL BANK FORMING, BIODIVERSITY RESTORATION, OR EVEN ECO-RECREATIONAL PROJECTS, TRANSFORMING THE LANDFILL INTO A MULTI-FUNCTIONAL, SUSTAINABLE ADAPT <p>SUCCESSFUL GLOBAL CASE STUDY</p> <p>FREDERICK COUNTY'S SITE B LANDFILL EXPANDED VERTICALLY BY 20M TO ACHIEVE AN AIRSPACE GAIN OF 10 MILLION OF (2.4 MILLION CUBIC YARDS), EXTENDING LIFESPAN BY 4-5 YEARS.</p> <p>CHALLENGES</p> <ul style="list-style-type: none"> TEMPORARY WILDLIFE RELOCATION FROM ESTABLISHED VEGETATION CELLS BOTTOM ASH & FLY ASH HAVE SLIGHTLY LOW DENSITIES RANGING FROM 1.5 - 2.9 G/CM³, REQUIRING EXTENSIVE BLEND WITH CONSTRUCTION AGGREGATES AND COMPACTION 	<p>RAFFLES INSTITUTION</p>	<p>Li Kit On Hubert, Joshua Ling, Marcus Lu, Loh Ming Yao Alexander</p>




Title	School	Names of Students
<p>Algae Guard</p>  <p>THE PROBLEM</p> <p>RISING SEA LEVELS: A DIRE WARNING FROM GLOBAL WARMING'S IMPACT</p> <p>Singapore's existing carbon reduction strategies include primarily using natural gas, cleaner than most fossil fuel but still CO₂-intensive. The carbon tax will rise to \$45/CO₂e by 2026-27, but it doesn't address the CO₂ emitted.</p> <p>To tackle this challenge, reducing CO₂ emissions in industrial production, which accounts for over 60% of emissions, is vital.</p> <p>More comprehensive measures are needed for significant reduction.</p> <p>Benefits</p> <ul style="list-style-type: none"> Algae-based solution supports its goal of achieving net-zero emissions by 2050. Reduces dependence on fossil fuels. Algae's rapid growth can be applied globally to reduce carbon footprints. Contributes to global climate change efforts. Mitigate the impact of rising sea levels while boosting green technology innovation. <p>Limitation & Improvements</p> <p>EFFICIENCY</p> <ol style="list-style-type: none"> Inadequate CO₂ absorption rate compared to factory emissions <ul style="list-style-type: none"> Symbiosis with bacteria: Engineer algae to form symbiotic relationships with CO₂-consuming bacteria to enhance CO₂ absorption. Algae biofilm formation: Encourage algae to form biofilm by providing textured surfaces, stimulating EPS production and straining high-biofilm algae. <p>RESOURCE DEMAND</p> <ol style="list-style-type: none"> Space consuming <ul style="list-style-type: none"> Vertical farming: Stack layers of photobioreactors. Roof-top systems: Utilize factories' rooftop. High setup cost <ul style="list-style-type: none"> Government subsidies and grants. Benefit from economies of scale. <p>iii) Maintain growth factor</p> <ul style="list-style-type: none"> Photobioreactors design: Maximize light utilization and CO₂ transferred to algae. Modify algae: Genetic modification to be more resilient to environmental stresses. Reuse wastewater: Utilize processed wastewater from industries or treated sewage. <p>POST-CULTIVATION PROCESSING</p> <ol style="list-style-type: none"> Biofuel <ul style="list-style-type: none"> Cell Disruption Methods: Use enzymatic hydrolysis or microwave-assisted extraction to break algae cells. Flocculation: Using bio-flocculants to clump algae together for drying-efficiency. Biochar <ul style="list-style-type: none"> Hydrothermal Carbonization (HTC): Convert algae into biochar in water at 180-250°C³. Recycle heat: Reuse heat generated during pyrolysis for drying algae for biofuel. 	<p>CEDAR GIRLS' SECONDARY SCHOOL</p>	<p>Ho Bao Khanh, Hoang Bao Chi, Bach Le Khanh Van</p>
<p>BIOCHAR: THE GOOD KIND OF CHAR</p> <p>NUS High School of Math and Science Alicia Lim Ke Xuan, Chong Jia Yu, Dhingra Saadya, Tan Le En, Tang Linda</p> <p>THE CHALLENGE: REACHING NET ZERO EMISSIONS</p> <p>In 2022, the total greenhouse gas emissions was 58.59MT. Achieving Singapore's goal of net zero greenhouse gas emissions (GHGE) by 2050 will be challenging due to Singapore's lack of alternative energy sources. In 10 years time, unless significant policy changes are implemented, this goal will not be feasible. Food waste contributes significantly to GHGE as they release stored carbon into the atmosphere after incineration or during decomposition. In 2023 alone, Singapore generated 755,000MT of food waste. Thus, minimising CO₂ emissions from food waste is crucial to reaching net zero GHGE.