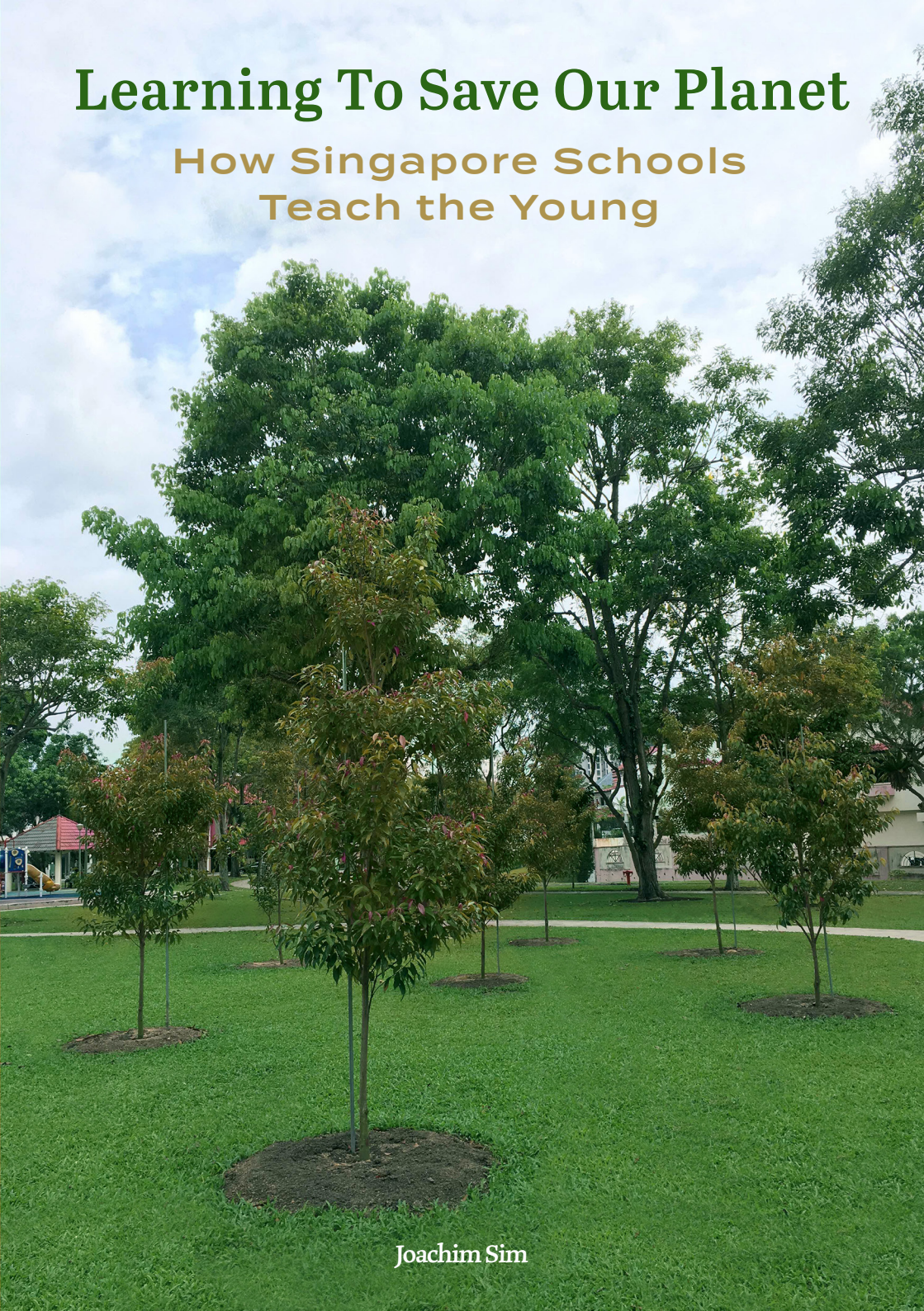
Learning To Save Our Planet

How Singapore Schools Teach the Young



Joachim Sim

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How Singapore Schools Teach the Young

Joachim Sim

This e-book is dedicated to my grandchildren Jonah and Ellyn and their generation who will inherit planet Earth

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What the cover design means:
The young trees signify the growing importance of environmental sustainability, which was underscored but overshadowed by the Covid-19 pandemic. They symbolise the young growing up with the older generation (depicted by tall trees in background) watching over them. The cluster of trees represents knowledge (understanding climate change), carbon reduction (mitigating climate change) and sustainable living (adapting to climate change).

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Preface

With climate change hitting home more severely and more frequently than before, the concept of the environment as the Third Teacher in holistic education has taken on a renewed sense of urgency for people living in a low-lying island-state like Singapore. It was cold comfort to learn that Singapore was ranked second highest for climate change risks and environmental pollution in risk analyst Verisk Maplecroft's 2021 risk assessment report. It is no longer just climate change but an impending existential crisis that will loom larger and longer than the Covid-19 pandemic. Environmental sustainability, economic development and social inclusion are parts of Singapore's sustainable development. Our sustainable future starts now.

The truth is, beyond awareness, interest and desire to help, taking action in a sustainable way to mitigate global warming is a real and present challenge due to the inconvenience the effort may cause to people's daily life. The UN Intergovernmental Panel on Climate Change's report in 2021 underscored an urgent need for the whole world to take immediate action for a sustainable environment for humanity. It had earlier warned that global warming was likely to accelerate the emergence of new viruses. That year recorded the hottest month in the past 142 years, according to the US National Oceanic and Atmospheric Administration. Natural historian Sir David Attenborough said it succinctly in 2020 when he shared that "saving our planet is now a communications challenge".

An environmental activist had lamented that there's too much information on climate change but too little inspiration. There is a need to encourage and inspire actions by more people beyond sharing information to create awareness and insights to forge deeper understanding. Inaction or insufficient actions may cost the earth, quite literally. On the other hand, mitigating climate change as a global response and priority will save it. We all need to play our part and act together

now before it's too late. There is no time to waste. Starting people on the green journey when they are young will go a long way.

Schools and students are a key part of the solution, together with government, business and individual stakeholders. Environmental education (EE) in schools is about students learning from green practices on campus, learning about environmental sustainability (ES) in classroom and outdoor, and relearning what's learnt through advocacy to other students and the community. EE happens when schools teach through examples, students learn by doing, and advocates lead by serving. It is about doing and learning, learning and doing more, and learning even more through advocacy. This e-book is not just about ideas but also about actions for sustainable living.

Replanting e-book idea

This e-book was conceived in 2016 and was inspired by the sections on re-imagining Singapore as a sustainable and learning nation in my SG50 book '[Beyond 50: Re-imagining Singapore]'. I was encouraged by Prime Minister Lee Hsien Loong's speech on climate change at the National Day Rally in 2019, after 2018 was designated the Year of Climate Change, to revive my e-book idea. His message hit home when he planted a tree among a cluster of seven in my housing estate in November that year and spurred me to 'replant' the idea.

This online publication seeks to propagate and promote environmental sustainability and responsibility through the stories shared by the featured schools, their leaders, students and other stakeholders. It will also help to amplify the schools' ES advocacy/outreach efforts through sharing their stories to inspire others. It is hoped that other Singapore schools' leaders, teachers and students, as well as educators and youths in general, will follow their examples in caring for our planet as ES practitioners, educators or advocates. The stories may encourage more schools to come up with innovative learning initiatives of their own to engage students more deeply, creatively and impactfully.

Each story tells how the school nurtures students to practise and advocate ES during and after leaving school. This outcome is achieved through students' participation in green practices on campus, attendance in classroom and outdoor lessons on ES, and outreach to the community to advocate sustainable living.

The picture on the e-book cover is both significant and symbolic. The young trees were planted during Tree Planting Day in 2019 and included one planted by PM Lee. They signify the growing importance of environmental sustainability, which was underscored but overshadowed by the Covid-19 pandemic in the following year when the e-book project started. The trees also symbolise the young generation growing up with the older generation (depicted by the tall trees in the background) watching over them. The cluster of trees indicates togetherness for a common cause and strength in teamwork. The trees represent knowledge (understanding climate change), carbon reduction (to mitigate climate change) and sustainable living (flourishing, flowering and fruiting in time to come while adapting to the environment). It also suggests author's ground-up initiative.

Reflecting diversity and inclusiveness in featured schools

When identifying potential schools to feature, I had attempted to reflect diversity and inclusiveness during shortlisting, based on their:

- Educational level – primary to polytechnic
- Educational stream – main and special education
- Public recognition/green awards received – past and potential
- Strengths in ES areas – such as energy and water conservation, waste management and biodiversity
- Partnerships – with other schools, government agencies, businesses, non-profit organisations and students' parents, among others.

Not all the shortlisted schools invited agreed to share their stories. Selection was based on their responses to request for background information.

For the purpose of this e-book, public recognition is meaningful to the story only if the awards, as unplanned outcomes, reflect the school's impact on students' environmental education, the environment and the community. It may also be significant because it reaffirmed that the school was on the right green path and its leaders were motivated to do even more. The ultimate beneficiary is humankind on our planet.

The featured schools – at special education, primary, secondary and pre-university levels – are (in alphabetical order) APSN Delta Senior School, Bukit View Secondary School, Commonwealth Secondary School, Compassvale Secondary School, Dunman High School, Institute of Technical Education, Marsiling Secondary School, Ngee Ann Polytechnic and Qihua Primary School.

Reaching out and searching within

Like any story worth telling, each featured story goes beyond what the book title suggests. Its scope is not limited to the how but includes the why, challenges overcame, learning outcomes and other aspects of environmental education.

Primary research to gather information and insights on schools' green journeys and achievements was conducted through in-depth interviews in 2021. The process served to help the featured schools think beyond their existing paradigms or frames of reference. Questions were based on the background information gathered from the schools and secondary sources. Interviews involved the schools' leaders, teachers, staff, student leaders, partners and other stakeholders. The goal was to go beyond the what, when, who and where, and to provide insights into the why and how wherever possible. Insights like how schools went about overcoming challenges thrown in their way.

Connecting green dots to develop stories

Writing the stories was about connecting the various green dots before doting the "i" and crossing the "t" as they flow. The stories were developed and co-created with the featured schools based on the inputs from their leaders and other stakeholders.

Telling their extraordinary ES stories required primary research on other significant aspects of their green journeys and achievements. The idea was to originate a truly unique story with insights to inspire and not merely to republish public information. Each story covers, where applicable, the school's vision, leadership, ES initiatives and impact, innovations, scalability and sustainability, among other areas that might have surfaced during the interviews. The text was written in the context of the school's experience in leveraging on the power of partnership to amplify its reach and impact in environmental education. Each school's unique story proposition gives a different texture to its narrative. The schools' green stories are part of the larger Singapore story, which has since progressed from the Clean Air Act of 1971 to the Sustainable Singapore Blueprint 2015 and Singapore Green Plan 2030.

When I first met with some of the schools to discuss my e-book project in February 2020, none of us had expected the coronavirus threat to become the global pandemic that is still disrupting the way we live, learn and work. Some of the schools' common responses to the Covid-19 challenges would be evident in their stories. The resulting delay in completing the e-book had meant that more milestones and additional achievements were included. Like each school's green journey, this e-book was a work-in-progress.

Scoping and structuring stories

The stories are about the schools' past environmental sustainability (ES) journeys and achievements, current efforts and future plans. They are about ES practices on campus, ES education for students and ES advocacy/outreach to students and the community. The views of past school leaders and teachers who had laid the foundation for their continuing ES journeys are included where possible, to add an historical perspective.

In the process of engaging students as practitioners, learners and advocates, the schools teach the young how to care for the environment. Their sharing would

be incomplete without mentioning some of the impact of Covid-19 on their ES plans from 2020. In a powerful way, the pandemic is a stern reminder that we need to live with nature and care for the environment. Without a healthy planet, life ceases to exist. It has taught the young how to respond to an existential crisis. They learnt the collective reality that everyone can play a part and that no one is safe until everyone is safe.

Each story is preceded by a synopsis, which is accompanied by a photo depicting the school's unique story proposition with a caption to explain its significance. It starts with the school leader's quote that shows the way forward in advancing on the green journey.

The story continues with an introduction that is unique to the school. This is followed by information on how and when the school started on its ES journey, its strategy for long-term ES development, and what it has achieved in ES practices, ES education and ES advocacy. Next, how and what students learnt from green practices on campus and in the community, about ES in classroom and outdoor, and through ES advocacy on campus and in the community are explained, before mentioning how some alumni continued to learn and champion ES. How the school overcame the Covid-19 disruption and other challenges along the way is described next, before including some stakeholders' views and sharing its future plans to achieve more. Values underpinning the school's commitment to the green cause and factors contributing to its extraordinary ES journey and achievements are also identified. The conclusion is also unique to the school. Both introduction and conclusion serve to add lustre to the fullness of a fact-filled narrative.

Beyond text, photos are included for visual impact. Some keywords are embedded with hyperlinks to webpages and other online sources for readers to access related information as well as videos showing actions of students that spoke louder than words.

Unique story propositions

The unique features of the schools' ES experiences were identified and highlighted in their stories.

APSN Delta Senior School goes beyond its focus on students learning ES by practising and advocating 4R habits for horticulture students, who are trained to take up green jobs after graduation.

At Bukit View Secondary School, the same green teacher IC had sustained its ES efforts for 20 years since 2000, when he joined as a new teacher. The staff's passion, dedication and resourcefulness saw to the school's launch of its JOULES Programme (2016) and JOULES Smart Centre (2018), as well as the publication of a commemorative book to mark the 17th anniversary of its green journey in 2017.

For Compassvale Secondary School, ES education is about nurturing students as green guiding stars to others through water and energy sustainability education.

Commonwealth Secondary School's practical lessons on human-wildlife harmony and care for wildlife in school through real-life demonstrations in the school's eco-habitats are part of students' daily school experience.

The previous principal of Dunman High School believed that planting the seeds of life for a sustainable future starts every day at school and shared what he had learnt with students.

The power of three is at work at Institute of Technical Education (ITE), where three ES committees had created three ES roadmaps and three e-books to mark its green journey since 2010. The ITE story is premised on the scale of its ES achievements and the execution of a scalable, comprehensive and integrated five-year plan by a whole-of-organisation committee through leadership at four

levels – central committee, campus, club and class – at the three large campuses with a total of 28,000 students.

Marsiling Secondary School makes its mark in nurturing self-directed learners who care for the environment by instilling eco-friendly habits among students through constant ES exposure.

Among the many schools at Ngee Ann Polytechnic's campus, some offer environment-related academic programmes to prepare students for green professional jobs and careers in the green industry. Some of them have their own green clubs to nurture students as green ambassadors/advocates.

QHPS' high potential to achieve more in environmental education through its Green Plan Committee at the campus, curriculum, club, class and community levels is evident. This is being realised under the guidance of a senior teacher and HOD who has 20 years of experience in heading a secondary school's green journey.

Realising ES learning outcomes that matter

ES education impacts students during and after school, directly and indirectly, as well as personally and professionally. Some of the featured schools' alumni mentioned in their stories became more self-confident, articulate and motivated in championing ES. After leaving school, they went on to become green practitioners, educators and advocates, green student leaders at institutes of higher education, green volunteers or ambassadors, green professionals and green business managers or entrepreneurs. Examples of students' ES learning outcomes, which included projects, essays, videos, microsites, e-book and innovations may be gleaned from the schools' stories. The experience and learning gained from impactful projects over the years enabled students to develop a stronger sense of citizenship and character.

In the essay by Deputy Prime Minister and Finance Minister and former Education Minister Lawrence Wong, the photo shows him walking the ground and learning

about a school's rainforest from one of its student leaders. The picture represents an important outcome of schools' green education through curriculum-based and outdoor lessons, campus activities, community projects and other initiatives. It portrays the young sharing what they have learnt about environmental sustainability with other stakeholders, including government policymakers and administrators. In the process of advocating to others, students reinforce what they have learnt. This outcome is in line with the Ministry of Education's (MOE) goal of "nurturing stewards of the environment" to support the Singapore Green Plan 2030, which sets the direction, tone and pace of ES education development in schools.

Rediscovering strengths in ES education

In the course of responding to the interview questions, some of the featured schools rediscovered their strengths in environmental education.

APSN Delta Senior School (DSS) noted that it has "done a lot as a school for environmental education with its dedicated and strong team", which is able to "unlock new possibilities".

Bukit View Secondary School (BVSS) sees its "culture of embracing ES advocacy as a whole-school endeavour and wide-spread acceptance of its programmes" among its strengths. Others include the JOULES Smart Centre and JOULES programme, which teaches environmental issues and allows students to reflect on the impact of their actions on the environment. JOULES projects let them practise critical and inventive thinking in developing SMART solutions to problems.

Compassvale Secondary School (CVSS) rediscovered its environmental education (EE) roots dating back to 2006. It sees its strengths in developing a robust EE curriculum that engages the head, heart and hands. This has evolved to include more topics through interdisciplinary project work that enables students to engage in real-world issues.

Institute of Technical Education (ITE) attributed its continuing achievements in EE at the three campuses to the successive committees' focus, teamwork and consistency in executing the five-year plan. At the college level, ITE College East's belief in teaching ES through personal involvement and participation in action-based activities has ensured that students internalise environmental issues and develop a desire to mitigate them.

Since embarking on the ES journey in 1992, Ngee Ann Polytechnic (NP) has "come a long way from just promoting environmental conservation in the earlier years to harnessing smart technology for our sustainability efforts today". Its Estate, Eco and Safety Office believes that technology has enabled the polytechnic to develop expertise in energy conservation and transformed its campus into a garden that promotes biodiversity.

Qihua Primary School (QHPS) recognises its strength in having four gardens, with over 100 species of plants and trees inhabited by birds and insects, as outdoor classrooms for students to understand the relationships between plants and animals. The former 'kampung' school is continuing with its heritage of serving the community by sharing what its students have cultivated and harvested on campus with residents in the neighbourhood.

Discovering new possibilities in ES education

While providing information for its story, DSS realised that its students are "capable of doing more".

BVSS sees the possibility of empowering more staff to play a leadership role on the school's green journey, while tapping solar power and using resources more efficiently.

For CVSS, the interview process has helped to affirm the school's unwavering commitment to environment education and encouraged it to refine and strengthen

its existing practices and programmes, while further developing a culture of promoting sustainable living among students.

ITE sees the Singapore Green Plan 2030 as providing a "golden opportunity to equip our students with green skills in sustainable solutions" and the need to seek new partners for its ES initiatives. It is also finding innovative ways to turn trash into treasure. At ITE College West, projects include turning shredded paper into recycled paper, finding ways to cultivate and re-bloom orchid plants and recycling coffee grounds into soap.

NP realised its potential to achieve more in energy and water efficiency, waste reduction and biodiversity on its campus.

At QHPS, the school is exploring the creation of interdisciplinary trails for students' experiential learning, new platforms to develop student leaders, and smart urban farming that applies technology to grow a large amount of food in a small area and has the potential to feature biodiversity, water, energy, building and waste management. It also sees the possibility of the Parent Support Group initiating green activities for students.

Seeing schools' strengths and new possibilities

After the interviews ended in 2021, the featured schools have achieved more on their continuing ES journeys despite the ongoing pandemic. Beyond teaching their own students, the school leaders, teachers and student leaders have been advocating ES to students at neighbouring schools and the community. Their additional achievements would bear testimony to the schools' sustained efforts. For them, CCA also means Climate Change Action!

Interviewing the schools and their stakeholders was an eye-opening and mind-broadening experience. The road to discovery is never-ending.

DSS exemplifies the fundamentals of going green. It shows the way forward through simple but effective acts of reducing, reusing, recycling and renewing.

Kudos to BVSS for producing the videos on its JOULES Smart Centre, Eco Garden, Environmental Gallery and recycling efforts that were presented by two Environmental Club student leaders. Their enthusiasm, poise and self-confidence reflect well on the outcomes of the school's environmental education.

Through CVSS, I had the opportunity to interview its ES partner Lee Kong Chian Natural History Museum and to discover its rich repository of information on Singapore's natural history and biodiversity.

CWSS' use of its eco-habitats on campus as outdoor classrooms in nature to teach man-wildlife co-existence through personal experience is a most effective way for students to learn about ES.

From interviewing a DHS' alumnus, I learnt something beautiful about ugly food. It is one way for everyone to reduce food waste. Food waste and wastage caused by discarding of blemished vegetables and fruits lead to wasteful use of energy to incinerate such unwanted food.

Looking up the high green walls across buildings at ITE College Central gave me an immediate sense of the scale of ITE's ES achievements. Its ESI Committee's focus, consistency and commitment in following through with the development and implementation of its five-year green roadmap while responding to the changing ES landscape have been evident since 2010. In sharing their parts of the story and in mobilising other ITE's stakeholders to do the same, the committee members amply exemplified the power of collective action. For this e-book, ITE stakeholders demonstrated commitment to the cause in sustaining their efforts in responding to the many interview questions. ITE's hands-on culture of taking action for a good cause among its students and staff is another key strength. In volunteering

their time and efforts, ITE staff and students showed that they care by sharing to benefit others. This is indeed a notable outcome of ITE's environmental education through practice, programming and propagation. Partnership with industry leaders has been preparing ITE students for new internship opportunities and green jobs that will be created in future.

A NP business graduate's 'Big Picture' perspective of the real world at a youthful age is commendable. The alumnus' progressive pathway in environmental education – from secondary school to polytechnic and beyond – as learner and leader is inspiring.

QHPS' staff teamwork and sharing culture were evident in its response to my request for information. Achieving more in ES practices, education and advocacy for the school can be expected through new partnerships with other schools, government agencies, businesses and non-profit organisations.

Learning from overcoming many challenges

Although this is my seventh book and the sixth that I have authored, publishing it was a new learning journey with its own set of challenges. It was mind-boggling to reconcile and integrate various details and anecdotes given by succeeding school stakeholders, following staff changes during the two years, into a coherent and purposeful whole.

Before I started on the project, I was looking forward to going back to school after so many years. Visiting the featured schools brought back fond memories. I grew up with nature as my second teacher in a 'kampung' house with wooden walls and attap roof before attending a countryside primary school that was nestled on a little hilltop surrounded by greenery. The natural environment has been my outdoor classroom ever since. Growing up at a table of scarcity had meant that reducing, reusing and recycling was a way of life. As kids, we were left very much to our own devices after school. However, we were resourceful in recovering and reusing discarded

wood, rubber and other materials that we found, as well as repairing discarded items that could be reused. Out of necessity, we also learnt to repurpose, improve, modify, adapt and upcycle them to make our own toys. We even kept fishes caught in nearby streams and fighting spiders found in the bushes as pets! You can say we were experiencing self-directed learning driven by an innate curiosity and sense of wonder in living harmoniously with plants and wildlife at our doorstep! As a secondary school student, I was growing a variety of vegetables in plots that I tilled in my family's backyard. (Food security was far from my mind then.)

The past two years plus have been most challenging for the featured schools and this e-book project. There were unprecedented times of adjusting to the Covid-19 situation on many fronts. The pandemic had taken its toll, including lost man hours and lost opportunities for in-person interviews. All the more the school stories need to be told – indelibly through the written word – to encourage and to inspire action.

In April 2020, stricter measures at schools were followed by the implementation of home-based learning after the closure of all schools as part of the nation-wide circuit breaker. Soon after, we learnt of a heightened circuit breaker and its four-week extension in May, with the June school holidays brought forward by a month. The schools had to refocus their available resources on essential activities while grappling with keeping everyone safe and well at all times. Fortunately, the situation in Singapore improved soon after. Schools re-opened for all classes at the end of June, with adjustments made for classroom and home-based teaching and learning. Given the Covid-19 situation, I had to postpone publication to 2021.

Came 2021 after a most difficult year. Research took the whole year to conclude. Understandably, the schools had to give first priority to their students' education and well-being while coping with the many changes and adaptations over the past two years. It did not help that there were staff changes, which meant that I had to reconnect with the new staff to continue with my research. I had no choice but to postpone publication to the following year yet again!

Before I started, I had to figure out how best to develop each school's green story with depth and scope. During my preliminary research, I realised that a background information document based on a comprehensive framework that I had conceived would be a good start. The information updated by each school provided a good basis for preparing relevant interview questions to elicit insights for its story development.

I learnt from the interviews that students were learning about environmental sustainability (ES) after participating in school green practices, observing what teachers are doing, attending classroom and outdoor lessons, going on field trips, and advocating ES to other students and the community, among other learning opportunities. Students reaching out to residents in the neighbourhood by knocking on their doors bring home the green message like no other.

Some of the schools' critical success factors identified and included in the stories are:

1. Leadership at different levels – from principals and chairpersons of green committees to staff ICs of environmental education and student leaders of green clubs;
2. Teamwork across the school – as was evident in its consolidated response as an integrated educational institution; and
3. Conceptualising environmental education as a whole-school initiative beyond co-curricular activities to develop student green champions – as ES practitioner on campus, educator to other students and advocate to the community.

The joy of learning is in discovering new things, ideas and possibilities as we continue to understand and appreciate more. It's the same for writing each story. It's a pleasure to learn how the young are doing good for a better environment. In one of my letters to the press in 2021, I suggested the idea of nurturing the young to become green ambassadors for life to help build a sustainable Singapore ('Nurture the young to be green envoys for life').

One of the benefits of working on this e-book project is learning from the many stakeholders in environmental sustainability that I've had the privilege of interviewing. From my interaction with the featured schools, I had the pleasure of engaging a number of 'gems of a find' among their leaders, teachers and other staff, as well as their students, club leaders and alumni. I also learnt about novel green ideas and new-frontier perspectives shared by some of them.

The successful completion of this e-book bears testimony to the collective sense of responsibility, resourcefulness and resilience of all stakeholders in our sustained efforts to work together for a common cause. When the world came together at the 2020 Tokyo Olympics Games in 2021 (after delay due to Covid-19), the 5,000 gold, silver and bronze medals given out were made entirely from recycled metals – extracted from nearly 79,000 tons of used consumer electronics, including laptops, games consoles and digital cameras. Our planet was a clear winner!

Many people to thank for helping to make it happen

I am most grateful to Deputy Prime Minister and Finance Minister Lawrence Wong for contributing his essay when he was Education Minister in 2021. The essay gives context to the text of the schools' stories. His 2022 Forward Singapore plan for a fairer, greener and more inclusive society reflects his views when he launched the Eco Stewardship Programme for schools in 2021.

Although I was working on the e-book single-handedly from concept to completion, I was never alone in my endeavour. I have the schools to help co-create their stories. I am grateful to their principals/CEOs for agreeing to share their stories, and to the school representatives who were liaising with me: Hema V.A., DSS; Reena Lloyd, BVSS; Preeti Vikas Palkar, CVSS; Jacob Tan, CWSS; Jason Chen and Darren Chin, DHS; Kristin Koh, ITE; Tan Tong Aik and Yap Ching Ying, MSS; Lea Wee, NP; and Heng Chong Yong, QHPS. I wish to thank them for updating the background information and providing as many details and insights as they

could when time permitted despite the challenges, and for facilitating interviews with various stakeholders. I would like to record my thanks and appreciation to other school leaders and many stakeholders, including the schools' external partners, who have shared their views for the stories.

I would very much wish to express my heartfelt appreciation to the co-sponsors Singapore Pools, DBS and Conint for supporting the e-book research and development, and for their understanding and patience. Special thanks to DBS for producing the PDF e-book for hosting on Singapore Pools website for free online access.

Saving the planet is about a sustainable future for all

Our small island state with less than six million inhabitants contributes little to reducing carbon emissions and global warming. However, it can impact global actions through its leadership, innovation, advocacy and example. What it does well could be amplified or scaled up across the world. Education Minister Chan Chun Sing's "power of example" rings true for the featured schools' ES journeys and achievements. Following MOE's announcement of its plan in 2021 to introduce the new Eco Stewardship Programme to all schools in Singapore, it is working on an Eco Stewardship Toolkit for their use. The public statement "An Urgent Call from Singaporean Youths on the Environmental Crisis" made in the same year was a timely and collective act of advocacy to the world. Both government and people initiatives exemplified the idea that although Singapore may be a tiny dot in environmental impact and mitigation, its thought leadership and examples may inspire other countries. Thinking of solutions after understanding the problems may make a real difference. But acting on the solutions make the difference real.

Environmental education for the young is about teaching them to conserve resources, protect the environment and help save the planet for their children. Its enduring goal is to nurture students to practise and advocate ES during and after leaving school. To sustain their ES movement, schools need to cultivate a green culture, inculcate the spirit of innovation and enterprise, and nurture a love for lifelong learning in them.

I hope I have shared evidence of such learning outcomes through some of the featured schools' alumni in this e-book. The schools have taught students to help save our planet by conserving earth's limited resources and taking actions towards lower energy, water and plastic usage, food wastage and carbon emissions while adopting renewable energy and other green alternatives, planting more trees and co-existing with wildlife. Students would have learnt that conservation is also about appreciating the environmental cost of replacing or discarding used but reusable low-priced products. From their green projects, they have learnt that innovative ideas could bridge the gap and balance the need for conservation and development.

For schools, their work as ES practitioner, educator and advocate is never finished. There is always a new beginning on the sustainability journey, with new challenges to meet, new discoveries to make and new milestones to reach.

Singapore and the world need more young champions and leaders who continue to practise, learn and advocate environmental sustainability in their higher education, at work and in their daily life. There are two schools of thought – they could train as green professionals to serve directly, or they could study other fields and contribute indirectly in business, technology and other disciplines. They could start when they are in primary school or even in preschool.

This e-book is a timely platform for school leaders, teachers, students and partners to amplify their green messaging, and for me as author to document their green journeys and achievements for posterity. It is about building on the past, preparing in the present and progressing into the future, with informed optimism, renewed hope and stronger sense of sustainability. I hope the extraordinary examples of the featured schools will inspire other educational institutions, educators and students to emulate their aspirations and achievements. It is also my hope that the schools will learn from each other's story and forge partnership to advance the green cause together. Schools sharing their stories is one way to ensure the

lessons learnt are not wasted. By creating awareness and interest to inspire a desire (to act) and action, the stories can go a long way in helping to communicate the urgent need to save our planet.

Making environmental sustainability a priority

It is said that the real problem in the world is not a lack of resources but the absence of sufficient attention or priority being given to things that matter most. I had made it a priority to help propagate the urgency of tackling climate change through this e-book. Taking care of our environment is about caring for our future generations.

At the first-ever Nobel Prize Summit in Paris last year, no less than 10 Nobel laureates shared in a joint statement that "only profound changes in the way society produces, distributes and consumes almost everything can forestall potentially catastrophic changes". They added that the world must repair and restore the "global commons" that have enabled life to flourish – climate, ice, land, ocean, freshwater, forests, soil and the rich biodiversity that regulates the state of our planet. There is as yet no Nobel Prize for environmental sustainability. This is telling.

As someone who believes in the sustainability cause, seeing the e-book project to its completion despite the challenges has been both worthwhile and fulfilling. Alas, an e-book on sustainability is never finished. Like sustainability itself, which is an endless journey with countless milestones, sharing sustainability stories will always be a work in progress.

Joachim Sim
August 2022

Nurturing Stewards of the Environment

Lawrence Wong

Deputy Prime Minister and Minister for Finance, and former Minister for Education

(This is an edited version of Minister Lawrence Wong's speech in Parliament in March 2021, titled 'Nurturing Stewards of the Environment')

In February 2021, the Government unveiled the Singapore Green Plan 2030, a whole-of-nation movement to advance the national agenda on sustainable development, which strengthens our commitments under the United Nations 2030 Sustainable Development Agenda and Paris Agreement.

Beyond specific policies laid out in the plan, we want to instill in Singaporeans a broader mindset change and environmentally conscious habits. These will take time to take root in our society, so we must start young and inculcate these mindsets in our students through education.

Environmental education is not new in our schools. It is part of the curriculum, and many schools have programmes to help our students learn to be more environmentally conscious. These efforts show – in the OECD's 2018 Programme for International Student Assessment (PISA) study, 89% of our students reported that they were familiar with the topic of climate change and global warming, while 71% believed they could take action on world problems.

I am confident that the Ministry of Education (MOE) will build on this strong foundation and take it further.

Eco Stewardship Programme

MOE will strengthen and deepen the current strands of environmental education in schools, and weave these together to create an Eco Stewardship Programme in all our schools, from primary to pre-university.

The term 'stewardship' represents our individual and collective responsibility to take good care of the environment – not just in the short term, but always with an eye for the future, and for generations to come. Doing so requires responsible and informed decision-making, and choosing to do what is good and right through our daily habits. It also entails an innovative spirit and a mindset of growth, which will enable us to pioneer new ways of doing things in caring for the environment.

With the Eco Stewardship Programme, we hope to inculcate informed and responsible sustainability habits in our students for life which will empower them to make a positive difference in their schools, homes and community. Environmental sustainability will be holistically integrated into the school environment through four approaches, which we call the 4Cs – Curriculum, Campus, Culture and Community.

Curriculum

Environmental and climate change education is already integrated into subjects like Science, Geography and Social Studies. We can do more to enhance the teaching and learning of sustainability in both the Sciences and the Humanities. MOE will equip our students with evidence-based understanding of sustainability, and help them understand how Singapore and other countries manage environmental challenges based on our unique geographical contexts.

For example, in the new upper secondary Geography syllabus, topics will be organised around the theme of sustainability. We will also refresh and strengthen the Singapore perspective on sustainable development.

To make the learning come alive, we will develop more learning resources which feature sustainability initiatives within our school environment. Think of Physics lessons where students analyse data on the amount of electricity generated by

solar panels in their schools. These resources will help students connect their learning to their actual lived experience in schools and make the learning more authentic and engaging.

Campus

MOE will progressively push forward with enhancing the infrastructure of our schools with a range of green features, and to also use technology to nudge a more sustainability-conscious lifestyle. The Singapore Economic Development Board and Housing & Development Board lead the SolarNova Programme, a whole-of-government effort to accelerate the deployment of solar panels in Singapore. We now have about 130 schools on this programme with solar panels being progressively installed on their rooftops, and we will extend this to cover most of our remaining schools in the coming decade. MOE will increase the solar generation potential of our schools in tandem with improvements in costs and technological developments for solar deployment.

The energy efficiency of our school campuses will also be improved. For instance, MOE will embark on a programme to gradually have LED lights as the main light source in our classrooms. These features will help schools reduce their overall energy consumption as well as improve thermal comfort in classrooms to ensure that they are conducive for learning.

Smart energy and water meters will also be installed in our schools, allowing them to monitor their own consumption. More importantly, these can serve as powerful learning resources for our students to understand the impact of their daily habits and actions.

There is no better way for students to learn about environmental sustainability than to bring the natural environment into schools. Some schools have already actively harnessed sustainability features within their campuses to enrich students' learning. During my visit to Commonwealth Secondary School, I was pleasantly

surprised to learn that the school is home to several eco-habitats, including its Rainforest, Stream and Wetland. These outdoor classrooms provide students with real eco-systems that they can study and observe. Students also plant their own vegetables in the school's nursery, another one of the eco-habitats, and harvest them for the canteen's use. This is the farm-to-table experience that students at Commonwealth Secondary School go through. With the immersive environment that the school creates, students develop a better appreciation of nature and biodiversity.

MOE will therefore continue to green our schools and testbed new innovations, so that our school buildings can be more sustainable and our school campuses can become learning laboratories for our students to experience sustainability in practice.

Culture

Beyond academic learning and infrastructure, we also need to instill the right habits in our students. This includes encouraging them to reduce waste, recycle and reduce energy use as a matter of habit.

It is important that we strengthen the eco-culture in schools towards sustainability, by building on existing efforts to instill daily habits of environmental consciousness.

Everyday responsibilities will be expanded to include sustainability habits. It could be simple activities such as switching off lights and fans upon leaving the classrooms. Some schools have already removed single-use plastic in the canteen and encouraged students to reduce and recycle food waste. Elias Park Primary School, a recipient of the President's Award for the Environment in 2019, has a food waste management programme. Students are taught and encouraged to order only what they can finish and use the bio-digesters in the canteen for recycling food waste. These good practices will be expanded to more schools, and we will

pilot ways for students to see that their daily habits can make a discernible impact on the environment.

We will also help students champion sustainability mindset and practices through leadership opportunities in environment-related areas such as co-curricular activities, so they can encourage their peers and friends towards more sustainable living.

Building a culture of sustainability requires schools, families and the community to complement one another's efforts. The learning from schools will reinforce our community efforts, and in turn, encourage and cultivate more good habits to create a ripple effect on society.

Community

Schools are part of a larger community ecosystem and work closely with partners across different government agencies, as well as with the private and people sectors. We will widen and enhance the platforms for students to participate in meaningful community projects to care for the environment and promote sustainable living. This will expand the scope of our education with sustainability as a key part of the curriculum.

MOE will also work with partners to strengthen students' awareness of future "green jobs". There are many opportunities for growth in the sustainability sector. These could be in the fields of green finance, sustainable urban design, climate science, waste extraction, renewable energy and food science, just to name a few. We should raise awareness and appreciation of the opportunities in this space among young people. Hence, we are equipping our teachers and school education and career guidance counsellors with the knowledge and skills to build students' awareness of these future opportunities, and to help them discover and explore their interests.

Building on Existing Efforts in Institutes of Higher Learning

These opportunities to explore and prepare our students for more careers in the environmental and sustainability sector will continue beyond schools to our Institutes of Higher Learning (IHLs).

IHLs will connect students with relevant industry partners through career fairs and the support of education and career guidance counsellors. They will also work with industry partners to curate internships to expose students to jobs in these sectors.

Beyond a greater push for our youths to consider a career in these sectors, the IHLs themselves are also enhancing the green infrastructure and promoting sustainable living initiatives within their campuses. For example, the National University of Singapore has developed a Climate Action Plan 2030 to cool its campus by four degrees Celsius and to build a carbon-neutral campus. Other universities, too, are embarking on their own sustainability journeys.

Championing Public Education on Sustainability through the new Science Centre

To further complement these green efforts in education, we will also leverage on the new Science Centre at Jurong Lake District. The Science Centre will champion public education on sustainability. It will serve as a showcase for innovative technologies through programmes and exhibits to engage youths and the public.

For example, the Science Centre will enhance its Young Scientists Badge Scheme, such as the Young Sustainability Champion Programme, to provide more opportunities for students to create solutions to environmental problems. Such programmes are complemented by interactive exhibitions on climate change, urban farming and other environmental sustainability themes. We hope these initiatives will also inspire sustainable lifestyle changes amongst Singaporeans and in our society.

Reducing Net Carbon Emissions

Through the Eco Stewardship Programme, we aim to reduce carbon emissions from our schools significantly. Two goals for 2030 are to achieve a two-third reduction of net carbon emissions from the schools sector and to have at least 20% of our schools to be carbon-neutral by 2030, with the rest to follow thereafter.

Solar energy will play a key role. The solar generated will be able to help schools reduce net carbon emissions significantly. We will also plant more trees in schools and explore other ways to green the environment.

MOE will start by piloting sustainability features and related concepts in some schools. As a start, four schools will be participating in this pilot – Elias Park Primary School, Mee Toh School, Commonwealth Secondary School and Tampines Secondary School. These schools have already adopted a holistic school-wide approach to sustainability. MOE will work with them to further reduce net carbon emissions from their school buildings and to encourage students to actively reduce their individual carbon footprint.

Learning from the experiences of the pilot schools, good and practical solutions can be progressively scaled up across all our schools.

Conclusion: Seeding the Love for the Environment from Young

We have set ambitious plans for ourselves. They are not just hard targets in reducing carbon emissions, but equally, if not more importantly, they are about nurturing our young with the values, skills and know-how to become responsible stewards of the environment.

We hope to see in every student an eco steward for life – where they will have a

sensible sensitivity towards the environment and understand what it means to live sustainably.

Through our concerted efforts, we can seed and grow a sustainability movement to help create a greener future for our children to harvest. They can then look forward with confidence to a better and brighter future for their own children, and for many more generations to come in Singapore.

Former Minister for Education Lawrence Wong visiting Commonwealth Secondary School. (Photo: Ministry of Education)

Featured Schools' Stories

APSN Delta Senior School

ASPN Delta Senior School (DSS) provides four vocational courses that prepare special needs students for employment. Students are also taught environmental education through hands-on experience in practising, learning and advocating environmental sustainability (ES) in and outside school. While DSS' horticulture graduates could take up jobs in the green industry, those who completed the training programmes in hotel and accommodation services, food and beverage, and retail operations are also trained by DSS to contribute to the green efforts of their employers. Although its Green Ambassador Club is not given curriculum time, teachers and students put in extra hours to organise or participate in ES activities. The recipient of the SEC School Green Award (now known as the Vanda Miss Joaquim Award) for its entry to the Schools' Recycling Bin Design Competition in 2016 was encouraged to do more in environmental education by the recognition that it was on the right track. The school believes that every achievement is a new milestone and is significant for the overall motivation, learning and development of the students.

The Hydroponics Showcase at the Choa Chu Kang Public Library, where DSS' horticulture students will be volunteering to care for its plants while honing their green skills from the later part of 2022. (Photo: National Library Board, Singapore)

APSN Delta Senior School's students practise green habits on campus, learn the 4Rs and advocate in community to prepare for green jobs

"Regardless of our background, social status or health condition, everyone can play a part in safeguarding the environment. For persons with special needs, it is even more critical that they receive the right education and guidance to become more aware of how they can contribute to environmental sustainability."

– Subash Lazar, Principal
ASPN Delta Senior School

Students hone green skills while serving community before employment

In the later part of 2022, horticulture students of ASPN Delta Senior School (DSS) will have the chance to apply what they have learnt about green practices and in their course at the Hydroponics Showcase of the Choa Chu Kang Public Library. The library aims to nurture awareness of food security in environmental sustainability (ES) in the community through the living showcase. The students will be volunteering their service twice a month to care for the plants on display there while practising and honing their horticultural skills. In the process, they will be advocating sustainable living to the community and preparing themselves for employment after graduating from DSS.

Horticulture students have been planting vegetables in the school and harvesting them for needy families. Like their peers taking other vocational courses at DSS, they have learnt how to care for the environment from the school's green

practices on campus, education in class and outdoor, and outreach activities to advocate ES to fellow students and the community.

Horticulture student tending to plants at the hydroponics garden in DSS. (Photo: DSS)

How and when DSS started on ES journey

DSS was included in the National Environment Agency's (NEA) Schools Recycling Corner Programme launched in 2002, when a notice board was put up with a recycling corner. In 2008, the school started its environmental education by setting up the Green Ambassador Club as an interest group for all students who were interested in learning about ES. The club sought to create interest among students and engage them in meaningful ES activities. At least one simple green activity was held each semester for students to gain hands-on experience and understand its outcome. After its completion, the teacher held a debriefing

and explained the significance of the outcome to Singapore and the rest of the world, where applicable. Teaching ES concepts was aided by the use of pictures, videos or students' participation in activities.

In 2010, DSS began to involve students in 'one-off' green practices like collecting used pens from family members and friends for recycling by the Save That Pen movement initiated by the National University of Singapore. Three years later, it started to advocate ES to its students, other ASPN schools and the community. It collaborated with some of the mainstream schools like Raffles Girls' School, whose Green Ginger team conducted a workshop on reusing used plastic containers as planters. Other APSN schools like Chaoyang and Katong were invited to send their students to DSS' gardens for their science lessons.

Focusing on 4Rs for more impactful learning outcomes

DSS' ES initiatives are focused on reducing, reusing, recycling and renewing (4Rs) in water, energy and waste management. They can remember the acronym easily and relate what they are practising and learning in school to what they see in their neighbourhoods, such as posters and leaflets promoting ES. For example, they could see how rainwater is not being wasted but used for watering plants in school to reduce water usage. They could also experience and learn about renewable energy when they took turn to peddle a cycling machine to power the attached blender to make a smoothie drink.

What school has achieved in ES practices

DSS staff and students have been recycling paper, plastic, cans and other used items since 2010. Recycling bins were placed at lift lobbies of all four floors of the school building in 2013. Tetra Pak and e-waste recycling bins were introduced in the school in 2019. For their recycling efforts, the school was recognised with Sembcorp Industries' Go Green Fund in 2019 and Schools Go Green Competition prize in 2020.

Separate bin provided for recycling empty beverage cartons under the Tetra Pak School Recycling Programme. (Photo: DSS)

Student showing the way in electronic waste recycling using a dedicated bin. (Photo: DSS)

Whole-of-school green efforts included using reusable cutlery in the canteen, using press-and-use taps in toilets to save water, reusing laminated sheets for events and used envelopes for other purposes, and using natural (mulch, coffee power and food waste), organic and granular fertiliser but not pesticide or insecticide for gardening.

No more disposable cutlery in canteen (left) and toilet with press-and-use taps for sinks and reminders to conserve water. (Photos: DSS)

The school aims to "actively involve students in services and ownership of the school such as maintenance of cleanliness, school improvement works, mosquito-breeding control and landscaping" through the Green Ambassador Club. The members perform recycling duties as a daily routine – collecting paper, plastic items and cans and putting them in different recycling bins, as well as guiding other students in using the bins correctly.

Recycling bins for paper, plastic items and cans on campus – Green Ambassador Club students on duty collecting and depositing recyclable items daily. They also guide other students in throwing them into the correct bins. (Photo: DSS)

The food waste recycling process 'Food Composting for a Sustainable Future' may be considered DSS' most significant innovation in ES practices to date. Its development involved staff from different departments and students from the Green Ambassador Club. The food-composting method was shared with special education teachers attending the SPED Conference 2018 and was commended at the MOE-NCSS Innovation Awards 2018.

DSS shared its innovation in food composting at the SPED Conference 2018 attended by special education teachers.

What DSS has achieved in ES education

For its ES education, DSS seeks to promote social responsibility by creating awareness of environmental issues related to waste management, energy management, water management as well as the use of green resources. It is doing this through assembly talks, school projects and collaborative efforts with the community. According to the school, staff and students have been participating in all its ES activities and contributing their ideas and creations. The food waste recycling project exemplified its success in using activities as learning opportunities for participating students and the experience gained was shared with other students. Developing it from scratch had taught them to be self-sufficient.

DSS' success in teaching students to learn about ES by doing may be illustrated by the green ambassadors' making of recycling bins using upcycled materials. They later brought the bins to their classrooms for classmates to use.

Imagine upcycling used items to make recycling bins! That's what these green ambassadors did. (Photo: DSS)

The school's sensory garden serves as a green learning facility for students. It has a variety of flowering and fruiting plants that attract insects. There students learn how butterflies and bees help in pollination and reproduction of plants. They could relate the lemon grass, pandan leaves, banana trees and sugar canes that they see in the garden to what they learn in science.

View of sensory garden. (Photo: DSS)

The impact of DSS' practical environmental education on students was evident in the self-confidence they gained from understanding and practising the 4Rs in and outside school. For example, during the Schools' Recycling Bin Design Competition in 2016, they were able to explain the reasons for and the functionality of their innovative design. Their self-confidence was also apparent in the green ambassadors who acted in a short film on recycling.

This was initiated and conceived by DSS staff and produced by an external vendor for the 2016 Sustainable Singapore Blueprint Photography and Short Film Competition. Despite the pandemic, the teachers continued to conceive new and exciting ways of engaging students in the 4Rs. For example, in 2020 students learnt to make interesting upcycled objects for submission for a SembWaste's initiative.

Recycling bin designed by DSS students on display to promote recycling at a community event. (Photo: DSS)

What school has achieved in ES advocacy

DSS' ES advocacy/outreach activities for students and teachers include Green Ambassador Club's notice board and activity corner, video shown in canteen during recess and posters placed around canteen on reducing food wastage, and green ambassadors' sharing on water and electricity conservation and renewable energy on World Water Day and Earth Day. In 2015, when Singapore celebrated its 50th anniversary of nation building, the school produced a video on its efforts to promote recycling.

Green Ambassador Club students at DSS event to commemorate World Water Day held in collaboration with partner Credit Suisse at Ang Mo Kio-Bishan Park in 2016. (Photo: DSS)

In addition, the school has been promoting ES topics like plant lifecycle, biodiversity and human impact on the environment to other APSN schools. For example, DSS invited the sister schools in Tanglin and Katong to send their students to visit its gardens.

The school aims to "build community partnership to learn and advocate green habits" through its participation in community activities. It has been taking part in one or more of such activities each semester or at least two a year.

How and what students learn from green practices in school

DSS teachers' green habits serve as examples for its students to follow, such as use of recycle bins in the staff room, using own cutlery and utensils to buy food from canteen, and donation of used items like bags, cups, toys and clothes. Another is reusing scrap materials for teaching or training purpose, like shredding used paper for sweeping practice. Other examples are using the other side of used paper for taking notes, using refillable printer cartridge and marker pen, using eco-friendly paper for printing, and switching off electrical equipment when not using them.

Some green projects or activities involved DSS staff and students working together, such as collecting used items like school uniforms (to give to needy students), empty cardboard boxes (for keeping completed forms), discarded plastic bottles (to create pen/pencil stands) and used but usable items for sale at flea market during year-end carnival, among others.

Pre-owned uniforms donated by graduated students for reuse by needy students (left) and pencil/pen stands created with empty plastic bottles by students. (Photos: DSS)

The students could see their efforts being recognised by external organisations at the end of the year, such as SembWaste's 2019 RECESS (Recycling is Championed and Encouraged by Students in Schools) reward programme. All DSS staff and students contribute to the recycling throughout the year, with RECESS dollars redeemable at the end of the year based on total tonnage collected.

The school commemorates Earth Day and World Water Day, which are marked throughout Singapore each year. Students become aware of them from their exposure to the banners, pamphlets, newspapers and other media publicity, and are able to relate to the two events. During the year-end class party or other celebrations, the school uses teachable moments to remind students to recycle relevant items and keep unused ones for future use.

World Water Day @DSS 2016: Green Ambassador Club member at exhibition booth explaining the NEA panels before asking fellow student to make the water pledge. (Photo: DSS)

How and what students learn about ES in classroom and outdoor

DSS students learn about environmental sustainability and responsibility by participating in school activities, which include regular assembly talks on recycling, and events like graduation day and employers' education programme. Past assembly talks were given by the National Library Board (NLB) and SembCorp Industries,

as well as by green ambassadors who shared their experiences. At events, the students practised what they had learnt about recycling by collecting paper cups used for drinking water or juice for washing and recycling. They also collected empty mineral water bottles for recycling.

Green Ambassador Club students learnt about the 'KSA' in ES from Vellore Anantharaman Hema when she served as its Staff IC from 2010 to 2020: Knowledge of what can and cannot be recycled daily in school and at home, problems caused by littering and global warming; Skills in recycling reusing items hygienically and effectively; and Attitude of understanding why the 4Rs are important, the effect of every act of recycling, and the causes of global warming and our role in mitigating it. They attended PUB's ABC Waters Learning Trail at Jurong Lake to learn about its biodiversity in 2015 and 2016. There they learnt how litter could end up in Singapore's water bodies and contaminate water used for consumption. In addition, they became aware of the effects of litter on the ecosystem and living creatures in the lake. In 2017, they visited Sungei Ulu Pandan, where they learnt about cleansing biotope, vegetated swale, floating wetland and sedimentation basin.

Green Ambassador Club students on PUB's ABC Waters Learning Trail at Jurong Lake to learn about Singapore's water resources, flora and fauna (left) and DSS students participating in the ABC Waters Learning Trail conducted by Ngee Ann Polytechnic students at Sungei Ulu Pandan in 2017. (Photos: DSS).

Hema led the DSS team in conceptualising the design and creating the prototype that was submitted for the Schools' Recycling Bin Design Competition 2016 and displayed at the Green Living exhibition that year. Students learnt from the step-by-step process. It started with a brainstorming session where they shared their ideas, before helping to sketch the prototype and items for making it. A day was then set aside for all the green ambassadors to build and decorate the prototype before the exhibition. Hema taught them how to explain its distinctive features to visitors with the write-up she had prepared.

Poster publicising DSS' entry for the Schools' Recycling Bin Design Competition 2016 was published on its Facebook page.

Students also learn about ES from school projects, like those on food waste-recycling, upcycling of discarded sport items and water conservation. In 2018, they were taught to use the SmartCara composting machine that grinds, dehydrates and filters odour to reduce food waste by up to 90%. According to DSS, the project taught students the benefits of using energy-saving equipment and the importance of conserving natural resources such as water, minerals as well as reducing the amount of waste sent to landfills and incinerators. The same year, students learnt to upcycle discarded sport items by painting table tennis balls to look like chicks, making chickens with paper, and using cardboard paper and a frisbee as a base to create a nest. They also participated in a pilot project on water conservation in 2018. This involved inverted recycled watering cans with cotton wicks dripping drops of water onto plants below them, thus reducing water consumption compared with the usual watering practice.

DSS student using the SmartCara food waste processor to turn vegetable and meat waste into compost for use as fertiliser for plants (left) and an example of students using plastic waste to make flower and butterfly. (Photos: DSS)

Recycled containers with cotton wicks dripping water onto planter boxes to reduce water usage and wastage. (Photo: DSS)

Other green learning opportunities included external events such as the Clean the World Project in collaboration with Mandarin Oriental Hotel to mark Earth Day in 2016. Students attended an assembly talk on the sanitary conditions in underdeveloped countries and how they could help by recycling unused soap instead of discarding it. At the School Green Awards workshop at Ang Mo Kio Secondary School that year, they were briefed on what were required for DSS' participation and took part in a recycling activity. The same year, DSS students attended an eco-awareness event co-organised by Tzu Chi Foundation and Ever Green Secondary School. In 2019, students walked around nearby public housing estates to see how recycling bins were being used, like what could and could not be recycled. They saw first-hand the challenges faced in implementing NEA's National Recycling Programme, such as contaminated items found in the bins. Following each visit, they noted their observations and recommendations for improvement, if any, for submission to SembWaste, the public waste collector for the neighbourhood.

Earth Day commemoration in 2016, when students presented on the Clean the World project that was completed in collaboration with Mandarin Oriental Hotel. A video clip on recycling produced by DSS staff and students was also screened. (Photo: DSS)

DSS students attending an eco-awareness event co-organised by Tzu Chi Foundation and Ever Green Secondary School in 2016. (Photo: DSS)

How and what students learn through ES advocacy on campus and in community

On Earth Day in 2017, green ambassadors shared their experience in reducing electricity usage through the 'Lights and Fans Off' drive in some classes to the whole school during the morning assembly. At their assembly talks, they explained the nature and benefits of renewable energy as shown by the cycling machine that generated electricity to power a fruit blender.