</p> <p>OUR SOLUTION: BIOCHAR-ENHANCED CONCRETE A SUSTAINABLE INNOVATION FOR CONSTRUCTION</p> <p>PRODUCTION:</p> <p>Biochar is a stable, carbon-rich organic compound, which helps to lock away carbon and prevent it from entering the atmosphere for thousands of years. During Pyrolysis, biomass, such as food waste, is thermally decomposed in the absence of oxygen, generating biochar, oil and syngas, a flammable gas which can be used to heat the reactor at the start of the Pyrolysis reaction and also supply renewable energy, ensuring that the production of biochar is self-sustained and carbon-friendly.</p> <p>PROPERTIES OF BIOCHAR MIX:</p> <ul style="list-style-type: none"> Enhanced Thermal and Acoustic Properties: Resilient to temperature fluctuations, improving energy efficiency of buildings Porous Structure: Increases surface area of concrete, improving water retention, and ability to remediate contaminated sites by adsorbing and retaining pollutants Enhances Mechanical Properties of Concrete: Improves compressive strength and durability of concrete, reduces shrinkage of sediment-based products <p>By using biochar-enhanced concrete, we effectively solve 3 issues at once!</p> <p>→ Food waste AND more durable concrete AND reducing carbon footprint</p> <ul style="list-style-type: none"> improved carbon sequestration and waste recycling reduced carbon emissions in cement production (which emits 0.9kg of CO₂ per kg of cement produced) improves strength and durability of cement } buildings with this cement last LONGER!! resistance to cracking due to porous structure <p>CON</p> <p>Biochar: Absorbent Nature</p> <p>influences cement hydration decreases cement to water ratio</p> <p>biochar cement being harder to handle</p> <p>PROS</p> <p>CONCLUSION</p> <p>While it is impossible to achieve zero carbon emissions, it is possible to achieve net-zero carbon emissions. By using biochar in cement, it solves multiple problems at once, making it a sustainable and effective solution in battling the carbon crisis.</p> <p>Additional research is necessary to develop the best mix. Biochar must also be made more widespread and cheaper, in order to implement it in large-scale construction projects.</p> <p>Citations:</p> <ol style="list-style-type: none"> Banbha, S., Das, B. B., & Karmali, F. (2024, January 9). Biochar-concrete: A comprehensive review of properties, production and Sustainability. Case Studies in Construction Materials. https://www.sciencedirect.com/science/article/pii/S224509592400010X Serdarheem, S. S., Gupta, S., Kian, H. W., Hou, D., Kim, S., Teng, D. C. W., & Ok, Y. S. (2023, July 22). Application of biochar in concrete – a review. Cement and Concrete Composites. https://www.sciencedirect.com/science/article/pii/S0958946523001270 	<p>NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE</p>	<p>Tan Le En, Tang Linda, Dhingra Saadya, Alicia Lim Ke Xuan, Chong Jia Yu</p>

Title	School	Names of Students
<p>BioMASH: Pyrolyzed Waste-derived Biochar for Wastewater Treatment</p>  <p>SEMAKAU LANDFILL IS EXPECTED TO BE FULL BY 2035.</p> <p>Currently, Semakau, Singapore's only landfill, accumulates 2,100 tonnes of incinerated waste each day. However, incinerating waste largely contributes releasing greenhouse gases and negatively affecting the environment.</p> <p>A solution is thus proposed:</p> <h2>BIOMASH</h2> <p>Pyrolyzed Waste-Derived Biochar for Wastewater Treatment</p> <h3>PYROLYSIS</h3> <ul style="list-style-type: none"> thermal conversion process in the absence of air to derive energy components from solid waste can produce useful products such as biochar has been examined as an <u>attractive alternative to incineration</u>, Singapore's current solution <h3>BIOCHAR</h3> <ul style="list-style-type: none"> produced from pyrolyzing waste removes contaminants like organic pollutants and metals can improve water quality <h3>WASTEWATER TREATMENT</h3> <ul style="list-style-type: none"> biochar's high surface area, pore volume, high cation exchange capacity, surface functionality, fixed carbon, and stability enhance its application as an adsorbent in bio-sand filter systems and constructed wetlands <h3>BENEFITS</h3> <p>This project can provide a low-cost and sustainable alternative to other wastewater treatment methods.</p> <p>Biochar can be produced from a variety of waste, thereby reusing waste for practical applications.</p> <p>This project presents a solution for two problems: the Semakau landfill reaching full capacity, and Singapore's water stress.</p> <h3>CHALLENGES</h3> <p>Pyrolysis is a costly method compared to incineration.</p> <p>Waste is composed of varied components, making it hard to estimate the quality of the produced biochar.</p> <p>Unlike incineration, pyrolysis is a complicated and intricate process that requires good handling.</p> <h3>SOURCES</h3> <p>https://doi.org/10.1016/j.wasman.2014.08.004 https://doi.org/10.1016/j.lenvman.2017.03.087 https://doi.org/10.1016/j.hyon.2023.103816 https://doi.org/10.1016/j.hyon.2024.106713 https://www.nsa.gov.sg/our-services/waste-management/waste-management-infrastructure/semakau-landfill</p> <p>Graphics: Canva (rasutoya)</p>	<p>PAYA LEBAR METHODIST GIRLS' SCHOOL (SECONDARY)</p>	<p>Hannah Eliz Go Lomotos, Macayle Paquing Ledesma, Angela Chloe Royeca Ong, Sophia Amelia Zhu Lee</p>

Title	School	Names of Students
<p>Ensuring Food Security In Singapore</p> <p>1 FUTURE PROBLEM THAT COULD ARISE IN 10 – 20 YEARS' TIME</p> <ul style="list-style-type: none"> The area of land available for use in agriculture is decreasing year by year in the world and it is exacerbated in Singapore. Climate change presents a significant threat to our crops and can result in significant drop in crop yields. More than 95 per cent of Singapore's food is imported, and about 10 per cent is locally produced. [1] Singapore needs to be self-sufficient by strengthening the food security as part its Total Defense Strategy. [4] <p>2 WHAT IS VERTICAL FARMING</p> <ul style="list-style-type: none"> Farming crops using vertical structures rather than traditional, horizontal agriculture. More efficient use of rooftop spaces and walls. By using vertically stacked layers, farmers can produce more food on the same amount of floor area. [2] Vertical Farming can be used to ensure food security in Singapore. <p>3 PROBLEMS FACED IN SINGAPORE RIGHT NOW</p> <ul style="list-style-type: none"> Current farming approaches in Singapore is expensive due to high labour and consumable costs (water and electricity) Only about 10% of Singapore's food is locally produced. The price of local produce deters consumers, as they tend to cost about 30% more compared to imported vegetables. [2] <p>4 PROPOSED SOLUTION</p> <ul style="list-style-type: none"> Generate electricity by using transparent solar panels. The solar panels can be used to shelter the plants from rain and heat. As the solar panels are transparent, plants will be able to trap sunlight and undergo photosynthesis. Rainwater can be collected using the solar panels and can be used to water the crops. Use sensors to monitor the nutrition value of soil and health of the crops. The sensors will be run on the electricity generated by the solar panels. <p>5 BENEFITS OF PROPOSED SOLUTION</p> <ul style="list-style-type: none"> Transparent solar panels are 30% cheaper compared to regular solar panels. [3] Transparent solar panels allow buildings to harness solar energy by using their glass surfaces. [5] Sustainable energy. Less labour costs. Less water or electricity costs as rainwater is harvested and electricity is generated by solar panels. Singapore would be less dependent on food exports. <p>6 CHALLENGES THAT HAVE TO BE ADDRESSED BEFORE SOLUTION CAN BE SCALED UP</p> <ul style="list-style-type: none"> Suitable rooftop areas should be allocated for farming. Initial costs of the set-up has to be sponsored by the government. [4] Low consumer awareness. [2] <p>7 REFERENCES</p> <p>1. The World Bank (2017). <i>World Development Report 2017: Digital Dividends</i>. Washington, DC: World Bank.</p> <p>2. The World Bank (2017). <i>World Development Report 2017: Digital Dividends</i>. Washington, DC: World Bank.</p> <p>3. The World Bank (2017). <i>World Development Report 2017: Digital Dividends</i>. Washington, DC: World Bank.</p> <p>4. The World Bank (2017). <i>World Development Report 2017: Digital Dividends</i>. Washington, DC: World Bank.</p> <p>5. The World Bank (2017). <i>World Development Report 2017: Digital Dividends</i>. Washington, DC: World Bank.</p> <p>BY BHEEMA LOKESH YUKTHA (STC 1E)</p>	<p>CHIJ ST. THERESA'S CONVENT</p>	<p>Bheema Lokesh Yuktha</p>