Lesson in energy conservation: A class doing its part to conserve electricity by relying on natural lighting and ventilation during DSS' commemoration of Earth Day. (Photo: DSS)

Since 2016, DSS has been collaborating with ITE College West to co-organise the annual Choa Chu Kang Recycling Day, for their students to collect recyclable items from residents and learn about recycling.

Students helping to collect recyclable items from residents during the Choa Chu Kang Recycling Day in 2016. (Photo: DSS)

Overcoming Covid-19 disruption

Since 2020, the Green Ambassador Club has been holding shorter meetings during break times in school. Informal chats and exchanging of information were done through messaging services. The students showed self-motivation in carrying on with their duties to deliver the required ES knowledge, skills and attitude with minimal monitoring, noted the club's former Staff IC Hema. Today, the students initiate and lead their own green outreach projects as the school continues to focus on their ES learning through advocacy.

Overcoming other challenges along the way

Getting teaching materials, finding like-minded partners to collaborate with or to guide the school through the various ES activities, and securing green learning opportunities were a few of the challenges faced by former Staff IC of the Green Ambassador Club Hema. However, her persistent efforts in approaching and following up with potential partners for help in planning and conducting workshops, student training, learning journeys and other green activities had paid off. DSS' partners now include SembCorp Industries, Singapore Environment Council (SEC), NEA, PUB and NLB.

Values underpinning DSS' commitment to green cause

DSS' provision of special education is underpinned by respect, responsibility, resilience and integrity. These values underpin its environmental responsibility as ES practitioner, educator and advocate as part of its holistic education for students. This has been particularly evident since the pandemic started in 2020. The school continues with students' green ambassador duties, collection of used items and use of recycled materials for vocational lessons. It issued reusable masks to staff to reduce waste from use of disposable masks. When students were learning at home, the Fitness and Health instructors taught them how to modify water bottles, used milk cans and other common items for use as weights for resistance training.

The school's commitment to the green cause is also supported by its philosophy of "engaging students in environmental efforts and education to create a more sustainable future", as well as its ES mission "to educate, empower and enable all its students in environmentally sustainable practices through the inspiration and influence of highly activated green ambassadors". It aims to enable persons with special needs to be active contributors to society and envisions itself as a leader in advocating and adopting green practices among Singapore schools. It thus sees its students' hands-on participation in environmentally sustainable practices as the best way to teach them ES.

What contributed to school's ES achievements

According to DSS, staff and students' whole-hearted practice of the 4Rs has contributed to its ES success to date. Besides the teachers, staff include those in the administration and allied health departments. Another factor is the encouragement, support and appreciation shown by the school leaders, Hema shared.

DSS' community partners' contributions and support also play an important role. Collaborating with suitable partners has provided learning opportunities for students while helping to amplify DSS' reach and impact in the community.

DSS' ES leadership starts at the top

DSS Principal Subash Lazar considers it a "blessing" to be supported by a "very strong team of passionate educators" in charting the school's own direction and curating programmes according to its students' profiles. He provides strategic advice for ensuring that its green practices have a wider reach. He also guides the teachers in pitching its ES education based on students' needs.

Subash shared that DSS' ES advocacy is related to vocational training, which highlights safe green practices, while its community work revolves around environmental education.

Achieving more through club and class leadership

In her role as Staff IC of the Green Ambassador Club, Hema was guided by Michelle Tan, who set targets for the club and obtained approval from the school leaders for collaboration projects with partners.

Hema described the club's student leaders as "ES specialists" who have the necessary knowledge, skills and attitude to lead by example and guide other students. A student leader and an assistant leader appointed by the Staff IC head the club each year. They monitor the students' duty roster, consult with teachers and members on issues faced, needs and requirements, as well as solicit ideas for school-wide activities.

Each class has one or two students nominated by their form teachers to be members of the Green Ambassador Club, based on their interest in environmental education and potential to learn and contribute. The class representatives take care of classroom maintenance.

Achieving more through passionate and dedicated teachers

Teachers involved in environmental education learnt about ES on the job while teaching their main subjects full-time.

Hema teaches in the Fitness and Health Department as well as environmental education in her supplementary role as Staff IC of the Green Ambassador Club from 2010 to 2020. She was chosen for her interest and experience in ES. "I am someone who tries to minimise wastage. I love to recycle, reuse and repurpose anything and everything," she shared. Her interest was sparked by her parents who "always went the extra mile to recycle and repurpose things and were totally against wastage". As a child, Hema was wearing clothes handed down to her by her older cousins. "The tradition continues till today," she added.

Hema's club duties included enrolling students for community activities and organising their learning journeys outside school. She shared that she learnt on the job to "make learning about the environment fun, enjoyable and meaningful so that the students will remember it for life". As a Fitness and Health teacher, she has been reminding students to use a proper water bottle to avoid unnecessary wastage. When drinks are provided during outdoor or school activities, she would tell them to recycle the plastic bottles. During her debriefing after an event, Hema would point out that it was irresponsible to litter the venue and explained how littering could affect the living creatures in Singapore waters.

During the 10 years of leading the green club, Hema single-handedly guided and supervised its student leaders and members who engaged and encouraged their fellow schoolmates to follow and perform the 4R activities daily. She recalled the chance meetings with some of her past students who could still remember their learning experiences as Green Ambassador Club members and who are continuing with their recycling and reusing habits at home or at work after leaving DSS. She felt a deep sense of satisfaction when they told her this. "It proved that they have internalised the KSA and are able to continue with the green practices independently," she was happy to note.

Amplifying reach and impact with external partners

DSS has forged partnerships with other schools, government agencies, businesses and non-profit organisations for one-off and ongoing projects. It also participated in activities organised by SEC, NEA and other environment-related organisations. For example, the Vegetarian Society gave a talk on renewable energy during a morning assembly in 2017 and let students experience the power of renewable energy by peddling a cycling machine attached to a fruit blender.

In its ES practices, DSS has been participating in SembCorp Industries' annual recycling programmes since 2015. SembWaste has been helping to monitor

Making smoothie the fun way by cycling: Green ambassador showing his peers how peddling could power the mechanical blender with renewable energy as an alternative to electricity. (Photo: DSS)

DSS' daily recycling efforts involving all students and encouraging the school through its RECESS reward programme. Izabel Tan, its Manager for Corporate Communications, shared that the school's teachers have been coming up with new and exciting ways of engaging its students in recycling.

According to the school, SEC has been proposing competitions or activities to engage its students in understanding the importance of ES.

For DSS' ES education, NLB has been giving assembly talks on World Water Day and Earth Day since 2016, besides providing students with green learning materials. Its librarians shared bite-sized facts and stories about ES and conducted quizzes. According to Keisha Anwar, Associate Librarian (Children and Teens) at Choa Chu Kang Public Library, these activities help students to

connect with ES and to adopt green practices in their daily lives. The partnership enables DSS students to benefit from NLB's library services and resources under the Library and Archives Blueprint 2025. In future, DSS students will be able to learn from NLB's new programmes and resources on sustainability that advocate sustainable living through green knowledge and collective action. For a start, horticulture students will be serving as volunteers at the Hydroponics Showcase of Choa Chu Kang Public Library from late 2022.

Story-telling session by National Library Board staff on Water Wally followed by quiz, during school assembly on World Water Day in 2015. (Photo: DSS)

Helping each other to do and learn more for sustainable living

In the process of reviewing its ES efforts, DSS realised that its students are capable of doing more for the environment and learning more about sustainable living. This could be observed in students from the different vocational courses. For example, horticulture students grew common herbs and harvested them for food and beverage (F&B) students to use in their lessons. In return, F&B students gathered food waste for horticulture students to compost for use in the gardens.

Indeed, the green achievements of the whole school may be greater than the sum of the different course cohorts' accomplishments.

Bukit View Secondary School

Bukit View Secondary School (BVSS) is the only Singapore secondary school that boasts of a green lab as the centrepiece of its environmental education facilities. Its JOULES Smart Centre opened in 2018 is used to conduct classes for the school's Junior Outstanding Leaders in Energy for Sustainability (JOULES) programme launched that year. This programme was upgraded to JOULES 2.0 in 2021 and underscores BVSS' environmental sustainability (ES) focus on clean energy and environmental technology. Its emphasis on the development of student environmental leadership in sustainable living is evident from the examples set by its students and alumni. Underpinning this strength of the school's ES education are its plans to enhance its development of the 4Cs (curriculum, campus, culture and community) over the next three years, in alignment with the Ministry of Education's Eco Stewardship Programme. For this recipient of the 2016 President's Award for the Environment, BVSS' green journey continues after achieving many milestones over the past 20 years under the stewardship of a dedicated, passionate and innovative staff IC. In 2017, the school marked its 17-year ES journey and achievements with a commemorative book 'Our Journey'.

Groups of students attending the JOULES programme at the JOULES Smart Centre, the 'Crown JOULES' of Bukit View Secondary School's environmental education. (Photo: Bukit View Secondary School)

Bukit View Secondary School develops students to be outstanding leaders in clean energy for a sustainable planet

"As Singapore embarks on its Green Plan 2030, our mission is to continue developing our students for a resource-constrained world through their learning in clean energy and environmental technology."

– Kevin Ang, Principal
Bukit View Secondary School

Opening up a new world of environmental sustainability education

There's a distinctive buzz of students in earnest discussion as one steps into Bukit View Secondary School's (BVSS) JOULES Smart Centre on a typical day. Students can be found huddled in groups exploring possible projects in harnessing clean energy to solve some of today's environmental problems. However, this is no ordinary class in session as it teaches beyond the curriculum. The teacher in charge can be seen walking around the energy-efficient classroom to listen in to the groups' discussions and sometimes joining in to share ideas with the students. Group members can be seen presenting their concepts with rough sketches, mock-ups or even prototypes made from recycled materials. As they immerse in their deliberation, the ceiling fans and air-conditioning set at a higher temperature would keep them comfortable while reducing electricity consumption. The indoor green wall improves air quality and reduces noise level by absorbing acoustic energy. In addition, green building products from paint to flooring and the centre's fittings and furniture have been offering students a conducive learning environment since it was opened in 2018. Welcome to the BVSS world of learning about environmental sustainability (ES)!

How BVSS started on ES journey

In 2000, BVSS started its ES practices by collecting old newspapers, scrap paper, cardboards, card boxes and other trash for its recycling contractor, to promote awareness of keeping the environment clean among students. Heng Chong Yong, then a new teacher, was elated when he was asked to lead its green journey. As a junior college student, he had already wanted to become a teacher so that he could influence others to be environmentally conscious. That year, the school participated in the Singapore Environment Council's (SEC) annual Schools' Green Audit Awards programme. After participating in public waste collector Alvater Jacob's battery- and paper-recycling programmes in 2001 and 2002 respectively, BVSS set up its recycling corner in 2003.

The school introduced environmental education for its students in 2006, when it aimed to build "a conducive and vibrant learning environment, serving as an educational platform for students to learn, experiment with, and develop innovative ideas and products that will bring benefits to the community". This followed the Singapore Green Plan 2012 launched in 2002 that envisioned the island as a model green city with a call for schools and the community to educate and nurture its people to embrace ES as a way of life. BVSS also responded by admitting new students based on their past green achievements through the Direct School Admission scheme. One of them enrolled in 2018 and led projects like the wormery for recycling food waste and facilitated an ES conference the following year.

Focusing on clean energy and environmental technology for more impactful learning outcomes

The school believes that Singapore students need to be scientifically literate in learning about ES with the nation's emphasis on energy efficiency for achieving economic sustainability. Thus, the JOULES programme was introduced to equip

students with knowledge of Science, Technology, Engineering and Mathematics (STEM), coding and problem-solving skills to overcome challenges in resource-constrained Singapore. It is based on the three pillars of environmental advocacy, computing and maker education. The same STEM skills are needed to come up with solutions in water conservation, waste management and biodiversity conservation.

BVSS has been focusing on teaching clean energy and environmental technology since 2013, when the effects of climate change were becoming more evident with the call to reduce carbon emission and reliance on crude oil getting louder across the world. As a result, the school was given the niche subject status in Environmental Science by the Ministry of Education (MOE) that year. It started the Applied Learning Programme (ALP) in Clean Energy and Environmental Technology that focused on solar energy with the support of polytechnics, which opened their facilities for BVSS students to use. This was followed by Computational Thinking in 2016 for students to learn how to program sensors used to collect data for analysing the impact of global warming on the planet.

What BVSS has achieved in ES practices

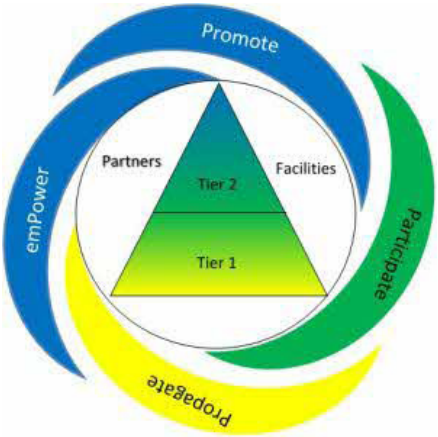
As an ES practitioner, the school has adopted green practices for its buildings, infrastructure, facilities, teachers and students. In 2004, BVSS joined the National Environment Agency's (NEA) Recycling Programme for Schools, which linked it with a waste management company that provided recycling bins and green ideas for adoption. Back then, NEA's other initiatives included 3R Project Competition, Corporate and School Partnership Programme, Environment Champion training for students and the annual Environment Educator Advisor Networking Session for teachers.

BVSS' green features include rooftop solar panels that power water sprinklers in the mini-science garden, water-saving devices in all toilet taps, motion sensors with meters to monitor usage in student toilets to save electricity, and recycling corners.

Such green practices provide opportunities for BVSS students to learn about ES through hands-on experience. The school was recognised for its efforts in reducing energy consumption by NEA with the Energy Efficiency National Partnership Award in 2017 and by Building and Construction Authority (BCA) with the Green Mark Gold Plus in 2018.

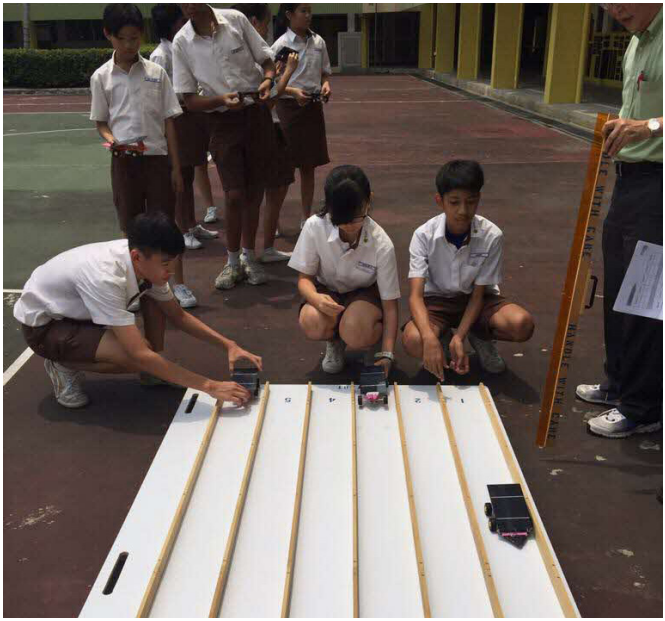
What BVSS has achieved in ES education

BVSS' environmental education has progressed from the 3P framework (promote, participate, propagate) to the 4P approach with the addition of "emPower" in 2016. Tier 1 learning caters to all students in the first three years of secondary education. At the Tier 2 level, selected students are given the opportunity to pursue their interest in ES further through participation in competitions, workshops and other activities. (Diagram: BVSS)



Students are "empowered" to learn more about the environment and sustainable energy by joining the Environmental Club or taking part in green competitions. Those interested in design thinking can study Design and Technology for national examinations, complete self-initiated projects with the use of 3D printers, laser cutters and other equipment available at the iSpace facility in school.

The school's ALP provides students with STEM knowledge and skills, particularly in clean energy. All secondary 1 pupils get to apply what they have learnt to build, code and race their own solar cars equipped with sensors. At secondary 2 level, the ALP focuses on water and smart cities and explores topics like water conservation, Singapore Water Story and water quality. Students are engaged in urban solutioning, prototyping, coding and building their own water-sensing robots and testing them in the eco garden or developing prototypes of solutions for smart cities. Through their projects, students have proposed solutions to conserve water, reduce food waste and reduce carbon emissions in a smart city. According to Heng Chong Yong, who was HOD Science then (before becoming HOD Partnership), using the context of nature and the environment to teach STEM subjects would motivate students to see their relevance in real life.



JOULES students preparing to race their solar-powered cars in 2017. (Photo: BVSS)

BVSS' ES academic courses included the Environment module for secondary 1 and 2 students that was taught from 2007 till 2013, before it was merged into the ALP for secondary 1, 2 and 3 in 2014. The Innovation and Enterprise module with environmental focus was introduced in secondary 2 in 2008. The school's multi-disciplinary approach in its Environmental Science Programme enables students to learn about the environment through different subjects.

The four-year JOULES programme in clean energy and environmental technology was developed by BVSS with Ngee Ann Polytechnic, Singapore Polytechnic, ITE and Senoko Energy in 2014. It was an adaptation of the STEM ALP curriculum that was co-developed with STEM Inc. to include other elements crucial to a holistic education. It teaches all lower secondary students how to apply coding and computational thinking to create innovative solutions for the community. For example, a team of BVSS students had noticed that the water bills residents received each month did not enable them to monitor their water usage. They designed a simple low-cost device that could do this with programming codes, which were easily editable to suit households' different needs for conserving water. The team received the first prize in the 2017 Singapore Junior Water Prize Competition for their project. The programme has been expanded to include ALP+ that enables secondary 3 students to pursue STEM-related courses at institutes of higher learning.

With many environmental programmes conducted by different departments and committees as well as the Environmental Club, the school has since consolidated them under the framework of the JOULES programme to optimise resources and efforts.

Other ES learning opportunities for students include non-academic programmes, BVSS' activities, external events, local and overseas field trips as well as projects initiated by school, students and partners.

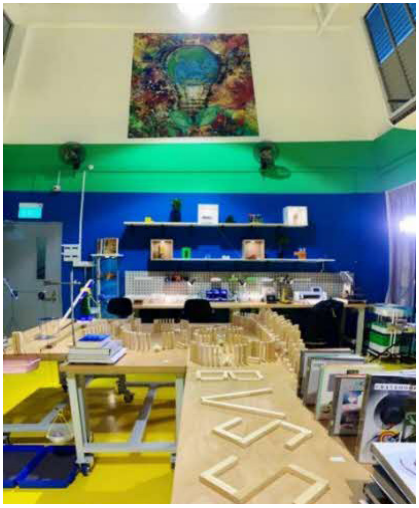
BVSS' green learning facilities enable students to learn about ES in fun, meaningful and authentic ways. They include the eco trail (including eco garden), learning walls outside Science Lab, educational panels in Environment Gallery, JOULES Smart Centre (with immersive facilities), pavilion for outdoor classes and biodiversity corner in its library. The eco garden was created as an outdoor classroom in a natural setting in 2008. It has rainwater collection tanks, natural water filtration system, water wheel to demonstrate the generation of hydroelectricity and solar panels with a tracking device. The eco trail serves as a science-focused learning journey for students in BVSS and neighbouring primary schools since 2010. The trail's learning stations feature eco adaptation, food chains, alternative energy, environmental awareness and biodiversity-friendly habitats for wildlife. The learning walls explain renewable energy, energy efficiency and water conservation, while the educational panels teach students about biodiversity, renewable energy, water and energy conservation, water and waste management, climate change and air pollution.

The JOULES Smart Centre was constructed as an energy-efficient and healthier classroom for students in collaboration with industry and community partners in 2018. Today, this Green Schools Initiative project of the Singapore Green Building Council showcases various innovations and different technologies available for Singapore to become carbon-neutral. In Heng Chong Yong's view, it is BVSS' most significant green achievement since 2010. The school hopes students will be inspired by the centre's green innovations to come up with sustainable solutions of their own. It has also served as a venue for external events like the Infocomm Media Development Authority's Intergen IT Bootcamp.

In 2021, iSpace was opened amidst the Covid-19 pandemic to further support the schools' programmes to develop students as ethical advocates of ES. It is a dedicated area for students to innovate and develop the skills they need to succeed in the world today. These include problem solving, working in teams and the ability to prototype, fail and keep trying, as part of their maker education,

which is the third pillar of the JOULES 2.0 programme launched in 2021.

Some green projects or activities involved BVSS staff and students working and learning together. They included the Student Environmental Leadership Conference (SELC), eco trail tour, beach cleaning, terrarium workshop conducted by Environmental Club students for staff and upcycling project to create table lamp using glass bottle.



Inside the iSpace, where students learn how to innovate to solve real-world problems as part of their maker education. (Photos: BVSS)

What BVSS has achieved in ES advocacy

While it is important to give students a good environmental education, the school considers it crucial to provide them with a platform to share what they have learnt with others and to advocate ES to them. In the process, they would learn more about ES.

Among many other initiatives, its annual Student Environmental Leadership Conference (previously named Responsibility to Society Forum) was developed

and launched in 2006 for this purpose. Each year, BVSS invites some 200 primary school students to attend the event, where its student environmental leaders engage them in various activities to promote ES. The participating students gain insights into the school's ES efforts and how to apply what they have learnt on their own campuses.

From 2011 to 2015, the school conceptualised and co-organised the Water Conservation Animation Competition for all primary schools in partnership with PUB. BVSS' Environment Video Competition for all secondary schools was held with NEA as its partner from 2007 to 2011.

The school has also reached out to the community through its staff's sharing sessions on ES, student activities like neighbourhood clean-ups, and hosting of senior citizens at the JOULES Smart Centre.

How and what BVSS students learn from green practices on campus and in community

BVSS students learn about ES from the school's green practices, which include uploading notes and slides on its website to save paper, banning plastic straws in canteen and placing recycling bins in classrooms, staff room, office, canteen and other areas.

The school's commemoration of annual eco events like Earth Day, Earth Hour, World Water Day and Youth for Environment Day helps to underscore the importance of ES among students.

The students also learn from teachers who serve as role models in green habits, such as printing on both sides of rationed paper, reusing paper printed on one side for taking notes, setting air-conditioning temperature at 24°C, collecting old newspapers for recycling, and packing food in reusable containers and using

reusable cutlery. For example, Reena Lloyd uses reusable bags, recycles paper, plastic and glass bottles, rarely turns on the air-conditioner and takes public transport often. Her eco-friendly habits encourage students to reduce waste and save energy. Other examples include Liang Kai Poh's use of recycled cardboard for students to make mock-ups for projects and Johnny Tan Chong Han's care of trees and biodiversity.

How and what BVSS students learn about ES in classroom and outdoor

Lower secondary Science students learn about ES that is infused in the curriculum. They also go through a JOULES curriculum that focuses on ES. In secondary 1, they learn about solar and other renewable sources of energy, and how to build a solar-powered car using recycled materials. In addition, the students research on one of the environmental issues taught in class before presenting their findings to their classmates. In secondary two, they learn to build a smart prototype out of recycled materials. Students are allowed to decide on the projects they wish to work on. These could be environment-related (motion-activated lights to conserve electricity, for example) or they could benefits people (such as windows with moisture sensors that automatically close when it rains).

The JOULES 2.0 programme is focused on environmental advocacy, computational thinking and maker education, with the latter two being weaved into the school's sustainability studies, according to Ng Wuay Boon, HOD Science who heads the JOULES Committee. This development was influenced by what the STEM staff learnt from their 2017 trip to Melbourne, where Australian schools embedded technology and maker education in their STEM programmes. Wuay Boon explained: "Under the JOULES curriculum, secondary 1 students learn and apply computational thinking in the context of a solar-powered remote control car. They construct and program a microprocessor to remotely control the car and learn how to power it using solar energy." Secondary 2 students use the micro:bit

processor to design a smart device to create innovative solutions for smart homes and schools, he added. They apply computational thinking and learn to code. For maker education, students apply design thinking when designing the solar car chassis and use their hands to make the smart home prototype. They can choose to design digital artefacts that can be 3D-printed or laser-cut to embellish the prototype. Those who wish to delve deeper into computational thinking and maker education could grow their passion through BVSS' other co-curricular activities (CCAs), enrichment activities and competitions.

JOULES students making their solar-powered cars in 2020. (Photo: BVSS)

Students at BVSS also learn about ES through green competitions as part of their experiential learning. For example, a four-student team applied what it had learnt in STEM education when it participated in the Shell STEM Youth Innovation Challenge 2015 organised by the Singapore Science Centre. The students' self-heating lunch box powered by energy from cycling received the top prize in

the food category. In addition, students learn from green projects not meant for competitions. An example was a student-initiated website launched by the Environmental Club in 2015 to provide information on the plants and animals that were found on BVSS campus.

ES learning activities included BVSS' events and those organised by its partners, as well as local and overseas field trips. For example, the Environmental Club introduced its Green-A-Month (GAM) initiative for its members in 2021. They took turn in groups of up to five students to research and present on a chosen ES topic each month, first to teachers and club leaders for their feedback before sharing with the whole school. The club's 2020-21 president Jayden Ho revealed that a sustainable technological application Philips Hue Light, which he had learnt from his first field trip as a club member in 2019, was a topic presented. The group of students explained that the smart lightbulb used energy-efficient LED technology, which could be controlled using an app on mobile devices. The app enabled users to select the "Eco-Friendly" function that dimmed the light to reduce energy consumption, among other functions. Jayden's GAM sharing included what he had learnt about sustainable air travel based on his experience on Etihad Airways Sustainable Flight, which used 67% biofuel that cut down on carbon emissions. He noticed that no single-use cutlery and plastic trash bags were used on board. Hot beverages were served in cups made of recycled paper while souvenir bags given out were upcycled from old aircraft curtains. In addition, the meal-serving trays and food containers came in recycled plastic with the cutlery made of light metallic material. "Even though flying isn't the most environmentally friendly way to travel, it was a great pilot project for airlines to do their part for the environment," he commented.

Students also learn about ES from the Environmental Club's initiatives involving the whole school. The most impactful one in 2021, according to Jayden, was BVSS' 35th Anniversary Class Plastic Bottle Challenge. All classes from all levels

participated by collecting as many empty plastic bottles as possible. Although it was tiring for the club's leaders and members to bag and count the plastic bottles collected from each class, they were happy for the secondary 2 students who would be using them for their Smart City Project in school. They cut the bottles stored in the JOULES Smart Centre and the club's room for making the mock-up according to their ideation and design thinking in the prototyping process.

Jayden led the Environmental Club team to build a prototype with recycled materials that was judged the best Smart City project. This turned out to be his most satisfying achievement as its president. The prototype featured a platform extension to close the gap between train and platform in an MRT station that was made from leftover wood, cardboard and other recycled items from past competitions. Looking back, he recalled with pride how his team had to stay back in school many times as they struggled with the programming of the motor. They learnt first-hand from the project how recycled materials could be repurposed into useful products.

2020-21 Environmental Club President Jayden Ho (first from left) and his JOULES team with their Smart City project featuring modified platform for wheelchair users at MRT station in 2020. (Photo: BVSS)

For Yasmin Sim, serving as president of BVSS' Environmental Club in 2015-16 gave her the opportunity to constantly challenge herself to get out of her comfort zone to learn new things. The experience taught her useful life skills like interpersonal skills, event planning and teamwork. As the school's representative at environmental events, the exposure to people from all walks of life taught her how to engage with people from ministers to young children to the elderly. Organising events taught her how to collaborate with different stakeholders to plan, mobilise resources and coordinate various activities. She also learnt how to rally, encourage and motivate her peers for the green cause.

Yasmin Sim, 2015-16 president of BVSS Environmental Club, engaging former Minister for National Development S. Dhanabalan at the Festival of Biodiversity in 2015. (Photo: BVSS)

An annual overseas STEM trip to Melbourne was organised for students in 2017. BVSS' STEM staff led them on a visit to a wind turbine farm to learn how Australia was harnessing alternative energy sources, an option they noted might not be feasible in Singapore due to its small land area. The group also visited centres for innovation and sustainability as well as attended a STEM education conference. According to Ng Wuay Boon, some members shared what they had learnt during

a morning assembly. Another group went to Shanghai in 2019 and visited Cannature, one of the largest manufacturers of residential and commercial water treatment systems and components in China, to learn about clean water technology.

How and what BVSS students learn through ES advocacy on campus and in community

The Student Environmental Leadership Conference as an outreach programme for primary school pupils provides an opportunity for BVSS students to learn about environmental leadership while advocating ES to younger students.

BVSS student facilitators guiding primary school participants virtually during the Student Environmental Leadership Conference (SELC) in 2021. (Photo: BVSS)

The JOULES programme also develops students as environmental leaders who are trained to conduct tours of the JOULES Smart Centre and eco trail for primary school students, seniors and other visitors, while showcasing the school's energy efficiency through the use of rooftop solar panels and other alternative sources of energy.

How BVSS alumni continue to learn and champion ES

Between 2009 and 2019, more than 30 BVSS alumni had pursued environment-related courses at local polytechnics. One of them was 2009 alumnus Bryan Quek, who graduated from Ngee Ann Polytechnic (NP) with the Diploma in Environmental and Water Technology. He also received NP's course award for his innovation to remove arsenic from ground water during his third year. The 2013 HSBC NYAA Youth Environmental Award recipient was recognised for his achievements in nature conservation and represented Singapore at the Asia-Pacific Youth Water Forum. Another example was 2011 alumnus Adwin Ong, who was awarded the National Environment and Water Scholarship by the then Ministry of the Environment and Water Resources in 2019.

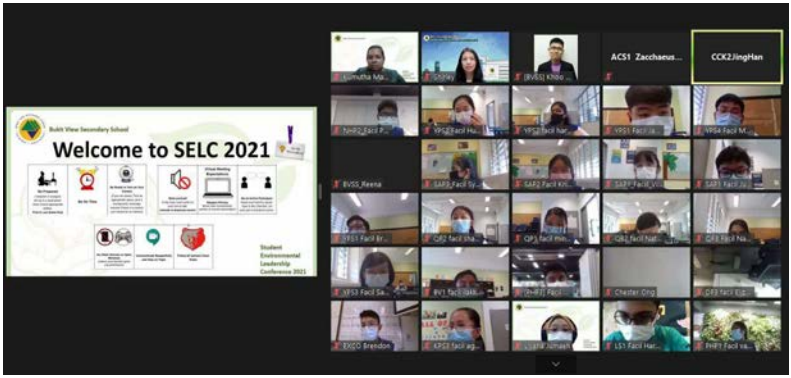
BVSS' 2016 alumnus Yasmin Sim continued to serve as a green student leader as president of the BA Green Club at NP from 2017 to 2019, after reviving the club during her first year there. She was recognised for her achievements by NEA with the EcoFriend Award in 2019. After graduating from NP with the Diploma in Business Studies in 2020, she enrolled for a business degree course with sustainability as a possible second major at Singapore Management University, where she is a member of its green club SMU Verts. She also volunteers as a publicity manager at Plastic-Lite Singapore, a volunteer group advocating an environmentally conscious and plastic-lite lifestyle.

In 2013, BVSS co-created the Project Fauna programme with an alumnus Mohammad Hannif for students to experience and learn about the environment and its relationship with animals. The avid bird watcher and photographer had conducted sharing sessions on bird watching for BVSS students.

A 2005 alumnus Darryl Yang even started a recycling business.

How school and stakeholders overcame Covid-19 disruption since 2020

Since the pandemic began in early 2020, some of the school's ALP learning journeys could not be held. These would include secondary 2 students' visits to BCA, NEWater plant, Singapore Sustainability Gallery, HDB Research Institute, Pacific Power and local polytechnics. Instead, their learning journey to BCA was organised virtually and livestreamed from the Singapore Sustainability Gallery. As tours of the eco trail for primary school pupils were cancelled, BVSS teachers came together to produce a video on the eco trail to share with them. The school's signature event Student Environmental Leadership Conference for primary schools has been held online as a webinar since 2021.



Learning screen-to-screen: Primary school students participating virtually in the Student Environmental Leadership Conference 2021. (Photo: BVSS)

In 2020, when many of the school's outreach programmes could not be conducted physically, it decided to engage the students while they were at home. Activities included students growing their own vegetables and making compost from food waste, and sharing photos taken with their classmates. BVSS even invited a volunteer from Singapore Young Farmers, the youth wing of the Kranji Countryside Association, to give a virtual talk on the career of a farmer to its Environmental Club members.

The Environmental Club was split into smaller groups in 2021 to carry out cleaning of some rooms, gardening and other repurposed activities, in place of the field trips and workshops that were cancelled. Its only field trip that year was to a local organic farm Insectta, where members learnt how dead soldier fly larvae could be mixed with soil for use as a sustainable alternative to organic fertiliser. The club's president Jayden Ho also shared that trials of online CCA sessions were conducted in person for some members who were facing technical challenges, so that their queries and problems could be addressed on the spot. Members turned to online platforms like Google Classroom, Padlet and Canva to complete tasks virtually. Tasks included production of posters, compilation of suggestions and completion of projects. "Going online had definitely increased our productivity and enabled the club to transit from physical to virtual activities quickly and easily," Jayden noted. He and his deputy encouraged members to sign up for workshops and other green activities in their neighbourhoods to compensate for events that were not held in school due to the pandemic.

How BVSS and stakeholders overcame other challenges along the way

When BVSS implemented its plastic-free policy to stop the use of plastic straws and disposable cutlery in its canteen, there was initial concern about how staff and students would respond to the change. To encourage their adoption of such green habits, the school's management shared information on the harmful effects of disposable plastic with them. In addition, staff were given reusable bamboo straws and food containers and cutlery on Teachers' Day. Today, the teachers are bringing their own reusable containers to take away food from the canteen and setting a good example for students to follow.

Making the ES curriculum, projects, competitions and activities relevant to students is always a challenge. They want to know the purpose of what they are learning. BVSS teachers thus need to explain the benefits of environmental

education and to design lessons that would excite and engage students for this non-examinable subject. They overcome this challenge by keeping the ES topics current and the contents relatable to the real world. They also teach at a level and pace that let students understand each topic clearly.

Based on his 20-year experience at BVSS, Heng Chong Yong shared that it was challenging to extend ES education into every aspect of a student's school life and to make it as pervasive as possible. He realised that leading by example was important to achieve this goal. "It helped that our programmes were audited by MOE and external agencies like NEA, SEC, NParks and South West Community Development Council (CDC)," he added. "Their evaluation and validation instilled confidence in us that the school's ES initiatives were sound and would educate students with the desired outcomes – confident persons, self-directed learners, active contributors and concerned citizens."

Values underpinning BVSS' commitment to green cause

BVSS' provision of secondary education is underpinned by zest, grit and gratitude. These values also underpin the school's environmental responsibility and drive its ES initiatives. The school aims to enthuse students to want to learn more about the environment and to seek sustainable solutions to environmental problems. Students are encouraged to display grit as they face challenges in trying to influence others to view environmental issues seriously and to take action. They are also expected to display gratitude and a sense of appreciation for our environment. BVSS believes that only then will they feel the need to protect and conserve the environment.

What contributed to BVSS' extraordinary ES journey and achievements

BVSS' sustained efforts and achievements in ES since 2000 may be attributed to the school's strong commitment to the green cause, its visionary and

supportive school leaders, inspiring teachers, motivated student leaders and generous industry partners. These factors have led to much effort being put in the design, implementation and facilitation of its many green initiatives.

Goh Pei Shuan, Manager, Biodiversity of NParks' National Biodiversity Centre, has collaborated with the school. She shared: "I think the school's success is due mainly to its staff and students' passion in environmental conservation and outreach. This has encouraged them to tap on customised resources from NParks and other government agencies based on their students' needs."

BVSS' ES leadership starts at the top

Kevin Tan joined the school as Principal in 2018. He and the vice-principals serve as advisors for environmental education, which is being overseen by the JOULES Committee, formerly known as the STEM Committee set up in 2017.

As Principal, Kevin ensures that the committee's plans are aligned with the school's vision, mission and values, and that there is coherence with the plans of other committees so that students are developed holistically. He shared that BVSS' culture in supporting the green cause as a whole-school endeavour could be articulated through the first part of its motto "Care and Share" and third part of its vision to develop students as ethical advocates. "Simply put, our green journey is part of our responsibility to care for the environment and adopt/share good practices that encourage others to do the same," he explained. As a result, "everyone in the school knows that this is something we value, work on and continue to develop."

Kevin sees students' green learning experience continually evolving with the times so that they are meaningfully engaged through the school's programmes and supporting facilities. "It is not about winning awards," he reiterated, although the school, staff and students have received many of them.

Achieving more through team leadership at school level

In his role heading the JOULES Committee, Ng Wuay Boon coordinates the school's JOULES activities across different disciplines and departments, including overseas cultural exchange trips. He also plans future programmes and oversees the committee's terms of reference and the development of a maker culture. The HOD Science is well-placed to tap on the manpower and relevant disciplines of his department to kickstart and implement the multidisciplinary JOULES programme. He shared: "The fact that staff members hailing from four to five disciplines are willing to work together for the greater good to produce an interdisciplinary experience in ES education for students is something I continue to be proud of." For him, the greatest satisfaction from the role is to know that they are preparing students to be future-ready global citizens who are empathetic towards the environment and thinking of ways of living sustainably. He considers the JOULES Smart Centre and iSpace, which he had helped to set up, as realised examples of how the school envisions future learning spaces for environmental education.

Reena Lloyd serves as deputy head of the JOULES Committee. After she took on the role of overseeing BVSS' environmental education in 2021, she continued with her predecessor Heng Chong Yong's work in liaising with external partners to organise ES-related activities. She noted that he had laid a strong foundation and left a legacy for the school to build on. As Level Head of Science and ALP, Reena has seen how the school's ALP evolved into the JOULES programme today. As a teacher, she serves as a role model in green habits for students to emulate and continues to encourage water and energy conservation in school.

Heng Chong Yong was leading BVSS' ES journey since he joined the school in 2000 until he left in 2020. When he was Level Head of Science, he started the

Environmental Club in 2006 as he realised the need to develop students' ownership and leadership of the increasing number of the school's green programmes. He had also thought that students would be more receptive to green messages from their peers. Chong Yong was appointed HOD Science in 2011 and HOD Partnership in 2014. As HOD Science, he initiated and laid the foundation for the ALP with focus on clean energy and environmental technology. As a member of the STEM Committee, he identified partners who were able and willing to offer students authentic learning opportunities such as workshops and learning journeys.

The school's sustained efforts and achievements in ES (as practitioner, educator and advocate) from 2000 to 2020 were due largely to Chong Yong's dedication and resourcefulness as BVSS' passionate and innovative driver. He shared: "My hope is to see our younger generation speak up and take action against any form of environmental destruction for the sake of their own future." For him, the implementation of the JOULES programme and the setting up of the JOULES Smart Centre signified that the environment education he passionately sought for the young had reached beyond the school level to impact the community at large. He was most gratified to see BVSS becoming a role model school in environmental education and visitors from Singapore and overseas learning from the school and its staff and students. The 2017 NEA EcoFriend Award recipient believes that "when we educate our students to care for the environment, we are helping them to build a sustainable future."

BVSS intends to empower more of its staff to "play leadership roles" on its green journey in future. According to Kevin Ang, its staff empowerment plan is aligned with MOE's new Eco Stewardship Programme that will be introduced to all schools.

Achieving more through teamwork at club level

The Environmental Club started in 2006 and was overseen by Heng Chong Yong as Teacher IC after the club idea he had proposed was accepted. Its initial objectives

included students' participation in environmental protection and community service through the Community Involvement Programme, now known as Values In Action (VIA) Programme. The club was nicknamed LIGERS (Learning Innovative Green Effort and Recreational Science) to reflect its roles as a catalyst for green efforts, advocate for the environmental cause and issues, and learner and leader in using science to protect and nurture the environment.

Being passionate about ES, Liang Kai Poh is happy to contribute as the present Teacher IC of BVSS' Environmental Club since 2007. Naturally, the club's activities aim to tackle environmental issues in Singapore. According to her, its success in teaching students about ES through green practices may be illustrated by their participation in South West CDC's Green Schools@South West programme since 2008. "The programme focuses on training and empowering students to take leadership and ownership in caring for the environment," she explained. Students attend five modules on waste minimisation, water conservation, dengue prevention, happy toilet and junior environment ambassador training. After completing the modules, they lead and organise environment-themed activities in schools and the community.

A former Teacher IC of the Environmental Club Johnny Tan Chong Han, who is a JOULES teacher, considers former club members' continuing involvement in environmental education in "one way or another" after leaving the school as his most satisfying achievement. He still remembers Singapore's largest hanging art installation, which was created by all the club's members for commemorating World Water Day in 2013, as its most significant achievement. The students collected and washed plastic bottles before drilling holes and stringing them together with yarn for the installation, which was displayed at the Jurong Lake Gardens. Reaching out to the community with its water message had made the project even more meaningful, Chong Han commented.

Achieving more through passionate and dedicated school teachers

The JOULES programme is being conducted by 15 full-time teachers who bring their own areas of expertise and subject knowledge of Science, Mathematics, Design and Technology, and Computing into the classroom. While the environmental education teachers did not attend formal training to prepare them for the role, they participated in overseas trips to learn about ES. For example, in 2013 they attended the Organisation for Tropical Studies' summer field course for teachers 'Inquiry in Rainforest' in San Pedro and San Jose, where they learnt about "infusion of biodiversity, energy conservation, concepts of physics and engineering into environment education". The course focused on using common objects to enthuse students in carrying out simple inquiry experiments/field studies. It also briefly explained the importance of preserving the rich biodiversity of rainforests. The S1 Inquiry project, for example, requires all secondary 1 students to choose a research question and to plan, investigate, collect and analyse the data to reach a conclusion. Questions that students had tackled included: "Does the thickness of paper affect the distance travelled by a paper plane?" and "Do ants prefer sweet or salty food?"

As a design and technology teacher, Liang Kai Poh is constantly encouraging students to design and make objects that have a practical purpose. With more attention being given to ES, she applies the design thinking process to involve students in solving environmental problems in a creative and innovative way like upcycling. Problems they tackled included plastic bags, food security and littering. Upcycling examples that students came up with were cultural costumes made from used plastic bags and Tetra Pak packets, and pouches and hair bows made from plastic bags and fabric. Others included plastic bags ironed to the required thickness for making plastic coin pouches with zippers, and old shirts cut and sewn into tote bags.

Johnny Tan Chong Han specialises in Chemistry but also teaches Science as a JOULES teacher since 2017/18. He keeps himself up-to-date with the latest news on STEM and sustainability developments, reading magazines and searching the Internet, digesting and filtering the information before sharing with his students. He led many of BVSS' green efforts, including eco trail, biodiversity in school, Green Wave programme, Community in Bloom competition, Bioblitz survey, Festival of Biodiversity, planting of native plants, keeping neighbourhood clean, and visits to St John's Island and Gardens by the Bay. He thought that the Bioblitz survey, which involved groups of 30 students who went around the campus to identify and record examples of biodiversity, had the most impact on students' learning. From walking the ground, they learnt to appreciate the biodiversity present in the school's urban setting and became more aware of nature around them.

Some of the JOULES teachers are involved in developing course contents. A module of the secondary 1 JOULES programme that was developed by Reena Lloyd requires students to know the environmental issues plaguing the world today, before selecting an issue to research on using the "4W1H" framework (what, where, when, why, how) and presenting their findings. As the programme covers alternative forms of energy with a focus on solar energy, students build their own solar-powered cars as part of their experiential learning.

Achieving more through passionate and dedicated student leaders and alumni

Most secondary 1 students who join BVSS' Environmental Club as members would have already shown their interest in advocating ES in primary school and in participating in green activities after enrolling at the secondary school. The club's student leaders are elected by the students. Since 2009, an environment ambassador nominated by the form teacher and classmates is appointed for each class to help coordinate activities organised by the Environmental Club.

When Jayden Ho became president of the Environmental Club in 2021, he was driven by his passion for ES and his purpose of sharing what he would be learning with club members. As someone who loves learning about solutions and understanding the complexity of achieving ES goals, he had thought the role would be more fulfilling as the school is committed to ES advocacy. "I wanted to include more opportunities for members to learn about sustainable technological applications that companies have adopted to support the green cause as well as environmental issues not taught in the classroom," he explained. Such issues included food wastage and expanding the 3Rs to 6Rs with the addition of "refuse, rethink and repair". During the year, Jayden worked with other CCA student leaders to plan the school's Student Environmental Leadership Conference and other annual ES events while developing his leadership and coordination skills. He shared: "It seemed daunting at first for me to organise an entire event for hundreds of primary school students, but with the support of other student leaders and effective communications among us, I gained first-hand experience of the efforts required to host a successful conference." He also realised the true power of teamwork and mutual support despite the ongoing pandemic. Jayden and his deputy also took the initiative to seek out competitions with the help of teachers for club members to take part in during the school holidays. Watch what he has to share about recycling at BVSS.

Yasmin Sim began her green journey as a student at BVSS when she joined its Environmental Club. Back then, as she recalled, caring for the environment was not popular among students as it was often associated with picking up litter. However, Yasmin felt the green club was one of the best school clubs to join. She saw the opportunity to do her part for the planet as well as to engage and educate the next generation. She was also attracted to the club's many fun activities like gardening and exciting learning journeys. What she did not realise then was that she was actually passionate about ES. "I just truly enjoyed what I was doing," she admitted. As a club member, Yasmin's passion for the environment grew day

by day. Till today, she has always considered BVSS as the starting point of her ES journey. “It’s where I fell in love with environmental advocacy,” she shared.

As she considered the Environmental Club an important CCA, Yasmin wanted to enhance its role and appeal to fellow students. She volunteered and was elected as its president in 2015-16. She guided members on their green learning journeys and conducted activities for them during CCA sessions. To raise the club’s profile, she represented the club in many external events, including NEA’s Clean and Green Schools Carnival and Ngee Ann Polytechnic’s National Youth Business Challenge. On her own initiative, she designed part of the school’s eco garden that included plants to attract butterflies. For Yasmin, it was very important to teach students from a young age to cultivate green habits in daily life so that they could influence their families. This was why she considered the club’s eco trail tour and Student Environmental Leadership Conference for primary school students as its most impactful initiatives under her leadership.

The 2016 recipient of the HSBC-NYAA Youth Environmental Award did not expect any public recognition but it motivated her to continue on her green advocacy journey after leaving school. She was also happy to be able to inspire others with her example. For Yasmin, it was rewarding enough to see how students’ perception of joining the club has changed for the better over the years after she left the school. “Whenever I visit BVSS each year, I could see more junior students truly enjoying what they are doing, having a purpose in joining the green club and feeling proud to be a member,” she added. In her view, it is never too early or too late to start caring for the environment.

Amplifying reach and impact with external partners

BVSS believes in partnering other schools, government agencies, industry, communities and individuals to achieve its vision of becoming a green school. Collaboration may involve a one-off project or an ongoing programme.

Besides supporting BCA's Greenovate Programme, the school hosted the BCA-CDL Green Sparks Competition 2017/2018 as a model school for participants to conceptualise a conducive school that will generate more clean energy. Its JOULES Smart Centre was the venue for BCA's BiG Green Club workshop for secondary school participants.

Since 2014, BVSS has been partnering NParks on the Greening Schools for Biodiversity and Green Wave programmes under the Community in Nature initiative. It also joined the Community in Bloom (CIB) programme that year. Under the Green Wave Programme, 10 trees from nine species important to National Education were planted in the school. NParks provided it with resources and advice on greening the campus, as well as connected it with community gardeners in greening the neighbourhood. Goh Pei Shuan of NParks explained: "Through active partnership with the school, we hope to raise awareness and appreciation of our local flora and fauna, and eventually cultivate the next generation of environmental stewards." She noted that BVSS was one of the schools that have joined the CIB programme to kickstart their edible gardens and was using gardening to enhance students' environmental education, as Singapore aspires to become a City in Nature. "We will continue to work closely with BVSS and other schools to encourage their students to become future stewards of greenery and biodiversity, through various programmes such as habitat enhancement, citizen science, community gardening and outreach projects," she added.

The school works closely with other government agencies such as NEA, PUB and Singapore Power, as well as with institutes of higher learning like Singapore Polytechnic and Ngee Ann Polytechnic on advanced elective modules (AEM) on Fundamental of Solar and Renewable Energy and Energy Explorer. These partnerships provide authentic learning experiences for its students and open their eyes to the current innovations and developments in the energy sector.

BVSS' industry partner Samwoh's staff presenting to students attending SELC in 2018. (Photo: BVSS)

BVSS' partnership with Singapore Green Building Council and its green consortium had enabled the school to build the JOULES Smart Centre, the first green and energy-efficient lab in a Singapore school that has become a learning destination for green technology. Its collaboration with Samwoh Corporation as sponsor of its annual JOULES scholarship has enabled more students to benefit from the JOULES programme. It is also working with Samwoh and other industry partners to share their green technologies and practices with primary school students and teachers attending its annual Student Environmental Leadership Conference.

As a provider of sustainable environmental solutions for civil engineering projects, Samwoh wants to nurture future leaders in the built environment. It thus decided to sponsor BVSS' JOULES Scholarship, which "encourages students to contribute to the JOULES programme and become ethical green advocates", from 2018 to 2020. According to Lim Wee Fong, Samwoh's Manager (Corporate Development and Communications), the company was won over by the programme's distinctive curriculum and the school's STEM applied learning that emphasised sustainable

energy and environmental leadership. Through its partnership with BVSS, Samwoh aims to inspire the young to pay more attention to environmental issues and to embrace sustainable living. Wee Fong still remembers vividly the secondary 1 students who applied for the JOULES Scholarship and with whom he had interacted. "They were either not confident in sharing their thoughts or lacked knowledge about environmental issues," he recalled. When he spoke with them again after they had completed the JOULES programme as secondary 4 students, he was amazed by their progress. He explained why: "They showed a lot more composure in articulating their ideas with firm conviction on specific environmental topics."

Where BVSS is going on its ES journey

Singapore embarked on its new Green Plan 2030 in 2021, the year MOE unveiled its Eco Stewardship Programme (ESP) for schools. BVSS' current mission in environmental education, as shared by its Principal Kevin Ang, is "to continue developing our students for a resource-constrained world through their learning in clean energy and environmental technology."

How and when BVSS is getting there

The school plans to further develop the 4Cs (curriculum, campus, culture and community) on its ES journey over the next three years, with guidance from MOE's ESP. It intends to realise this goal by:

- Infusing environmental education in the curriculum of English, Mathematics, Mother Tongue and other subjects, as well as enhancing its maker education and culture
- Making its campus greener by installing a food digester and cultivating an edible garden
- Further developing a culture of recycling and reducing food wastage
- Continuing to engage the community with ES initiatives.

Striving to become a green school for a sustainable future

Green classrooms with green features constructed with environmentally friendly building materials, like the JOULES Smart Centre, are part of BVSS' vision of a smart building. This aspiration is guided by the school's vision to become carbon-neutral, in line with Singapore's green plan for 20% of all schools to reach this goal by 2030. BVSS has made physical changes to its campus by adding solar panels, LED lighting, motion-sensitive lights and fans, and sustainably sourced furniture, among other improvements. In the process, BVSS teaches students about ES through its example, in the classroom and outdoor, and develops them as passionate ethical advocates beyond their secondary school years.

While building a green culture within, the school is expanding its vision of becoming a green school for sustainable living.

Commonwealth Secondary School

Commonwealth Secondary School (CWSS) has been blazing a trail as practitioner, educator and advocate in human-wildlife co-existence since it embarked on its environmental sustainability (ES) journey in 2008. The school wanted its ES education to differentiate it from other schools and was the first school to receive the President's Award for the Environment in 2009. Today, its seven diverse eco-habitats, which were enhanced in 2012, serve as outdoor classrooms for teaching and learning about the natural environment. They attract many wildlife species that make the campus their home and a safe haven for their young. CWSS sees itself as a microcosm of Singapore's "City in Nature" and is nurturing its students as custodians of wildlife on campus. Encounters with wildlife and plants are part of students' daily campus experience that enables them to cultivate an appreciation and love of nature. CWSS is enhancing its efforts in developing students as environmental stewards as a pilot school for the Ministry of Education's new Eco Stewardship Programme (ESP), which supports the Singapore Green Plan 2030. This development augments the school's current green plan that is aligned with ESP's 4C framework and underpinned by the school's 2020 vision of building a "School in Nature", where students become "confident learners, imaginative trailblazers and compassionate leaders".

Lush is the word: Bird's-eye view of Commonwealth Secondary School's campus and greenery, with its Rainforest seen in between two blocks on the right and solar panels on all its rooftops. (Photo: Commonwealth Secondary School)

Trail-blazing school in teaching human-wildlife co-existence charting new frontiers in environmental education

"We want our students to step up from advocating environmental sustainability to creating new knowledge and solutions through design and innovation for sustainable living."

– Ng Boon Kiat, Principal
Commonwealth Secondary School

Environmental education begins with respect and care for nature

It was a loud thud that shattered the quiet of the school in session and broke the hearts of more than a few students and teachers. "Not another," a student could be heard muttering to herself. It mattered much to the Commonwealth Secondary School's (CWSS) Green Club member what the sudden sound would mean. It had happened before – a bird crashing onto the reflective glass panel of a window or door of a school building. It was yet another wildlife casualty of a built environment that had mistaken the reflection on the glass for the real greenery! "But it need not be so," she thought to herself. Just the other day, a bird had flown into a classroom during a Biology lesson!

In 2020, the Eco Club's vice-president Marissa Nariesta suggested to the school that non-reflective strips be pasted onto glass panels to reduce reflection and prevent such bird collision. The 2019-20 club president Thahmina Begum was prompted to produce a video on human-wildlife co-existence to promote respect, protection and care for animals that chose to share the school compound with staff and students. Each time Teacher IC of the Eco Club Jacob Tan was informed

to attend to an unfortunate bird incident, he used it as a teachable moment for students to learn about the birds living in their midst. For the senior Biology teacher, students' encounters with wildlife in the school's eco-habitats present opportunities to teach and learn about them. In addition, CWSS would email all students to take them through the appropriate wildlife response process. Outdoor lessons learnt through real-life experiences have been a key feature of the 2009 President's Award for the Environment recipient's environmental education.