<p>GEMM (Genetically Engineered, Modified & Manipulated) Rice as a Protein Alternative</p> <p>GEMM (Genetically Engineered, Modified & Manipulated) Rice as a Protein Alternative</p> <p>Balancing Environmental Responsibility & International Food Security: Boosting Rice Protein Content through STEM</p> <p>By Alina Lew Lin Rong, Clarysse Wong Jing Kei, Samantha Ang Jia En, Quek Xinyan Kyra, Gao Yexuan</p> <p>GEMM Rice: Pioneering Genetic Engineering, Modification & Manipulation at the core of our solutions to Food Insecurity, while achieving higher protein levels within the staples we eat --- Rice.</p> <p>Why rice? A glimpse into problems that may arise in our near future...</p> <p>The future that awaits us in 20, even 10 years' time is a depressingly bleak one where the stability of food security is threatened to an extent that humanity cannot afford. Even in status quo, we see an increasing urgency brought forward by wartime disasters and worldwide famines, where current food alternatives are environmentally harmful, or are met with fierce resistance from consumers, where protein alternatives are actively degrading our environment (Think dying wildlife and burning forests). So... why rice? Rice is a staple food relied on by for more than 4 BILLION PEOPLE worldwide --- It's an essential to our cultures & cuisines, consumer-oriented, and a rapidly growing industry both in agriculture and F&B. (Not to mention, its cooking ease, palatability, and shelf life)</p> <p>Issues with our current sources of protein:</p> <ol style="list-style-type: none"> Insects? Such an ick! Despite efforts made for Singaporeans to incorporate insect based protein alternatives into their diet, assimilation efforts have been met with strong resistance. Unsustainable Protein Sources in our status quo: Singapore imports over 90% of its protein. In times of food shortages (eg bans on Malaysian Chicken), Singapore is left completely vulnerable to supply chain disruptions in the long term. Environmental Sustainability... with a ticking clock: Singapore's mission to produce 30% of its nutritional needs locally by 2030 is one that emphasizes the importance of innovative food alternatives to create a more resilient food system that meets both nutritional needs and environmental goals. For example, this is in line with the domestic cultivation of rice using the precision drip irrigation method in a HDB block at Tampines! <p>Growing Demand On a Regional & International Scale</p> <p>In 2017, Singaporeans consume an average of 8kg of rice a year per capita -- and that number is only projected to get higher. Internationally, the total rice consumption of all cultures & diverse places come up to 8 MILLION metric tonnes --- which is equal to a full 8,000,000,000 kilograms --- essentially the weight of 12 MILLION cows.</p> <p>A graph showing the increasing trend of rice consumption in Singapore's past 3 years</p> <p>How can STEM incorporate more protein into rice? [The Beans - or Genes?]</p> <p>Beans: (The Genes)</p> <p>Beans are uniquely high in protein due to the fact that it is full of plant-based nutrients, specifically amino acids. Amino acids are the building blocks of protein, and beans contain a wide variety of them. For example, certain beans contain 241% more protein than white rice, which is important when we analyse how large an impact this can have on humans, especially those in more disadvantaged situations (Eg poorer countries), where malnutrition & protein deficiencies are a daily problems for millions. By analysing the cell structures of these Beans genes, we are able to utilize CRISPR to ensure the enhancement of our Rice protein cells!</p> <p>Phaseolin is the main storage protein in beans. It has a significant role in the seed's storage proteins, contributing to the nutritional value of beans.</p> <p>The Genes: Introducing CRISPR!</p> <p>CRISPR technology! (GEMM: Genetic Engineering, Modification & Manipulation)</p> <p>Employ Cas9 proteins to carry a guide RNA into a cell → Cas9 cuts the rice's DNA. Insertion of guide RNA gene responsible for phaseolin production into rice DNA</p> <p>After the experimented crop is tested and stable, we get rice with a higher protein content! → Rice is genetically engineered to produce phaseolin which is a protein, increasing protein content in rice</p> <p>Somatic mutation will pass on this change in DNA to all other cells</p> <p>Additional Benefits of GEMM:</p> <ol style="list-style-type: none"> Modifying rice to contain higher protein levels could help reduce the reliance on other sources of protein, hence less land, water, and resources will be needed to produce food containing the same amount of protein. Rice would be more widely accepted as a source of protein as it is already an integral part of our culture, insects such as crickets and mealworms. Increasing protein content in rice will reduce the glycemic index, helping to reduce the risk of diabetes in Singapore. For low-income households, the higher protein content of rice would reduce the money spent on other protein alternatives. Rice is also much cheaper to produce in large quantities unlike chicken or other sources of meat <p>Sources: The World Bank (2017). <i>World Development Report 2017: Digital Dividends</i>. Washington, DC: World Bank.</p>	<p>NANYANG GIRLS' HIGH SCHOOL</p>	<p>Alina Lew Lin Rong, Samantha Ang Jia En, Clarysse Wong Jing Kei, Gao Yexuan, Quek Xinyan Kyra</p>

Title	School	Names of Students
<p>Care in Crises: Addressing Singapore's Healthcare Crisis in 2040</p> <p>Team: Theresa Alphonse, Tang Lijuan, Yuan Qiaoen, Lee Heejae, Wu Meiyi</p> <p>PROBLEM STATEMENT Given the increasing demand for elderly healthcare in Singapore, how can we develop a care ecosystem that ensures timely, efficient, and equitable care for senior citizens while maintaining high quality and reducing the burden on the healthcare system?</p> <p>The challenge of Singapore faces is to help seniors keep active, provide access to better healthcare options, increase longevity and live more independently.</p> <p>AIM OF THE STEM SOLUTION – SMARTERLY HOMES To develop a care model supported through STEM initiatives that ensure timely, efficient, and equitable elderly care, maintaining high-quality service amidst an aging population and increasing healthcare demand in Singapore.</p> <p>SMARTERLY PLATFORM is an integrated ecosystem of IoT sensors, wearables, health monitoring trackers, elderly-friendly home automation controls, AI-powered cognitive assistance with reminders & robots with a Webportal & mobile Apps front end</p> <p>SMART SENSORS Intelligent tracking & preventive care The Smarterly platform has IoT sensors (accelerometers, gyroscopes, barometers, etc.) placed throughout the home to monitor movement. Connected via Bluetooth or Wi-Fi, they gather data to an IoT hub at cloud where AI-enabled machine learning algorithms analyze it to detect patterns, such as unusual movement, sleep issues, or fall risks etc.</p> <p>VOICE-ACTIVATED MONITORING Seamless engagement with elderly The Smarterly platform is empowered by AI to listen to an elderly person's voice and detect health issues like breathing problems, stress, or memory decline. It analyzes speech using built-in NLP algorithms. PROVIDING HELP to understand emotional cues and health issues. It also uses NLP to convert spoken words into text.</p> <p>SMART MEDICATION ASSISTANCE Ensure timely medication adherence The Smarterly system will use cameras, sensors, etc. to observe pill, verify the medication before dispensing them, ensuring accuracy of medicine taken. AI-driven models can predict missed doses based on historical data and schedules, audio reminders, and telephonic etc.</p> <p>EMERGENCY RESPONSE SYSTEM Immediate actions for urgent care The Smarterly platform will use a combination of IoT sensors to detect falls or abnormal activity and provide automated and user-initiated alerts. Motion sensors, infrared sensors, accelerometers, etc. can track movement continuously and detect the full severity responses.</p> <p>SOCIALLY CONNECTED CARE Family participation in care management Family members join the Smarterly platform to actively participate in their elderly members' health progress and help in care management through Web & Mobile Apps powered by STEM-based solutions. Progress reports, activities of daily living (ADL) reports, and social, physical, mental and medication insights help to build a more socially integrated ecosystem.