Starting with nature conservation, food security and clean energy

Since embarking on its environmental sustainability (ES) journey as an environmentally responsible educational institution in 2008, CWSS has been focusing on nature conservation, food security, clean energy and water resources for a sustainable lifestyle. Nature conservation includes the creation of a safe haven for wildlife that involves its protection and rescue, while urban farming and farm-to-table initiatives are part of its plan for food security.

The school started to restore nature in its urban landscape in 2013, when the then principal wanted to create eco-habitats on its campus to complement teaching and learning. He asked some Biology teachers to suggest suitable ideas for greening the campus. One of them, Jacob Tan, proposed the idea of a biophilic school where students and staff learn to live in harmony with nature and wildlife. After becoming Teacher IC of the Eco Club in 2015, Jacob has been leading students to strengthen and sustain the eco-habitats as a healthy natural eco-system.

Developing ES education for the long term

In the long run, CWSS plans to develop environmental education by creating new knowledge about environmental issues through scientific inquiry and research, organising education and outreach programmes, and developing student leadership in environmental and community issues. To achieve these goals, it is nurturing

students' appreciation of and connection with nature as environmentally conscious stewards. Its school leaders believe that once students have this connection, "advocacy and activism emerge as a natural outflow of this love for nature".

Teaching human-wildlife co-existence for impactful learning outcomes

Seven eco-habitats on CWSS campus were opened in 2014 to provide students with natural eco-systems to observe and study how animals and plants depend on each other for survival. The school believes the daily exposure to biodiversity and close encounters with wildlife in such outdoor learning spaces will enable students and staff to develop a greater appreciation of nature and respect for wildlife. There they could catch real-life creatures with phone cameras and not virtual Pokemon ones! Encounters with wildlife may involve rescuing animals in distress that require attention or relocation. The school has been documenting the increasing number of such encounters. One of them was with a praying mantis that a student found on a worksheet! Another was the sighting of a small reticulated python perched on the metal sunshade along a corridor. After the snake was carefully and safely removed into a trash bag, Jacob Tan transferred it into a transparent plastic container. He then brought it into his Biology class to show his students and use the opportunity to explain why they should learn to co-exist with wildlife in their midst. The young python was later released back into the wild. Yet another rescue involved a monitor lizard caught in a trap that was laid for pests!

After a spice garden was converted into the Plant Nursery in 2019, the eco-habitats continue to serve as green learning facilities for students as well as sources of food and safe havens for wildlife. Walking the trail in the Rainforest, students can look out for butterflies, moths, birds, insects, reptiles and mammals that have made it their home. At the Wetland, they witness up close the prey-predator relationship among the many birds, butterflies, dragonflies, damselflies, millipedes, monitor lizards, snails and plants living there. At the Stream, students search for bull frogs,

birds, butterflies, moths, dragonflies, fish, spiders and lizards among the plants. While passing by the Gardens by the Corridor outside the staff room, students could chance upon the birds, butterflies and moths flying among the plants there. Inside the Marine Aquarium, they observe and learn about fish, starfish, snails, shellfish, shrimps, crabs, anemone, coral, sea squirt, sea salad, seagrass, seaweed and algae.

Singapore's natural habitats for wildlife have been shrinking due to deforestation required for its urbanisation. Some of the displaced animals were attracted to the greenery in CWSS and made its campus their home. The school recognises the urgent need to educate people, especially the young, to live in harmony with wildlife that they come across. Students are given the responsibility to report any wildlife sightings in school, especially when the animals need protection or attention for injury. There have been many instances when they wandered into classrooms during lessons. For Marissa Nariesta, such encounters had taught her the importance of sharing our living space with wildlife. Sometimes, there's a need to adapt our environment to ensure their safety, she commented.

Inculcating eco-friendly mindset through progressive ES practices

CWSS has made responsible stewardship of the environment a priority. At the same time, it is developing an eco-friendly mindset and lifestyle amongst staff, students and parents. This is being achieved through progressive green practices in school, from no plastic straws to no mineral water bottles to no single-use disposable plastic food containers. Even metal frames of old tables and chairs were reused as flowerpot stands at the Gardens by the Corridor and refurbished metal containers repurposed as dustpans for cleaners to use! In 2020, the school started to provide students with reusable containers to pack food back to classrooms instead of using disposable packaging given by canteen stalls. It has been reducing the use of plastic and other disposable items as part of its plan to tackle other ES areas like waste management since 2018. Food digesters were introduced in

the canteen in 2021 for students to use and learn how to turn food waste into compost for feeding plants in the school. This practice supplements the centralised composting site for kitchen and garden waste.

2021 was the year when a spare classroom was repurposed and transformed into an indoor farming centre and an urban farm serving as an outdoor learning space was built at the Plant Nursery, to further support teaching and learning in sustainable living. Since 2020, urban farming initiatives have been part of CWSS' plan for food security. They are being scaled up and involve a group of students growing green leafy vegetables along corridor outside the staff room and Eco Club students tending to vegetables at the outdoor farm. Such sustained efforts demonstrate tenacity, one of the school's institutional values.

A typical classroom with 40 tables and chairs was transformed into the Indoor Farming Centre. (Photos: CWSS)

The school has adopted green practices for its buildings, infrastructure, facilities, teachers and students. Its innovative use of campus space, like the eco-habitats, has restored nature on its urban landscape. The layers of vegetation in the Rainforest, Wetland and other green areas had helped to soak up excess rain water during a heavy downpour and delayed flooding on its campus during a flash flood outside the school in 2020!

Commemoration of annual eco events like Earth Week, Climate Action Week, International Day for Biological Diversity and Youth for Environment Day has been providing opportunities for students to learn about environmental sustainability and responsibility from the school's examples, through their participation and hands-on experience.

When CWSS teachers bring their own reusable lunchbox and cutlery for take-away food from the canteen among other personal green habits, they serve as role models in green practices for students to follow. They use refillable whiteboard markers and some even ride bicycles to school on certain days of the week. Some of the green projects involve the school staff and students working together. An example is the Farm to Table initiative, in which Eco Club and STEM elective students and teachers grew and harvested vegetables from the urban farm in the Plant Nursery for canteen vendors to cook for staff and students. This practice has helped to reduce carbon footprint on campus. Another example was the tree planting during the annual International Day for Biological Diversity when school leaders and teachers joined members of the Eco Club to mark the occasion.

School leaders and teachers led by the principal Ng Boon Kiat (left) joining Eco Club students in tree planting during the annual International Day for Biological Diversity. (Photo: CWSS)

The school's ES practices have impacted energy and water consumption, and paper and plastic waste generation, among other things. The renewable energy generated by its full rooftop solar panels has been supplying about half of the electricity consumed on campus since 2020.

Achieving excellence in ES education

Environmental education was made CWSS' "signature programme" in 2017 to differentiate it from other secondary schools. It has infused environmental topics into the syllabuses of core subjects and the curriculum for Citizenship and Character Education (CCE). The school's authentic eco-habitats offer students opportunities to learn first-hand about wildlife and biodiversity as well as connect with and experience nature in school. They are being taught to respect wildlife by not disturbing nesting birds and releasing animals found in classrooms to the eco-habitats or outside school. Science and Geography teachers are infusing green topics in their lesson design, including exploration and experiments at the eco-habitats. CCE includes assembly programmes on Earth Day and during Climate Action Week, lesson packages and discussions, while secondary 3 Value-in-Action projects are aligned with UN Sustainable Development Goals.

The year CWSS officially embarked on its ES journey was also the year the school was named West Zone Centre of Excellence for Environmental Education for eight years. 2008 was the time when it also started to share its environmental education practices with teachers in other schools and provide them with professional development opportunities, including Biology teachers through its partnership with the Biology chapter of the Academy of Singapore Teachers. This was why its principal considered the achievement as most significant to date. The milestone was marked during CWSS' Earth Hour Day commemoration, when two Superhero characters came down to the school as actors Andrew Garfield (as Spiderman) and Jamie Foxx (as Electro), who planted trees and toured the eco-habitats.

What earthly hour! When Superhero characters came down to earth as actors Andrew Garfield (on left) and Jamie Foxx (centre) to plant trees at CWSS to celebrate Earth Hour, with student leaders assisting them and then principal Aaron Loh looking on. (Photo: CWSS)

In 2019, two of the school's Biology teachers who were passionate about science research developed a STEM elective for secondary 3 and 4 students. Jacob Tan and the Subject Head for Science and Research co-wrote the elective on sustainable living, based on their professional knowledge and contents sourced from their research after referring to the UN Sustainable Development Goals. The elective teaches sustainability issues holistically with real-world applications in collaboration with industry partners. Its multi-disciplinary core modules are on nature conservation, food security, water resources and clean energy. According to CWSS Principal Ng Boon Kiat, the elective teaches students research skills so that they can do self-directed research on their areas of interest, mentored by teachers or external experts, and design or innovate with sustainable living in mind, if applicable. "The teachers crafted minimal content, but sufficient to inspire students to do further open inquiry. The bulk of curriculum time is for students to research, consult, design solutions and make presentations," he explained. In 2020, Boon Kiat asked a Physics teacher to enhance the elective with the addition of more contemporary STEM topics to inspire students to think deeper and broader.

After joining the development team in 2021, HOD Innovation & Design (I & D)Ye Dan is looking into further enhancing the elective by exposing students to sustainable transportation, infrastructure, sanitation and carbon reduction. External experts mentoring students may hail from tertiary institutions and related industries.

Another in-house elective that the school offers is on design, with students free to explore various aspects of sustainability. Ye Dan shared that one project on how to reduce plastic packaging had led to the design of an unmanned no-package store shopping experience. Another on waste water treatment resulted in a nature-based solution using plants as natural filters.

Transforming shy learners into engaging green ambassadors through ES advocacy

According to CWSS, some of its students were transformed from shy and passive learners at the start of the year into outgoing and engaging green ambassadors as their passion for ES grew in the course of reaching out to others with their green messages. One such outreach activity is the school's Biodiversity Roving Museum, where Eco Club members introduce specimens of creatures collected on the campus to students during recess time in the canteen.

Since 2014, the school has been publishing its twice-yearly online biodiversity newsletter to raise awareness of Singapore's flora and fauna as well as the school's green initiatives among students and staff of CWSS and other schools. It has been hosting students, teachers and leaders from other schools as well as government officers since 2014 to share its ES journey and experiences. For example, the school shared how its eco-habitats were being used to bring learning about ES alive when it hosted the Academy of Singapore Teachers' Biology chapter's Lead Teachers Network Meeting in 2016.

The Eco Club's advocacy efforts in the community continued in 2020 during

the pandemic, when it promoted waste reduction, reduced use of disposable plastic and human-wildlife co-existence at the Clean Up South West carnival at the Choa Chu Kang Community Centre, among other initiatives.

How and what CWSS students learn from green practices on campus and in community

During their Geographical Fieldwork Investigation, secondary 3 Geography students explored the possibility of promoting the school's Rainforest as a 'wild paradise' and natural tourist attraction. They observed its key unique features as well as surveyed and recorded how areas in and around the rainforest were being used, before drawing their conclusion and presenting their findings.

Former Eco Club president Thahmina Begum remembered the 'Say No to Plastic' campaign implemented in CWSS' canteen and cafeteria as having a lasting impact on her lifestyle. "Now I have the habit of skipping the plastic straws and would also persuade my friends to do the same," she shared.

How and what CWSS students learn about ES in classroom and outdoor

During Biology lessons, students visit the eco-habitats when studying reproduction of plants to observe different types of flowers and when learning about ecosystems to appreciate how organisms depend on each other for survival. The "Fern-O-Rama" ecology activity teaches Biology students to catalogue fern species found in the Rainforest using a biodiversity sampling technique. Geography students attending class on sustainable management of water collect samples from the Marine Aquarium, Wetland and Stream for testing water quality, while those being taught spatial distribution of tropical rainforests and mangroves visit the school's Rainforest to observe its structure and how plants adapt. Mathematics lessons explore the Fibonacci sequence using growth patterns of tree branches,

while flowers gathered from the eco-habitats are mashed up to produce a mixture that demonstrates chromatography during Chemistry class. For Physics lesson on unit of measurement, students learn to use appropriate instruments to measure objects found in the eco-habitats, such as the thickness of a leaf, length of a petal and circumference of a tree trunk. Literature students inspired by the eco-habitats are encouraged to pen their poems to capture and share their thoughts. After reading essays for the units on Man and Environment – Food and Sustainability and Climate Change and Youths during English classes, students may respond orally or in writing to the teachers' questions. Chinese Language students practise their written skill by describing what they see in the eco-habitats.

Students learning about nature and wildlife in the school's Rainforest. (Photo: CWSS)

In early 2020, just before safe management measures were introduced due to Covid-19, students attended talks and workshops to learn about nature conservation as part of the STEM elective. These included Yellow Boots Thursday, when two teams of students prepared soil mix in bags and transferred saplings to the Plant Nursery. Talks on greening of Singapore, conservation of marine life, co-existence with wildlife and restoration of nature were given by NParks and Animal Concerns

Research and Education Society (ACRES). During a horticulture workshop, they learnt about plant nursery, misting irrigation, leaf litter compost, use and care of tools and equipment in a propagation nursery, with practical lessons on stem cutting, grafting, marcotting, different types of potting mix, seed collection and germination.

The STEM elective students also learnt about food security in person and virtually in 2020. In March, the Singapore Food Agency shared with them an overview of Singapore's food security strategy and "30 by 30" vision (30% of national nutritional needs by year 2030) while its Community Engagement and Partnership staff shared on the three food baskets – diversifying food imports, growing local and growing overseas. In April, students met with a local urban farmer of micro-greens via videoconferencing to learn about his mission to promote consumption of vegetables, the co-author of an article 'Hunger in a Food Lover's Paradise' from Lien Centre for Social Innovation to learn more, and an urban planner and the co-author of book 'Food and the City: Overcoming Challenges for Food Security' on her research findings on food systems and resilience.

In the second year of the STEM elective course in 2021, students learnt to research and create while their teachers continued to develop inquiry-based and project-based pedagogies. HOD (I & D) Ye Dan explained: "We encourage the students to explore current situations, do research to learn relevant knowledge and skills and existing solutions, and be brave to ideate and create improved solutions." Although it takes time to make solutions implementable, students are realising that they do not stop at learning existing knowledge and solutions, and that this learning is to enable them to generate new knowledge and better solutions for a sustainable future. Examples of the early prototypes developed being considered for refinement include a microbit for amplifying the signal light on air-conditioner to remind room users to switch it off, gadgets to measure water quality more efficiently, improved tray design to enable better water usage in hydroponic urban farming, and automated system to monitor nutrient concentration to reduce nutrient burn.

ES non-academic programmes attended by CWSS students included the HSBC Environment Discovery Programme, NParks' Greening Schools for Biodiversity Programme and Native Plant Conservation Programme, and World Wide Fund for Nature (WWF) Leadership Programme for Eco Club students. They also learnt from their participation in green competitions, projects and activities as part of their experiential learning. Teachers mentored them during CCA sessions when they were creating environment-related posters and videos, which included the video on human-wildlife existence and posters on window collision of birds in school. There were also other projects not meant for competitions, like the school habitat enhancement and macro-debris sampling. In 2018, Eco Club students learnt to make 'ecobricks' by converting plastic waste into reusable building blocks, for constructing a stool.

The urban farm at the Plant Nursery. (Photo: CWSS)

According to Vice-Principal for Administration (VP [Admin]) Lena Chua, green facilities like the indoor farming centre, urban farm and food digesters enable students to learn about modern farming practices, practise the farm-to-table concept and sustainable waste management, and apply what they have learnt from textbooks in real life. They learn about food security while growing vegetables for the canteen. "As we are already an eco-school, the transformation and enhancements were seamless," she commented.

Student learning activities included CWSS' events and local field trips. One event was Eco Club's habitat enhancement by members who trimmed and watered plants, pulled out weeds and harvested compost from the centralised composting site for mulching in 2020. Other activities were BioBlitz Week for documenting species of plants and animals in the school and workshop on dragonflies and damselflies conducted by NParks National Biodiversity Centre. In 2019, students visited Windsor Nature Park to learn about the role of nature parks adjacent to the nature reserve, with reference to the possible impact of the Cross Island MRT line running beneath the MacRitchie forest.

How and what CWSS students learn through ES advocacy on campus and in community

When students join as members of the Eco Club and lead tours of the eco-habitats and share CWSS' green movement at public exhibitions, they learn to become stewards of nature and to influence the community to embrace green habits.

Marissa Nariesta shared how members created posters to raise awareness of saving water, reducing single-use plastic items and other green habits in the school's population. Her "biggest takeaway" from her green leadership experience was that small changes in one's lifestyle would have a positive impact on the environment. "As a group, we can collectively help the planet," she explained. In her view, the Eco Club's most impactful initiative in 2020 was the eradication of single-use

plastic utensils and straws in the canteen and cafeteria. In the process, members and their peers learnt how plastic has caused much harm to marine animals and how they could play their part by bringing their own reusable water bottles. They concluded that if more schools and other organisations use less plastic, there would be less plastic pollution around the world.

How CWSS alumni continue to champion ES

The school's practice of using only reusable non-plastic utensils and straws has a lasting impact on Marissa Nariesta. She owns and uses metal and bamboo straws for drinking from cups or bottles. She also tries to influence her family and friends to use reusable straws whenever possible. In addition, she would buy bamboo instead of single-use utensils when celebrating birthdays or festive occasions. The 2020 NParks Community in Nature Schools Award recipient was encouraged by the recognition to pursue other projects in conserving and protecting the environment. She and her friends are volunteering at the Singapore Wildcat Action Group that is giving a 'voice' to "unheard animals" and helping to protect them. She hopes to contribute more to other aspects of ES in future.

Two CWSS alumni who continued to champion environmental sustainability at other institutes of higher learning or at work were Yong Ding Li, as Programme Manager at BirdLife International, and Koh Yung Kang, who handled community coordination for Pesta Ubin at Singapore Polytechnic.

How school and stakeholders overcame Covid-19 disruption since 2020

When learning journeys outside school were not allowed, the benefits of having the eco-habitats on campus became apparent. CWSS students were able to continue with their field studies in school instead. The pandemic also hastened the adoption of reusable containers for buying food from the canteen. The sustainability mindset developed over the years was also put to good use in the

school's design and fabrication of its own reusable safe dining table shields.

While students' farming activities stopped and the vegetables in the planter beds were choked by weeds during the circuit breaker in 2020, the pandemic allowed the Eco Club to slow down and review its plans. As Teacher IC Jacob Tan recalled: "It was a good period for nature to restore itself. In our school, the flora went wild and exhibited its beauty without being manicured." During the pause, seedlings (including those critically endangered or locally extinct) in the Plant Nursery were misted automatically twice daily.

How CWSS and stakeholders overcame other challenges along the way

It was not smooth sailing for CWSS at first on its ES journey. The principal revealed that some students, staff and parents needed more time to accept the school's green practices and the idea of living in harmony with wildlife on its campus. School leaders and Eco Club teachers and students had to persevere in reminding them of the importance of environmental sustainability and responding positively to their encounters with wildlife in school.

One major challenge for the Eco Club has been the coordination with the school's administration and operations in providing support for the various green learning opportunities. Jacob Tan works closely with them to address their infrastructural concerns in providing the facilities and other resources for wildlife encounters, dengue vector control, ecological balance and other needs.

Values underpinning CWSS' commitment to green cause

CWSS' provision of secondary education is underpinned by warmth, enterprise, adventurousness, loyalty, tenacity and honour (WEALTH). According to its principal Ng Boon Kiat, the values that underpin the school's responsibility

and drive its environmental sustainability initiatives are warmth, enterprise and tenacity. "Our students must demonstrate care and concern for the sustainable community and the world, have the initiative and resourcefulness to trail-blaze ideas for sustainable living, and have the grit and willingness to engage in productive failure in order to achieve long-term success," he shared.

What contributed to CWSS' extraordinary ES journey and achievements

Three success factors stand out from the many examples of ES practices, education and advocacy shared by the school – passion, pervasiveness and perseverance. These are being supported by team leadership at the top, school and club levels, committed teachers and student leaders as well as external partners.

Passionate and dedicated staff were empowered to initiate green practices on campus, develop ES education through the curriculum, reach out to the community (including potential partners) and nurture a sustainability culture with stakeholders.

There were pervasive efforts by the school in infusing environmental education in its curriculum, designing an eco-campus, encouraging eco-lifestyle among staff and students, and collaborating with external partners.

The school and student leaders in the Eco Club were perseverant in leading and advocating ES to their peers and the community at large.

Achieving more through CWSS Green Plan

When the Singapore Green Plan 2030 was released in 2021, the Eco Club's Teacher IC Jacob Tan mapped out all the school's major green initiatives under the 4Cs of the Ministry of Education's (MOE) Eco Stewardship Programme. The result is the new CWSS Green Plan, which was announced to the whole school during a virtual assembly.

CWSS' principal shows the way forward

Soon after Ng Boon Kiat joined CWSS as Principal in 2018, he empowered the Eco Club teachers to design the learning experiences for members as well as awareness activities for the whole school and the public. He also explored with the Academic Committee, HOD (I & D) and VP (Admin) new opportunities for expanding the school's initiatives in ES education and practices. These included a new upper secondary STEM elective that focuses on designing sustainable living and other solutions for the future, building an Environment Hub in 2021, replacing vending machines dispensing bottled mineral water with water coolers to reduce plastic waste, and forging new partnerships with external organisations.

While it is important for students to learn about and advocate ES, he recognises the need to inspire them to go beyond and create new knowledge and solutions for sustainable living. "This was why I wanted to add sustainable living to the school's design and innovation efforts," Boon Kiat explained. He asked the Science department to introduce an in-house STEM elective, for students to take in lieu of an examinable subject and to research and design solutions instead of studying for examinations. He hopes the school's blended learning, which involves both in-school face-to-face and online or off-line interactions, will encourage more of them to participate in maker-type student-initiated learning to create something useful in sustainable living for the community.

Achieving more through team leadership at school level

The Environmental Education Committee headed by HOD Humanities and HOD Science spearheaded ES education lessons and ES advocacy/outreach activities, which included the development of the eco-habitats, from 2008 to 2015. Since 2016, CWSS' green practices, education and advocacy are being overseen by its school estate management, Academic Committee and Eco Club, respectively. This followed the school's repositioning as a Centre of Excellence for Design and Innovation for teaching design thinking and maker education. The estate management

team headed by its VP (Admin) is responsible for creating a sustainable campus, while the Academic Committee chaired by a HOD on a rotational basis infuses environmental education into the curriculum. Both are being supported by HOD (I & D) since 2021.

VP (Admin) Lena Chua's estate management team works with teachers to align the school's infrastructure with its curriculum. In constructing or refurbishing any area, the team applies design thinking and consults teachers on teaching requirements. For classrooms, it also considers students' feedback. At the indoor farming centre, movable whiteboards and configurable furniture for group/individual brainstorming and presentation were added at the request of teachers and students.

The Indoor Farming Centre has a corner space with configurable furniture for audio-visual presentation. (Photo: CWSS)

HOD (I & D) Ye Dan oversees the school's Trailblazer Programme offering workshops for students to learn how to make useful things with their hands, based on their own designs and modifications where necessary. These are conducted through in-school attendance and home-based learning. Her team aims to "build creative confidence in our students and develop them to be adventurous and enterprising in trying new things and making purposeful creations, including new knowledge and solutions in environmental education". Interested students

can take up maker-based topics and work on self-initiated projects that may have direct or indirect links to sustainable living. Ye Dan herself has initiated her own project to create a sensor for monitoring the water level in the water tanks of the Indoor Farming Centre.

Pictorial cut-outs of some of the wildlife found in CWSS' eco-habitats. (Photos: CWSS)

Teaching, learning and achieving more as green club leader

Jacob Tan joined CWSS as a Science and Biology teacher in 2010 and became its Eco Club Teacher IC five years later. He liaises with external partners for the school's participation in public green events like the Clean and Green Singapore Carnival and Festival of Biodiversity. He became interested in ES while teaching in the National Cadet Corps from 2010 to 2014. "Initially, I knew I wasn't as interested in plants and ecology as in human physiology," the biomedical sciences graduate confessed. He decided to learn more about ES and joined the Green Club to attend NParks' talks on common wildlife in Singapore that were arranged for the school's students. After attending MOE's Overseas Teacher Attachment Programme in Costa Rica in 2015, he wanted to learn more about biodiversity.

Receiving the National Environment Agency's (NEA) EcoFriend Award in 2019 and NParks Community in Nature Schools Award for Teacher of the Year in 2020

only spurred Jacob to want to do more for ES education. The recognition has opened up opportunities for him to share his views on environmental issues that he feels strongly about with teachers from other schools. For the senior Biology teacher, "there is no greater joy than to see my students in awe and wonder of the intricacy of life and nature." In January 2021, he spoke for the 100th time at a NParks' webinar as part of his continuing efforts to share CWSS' ES journey and achievements. He has gained more insights into ES from networking with other educators and government officers involved in the green movement. In his view, shifting the mindset is always the most challenging. "How can different ministries and agencies work together to achieve a real sustainability impact in Singapore?" he posed. He further shared: "The urgency of saving the environment far outweighs any personal inconvenience arising from doing one's part. The younger generation must learn sustainable ways of stewarding this planet."

Passionate and dedicated school teachers make things happen at CWSS

Although CWSS' four environmental education teachers are teaching Geography, Biology, Science and Computing, they share a common interest in teaching Eco Club students about ES. They learnt to teach ES on the job, while sharing knowledge about the environment, supervising students who maintain the eco-habitats, guiding students to share/advocate environmental sustainability to the school and community, and sourcing for external partners to enrich Eco Club students' learning. In addition, they attended training sessions provided by NParks, NEA, WWF Singapore and Jane Goodall Roots and Shoots.

One of the teachers is Lye Zhen Xi, who teaches Geography and History. Her knowledge of physical geography enables her to explain various environmental phenomena to the students in classroom and during field trips. Since 2017, she has been teaching tropical rainforests, mangroves, water management and biodiversity. Although it is not easy to persuade students to pick up green habits

or to take action in protecting the environment, she has been reminding them constantly and posting on social media to encourage them. "It is heartening to receive students' emails informing me of what they have done for the planet and sharing photos of animals that they have encountered," Zhen Xi shared. She finds it most satisfying to see how her secondary 1 students have grown from not knowing much about the environment to confident secondary 4 students who guide their juniors and visitors around the school to introduce its flora, fauna and green practices, as proud CWSS representatives. It was a particularly proud moment to see her Eco Club students presenting the eco-habitats to then Education Minister Lawrence Wong, who visited the school in early 2021, responding to his questions and engaging him in conversation. In her view, having green features on campus to inspire students are especially important. Viewing videos does not provide students with the emotional connection, she explained. "At CWSS, they are constantly immersed in the eco-habitats that are easily accessible by them.".

Achieving more through passionate and dedicated student leaders and alumni

The Eco Club's executive committee includes a president and a vice-president who look after outreach, education and operations. The student leaders are appointed by the club's teacher IC.