</p> <p>UPON DETECTING AN ANOMALY, SYSTEM TRIGGERS ALERTS TO CAREGIVERS & EMERGENCY RESPONDERS</p> <p>BENEFITS</p> <ul style="list-style-type: none"> PROVIDES TIMELY INTERVENTION FOR THE ELDERLY - It can detect health issues automatically, acting in reducing the need for extensive treatment & reduce the burden on the healthcare system. IMPROVES QUALITY OF LIFE FOR THE ELDERLY - The Smarterly home platform allows elderly to have peace of mind about their health and have independence in their lives. REDUCES HEALTHCARE COSTS - By reducing unnecessary hospitalizations, the system helps reduce healthcare costs, easing the financial burden on. <p>LIMITATIONS</p> <ul style="list-style-type: none"> RESISTANCE FOR ADOPTION AMONG ELDERLY - Elderly may struggle with adapting to new technology. Solution: Provide intuitive interfaces and technological support with family members to ease the set-up. COST OF IMPLEMENTATION - Although high cost of system relying on new technology. Solution: Partner with gov't to ensure that elderly have all sorts of life-time access to the system. PRIVACY AND DATA - Data is stored on private and personal medical data. Solution: Ensure standards and compliance set by MHA or regulators. 	<p>RAFFLES GIRLS' SCHOOL (SECONDARY)</p>	<p>Theresa Alphonse Kuzhimattathil, Wu Meiyi, Tang Lijuan, Yuan Qiaoen, Lee Heejae</p>

Title	School	Names of Students
<p>Reducing Plastic Waste in Singapore</p>  <p>REDUCING PLASTIC WASTE IN SINGAPORE: CURRENT AND FUTURE SITUATION IF LEFT UNCHECKED</p> <ul style="list-style-type: none"> Recycling plastic is key to reducing plastic waste in Singapore. In the past 10 years, Singapore's recycling rates have declined (NEA, 2023). In the same period, plastic waste generation has increased, yet plastic recycling rates have remained constantly low (Fig. 1: GreenFuture, 2020), fluctuating between 4% and 6% (NEA, 2023). Plastics therefore take up 30% of total waste disposed, making it the most abundant material disposed in Singapore's landfill (The Straits Times, 2021). Pulau Semakau, Singapore's sole landfill due to severe land scarcity, will run out of space by 2035 at this rate, posing a huge concern (MSE, 2024). <p>WHY IS REDUCING PLASTIC WASTE IMPORTANT?</p> <p>SAVING RESOURCES</p> <ul style="list-style-type: none"> Plastics are made from finite and non-renewable petroleum (Williams, 2022). As most plastics disposed are still in good condition, they can be easily recycled, reducing the need to produce new ones, saving resources (Hopewell, 2009). <p>LANDFILL WASTE</p> <ul style="list-style-type: none"> Plastic takes 20-500 years to fully biodegrade (United Nations, 2021). Certain plastic types like LDPE requires UV light to break down - this is absent underground in landfills (Dogan, 2021). Plastic therefore takes up much space in landfills, a pressing concern for Singapore due to limited land space. <p>ADVERSE EFFECTS</p> <ol style="list-style-type: none"> Plastic disposal into landfills allows toxic substances to seep into the environment, affecting flora and fauna (UNEP, 2018). This has resulted in health problems in humans, such as thyroid hormone disruption and autoimmune diseases (Brent, 2010). <p>OUR TWO-PRONGED SOLUTION TO REDUCE PLASTIC WASTE IN SINGAPORE: RECYCLING & PRODUCTION</p> <p>INCREASING RECYCLING CONVENIENCE</p> <p>MOBILE COLLECTION</p> <ul style="list-style-type: none"> Collection from homes for easier access. Using the NEA app, residents request for mobile bins to throw plastic recyclables. Mobile bins (Fig. 2) and routes to homes are equipped with robot navigation system powered by RFID and ultrasonic sensors (Arulselvi, 2014). Bins then return to neighbourhood processing facility to be emptied to reduce chances of overflowing bins. <p>PLASTIC SELF-SORTER</p> <ul style="list-style-type: none"> Mobile bin contains infrared technology to automatically sort plastics based on their emission wavelength value (Emom, 2024). No self-sorting by users or manual sorting at facilities required, increasing convenience and downstream efficiency. This single-stream collection method rejects contaminated plastics and non-plastics to ensure clean pure plastics are collected, which are important for processing and production of high quality resins (Chia, 2023; CGS, n.d.). Recycling statistics are automatically forwarded to NEA for nation-wide monitoring, aligned to Singapore's Smart Nation initiative and inform policy-makers on recycling trends. <p>INCREASING RECYCLING MOTIVATION</p> <p>EXTRINSIC MOTIVATION: REWARDS</p> <ul style="list-style-type: none"> Residents scan a QR code using Singpass to activate the mobile bin. Points are awarded when items are accepted for recycling. These points can be used to exchange for climate vouchers to purchase energy- and water-efficient products. This could be a more sustainable model for the Climate Friendly Households Programme. Data-driven programme: Depending on recycling statistics, more points could be awarded for plastics that are recycled less often to encourage more recycling. <p>INTRINSIC MOTIVATION: EDUCATION</p> <p>Personalised Recycling Facts</p> <ul style="list-style-type: none"> Generated on the mobile bin screen to provide users a sense of accomplishment, motivating users to recycle more. Customised and generated based on the quantity of plastics per user and calculated into a real-world context for users to feel impact of their efforts (Fig. 3). <p>Learn Recycling Process</p> <ul style="list-style-type: none"> Mobile bins return to a facility located near playgrounds for processing (Fig. 4), where children can be engaged in and learn more about the recycling process. Such visuals heightens brain activity and reinforces learning and memory (FutureLearn, 2022). Each facility comprises a transparent casement containing a washer, shredder and compressor. <p>USING RECYCLED PLASTIC FOR BUILDING AND CONSTRUCTION IN SINGAPORE</p> <ul style="list-style-type: none"> Compressed plastic granules are collected from processing facilities in neighbourhoods to a centralised facility in Singapore. These plastic granules could be made into <ul style="list-style-type: none"> Recycled plastic bricks through superheating and re-moulding, and Concrete-plastic mixtures for the building and construction of indoor non-structural works which do not bear too heavy weights. These solutions are both sustainable and cost-saving, two important requirements for the local industry. 	<p>CHONGZHENG PRIMARY SCHOOL</p>	<p>Ebel Ng Rui Xuan, Schvella Gan Yu Xuan, Hu Xiang Ying, Sim Kah Yee, Wu Chien He</p>
<p>Rising Sea Level in Singapore</p>  <p>RISING SEA LEVEL IN SINGAPORE</p> <p>Problem</p> <ol style="list-style-type: none"> Rising Sea Levels <ul style="list-style-type: none"> By 2050, sea levels would rise by 1.1m. (World Bank, Low-Cost Urban Coastal Protection, 2019) Sea level rise & coastal erosion would affect 10% of Singapore's land area (World Bank, 2019) Sea level rise & coastal erosion would affect 10% of Singapore's land area (World Bank, 2019) Climate Change from CO2 Emissions <ul style="list-style-type: none"> By 2050, global average sea level rise would be 1.1m (World Bank, 2019) Large temperature rise attributed to increase from 1.4degC to 4.4degC (IPCC, 2014) causing extreme heat stress. High Cost of Building Barrages around an Island <ul style="list-style-type: none"> In 2019, US \$1.6 billion will build two EMB barrages around island (World Bank, 2019) to protect Singapore against rising sea level. This is very expensive. <p>Thought-process + Insight</p> <ul style="list-style-type: none"> Realising there are only 7 million Singapore citizens and 71% to share the cost of a \$2.6B project. It is a very expensive cost. An average employed Singaporean had to pay \$8,500/year for loans pay in 50yrs. About \$10 million loans were borrowed to Singapore, leaving the government collect \$1.88B to pay the loan. This was a very heavy burden on citizens to have loans to collect through tax before we can start the project. However, the more we study, the more risk we will have and it might be too late. Thus, the way Singapore solves the problem must be more sustainable and affordable than other countries with higher GDP. <p>Problem Statement</p> <p>How might we create a very affordable solution, that <u>more nature</u>, to help Singapore tackle rising sea level and climate change, sustainably over the next 100 years?