For 2020-21 Eco Club president Alvis Cheong, it was an especially memorable February in 2021 when then Education Minister Lawrence Wong visited the school. He and two other student leaders took turn to show the minister the eco-habitats. During Minister Wong's tour of the Rainforest, Alvis explained the biodiversity that was present and how it was used as a natural outdoor classroom for teaching non-related subjects like Physics and Chinese Language. At one point, he paused to share with the minister: "Personally, I like the Rainforest as I find it calming to listen to the sound of the crickets and cooling to walk under the shade of the trees." Eco Club and environmental education teacher Lye Zhen Xi

described Alvis as a natural leader who had initiated various projects to give members opportunities to learn more about ES. "His passion for the green cause was demonstrated in the many environment-related activities and exhibitions he participated in, including the Clean Up South West 2020 carnival," Zhen Xi shared. Under Alvis' leadership, the Eco Club was recognised for its achievements with the Green Schools @ South West (Sustained Achievement) Gold Award in 2020.

Thahmina Begum considered it a "rare opportunity" to lead the Eco Club of CWSS as the school is a Centre of Excellence for Environmental Education in Singapore. Under her leadership as president in 2019-20, the club produced a video on human-wildlife co-existence to promote the idea of living in harmony with wildlife on campus to the school's population. The presentation also provided insights into CWSS' biodiversity. Thahmina shared: "It took us days of hard work and sleepless nights, but I was very happy with the finished product. My team and I put great effort into the video, which we are very proud of to this very day." She felt very grateful when she was recognised for her achievements in ES advocacy by the NParks' Community in Nature (CIN) Schools Award in 2020. For her, "my efforts will not stop at CWSS but will continue for the rest of my life." She added: "CWSS' environmental education has taught me the importance of conserving the environment and of students understanding their role. While most people assume that it takes much effort to contribute to ES, I have learnt from my experience at CWSS that all it takes are a few changes to our lifestyle to adopt green habits."

As a member of the Eco Club, Marissa Nariesta learnt the importance of ES and how small acts could benefit the environment. Serving as the club's vice-president was an opportunity for her to share the knowledge and passion that she had gained with her juniors. It also gave her the chance to "learn other ways of saving the environment from them". Her passion for ES comes from a personal sense of responsibility to protect the environment and save the earth. "It is everyone's responsibility to play a part," she added. She noted that the flora and fauna in the environment are being threatened constantly and damaged by human activities.

These have resulted in endangered animal and plant species and global warming, which causes climate change and further damage to the planet. "We definitely have to start making changes to preserve the environment for ourselves and future generations," she urged. Among the activities for fellow students that she had planned with other club leaders and teachers, she had found the planting sessions "extremely fulfilling" as she could see the results of their efforts. "The once bare grass patches in school are now covered with plants," she noted. Looking back, Marissa recalled with satisfaction when she saw how the junior members had grown in their passion for ES during her green journey with them.

Achieving more impact with external partners

CWSS' green efforts in nurturing a biophilic community are being supported by students' parents in areas like reducing use of disposable plastic, increasing natural ventilation wherever possible and teaching the students to respect, protect and co-exist with wildlife in school. It is collaborating with government agencies, companies and non-profit organisations to expand its ES initiatives, enhance its educational programmes and extend its outreach activities.

ACRES has trained a team of the school's teachers in wildlife rescue to handle the regular wildlife encounters on its campus. It also gave talks on co-existence with wildlife to students.

The school participated in NParks' Greening Schools for Biodiversity programme under its Community in Nature (CIN) initiative in 2015 to supplement its biodiversity conservation efforts. According to Goh Pei Shuan, NParks' Manager (Biodiversity), the programme enabled CWSS to enhance its eco-habitats with biodiversity-attracting native plants, implement regular citizen science surveys, and create and maintain a biodiversity trail on its campus. She shared: "Due to the school's passion and long-term commitment to promote the conservation of local biodiversity, it became one of the role

models for other schools that were new to the field." Since 2017, CWSS has been collaborating with NParks in offering workshops on nature conservation for other teachers to learn how to implement it in more than 40 schools.

Since 2015, the school has taken part in various other NParks' CIN programmes, including Biodiversity Week for Schools and CIN Biodiversity Watch. In 2016, CWSS joined NParks' gardening programme Community in Bloom. It has also supplemented STEM elective students' learning with NParks' learning journeys, talks and fireside chats. Eco Club's leaders learnt how to produce the video on human-wildlife co-existence at NParks' workshop on wildlife documentary production. As Singapore becomes a City in Nature under its new Singapore Green Plan 2030, NParks continues to encourage CWSS students to become future stewards of greenery and biodiversity through its programmes.

The school's partnership with the Housing and Development Board and SembCorp Industries had enabled the school to install full rooftop solar panels in 2019. The installation has been supplying renewable energy for about half of its electricity consumption since 2020.

Where CWSS is going on its ES journey

The CWSS Green Plan released in 2021 charts the way forward for the school's ES journey as practitioner, educator and advocate. Where it is going is guided and stated by the school's environmental education vision of "nurturing stewards of the environment who are empowered to make a positive difference in our school, homes and community for a sustainable Singapore".

How CWSS is getting there

On campus, more green features will be added to enhance its biodiversity and transform CWSS into a School in Nature that cares for wildlife, promotes local food production and becomes carbon-neutral by 2030. The school is nurturing

the next generation of urban farmers as more students learn about food security by growing and harvesting vegetables at the Outdoor Farm and Gardens by the Corridor for the canteen stalls. Its 'farm-to-fork' concept takes less than 100 metres to complete and results in fresher vegetables and smaller carbon footprint. The 1,744 solar panels on all the rooftops are reducing the campus' carbon footprint in a significant and sustainable way.

CWSS' Indoor Farming Centre started in 2021 enables students to learn about food security while growing vegetables for its canteen. (Photos: CWSS)

Curriculum-wise, CWSS intends to develop more education resources to enhance ES teaching and learning through both science and humanities subjects. It is keeping sustainability as a key theme in the STEM elective, while deepening and broadening students' understanding of ES through experiential learning and encouraging them to articulate what they have learnt through video production.

As part of the community, CWSS is strengthening its existing partnerships with government agencies and non-government organisations to expand its outreach efforts and advocacy activities. Its Plant Nursery is contributing to the One Million Trees movement by nurturing over 600 saplings of forest tree species with conservation status, including those that are common, vulnerable,

endangered, critically endangered, locally extinct and recently rediscovered. In addition, the nursery is germinating and propagating seeds collected by NParks. Eventually the grown trees will be planted around the school's campus and in Singapore's nature parks and the nature reserve, as part of NParks' Forest Restoration Action Plan.

Eco Club students tending to the many saplings in the Plant Nursery. (Photo: CWSS)

The school will build on its existing efforts to instil daily green habits and a culture of environmental consciousness among more students and staff that will have a ripple effect beyond its campus. These habits include turning food waste at the canteen into compost using the food digesters and not using disposable plastic items.

Piloting new Eco Stewardship Programme for schools

As a school piloting MOE's Eco Stewardship Programme (ESP) from 2021 to 2023, CWSS is helping to develop ESP for implementation in other schools. It is working with the ministry in trialling new ES lessons to integrate curriculum and sustainability infrastructure, upgrading of green infrastructure to support curriculum delivery, planting more trees and personal carbon profiling. The school is also sharing its ongoing eco stewardship efforts with MOE, including indoor urban farming, before scaling up some of them to other schools from 2024.

The green journey may appear endless, but CWSS is blazing a broader trail as the school advances farther on its mission of developing the young as future stewards of the environment for a sustainable future.

Compassvale Secondary School

Compassvale Secondary School (CVSS) treasures each student as a "North Star" and considers helping the young find their compass in life as its responsibility. The school's flagship Green Compass Programme enables students who have a passion for environmental sustainability (ES) to pursue their green aspirations. The programme started as the Green Moral Character Programme in partnership with North East Community Development Council in 2011 before CVSS redeveloped it as its own in 2014. The school's Project Work curriculum engages lower secondary students in understanding ES issues and exploring possible solutions to real-world problems. CVSS also believes in exposing students to urban farming by cultivating vegetables on its campus and harvesting them for sharing with school staff and teachers and students' families. The 2013 PUB Watermark Award recipient was recognised for its continued efforts in prioritising and promoting water conservation on campus and in the community under the Friends of Water Programme. It is using Singapore's largest man-made floating wetland in Sengkang as an outdoor classroom for teaching and advocating water conservation as part of sustainable living, through the Active, Beautiful and Clean (ABC) Waters Learning Trail.

A water ambassador and secondary 2 student, with water-testing kit in hand, leading a group of students from Hougang Primary School on the ABC Waters Learning Trail at Sengkang Floating Wetland. (Photo: Compassvale Secondary School)

Nurturing students as green guiding stars to others through water and energy sustainability education

"Our Green Compass Programme prepares every student to take responsibility and action to protect the environment for future generations."

– Chia Chor Yann, Principal
Compassvale Secondary School

Learning to be a guiding star in water sustainability education

Students from Compassvale Secondary School (CVSS) and other schools gathered at the entrance to the Sengkang Floating Wetland one breezy and sunny morning in Punggol Reservoir. They were waiting eagerly for their learning journey to start, with each holding a copy of the Active Beautiful Clean (ABC) Waters Learning Trail guidebook, which CVSS had co-produced with PUB. When it was time to begin, a student stepped forward in front of the group to greet them and to introduce herself. She was a CVSS Environment Club's water ambassador trained by PUB to lead them on the trail of discovery at the floating wetland. But first she had a question for everyone present. "Besides the Punggol Reservoir where we are now and the many other reservoirs in Singapore, do you know where else we are getting our water from?" she asked. Hands were raised. After complimenting a student for getting it right, she directed them to the answer on page 2 of the guidebook. "We will be referring to it as we walk along, stop to take photos or to note our observations and responses to questions on its pages," she pointed out. With that introduction, the tour began in earnest with the water ambassador showing the way.

How and when CVSS started on ES journey

Showing the way as an environmentally responsible school in green practices was how CVSS officially embarked on its environmental sustainability (ES) journey in 2006. That year, Teng Siew Lee joined the school and the Environment Club was set up as a co-curricular activity (CCA) with some student volunteers to lead the initiative and champion green practices on campus. Plastic bottles were the first to go, Siew Lee recalled. The canteen stopped selling bottled soft drinks and more water coolers were installed instead. Soon after, the club began to coordinate and implement commemorative activities for world environmental events like World Water Day and Earth Day in the school.

CVSS started to advocate ES to other schools and the community in 2011. As the school was moving towards Values in Action (VIA) activities, it wanted students to apply what they learnt about ES in the real world by advocating it to other schools. The school adopted the Punggol Reservoir in 2011 while its Environment Club adopted the Sengkang Floating Wetland under the Friends of Water Programme. In 2012, CVSS collaborated with PUB under the ABC Waters Programme to co-create the ABC Waters Learning Trail for the floating wetland. Its students were trained as water ambassadors by PUB to lead other students from CVSS and primary schools on the trail.

In 2012, the school began teaching students ES through its curriculum and beyond. Teams were formed to look into integrating water messages in the curriculum for the first time that year, when it started to develop environmental education (EE) as one of its niche areas. Teng Siew Lee conceptualised the school's EE framework that covered knowledge (awareness), action (involvement) and leadership (advocacy). Gradually, most of the school-wide initiatives, including the Applied Learning Programme and Service Learning Programme, adopted the ES theme to align with the school's EE. This morphed into a community leadership programme and eventually as the Learning for Life Programme after 2013. After four years,

students would have learnt to advocate sustainable living beyond adopting green practices, Siew Lee shared.

With global attention on climate change and sustainable living, CVSS adopted the latter as the theme to engage students in real-world issues outside the classroom. They learn about waste management in secondary 1 and energy sustainability in secondary 2.

What support CVSS' long-term ES development

"Through experiential learning, students will become youth leaders of the community, initiating projects to serve, having a positive impact on the community and inspiring others to act. By leading and serving in community projects, students get to live out the school's values." This over-arching philosophy underpins CVSS' commitment to ES as part of its holistic education. Its environmental education aims to raise awareness, care and concern among staff and students for the environment.

The school's institutional vision is to develop students to be world-ready youths who are innovative contributors and upright citizens with a global outlook. Since 2015, its EE vision has been enlarged beyond grooming students into "Advocates of Sustainable Living" through its comprehensive water programme to encompass ES as a whole today. CVSS aims to develop students into concerned citizens who understand the sustainability challenges and the impact of their actions on the planet. This is being realised through curricular and co-curricular programmes as well as school-wide initiatives.

It actively seeks and continuously strengthens strategic partnerships with stakeholders and partners who enrich the learning experience for students and enlarge the capacity of staff.

Focusing on key ES aspects for more impactful learning outcomes

CVSS is developing its environmental education for staff and students to learn to conserve water and energy resources. To enable students to delve deeper into environmental issues faced by Singapore, the school is focusing on energy sustainability and waste management for the Project Work (PW) curriculum.

What CVSS has achieved in ES practices

As an ES practitioner, CVSS has adopted green practices for its buildings, infrastructure, facilities, teachers and students. It has been conserving water by using water-saving devices, water efficiency management system, rainwater harvester and fault-reporting system for water leakage. It is also monitoring water usage at the canteen and other tenanted spaces and finding ways to reduce it.

Environment Club students weighing e-waste collected from recycling drive on campus in 2020. (Photo: CVSS)

Sensor-activated lighting systems and LED lights are used to cut down on energy consumption. In addition, it has reduced the use of Styrofoam containers by canteen stalls, placed paper-recycling bins in every classroom block and introduced an e-waste recycling bin.

The Environment Education Committee conducted an e-waste collection and recycling drive among all the school's staff and students in 2020. E-waste collection points were set up at various staff rooms in the school.

The school has separate plans for energy, water and waste conservation, as shown below:

ENERGY CONSERVATION PLAN

Current Energy utilisation (EUI) based on area: level 1 – 56.81

Target EUI: level 2 – <40.22

Current Energy Index based on occupant: level 3 – 601.31

Target Energy Index based on occupant: level 4 - < 577

We adopt the following strategies to achieve our goals:

No	Plan	Target	Action by	Review Date
1	Adopt a green procurement policy in engaging services and purchasing goods from suppliers	To ensure that all goods and services purchased have been considered for their environmentally friendly status	AM OM	Yearly
2	Monitor monthly energy usage in school	Maintain and/or reduce in energy usage	AM OM	Monthly
3	Conduct sharing of energy usage with staff and students	Once a semester	Teacher Environment Club	Termly
4	All to maintain aircon Temperature between 24 – 25 deg. Celsius	See targets above the table	All Staff	Termly
5	Ensure all electrical appliances are switched off when students leave the classroom	See targets above the table	Teachers and Students	Termly
6	Corridor lights to be switched off when not required	See targets above the table	OM OSOs	Termly

WATER CONSERVATION PLAN

Current Water efficient index (WEI): 40.9 litres/person/day

Target WEI: 11 litres/person/day

No	Plan	Target	Action by	Review Date
1.	Monitor monthly water usage in school	At least see a reduction in usage	AM OM	Monthly
2.	Conduct sharing of water usage with staff and students	Once a semester	Teacher Environment Club	Once a semester
3.	Remind all staff and students to turn off taps when not in use	See targets above table	Teachers	Termly
4.	To regularly check for leakages	See targets above table	OM	Termly

WASTE CONSERVATION PLAN

No	Plan	Target	Action by	Review Date
1.	Monitor recycling efforts of the school	To start a recycling programme beyond paper e.g. plastic bottles, Tetra Paks in the canteen in 2019	Environmental Education Committee	Every semester
2.	Manage and minimise print wastage by printing on both sides; and wherever possible, for submissions to be completed digitally.	To increase participation in the recycling programme for paper in 2019	AM OM	Every semester
3.	Provide recycling bins at refusal area	To start a recycling programme beyond paper e.g. plastic bottles, Tetra Paks in the canteen in 2019	OM	Oct/Nov 2021
4.	Set up a green corner for heighten students awareness	To increase student participation of the environmental issues using the green corners e.g. quizzes	Environmental Education Committee	Oct/Nov 2021

(Tables: CVSS)

From the weekly class audits conducted by Environment Club students, the cleanest classrooms of the different levels are being identified and their students recognised for keeping the classrooms and campus clean (through awards until 2020), as part of the Keep CVSS Clean movement. The same audit checklist is used by the environment champions of each class. The club's 2020 chairperson Zeus Ong singled out the morning class cleaning as having the most learning

impact on him, as it reinforced the importance of keeping the environment clean as a habit and instilled a sense of responsibility in school and at home.

CVSS' green features include energy-efficient lights and office equipment. It is using LED lights in classrooms, special-purpose rooms and toilets, some of them with motion sensors, to reduce electricity consumption. Staff and students are reminded to set the temperature of all air-conditioned rooms at 25°C. They are able to track the school's energy usage as the information is shared with them.

2013 was a particularly memorable year for the school when it was recognised for its continued efforts in promoting water conservation in school and the community by PUB with the Watermark Award. It was designated a "Bright Spot" by the Public Hygiene Council and MOE under the Keep Singapore Clean Movement from 2016.

What CVSS has achieved in ES education

CVSS has been teaching secondary 1 and 2 students PW involving various subjects like Science and Humanities with sustainable living as the theme since 2017. Before this, it was teaching the Learning for Life Programme from 2015 to 2017. A PW committee formed in 2016 comprised teachers who studied the design thinking framework and explored key environmental issues before developing the curriculum and planning the lessons. Teacher IC for environmental education and the Environment Club Tay Siew Woon guided them on using relevant resources for creating lessons to engage students in understanding environmental problems and discussing possible solutions. Subsequently, the curriculum was enhanced with assessment tasks and rubrics developed and refined. In 2021, the teachers developed a new STEM lesson package on energy sustainability for secondary 2 project work, under the inaugural Empowering STEM Education Professionals Programme of meriSTEM@NIE. Lessons cover the importance of energy as a precious resource through perspective-taking and creative problem-solving using design thinking.

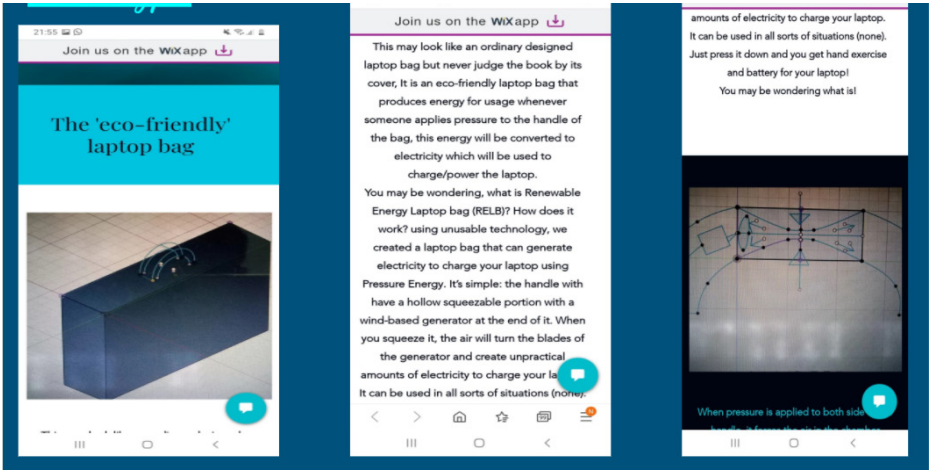
The school's consumption of water and electricity is being shared with students through the relevant subjects. For example, they learn about its water usage as part of their Geography lessons, and similarly for energy usage during secondary 2 students' PW lessons on energy sustainability. These reinforce and ingrain in students the importance of energy conservation in their daily life. In addition, form teachers share the information with their classes when the school commemorates environment-related events.

In 2020, CVSS realised its goal of focusing on science in its environmental education (EE) for inter-disciplinary project work for all lower secondary students taught by its full-time EE teachers. Despite the circuit breaker during the pandemic, students completed and presented their projects while observing safe management measures. This was followed by the school's twice-yearly Project Work Learning Festival, where students shared their project ideas with each other as well as learnt about waste management and energy sustainability issues. Secondary 2 students tackling energy sustainability made prototypes to reduce usage of non-renewable energy or explored various ways of harnessing renewable energy to power a household device.

Venue	Projects on Display		Classes	Teacher in Charge
Compass Room	Gr 1	Reducing dependence on air-conditioning through the use of translucent film on window panes	2E1	Mr Chong
	Gr 2	Vehicles that work like wind turbines	2N2	
	Gr 3	App to control lighting usage	2N3	
AVA	Gr 4	Solar powered watch	2E2	Ms Tay
	Gr 5	ECT Brandings - Energy Conserving Tiles to supply alternative source (kinetic energy) of energy for schools high electrical energy usage	2E4	
	Gr 6	A digital to-do list that lights up powered by solar energy.	2E5	
ALC	Gr 7	Ultra Light-weight Electricity Generator Shoes	2E3	Ms Jothi
	Gr 8	App that tracks electricity usage and incorporating the ability to adjust lighting	2N1	
	Gr 9	Solar powered umbrella fans	2N2	
Recorded	Gr 10	Using sound energy to create electricity	2E2	Mdm Preeti
	Gr 11	Attachable Mobile Hydro Electricity Conversion Box	2E3	
	Gr 12	The laptop bag charges the laptop via pressure energy (pumping a fluid to rotate a turbine for energy).	2E5	

Shortlisted projects on display at the 2020 Project Work Learning Festival.

One prototype showed how pressure could be applied to generate electricity to power a laptop computer, while another demonstrated how rainwater could be harnessed to generate electricity to power buildings. Both were outcomes of students' learning about alternative energy sources. From the projects, they also learnt about the advantages and disadvantages of different energy sources and their practical application in real life.



Renewable Energy Laptop Bag that used pressure to generate electricity, which was then used to charge the laptop (top) and harnessing hydroelectric power from rainwater to generate electricity to power HDB blocks. (Photos: CVSS)

Other ES learning opportunities available to students included CVSS' flagship EE programme Green Compass Programme (formerly known as Green Moral Character Programme), Friends of Water Programme and Greening Schools for Biodiversity Programme under the Community in Nature Initiative. There are also school activities and events like the Project Work Learning Festival, Green Ideas Festival and urban farming for vulnerable students. External events included the NEA G!nnovation Challenge, National Youth Upcycling Movement and NEA North-East Clean and Green Singapore Carnival.

At Project Work Learning Festival: Students sharing how their energy sustainability project on solar-powered watch worked (left) and students raising awareness of waste management issues through games. (Photos: CVSS)

The Green Compass Programme was developed by the Character and Citizenship Education and the VIA Committees over the years. It aims to nurture interest and commitment in students to lead an environmentally sustainable lifestyle.

The school's Environment Club has been initiating many activities to instil lifelong green habits among students. These included paper recycling, beach clean-up, recycled art and crafts, gardening, field trips and environment-related VIA activities. Instead of using waste materials such as paper for making recycled art and crafts, club members applied the design thinking process to upcycle fabric and plastic to make useful products. The club's 2020 chairperson Zeus Ong had found

recycling and upcycling activities to be effective in helping members understand their importance in conserving earth's limited resources.

CVSS' green learning facilities include the rainwater harvester, eco garden, urban farming plot and smart water meters that enable students to learn how to conduct water audits and monitor water usage better. It considers the urban farming plot to have the most impact on students' learning, as it engages them in preparing the plot and caring for the plants regularly. In the process, they learn how to cultivate vegetables as well as responsibility and resilience. They also get to harvest the fruits of their labour and sharing them with CVSS staff and their teachers and families.

It's harvesting time for these student farmers at the school's urban farming plot. (Photo: CVSS)

An Environment Club secondary 2 student's transformation from a "quiet and timid" primary 6 boy at Compassvale Primary School into a confident presenter of CVSS at a Singapore Environment Council's (SEC) School Green Awards ceremony was one of the remarkable outcomes of students' environmental education at CVSS, thanks to teachers and mentors like its former Teacher IC Teng Siew Lee. A 2016 alumnus Soh Jin Wen credited the school for "kickstarting" his environmental journey. "The experience gained from leading the Environment Club had definitely made me a more confident person," he shared. He was shy and had difficulty speaking up or taking the initiative before taking up the leadership role, which gave him many opportunities to step out of his comfort zone.

What CVSS has achieved in ES advocacy

The school's Green Compass Programme enables its lower secondary students to care for the Sengkang community and its environment. It has been getting more involved in green community events such as the North East Clean and Green Singapore Carnival through its Environment Club since 2013. Its water ambassadors have been engaging the public on the importance of water conservation during World Water Day at booths set up in the community. CVSS' other events included exhibitions and workshops at the G!nnovation Carnival in 2017 and 2018 for the public, as well as the Just One Earth Day 2017 for PCF Kindergarten pupils and their parents.

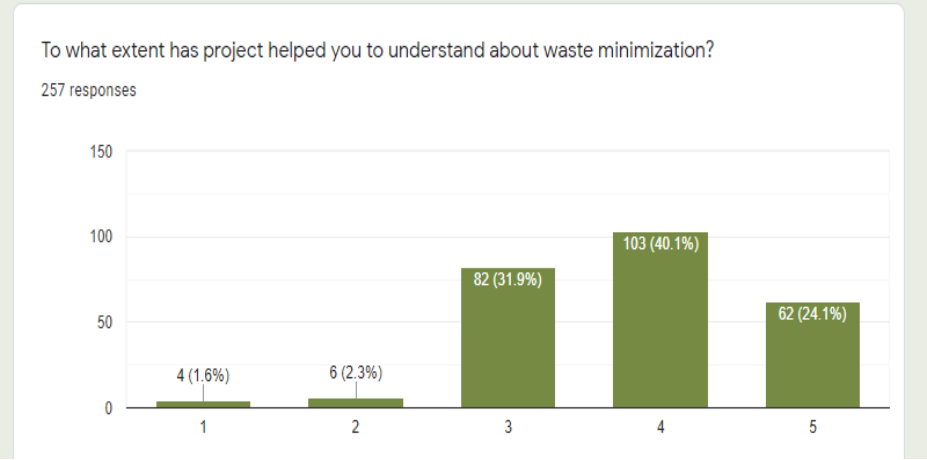
CVSS was organising the International Coastal Clean-up to encourage the community to do its part in keeping the shoreline clean by removing debris but had to discontinue it in 2019 due to the haze and from 2020 due to the pandemic.

Within the school, posters in the canteen and toilets encourage students to use water wisely. The video 'Saving Water in CVSS' produced by the Environment Club in 2021 to advocate water conservation and commemorate World Water Day was viewed by all classes. The club is also encouraging a sustainable lifestyle on campus through another video 'Green Habits in CVSS' that it curated to mark Earth Day that year.

Notice board with green messages on water, energy and waste management from Environment Club in canteen during school's commemoration of Earth Day. The messages are updated by the Environment Education Committee. (Photo: CVSS)

Other ES advocacy/outreach activities for its students and teachers included Green Ideas Carnival, where secondary 2 students from Green Compass Programme shared their upcycling ideas and showed their upcycled artefacts, Project Work Learning Festival and commemoration of world environmental events. Their impact on students' understanding of waste minimisation, for example, was apparent in former Environment Club's president Gerald Ong Kheng Wen, who learnt about upcycling and reusing old materials to reduce wastage. He believes that "we should buy only what we can eat to avoid wasting food."

It was also evident in the results of a 2021 perception survey on how CVSS students felt about environmental issues after completing a green project, as shown in the bar chart below.



Respondents indicated the actions they took to minimise wastage, such as using reusable bags and bottles, finishing food on the plate, not buying biodegradable products and recycling plastic bags. They also shared what they learnt about waste management in Singapore, including the amount of waste, how everyone can reduce and recycle waste, and which used products could be upcycled into useful items.

Outside the school, CVSS organised ES advocacy/outreach activities for primary schools. Secondary 2 students shared what they had learnt from the Green Compass Programme with primary pupils in 2018 and 2019. Environment Club's members facilitated the ABC Waters Learning Trail (with guidebook for primary students) in 2016. Secondary 3 students conducted water workshops for them in 2013. How water quality was tested was also shared at the Primary School Water Festival 2012.

How and what students learn from green practices on campus

Secondary 1 students attending the Green Compass Programme learn to take action in repurposing waste by collecting and sorting reusable and recyclable items, while those in secondary 2 create upcycled artifacts from the waste collected from their homes.

In following the school's example of setting up paper-recycling corners at classroom blocks with their own recycling corners in classrooms, students became more conscious of paper usage and waste whenever they empty the bins and the need to do their part to reduce wastage. The recycling efforts had the most learning impact on Soh Jin Wen, who was chairing CVSS' Environment Club.

How and what students learn about ES in classroom and outdoor

Under the Green Compass Programme, secondary 1 students attended a talk on waste minimisation organised by the National Environment Agency (NEA) in January 2020, just before the Covid-19 pandemic. They also learnt about good recycling practices from secondary 1 VIA champions who led them on a campus-wide Recycle and Reusable collection drive. They sorted collected items and separated paper and plastic waste from useful items like clothes, stationery and textbooks. Secondary 2 students went on a virtual tour of the Sustainable Singapore Gallery and attended live workshops facilitated by Terra Singapore,

before they created upcycled items such as mask holders, pencil cases and card holders from milk cartons and plastic banners. Classes applied design thinking to make artefacts for use in the canteen, toilets, art studio and area outside the general office.

CVSS students attending the Active, Beautiful and Clean (ABC) Waters Learning Trail at the Sengkang Floating Wetland learn about the Friends of Water Programme, water sustainability and the four national taps, water quality and biodiversity, and the Punggol Reservoir itself. They are given a guidebook to read and record what they have observed during the trail as well as respond to some reflection questions and offer their suggestions.

Students also learn about ES from projects submitted for competitions. They are guided by teachers in conceptualising projects and learn how to program apps for prototyping at training sessions arranged by the school. An app to help reduce plastic waste in the community was conceived and developed by a team of secondary 1 students for the 2020 NEA G!nnovation Challenge and was recognised with the top prize. A secondary 1 student was a prize recipient for his video 'Water: Our Precious Resource' submitted for the Crea8 Sustainability Youth Eco-Reporter Competition in 2020.

For the National Youth Upcycling Movement organised by Crescent Girls School, the Environment Club teams upcycled old clothes to make pencil cases, pouches and coasters in 2018, and made mobile phone holders from plastic bottles and pillow cases and aprons from old clothes in 2019. Student teams created a solar-powered self-regulating watering system and a method for harvesting rainwater to generate electricity for the Sustainable Lifestyle Challenge in 2018, and came up with a newspaper plant-growing kit in 2017. The Environment Club's 2020 chairperson Zeus Ong felt that participation in green competitions during the circuit breaker was helpful in keeping students staying at home active in exercising their creativity to come up with ideas for solving environmental problems.

During project work lessons on energy sustainability, students received constructive comments from teachers on the innovativeness and practicality of their prototypes, as well as rubrics on how prototypes would be assessed. They were then guided on how they could improve their prototype designs or were directed to resources for ideas and suggestions. Students were encouraged to showcase their prototypes on digital platforms and teachers would step in if they needed help with using digital tools.

Students learning the design thinking process during PW lessons are "guided to empathise with the user, define a problem, ideate for solutions, create a prototype as well as test and refine the prototype", according to Chemistry teacher Tay Siew Woon, who co-developed the course contents with teachers from other subject disciplines.

Under the GEAR-UP Programme to promote learning motivation and school connectedness, and cultivate resilience among vulnerable students, a plot of land was set aside for them to experience mindfulness through urban farming. Students attended workshops conducted by external vendors to learn how to make compost, grow and harvest organic vegetables. They also learnt the importance of commitment, teamwork and resilience in watering and caring for the plants regularly.

Students also learn about ES through field trips or learning journeys in Singapore. An impactful and memorable one was the intertidal walk at Pulau Hantu conducted by guides from the Lee Kong Chian Natural History Museum. During the walk, they had the chance to get close to nature when they touched corals and other marine creatures to learn their characteristics and about marine life. Visiting the Semakau Landfill in 2016 was an eye-opener for former Environment Club chairperson Soh Jin Wen, as he could see for himself how Singapore was running out of space for disposing trash from the main island.

Guide from the Lee Kong Chian Natural History Museum explaining marine life to students during their intertidal walk on beach at Pulau Hantu. (Photo: CVSS)

CVSS staff's green habits serve as examples for students to follow, such as using Tupperware and non-disposable containers for take-away food. Other examples include maintaining air-conditioning in staff rooms at 25°C, setting electronic devices in power-saving mode and printers with double-sided printing as the default, reusing paper printed on one side for other purposes and recycling used envelopes.

In Teng Siew Lee's view, students learnt to see the connection between what was taught about ES through the various subjects and the ES activities, and to understand better how they could contribute to make a difference. For her, helping students make such a connection and deepen their thinking was about seizing teachable moments. She shared an example of the moment when students saw how much paper was being used and the amount of waste generated after they set up a recycling corner in the classroom. Another teachable moment she shared was when students exclaimed in disbelief at the amount of trash they saw on the beach during the school's International Coastal Clean-up. That was an opportunity to mention the impact of discarded non-recyclable rubbish on the environment, she added. She also cited an "unforgettable incident" during the clean-up to underscore the value of experiential learning. The students

discovered a dead fish that was half-stuck in a bottle on the beach. They were curious to know why the fish was in that position. "I seized the moment and asked them to think about how the fish got trapped, and that triggered a discussion on the consequences of irresponsible disposal of litter," Siew Lee shared. It became a "very reassuring moment" for her as a teacher as she listened to the students' discussion and the conclusion they drew from the experience. They had learnt about being responsible in their actions and helping others to understand the consequences of careless disposal of litter and the need to put trash into waste bins. This learning point struck a chord for students who had attended the Waterways Watch Society's workshop on how litter could accumulate downstream in Singapore waterways and harm marine life there.

From watching documentaries in school, former Environment Club chairperson Zeus Ong shared that he learnt about the impact of industrialisation on the environment and Singapore's ecosystems. From his participation in green competitions like the 2019 NEA G!nnovation Challenge, he learnt to look at issues from different perspectives. For example, in tackling an ES problem, he would need to consider what were causing it and not merely its consequences. A tangible outcome of Zeus' environmental education at CVSS was his team's essay 'Preserving Ecosystems in Singapore', which was submitted for the 2020 Crea8 Sustainability Youth Eco-Reporter Competition.

How and what students learn through ES advocacy on campus and in community

The Green Compass Programme guides secondary 1 pupils in activities like collecting recyclables from door-to-door visits and reaching out to residents with green messages through leaflets and conversations with them. Secondary 2 students attend talks and workshops on upcycling as well as design thinking workshops. They also participate in the school's Green Ideas Carnival and community outreach initiatives in upcycling. For example, they shared what they had learnt about upcycling with primary pupils at Compassvale Primary School

in 2019 and Joy Connection Student Care Centre in 2018. In the process, they relearnt about upcycling to protect the environment. When he was a secondary 1 participant, former Environment Club's president Gerald Ong realised from his observation that public sentiment for ES was actually stronger than what was generally portrayed.

Students going from door to door to collect recyclable items. (Photo: CVSS)

While sharing their learning experiences in protecting and raising awareness of Singapore's precious water resources with the community as water ambassadors, CVSS students learnt more about Singapore's water story and the increasing importance of water conservation.

When Environment Club students set up displays in the canteen and created the videos '[Saving Water in CVSS]' and '[Green Habits in CVSS]' to promote water conservation and green habits among their peers, they reinforced what they had learnt. Students participating in the International Coastal Clean-up learnt the importance of waste minimisation to reduce shoreline debris while keeping the beaches clean.

How CVSS alumni continue to learn and champion ES

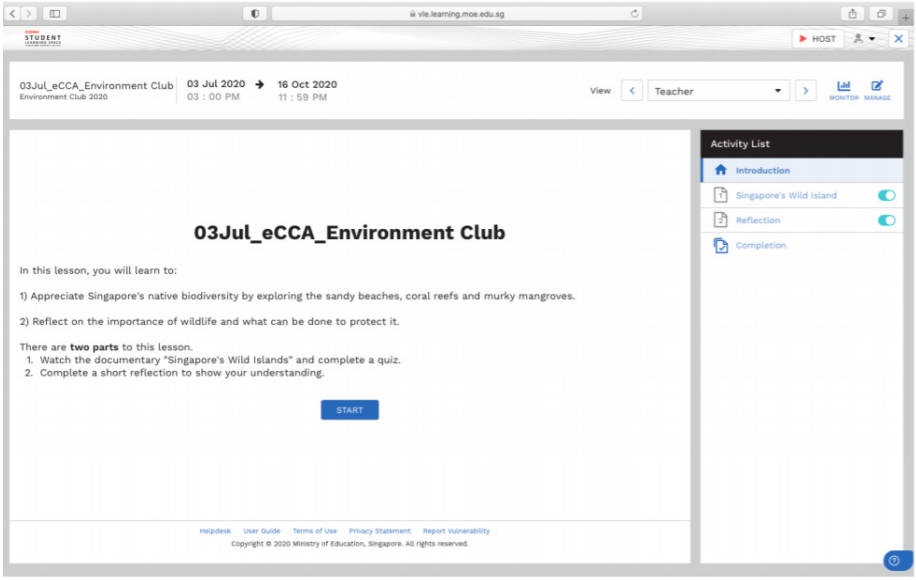
Some alumni pursued environment-related courses after graduating from CVSS. One of them was Soh Jin Wen, who was admitted into Ngee Ann Polytechnic (NP) through its Early Admission Exercise based on his green achievements at CVSS. The Environment Club's 2016 chairperson chose to study clean energy management there as he was interested in learning about solar energy and wind turbine. After enrolling, he joined NP's Environmental Rangers Club before becoming a committee member. He planned to practise what he has learnt at NP in the green industry, possibly as energy auditor or solar technologist, after obtaining his Diploma in Clean Energy Management.

Another CVSS alumnus Draman Chew Sheng Lang was studying at a local polytechnic but found time to conduct upcycling workshops in his personal capacity for Environment Club members in 2018 and 2019. He showed examples of how plastic bottles and fabric could be upcycled to make pouches and upcycling of milk cartons into coin pouches.

CVSS alumnus Draman Chew Sheng Lang demonstrating how to upcycle plastic bottles into pouches to Environment Club members in 2018. (Photo: CVSS)

Overcoming Covid-19 disruption since 2020

Although it has been challenging for CVSS to advocate ES to the community since the pandemic started in 2020, the school tried to continue its EE activities wherever and whenever possible. For example, teachers arranged for students to collaborate online for project work on sustainability issues. Such an initiative promoted teamwork, one of CVSS' values. Students showed resilience (another CVSS value) in learning how to use online platforms like Jamboard, Google Suite and wix.com to create their presentations and websites. During the pandemic, it was difficult for student groups to work virtually on projects for competitions with the timeline given for their completion. As school hours were limited, the teachers would encourage them to be more self-directed and motivated in collaborating on their own and giving them more time and support as and when required.



School Learning System screenshot taken from e-learning package created by Environment Club teachers.

To commemorate the 2020 International Day of Biological Diversity, teachers designed an e-learning package to enable Environment Club students to understand and appreciate Singapore's biodiversity by exploring sandy beaches, coral reefs and murky mangroves. The package required students to watch a documentary "Singapore's Wild Islands" and complete a quiz as well as write a short reflection essay. They also created other packages for students to continue learning about environmental protection.

To commemorate Earth Day in 2020, Environment Club student leaders created a video on how the 5-Step Mozzie Wipeout could be practised at home, as dengue was a major concern during the circuit breaker. The club leaders guided by teachers filmed and produced the video on their own. This was shared with all students as part of a CCE lesson package on climate change that day through the Student Learning Space (SLS). The club's former chairperson Zeus Ong found the SLS to be impactful in delivering lessons for members to attend in their own time when they also cultivated eco-friendly habits at home. In place of the usual learning journey to a berthed yacht as a floating classroom at Keppel Marina, the club designed a SLS lesson package in collaboration with the International Seakeepers Society Asia for students to learn about Singapore's biodiversity.

When the school re-opened after the circuit breaker in 2020, buying take-away food became the default option for both students and staff. Few of them brought their own reusable containers due to hygiene concern. Students were given disposable containers to take away food from the canteen stalls to the school hall or classrooms, instead of reusable utensils as returning these to the canteen while observing the safe management measures would pose a logistical problem. Understandably, the temporary measure had disrupted the plan to reduce the use of disposable items. However, some of them brought their own containers to pack the food. This practice has continued till today as a way of reducing packaging waste.

Although the Environment Club was unable to carry out many activities planned for 2021, its president Gerald Ong singled out the Horticultural and Propagation Workshop conducted by NParks as particularly impactful. He shared: "We learnt more about the flora and fauna on our campus as well as how to upcycle plastic bottles to make flower pots to propagate plants from our school garden." As the club could not reach out to the community at large, Gerald and his team decided to focus on the school community instead. It produced the video advocating water conservation to commemorate World Water Day and the video promoting green habits to mark Earth Day.

The higher frequency of cleaning and washing during the pandemic requires more water to be used. However, the school has been tracking consumption and taking necessary steps to minimise water usage on campus.

Overcoming other challenges along the way

Implementing green practices without causing inconvenience to staff and students was a challenge. For staff, this was overcome by placing recycling bins in the staff room and making reusable envelopes available in the office. It was also a challenge to ensure recycling bins in the canteen were being used correctly. To reduce the number of contaminated items put into such bins, they are placed away from rubbish bins. Environment Club members and class environment champions are being briefed to tell their friends and peers when they see any inappropriate use of the recycling bins.

Teaching ES as part of the curriculum had its fair share of challenges for CVSS teachers. To help students see its interdisciplinary nature and appreciate it as a bridge between various subjects, PW lessons involving them are being taught. Getting students to take action and advocate to others was one of the objectives of the Green Compass Programme. ES messages were emailed to teachers on days when the school commemorated environmental events to get their buy-in in practising green habits for students to observe and follow.

Providing more opportunities for students to pursue areas of personal interest was constrained by the limited resources available. To overcome this, CVSS has been collaborating with more partners to provide them with external ES learning experiences.

As the scope of PW is diverse, teachers may not have the necessary knowledge to moderate or resolve issues faced by students. When the need arises, they would consult other teachers in the Project Work committee.

Values underpinning CVSS' commitment to green cause

CVSS' provision of secondary education is underpinned by graciousness, gratitude, respect, responsibility, resilience, integrity and teamwork (G^2R^3IT). The same values underpin its environmental responsibility as practitioner, educator and advocate, especially during the Covid-19 pandemic.

Support from school leaders, teachers and staff for ES programmes has contributed to CVSS' extraordinary green journey and achievements. They view environmental education as important and are consciously inculcating environmental literacy and sensitivity in students.

School's ES leadership starts at the top

After Chia Chor Yann joined the school as Principal in 2016, he proposed interdisciplinary project work with environmental education as the theme when PW was re-introduced for all lower secondary students that year. In 2019, he appointed the Subject Head for PW to spearhead CVSS' EE and chair the Environment Education Committee, and the HOD Science as Teacher IC of the Environment Club. As he wanted the VIA Programme on the environment for secondary 1 and 2 students to reflect the school's name and inspire them to protect the environment, Chor Yann decided to change its name to Green

Compass Programme. The name reflects his belief in "helping every student find the green compass in life."

Achieving more through leadership at school level

CVSS' Environment Education Committee is chaired by Preeti Vikas Palkar, who is Subject Head for PW as well as EE teacher and course developer. Its members and EE teachers regularly attend talks, workshops, conferences, competitions and learning journeys to update themselves on environmental issues. Such learning opportunities are provided mainly by CVSS' external partners. Before the pandemic, they visited the Singapore Zoo to advocate ES and Bollywood Veggies to learn about sustainable farming.

The Teacher IC for environment education and Environment Club, Tay Siew Woon also advises the Environment Education Committee on its programmes and provides the necessary information, materials and expertise. In addition, she identifies environment-related opportunities for the school, club and students.

Achieving more through leadership at green club level

The Environment Club was formed as a CCA in 2006 when CVSS embarked on its green practices as an environmentally responsible school. For Teacher IC Tay Siew Woon, who took on the role in 2015, her most satisfying achievement is in seeing her students becoming ardent and committed environment champions after attending the programmes she developed and how they continue to contribute to environment-related activities after leaving the school. She also feels a sense of achievement in developing them to be more critically aware of pertinent ES issues and to become advocates of green habits through their words and examples. The 2019 recipient of the North East District Environment Award felt more motivated to contribute to the green cause as an educator, practitioner and advocate, following the recognition by the North East Community Development Council and NEA.

In Siew Woon's view, the Environment Club's most significant contributions to date would be its community outreach initiatives such as the International Coastal Clean-up and North East Clean and Green Singapore Carnival. "These serve as important opportunities for students to organise and learn from environmental activities that develop them as advocates for environmental causes like marine conservation and waste management in the community," she explained.

During her past service as Teacher IC of the Environment Club, Teng Siew Lee started many EE programmes covering the 3Rs, water conservation, biodiversity and wildlife conservation. She recalled initiating a series of 3R practices to reduce the "very high usage of paper" as examples for students to follow. Bins were placed at paper-recycling corners at all classroom blocks with messages to remind everyone to cut down on printing, print on both sides of paper, reuse paper printed on one side and recycle used paper and old newspapers. She also developed numerous outreach initiatives in collaboration with partners, including environment champions (with NEA), water ambassadors and ABC Waters Learning Trail at Sengkang Floating Wetland (PUB), zoo buddies (Singapore Zoo), CVSS international coastal clean-up and biodiversity programme at Riverside Park. In addition, she also worked with the US Embassy on the ASEAN Youth Leadership Programme and led a team of teachers to research on EE.

It was particularly satisfying for Siew Lee to see her students learning to care for the environment and becoming confident youth advocates for ES. She can still recollect another teacher telling her that one of the CVSS Environment Club's student presenters at a SEC's School Green Awards event was her primary 6 student at Compassvale Primary School. "The teacher was excited to see him on stage as she remembered him as a quiet and timid boy, but she was very amazed by his confidence at secondary 2," the 2012 EcoFriend Award recipient recalled. In her view, one of the club's more significant achievements was the Water Testing and Conservation Programme developed in partnership with PUB. This included the school's water-saving project, ABC Waters Learning

Trail and a World Water Day project. Participating students in the programme learnt about youth leadership, environmental study and community outreach.

Siew Lee's passion for ES could be traced back to her teenage years, when she had the habit of picking up used sheets of paper from waste bins or recycling boxes for writing her drafts on the other side. In college, she would use them to practise solving mathematics problems. When she was a teacher, she used them for students to write on during learning activities or quizzes. Her most memorable experience then was seeing students' expression of shock whenever a class was given the wrappers of A4-sized printing paper for the first time instead of the usual plain paper, for their use in group discussions and presentations. Sure enough, she soon noticed some students following her example in using the other side of used paper. "I think this is the power of teacher's role modelling in education," commented the Master Teacher for Chemistry at the Pedagogical Excellence Branch, Academy of Singapore Teachers.

Achieving more through passionate and dedicated teachers

As a PW teacher, Preeti Vikas Palkar is constantly updating herself on new developments in environmental sciences and technology to guide students on making their projects interesting, relevant and feasible. Besides teaching PW and Science, she creates lesson packages, sources for EE assembly programmes for students and staff as well as drive EE initiatives in school. Her teaching role has enabled her as Subject Head for PW to review and revise where necessary the PW curriculum to keep up with evolving ES trends. For example, electronic waste was included when teaching waste management, which had hitherto focused on paper, plastic and food waste. What Preeti has found to be satisfying as an EE teacher was seeing the high level of engagement among her students during lessons, and hearing them expressing care for the environment and wishing to do more to protect it during discussions and daily interactions.

The Environment Club's Teacher IC Tay Siew Woon teaches PW as an EE subject with sustainable living as its theme, in addition to Chemistry as her main teaching subject. She shared how the two subjects could be related: "In Chemistry, students learn about the atmosphere as well as fuel and crude oil." She covers current affairs, such as the haze problems, and relates them to the Singapore context to emphasise the importance of protecting and conserving our environment. "This is how we infuse Practices of Science like Relating Science-Technology-Society-Environment in our Science Curriculum Framework," she explained. Siew Woon and different subject teachers in the PW committee applied design thinking to develop the PW curriculum.

Achieving more through passionate and dedicated student leaders

The Environment Club is being led by student leaders who are appointed as chairperson and vice-chairpersons by its Teacher IC.

For the club's 2021 chairperson Gerald Ong, it was an opportunity to develop his leadership skills, as he would be required to "think of the big picture" and "do a lot of forward planning for CCA activities". "There were many times when I had to step out of my comfort zone," he admitted. His passion for ES was supported by his sense of responsibility to take "conscious and conscientious actions towards protecting and conserving the environment now" as the damage to the planet might be irreversible in future. Leading his team to curate the video commemorating World Water Day that year was a most satisfying experience for him. He brainstormed ideas with club members and was involved in filming and editing the video.

After enrolling in CVSS, Zeus Ong started to notice how climate change kept getting worse. It was "something big" for him, as "it concerns the whole planet and our fate." It did not take him long to realise that global warming was not going to stop suddenly like the happy ending in a kids' story. He felt people should not just be saying what needed to be done but doing something about the problem

and "helping out in whatever ways possible." He explained: "They could be the smallest things like picking up trash or keeping the environment clean." He felt he should do the same, as wanting to do something was not going to help. "If not me, then who? This was what motivated me to support the green cause," Zeus shared.

Joining the school's Environment Club was something Zeus could do for a start. During the first two years as a member, his conviction in the club's activities grew and he felt they were meaningful and helping to create awareness among students. He began to "put in a lot more effort" in serving the club. Soon he figured that he could motivate and encourage members to do more for the environment as a club leader. He was shortlisted and selected for the chairperson role in 2020. As student leader, he learnt the importance of sharing the responsibility of managing others with his deputies and giving members time and space to get things done. For him, forging the bonds among members during his leadership was a most satisfying achievement.

Soh Jin Wen has always been fascinated by nature since he was young. His love of nature grew when his parents brought him out tracking in the forest and picnicking in the park. Over time, he also noted the effects of human activities on nature. When he was asked to lead CVSS' Environment Club in 2016, he "jumped at the opportunity" to do his part for the environment. The leadership experience taught him about planning activities and collaboration with other CCA student leaders and external partners to amplify the club's reach and impact. He recalled the North East Clean and Green Singapore Carnival as the club's most impactful initiative. "It was also very meaningful as we had the chance to reach out to people of all ages in the community to advocate green habits," he revealed. Planning the beach clean-up was particularly satisfying for Jin Wen, as students from all CCAs and secondary levels contributed.

Two environment champions are appointed in each class by the form teacher to coordinate with the Environment Club for its activities, among their other responsibilities in green practices at the class and school levels.

Amplifying reach and impact with external partners

Former Teacher IC of Environment Club Teng Siew Lee remembered how NEA, PUB and Waterways Watch Society had supported the development of the school's ES programmes in its early years.

Today, NEA engages schools in a wide range of green topics to "educate, encourage and inspire students to do their part for a sustainable Singapore". Topics may relate to environmental protection (such as 3Rs and waste management) and public health (littering and dengue, for example). It supports CVSS' ES efforts by giving talks on waste minimisation to its students. Nur Muhammad, NEA's Manager for Community Engagement and Relations in the North East, said that every engagement session with CVSS teachers and students was "fruitful and enjoyable" as they readily shared their own experiences with NEA's new initiatives. He disclosed that NEA is providing MOE with updated contents and learning resources on environmental topics. These will be available to students and teachers through MOE's Eco Stewardship Programme, which will also provide information on learning journeys and volunteering opportunities.

According to Noorliana Sadli, Senior Manager for Community Relations at PUB's 3P Network Department, the water agency decided to co-create the ABC Waters Learning Trail with CVSS as the school had adopted the Punggol Reservoir and were using the Sengkang Floating Wetland as an outdoor classroom to teach and advocate water sustainability to students. "This is also part of PUB's engagement efforts in training community partners to build their capacity for water advocacy initiatives," she explained.

Another regular partner is the Lee Kong Chian Natural History Museum (LKCNHM), which offers indoor and outdoor programmes on biodiversity, natural history and conservation topics for different levels of students. In 2021, the museum conducted a virtual assembly talk on marine protection for CVSS students

under its HSBC Marine Protection Programme. This aims to "increase awareness of the natural history of Singapore and Southeast Asia, with a focus on the marine ecosystem", according to Senior Education Officer Jharyathri Thiagarajah at its Outreach and Education Unit. "In particular, we wanted to highlight the findings related to the sperm whale (found in 2015) and its conservation issues," she added. Future talks may cover forest and mangrove ecosystem conservation, endangered animals, climate change, biodiversity and sustainability.

LKCNHM had also conducted a walk in the MacRitchie forest for CVSS students, who learnt about its flora and fauna as well as threats to its conservation. Students who took part in the ExxonMobil SG200 Gallery Walk, part of the ExxonMobil Singapore Bicentennial Project in 2019, visited the museum's heritage gallery to learn how Singapore's natural history heritage was conserved. They also learnt how people interacted with the environment and wildlife in the early years. Jharyathri shared that topics on nature-based climate solutions will increasingly feature in schools' curriculum, following the launch of the Singapore Green Plan 2030, and the museum will be engaging CVSS with related activities.

Shining as a North Star in environmental sustainability education

CVSS' holistic education aims to develop each student as a "star" who "seeks out his/her strengths, takes responsibility, adopts an enterprising spirit and is ready for the world." The school in northern Singapore is equipping students with the green compass early in life through its green practices on campus, education in classroom and outdoor, and advocacy in school and the community. In the process, the students find their own ways in playing their part in environmental sustainability as guiding stars to others in school, at work and at home. They become what the school envisions them to be – "Advocates of Sustainable Living" for life.

Dunman High School

Dunman High School (DHS) marked its 12 years of continuous improvements in environmental sustainability (ES) education for students in 2013, when it received the President's Award for the Environment. The public recognition of the school's green achievements reflected the impact of its ES journey on the environment as practitioner, on its students as educator and on the community as advocate. These were realised through environment-related projects with strategic partners that helped to build students' confidence as active citizens while meeting DHS' desired learning outcomes. Its green journey has continued till today. The school's recognition of ES advocacy as part of its community service is reflected in its Environmental Club, which is organised as one of the Community Service Club's three branches. Students' ES learning outcomes are evident in their green achievements and ideas shared through essays, poems, publications and other projects during and after leaving school.