</p> <p>ECO-SOLUTION: Low-cost Hybrid Barrage with Mangroves</p> <p>Why possible? more nature</p> <p>Source: CBS</p> <p>Benefits: The BEN of Mangroves is obvious when we build Barrages</p> <ul style="list-style-type: none"> More Affordable Barrage <ul style="list-style-type: none"> Uses up to 50% of precast concrete materials needed with mangrove roots. Mangrove roots wave height and energy, follows maximal demands of the barrages. Saving cost of the barrages further. More CO2 absorption <ul style="list-style-type: none"> Mangroves removes 200-400 tons than land-based trees (5). It stores large amounts of carbon in biomass for 100% of years (6). Prevents Marine life <ul style="list-style-type: none"> Building barrages along the coast cause the marine life over the island. It also will be destroyed if mangroves reduce the CO2 levels, prevent marine life. It provides a natural barrier with a natural pond view. 	<p>METHODIST GIRLS' SCHOOL (PRIMARY)</p>	<p>Abbylyn Peh Xin Ping</p>

Title	School	Names of Students
<p data-bbox="100 142 346 178">Climate Change</p>  <p data-bbox="394 480 682 534">What is Happening?</p> <p data-bbox="184 549 934 682">The world is facing climate change in many different ways such as the rise of heat level in many parts of the world including Singapore. As humans are using harmful things such as the fuel creating carbon emissions to destroy the ozone layer, causing an increase in heat level. The plants, trees and animals even us and our health to be at risk. The global surface temperature has increased faster since 1970 than in any other 50-year period over at least 2000 years. Earth is now about 1.2 degrees Celsius warmer than it was in the pre-industrial era (1850-1900) Moving forward, we will ensure that a sustainable eco system is made, so that we have a nice living condition to live in and a safe place for everyone to live in.</p> <p data-bbox="231 742 430 786">Innovative ideas</p> <ul data-bbox="178 786 514 1068" style="list-style-type: none"> • Painting the cool paint on the outside of different transportations is another solution to moderate the rise in heat level as transportations such as cars are always under the sun that produces heat. Cool paint can reduce the energy consumption of air-conditioning of transportation. • Using the same technology as some of our glasses that have a lenses called transition lenses that automatically respond to lighting conditions by "transportations" to the appropriate tint. They darken in the bright sunlight and return to a regular tint in dimly lit. Therefore, the same technology can be used on car windows. <p data-bbox="367 1083 514 1142">Down: To disintegrate plastic bottles to make cool paint.</p>  <p data-bbox="136 1240 388 1276">Up: The image illustrates how cool coating works</p> <p data-bbox="168 1291 346 1350">Right: Uses of photochromic lenses for transportation's window</p>  <p data-bbox="199 1380 483 1424">Created by: Tang Suet Yee and Kelly Koh School: Sengkang Green Primary School</p> <p data-bbox="609 742 861 786">Time to solve it!</p> <ul data-bbox="556 786 966 1187" style="list-style-type: none"> • We can increase the greenery and piloting the use of cool paint on building facades. • Cool paint is a type of cool material, which can be applied on the exterior surfaces of buildings such as roofs and walls, and other urban surfaces like pavements and parking lots. • Cool paint is a heat reflective technology for exterior building surfaces, which has numerous well-documented benefits, particularly in terms of increasing sustainability, and mitigating the urban heat island effect. • Disintegrating plastic bottles and making them into a new type of cool paint that can reach 1.2 degree Celsius below the surrounding air temperature when exposed to direct sunlight. At night, the coating could reach 3 degree Celsius below the ambient temperature. The coating can reflected across its spectrum. • Painting the cool paint on the outside of different transportations is another solution to moderate the rise in heat level as transportations such as cars are always under the sun that produces heat. <p data-bbox="724 1261 808 1305">Source:</p> <ol data-bbox="619 1305 850 1409" style="list-style-type: none"> 1. https://www.un.org/ 2. https://www.rubeco.com/ 3. https://maintainability.com.sg/ 4. https://www.ntu.edu.sg/ 5. https://www.hdb.gov.sg/ 	<p data-bbox="1039 142 1333 222">SENGKANG GREEN PRIMARY SCHOOL</p>	<p data-bbox="1470 142 1753 222">Kelly Koh En Ning, Tang Suet Yee</p>