DHS' vertical garden signifies the school planting the seeds of life, with the plants nurtured from seedlings before being transplanted there. The life cycle continues with each year's cohort of students, who learn about sustainable living in space-constrained Singapore from DHS teachers and school leaders. (Photo: Dunman High School)

Planting seeds of life for a sustainable future starts every day at Dunman High School

"The future begins here and now. What we do today will impact our tomorrow."

– Tony Low, Principal (2017-21)
Dunman High School

Environmental education starts at the top

Before he joined Dunman High School (DHS) as Principal in 2017, Tony Low attended the Shanghai Expo in 2010. There he was impressed by participating countries' visions and exhibits to portray and promote the event's theme "Better City, Better Life". He was particularly astounded by the UK Pavilion with its Seed Cathedral by Thomas Heatherwick. The magnificent structure comprised 60,000 fibre-optic rods, each containing plant seeds at its tip to signify the huge potential of life. It dawned on him that it was a clarion call to his generation to do what they can to pass on what they might have taken for granted to the next and future generations to come. During a morning assembly at DHS, Tony shared what he had learnt at the Shanghai Expo and cited the UK example. He ended his sharing by encouraging the students to seize the day, "for the future begins here and now, and what we do today will impact our tomorrow".

How and when DHS started on ES journey

DHS officially embarked on its environmental sustainability (ES) journey as educator in 2001, when its year 1 students cleaned a beach and learnt about environmental responsibility from their experience. The following year, the National Environment Agency (NEA) invited schools to attend a workshop on environmental issues, with PUB staff sharing the Singapore Water Story. At that time, the school was considering which of the community service activities

would be suitable for its year 1 cohort, as part of its Community Involvement Programme that included environmental projects. Leong Swee Ling, who was environmental education advisor from 2005 to 2016, was inspired by the cleaning and transformation of the Singapore River and thought of bringing students to clean up the Kallang River, which was within walking distance from the school. They would use a fishing net attached to a long pole to collect rubbish from the river. When the dam was built, they continued with picking up litter along the river banks.

The school's ES advocacy/outreach initiatives started in 2006 and were led primarily by teachers in the Community Service Club (CSC) and Values In Action Committee. In 2009, DHS formed the Environmental Education Committee to look into activities to engage students at all six school levels in ES practices. It came up with the Environmental Education@DHS framework based on its concept of education of, in and for the environment.

Strategy for long-term ES development

The school's approach to ES education is underpinned by its Eco Pledge and looks at five key areas:

- Ecological paradigm that considers the impact of ES programmes on economic viability, social and environmental responsibility of people, public and private stakeholders
- Experiential learning
- Participatory learning
- Multi-disciplinary learning
- Community learning.

DHS focuses on water conservation, water minimisation, recycling, nature preservation and public cleanliness for more impactful ES learning outcomes.

Classes and the green club would use commemorative events like the World Water Day and Earth Day to promote energy and water conservation through exhibitions, quizzes, posters and stickers, among other areas of focus.

What the school has achieved in ES practices

There are whole-of-school green efforts like recycling water bottles since 2008, posters in every room to remind students, teachers and staff to turn off lights, fans and air-conditioners when they leave the room, and the use of recycling basket in every classroom. In 2021, a reverse vending machine was introduced to encourage recycling and the response from the school community was overwhelming!

DHS commemorates other annual eco events like Earth Hour, Recycling Week, Bring Your Own Mug Day and Environment Week. It has been marking Earth Day since 2006 with activities like exhibitions and competitions. Its first World Water Day in 2005 featured talks, exhibitions and competitions organised by PUB. Other past activities led by its Community Service Club included day camp for primary school students, workshops for Value-in-Action (VIA) ambassadors and educational emails to the whole school. For the Environment Week in 2017, the school organised a terrarium workshop and raised fund for Nature Society Singapore by selling badges. In the same year, it participated in the International Coastal Clean-up. This was part of the Seashore Life Programme that the school adopted for several years.

Policies for energy conservation require all air-conditioned rooms to maintain the temperature at 25°C, lighting and air-conditioning to be turned off automatically after 6.30pm, and the use of staff pass to activate lighting and air-conditioning at mass venues, among others. Water-saving pipes or devices such as water sprinklers for its gardens are being used. To cut down on food waste, a project with NEA Love Your Food@Schools saw students using the food digester to convert unwanted food into compost for plants.

What DHS has achieved in ES education

The Dunman High Water Education Programme started in 2008. It covers water-related issues and students learn to create solutions to water problems and to become good stewards of water resources while bonding with water through activities.

Since 2013, DHS has been developing more sustainability programmes and encouraging more student environmental projects. These involve service learning for year 3 and 4 students with more themes on environmental issues and concerns, as well as professional development of teachers in ES. The Service Learning Research Programme includes green projects and deeper understanding of ES issues through weekly lessons. According to Leong Swee Ling, the goal to align sustainability with research projects was achieved in 2014. The Talent Development Programme was renamed Thinking and Research Programme, with ES included as a theme for research projects of year 1 to 3 students.

At DHS, environmental education (EE) is integrated into various subject syllabuses. For example, Geography curriculum includes climate change for year 2 and UN Sustainable Development Goals for year 4, while year 5 students do project work on environmental topics.

What the school has achieved in ES advocacy

One of DHS' ES advocacy projects was Project D'Compost, which was started by year 4 students in 2017 to raise awareness and educate the school population and the community on the importance and methods of reducing food wastage. This initiative was an outcome of the interest generated by a year 4 students' team project in 2016 to reduce food wastage on campus.

Singapore designated 2018 as its Year of Climate Action and DHS participated with a booth in the Singapore Climate Action Festival. With "Climate Action for

a Sustainable Future" as the theme for the Youth for the Environment Day that year, its Environmental Club encouraged students to take steps to reduce their carbon footprint. (Illustration: DHS)

Another ES advocacy project targeted at DHS students was the D'Green e-newsletter published annually by DHS Community Service Club's environmental branch to commemorate the annual Youth for the Environment Day from 2018 to 2020. The three issues featured news updates, essays on environmental issues and green events, among others.

Advocacy/outreach activities to other schools included an outing to Marina Barrage for students of Stamford Primary School's Care Hut Student Care Centre as part of DHS' commemoration of World Water Day in 2019. They learnt about water conservation through games and visited the Singapore Sustainability Gallery at the barrage.

Past advocacy/outreach activities to the community included Project F!ush in 2012, when the school adopted an eating house and two hawker centres, where its students helped to inspect and clean toilets and put up posters to remind the public to keep the premises clean. DHS students' sharing of environmental messages on anti-littering, nature preservation, energy and water conservation, dengue prevention and toilet cleanliness is still ongoing through class and student-initiated VIA activities as well as initiatives by the Environmental Club.

DHS' EE advisor from 2017 to 2019 Christine Tan considered the school's impact on its neighbourhood as the most significant achievement on its ES journey, based on its collaboration with the Katong, Mountbatten and Marine Parade Community Clubs, Tanjong Rhu Neighbourhood Committee, St Hilda's Community Services Centre, Towner Gardens School and Kong Hwa School under the three-year Eco Kepalas @South East School Programme. This was launched by NEA and South East Community Development Council (CDC) in 2014 to groom students as green leaders and champions by enhancing their understanding of environmental issues and nurturing their skills in project development. For example, DHS partnered the South East CDC, NEA and Tanjong Rhu Neighbourhood Committee to collect e-waste from residents staying in the area, in support of the Year Towards Zero Waste campaign in 2019. Items included small household appliances and information and communication technology equipment. To promote food waste reduction, students conducted workshops on fruit peel enzyme during the DHS Open House. They also shared how unwanted fruit peel scraps could be turned into a home-cleaning agent with students at Kong Hwa School.

DHS' e-waste collection from neighbourhood residents, in collaboration with South East CDC, NEA and Tanjong Rhu Neighbourhood Committee. (Photo: DHS)

How and what students learn from green practices on campus and in community

DHS encourages and provides opportunities for its students to learn about ES through hands-on experience like recycling in class and at the school canteen, as well as saving electricity by turning off lights, projectors and fans when they are not being used.

As a year 5 student, Gabriel Lee shared in the school's D'Green e-newsletter: "Recycling is important because it helps us to address the conundrum of waste and gives old items another lease of life. Through recycling, we can help to mitigate the adverse impact of waste on the environment, while reducing the resources that go into producing new items for our use." Another year 5 student Chloe Lim wrote: "If we can recycle more of our used goods, not only does it mean we take less from our environment, we also save the water and energy needed for manufacturing these goods. Recycling is a habit that we can easily foster, even at home! In Singapore, we are already given the convenience of depositing any recyclable items into the recycling bins near our house. Though this action may seem small, I believe that if more people start recycling, we would definitely be able to make an impact to protect our earth's precious resources!"

Among the many initiatives by teachers and students, two had left a strong impression on Wong Yi Xuan, who led the Environmental Club in 2021. When he was in year 1, his class took turn in different groups to maintain the food-composting machine that was leased from NEA to help reduce food wastage in school. The compost generated daily was given to the elderly living in the neighbourhood for growing their plants. "This project was especially impactful for me as it reduced food waste within the school while helping others in the community in a simple and effective way," Yi Xuan shared. The other initiative that "really struck" him was the reverse vending machine to address the plastic waste problem. This collected empty plastic bottles for recycling by a contractor.

A total of 4,800 bottles were sent for recycling in the short span of two terms, with the number increasing over time. He was encouraged by the results and saw the Environmental Club's role as crucial to catalyse the adoption of such green practices at DHS.

From the school's campaigns to encourage students to bring their own food and other containers, former CSC student leader Kang Yi Xi learnt that banning single-use plastic items might be an effective way to go plastic-free on campus.

How and what students learn about ES in classroom and outdoor

Students had the opportunity to participate in related research projects when the school was installing the rain, roof and vertical gardens. Some of them used the rain garden to research on how it affected the school's environment. From their research for the roof garden, they learnt how the temperature of the room below it was affected. Their research for the vertical garden taught them which types of plants were suitable for such cultivation. This green feature teaches students a sustainable solution to a real problem in Singapore – land constraint. In addition, the community garden enables students to learn about herbs, vegetables and other plants.

At the herbs garden created by students as their gardening project in 2021, with (left photo, from centre clockwise) tomato, snake grass, sugar cane, curry leaves and lemon grass plants. The garden can be used for teaching students urban farming through hands-on learning (right photo). (Photos: DHS)

The multidisciplinary Service Learning Research Programme aims to develop students as concerned citizens who see their roles in the community and the connections between what they learn and what is happening in the community. They learn from implementing projects that address real-world problems related to sustainable development. Lessons are based on case studies of projects, brainstorming after reviewing literature, use of cognitive maps to identify areas of concern and determine the needs of a community, and proposed action plans to meet them.

In 2011, year 2 students attended a Grow Your Own Vegetables workshop co-organised by DHS and National University of Singapore's (NUS) Biology Department. A workshop on growing plants using plastic bottles was conducted for DHS students at Gardens by the Bay in 2019. From 2012 to 2016, a few groups of students conducted research on food waste as part of their projects, Leong Swee Ling shared.

DHS students had participated in green projects and activities as part of their experiential learning. These included projects submitted for competitions, such as the 2017 NEA Environmental Challenge with the theme "Waste Minimisation". DHS collaborated with City Developments Limited to propose ways to minimise waste in Singapore, including a gardening prototype. Students also participated in school-initiated ES projects as learning opportunities. These included Community in Bloom to engage students through outdoor lessons and gardening activities since 2011. Another project was Community Engagement Day involving beach clean-up, e-waste collection and anti-dengue outreach to nearby residents as part of DHS' 2013 National Day celebrations. They were guided by DHS teachers who met them regularly to review their project proposals and progress, as well as to respond to any queries they might have.

Environmental Club members with the fruits of their gardening activities at NParks' Farmers' Market. (Photo: DHS)

In 2019, year 6 student Gabriel Lee received the first prize for his entry proposing innovative solutions to Singapore's solid waste management problems to the case study contest co-organised by NEA and the Indian Institute of Management Alumni of Singapore, in conjunction with the IIMPACT event that year. He also received the Best Article Award in the World Wide Fund for Nature's National Competition 2018. He wanted to advocate ES through writing and was encouraged by DHS teachers to take part in both competitions. They guided him with feedback on his drafts with suggestions for developing their contents.

Gabriel's essay on the importance of responsible consumption and production suggested measures that consumers, producers and the government in Singapore could adopt to avoid the 'Tragedy of the Commons'. This refers to the environmental conundrum caused by individuals and organisations pursuing self-interest instead of society's collective welfare by depleting or degrading shared resources through their actions. He had noted from a BBC News' 2018 report that 3.4 earths would be required to sustain Singapore's level of consumption of fresh water, food and energy.

A DHS team, comprising two year 6 students (including Gabriel Lee) and three year 5 students, was a finalist in the Singapore Green Building Council's Design Thinking Challenge organised as part of its Green Schools Initiative in 2019. They proposed a design with innovative green features for the relocated Science Centre building.

Former student leader Kang Yi Xi learnt from DHS environmental education that mankind's continuous extraction of resources from the environment is unsustainable and that everyone can make a positive impact by changing his or her daily habits. For former Environmental Club president Gan Rui Yi, the field trip to Siloso Beach Resort in Sentosa had the most learning impact on him. "This was where I was introduced to the idea of sustainability and saw how its concepts could be applied to businesses," he shared.

How and what students learn through ES advocacy on campus and in community

Year 5 students who are interested in the green movement may join the Environmental Club as a co-curricular activity. They are interviewed by the club's committee comprising year 6 students who look for their interest in environmental conservation, willingness to lead or be part of a team to contribute to school-wide initiatives.

Among other activities from 2016 to 2019, year 3 students who were eco advocates attended a four-day programme to learn how to make terrarium at St Hilda's Community Services. In 2018, year 3 and 4 students who were VIA ambassadors were trained as green advocates in NParks' Community in Nature Programme.

Leong Swee Ling remembered the many initiatives of Environmental Club and VIA students to advocate green habits in school. These included those promoting empty plates, less use of plastic, turning off of lights and fans not in use, clean toilets and recycling of unwanted items. The 2009 NEA EcoFriend Award recipient noted that such student advocates would take ownership of the environment and encourage others to love and care for it. She also shared that a group of students collaborated with Nature Society Singapore to promote biodiversity through assembly talk and clean-up of Pulau Ubin island.

Gabriel Lee's entry for the IIMPACT case study contest on solid waste management in Singapore's HDB and condominium apartments was an outcome of his initiative to advocate ES. He also learnt from participating in DHS' EcoBuddies outreach programme, which guided Kong Hwa School's primary 4 and 5 pupils with appropriate environmental values and attitudes in contributing as green captains in school. The eight sessions involved activities based on different themes – green economy, clean and green Singapore, car-lite nation, eco-smart city and zero waste. An Environmental Club member and year 6 student Karina Wong

shared that "leading a group of children to do something for the environment during the programme allowed me to share insights to help them come up with ideas to tackle issues such as recycling. By spending more effort to recycle our waste, it is a huge step forward in not only raising environmental awareness but also making the world green again!"

How DHS alumni continue to learn and champion ES

The impact of DHS' environmental education on its students is evident in some of its alumni's careers. For example, a former student from a 2006 class, Eleanor Quek is now a teacher who advocates EE at a primary school, where she is a subject head.

Gan Rui Yi, who was president of the Environmental Club in 2017-18, is studying Computer Science at the National University of Singapore, where he is a member of an urban farming interest group at Tembusu College. He believes computer science is versatile and can be applied to solve environment-related issues and in green jobs. After graduation, he hopes to pursue a career in renewable energy or green urban landscape. He also finds time to apply what he had learnt about urban farming from his internship at Netatech Engineering after junior college.

A 2013 senior high alumnus Yeo Pei Shan's learning experience at DHS had spurred her to dream of a bigger impact in serving the community. The school's concept of moral courage to overcome challenges for a better planet had resonated strongly with her. "DHS' culture shaped me to explore sustainability," she shared. Pei Shan co-founded UglyFood with a former classmate at Singapore University of Technology and Design (SUTD) in 2018 to help reduce food waste after her graduation. They developed the business concept in 2017 while working on a project at the university, where she was studying Engineering Product Development. She was also pursuing her Business Management degree at Singapore Management University (SMU) as a pioneer student under the SUTD-SMU Dual Degree Programme.

Growing up, Pei Shan was taught by her grandmother to finish all her food. "Making sure no grain is left on my plate has been a habit ingrained since young," she revealed. Her heart for the environment grew stronger when she read up on healthy living, based on a diet with more fresh fruits and vegetables and less meat and processed food, after both her grandmothers fell ill. While studying at SUTD, she discovered the "hidden truth" about "wasting perfectly edible food". She was inspired by a friend and advocate of plant-based diet who told her that agriculture contributed about a third of human greenhouse gas emissions that led to climate change. "It was then that I realised that being environmentally conscious is not just about recycling, it could also be about our daily habits!" Pei Shan noted. In 2016, she participated in SUTD's Design Odyssey Programme and chose cosmetic filtering as her field of interest, thinking that it was a good match between reducing waste in the environment and promoting a healthier plant-based diet.

While volunteering in community service as a university student, Pei Shan was encouraged by the experience to start doing something on her own. The opportunity came when a programme at SUTD allowed her to explore any community issue and come up with a solution. That was when she thought of a new business to reduce food waste while providing fresh produce for people to live healthily. She chose to embrace imperfect and surplus fresh produce, advocate plant-based diet as it has the least environmental impact, and encourage home-cooked meals. UglyFood is her way of taking action for a sustainable future. She was "fuelled" by the students who wished to interview her after her sharing sessions as they wanted to work on less-than-perfect produce as their school projects. "It is really heartening to know that my personal project is a form of catalyst for them," she shared.

A 2006 junior high alumnus Preston Wong founded Treatsure in 2017 to help reduce food wastage as its CEO and Lead Innovator. He was always interested in geography and learning about the earth in secondary school. His DHS teachers taught him lessons on environmental conservation and during field trips and

other out-of-school activities. "These broadened my perspective on ES issues," he clarified.

Senior high alumnus from a 2018 class Kang Yi Xi is pursuing further studies of geography at University College London, where he hopes to learn more about the impact of environmental issues on human equality. Before he left, he presented to the school on the severe harm being caused by single-use plastic and what individuals could do to reduce its use. He initiated the sharing after he was inspired by a straw-free campaign in DHS that year to research deeper into the impact of plastic on the marine ecosystem. "Rejecting straws did seem like a really simple action that anyone could take," he recalled. While interning at Netatech Engineering, he had the chance to work on the Arise & Farm project initiated by the company to promote urban farming in Singapore. His team promoted greenhouses to schools for their students to learn about sustainable food production.

Overcoming Covid-19 and other challenges along the way

DHS' EcoBuddies project on the 3Rs carried out each year for primary students of Kong Hwa School from 2017 to 2019 was held via videoconferencing instead with a reduced number of sessions due to the changed timeframe, according to CSC Teacher OIC Eileen Lim.

Environmental Club's student leader Wong Yi Xuan noted the reduced human touch when interacting online with attendees of activities, particularly when engaging younger students who required it to stimulate their curiosity and pique their interest. Not receiving visual feedback from those who did not turn on the webcam had only exacerbated the difficulty in managing the transition to an online platform. However, going virtual meant his team was able to tap more online resources and to use platforms like AhaSlides and Kahoot! for events, to engage students through friendly competitions and interactive polls in real time. The results for its EcoBuddies project in 2021 were higher students' participation in the quizzes and better tracking of their learning.

From the school's experience, it was a challenge to convince staff and students to adopt environmentally conscious habits such as not using plastic and Styrofoam products. Former EE advisor Christine Tan attributed it to the mindset and habits formed since young. To overcome it, she would ask students who were role models to share their green experiences during the morning assembly or on special environmental events like World Water Day.

Values underpinning DHS' commitment to green cause

DHS' provision of secondary education is underpinned by honesty, trustworthiness, moral courage and loyalty. The values that underpin the school's environmental responsibility and drive its environmental sustainability initiatives are evident in its Eco Pledge found in the Service Learning Plan of 2010. This was stated as the school's ES philosophy:

"We are citizens of the earth and part of the web of life, we need to have the knowledge and understanding of the environment and all the communities of lives within it. With this knowledge and skills, we need to know how to manage our resources to ensure a high quality of life for all its citizens. By caring for the environment and all that is within it, we hope to leave a lasting legacy for future generations."

What contributed to school's extraordinary ES journey and achievements

Dedicated and committed staff who serve as good role models to students and their colleagues have been sustaining DHS' ES efforts and achievements over the years. According to Christine Tan, they have been contributing selflessly to the green cause with a nurturing mindset and a love for the environment.

In addition, initiatives like the Service Learning Research Programme and learning journeys to Siloso Beach Resort in Sentosa, landfill on Semakau Island and other places have been inspiring students to become more active ES advocates.

Building on achievements of successive leadership at school and club levels

The principal Tony Low was one of DHS' ES advisors, sharing his views on VIA direction and environmental issues, before he left the school at the end of 2021. Leong Swee Ling served as lead teacher and EE advisor from 2013 to 2016. She was succeeded by Christine Tan in 2017 before Fang Chye Pin took up the role in 2020.

The Environmental Club was a separate club before it merged with the Community Service Club to pool their resources and became one of its three branches. Teacher OIC Eileen Lim oversees them since 2020. She supports the green club's Teacher IC and provides mentorship for events that require additional help. She also looks out for new initiatives that students can take on, such as the introduction of the reverse vending machine. The club was headed by Teacher IC Lim Hwee Teng, who mentored and guided its members in their weekly sessions until 2021.

Achieving more through passionate and dedicated student leaders and alumni

According to CSC OIC Eileen Lim, the student IC of the Environmental Club leads the weekly sessions and propose and initiate projects. Each year, he or she and the club's committee plan and organise the annual World Water Day commemoration as well as the Green Week with school- and level-wide activities.

Wong Yi Xuan wanted to lead the Environmental Club in 2021 as he felt that he could help to spearhead the CSC branch in adapting its initiatives to go beyond its community focus, to include campus, curriculum and culture outlined in MOE's Eco Stewardship Programme. This meant broadening the scope of the club's activities and making its projects more "well-rounded", he shared. Under his leadership, the club organised DHS' first official Green Week in 2021. The event aimed to inform and educate students about environmental issues and to

encourage them to adopt green habits in daily life. It also sought to encourage students to champion green initiatives and sustainable practices while laying the groundwork for future development. "It was an extremely satisfying and rewarding experience for me, as the event was a stepping stone towards embracing an environmentally conscious culture in the school," he commented.

When asked why he's so passionate about the green cause, Yi Xuan shared that he's inspired by the earth's vastness and the number of species inhabiting it. With a large part of the world still unexplored, especially the forests and oceans, there's so much that we do not know, he explained. He believes it is wasteful to damage the environment in the name of convenience or economic progress when the solutions to many of our problems could potentially be found in nature, which we should explore, embrace and protect. He cited the Calophyllum lanigerum var austrocoriaceum as an example of a tree with a compound that has anti-HIV properties. The tree was almost lost before it was discovered in the rainforest of Sarawak, Malaysia, possibly due to the local inhabitants cutting it down to use as firewood or building material. Fortunately for the world, the tree was rediscovered at the Singapore Botanic Gardens. "There are likely to be many of such miracles waiting to be discovered in nature," Yi Xuan enthused.

Gan Rui Yi became president of the Environmental Club in 2017 before its merger with the Community Service Club in 2018. He wanted to lead the club as he felt passionately for the role and wished to make a difference. His passion for ES stemmed from his rejection of the idea of being indebted to the earth. He believes in not having a net negative impact on our living environment. "To save the planet, we should embrace the new 3Rs – respect the environment, take up the responsibility and face the reality," he shared. Despite the club's limited funding, he and his team sourced for opportunities on their own to fulfil the club's purpose and learnt much from the experience. He considered the first edition of the e-newsletter D'Green as having "greater time value" than the club's other outreach efforts during his leadership. "It can be read again, and its contents

could be reused for future events or publicity," he explained. Rui Yi also found the Environment Week commemoration to be most satisfying. He remembered clearly how his team reached out to Nature Society Singapore and other green interest groups to collaborate in raising awareness of environmental issues. For him, receiving the NEA EcoFriend Award in 2018 was a "reminder for me to continue my efforts and play a bigger role in making Singapore clean and green".

Kang Yi Xi served as vice-chairperson of CSC in 2017-18 and helped to organise the annual H2olympics to teach primary school students why there is a need and how to conserve water in a fun and interactive way. His interest in environmental issues interest was sparked at home, where he watched documentaries on "exploring new places" since young. His passion for ES was "re-ignited" while he was studying H2 Geography at DHS, particularly by the relationship between humans and the environment. He was intrigued by the various perspectives gained, such as anthropocentrism (human-centric), ecocentrism (nature first) and technocentrism (belief that technology can solve environmental issues). He envisioned an 'Edible Garden City' cared for by a "collective farming community" involving everyone.

In 2020, alumnus Yeo Pei Shan curated a three-week job shadowing programme for DHS' year 5 students at UglyFood to learn about reducing food waste. Four of them subsequently launched their own YummyUgly project to raise awareness of blemished but edible produce. They also collaborated with UglyFood to make them available to the school community. A DHS student who attended her talk in 2019 interned at UglyFood for three months after graduating and continued to work part-time there till the end of 2020.

Amplifying reach and impact with external partners

DHS has forged partnerships with educational institutions, government agencies and overseas organisations, among others. For example, PUB helped it to install the rain garden, while it partnered NParks to set up the roof and vertical gardens.

The school's overseas partnership has also benefited students' environmental education. For example, the nine-month project in service learning for year 5 students involved training during the December holidays and visiting Yunnan, China in June the following year. Its partner there planned the project and DHS implemented it. Participating students learnt how to build a biogas tank and how to plant trees to enhance the environment. They also learnt the local culture and to live in less comfortable conditions. "We borrowed the villagers' toilets to take our showers and drew water from the well to cook," recalled Leong Swee Ling, who led the group there. In the process, students learnt valuable life skills as well as cultural differences, she added.

As president of the Environmental Club in 2017-18, Gan Rui Yi reached out to and collaborated with external partners to expand the Environmental Club's network and co-organise better events. He credited Nature Society Singapore, which was raising funds for its local biodiversity conservation initiatives, for providing the club with the momentum to continue with more green projects. He shared: "Working with an external organisation motivated our team to reach out to other potential partners, including schools." He expressed appreciation to Kong Hwa School for providing a platform for raising awareness of green issues among primary students through the club's activities related to sustainable cities, food waste, climate change and other topics.

Planting seeds of thought for environmental action among the young

DHS' e-book on its new ES advocacy initiative Green Week in 2021 was a collective outcome of students' environmental education in school. It featured their green projects, poetry, prose and posters, among other environment-related contents. The many ideas, views and suggestions shared through the e-publication serve to plant the seeds of thought for environmental action among the young within and outside the school's campus. In the process, DHS amplifies its ES advocacy efforts beyond the present generation.

Institute of Technical Education

Upon entering ITE College Central, visitors are greeted by the immensity of the green walls spread across eight buildings. Behind this impressive façade is the Institute of Technical Education's (ITE) evolving five-year Environmental Sustainability Roadmap that charts its green initiatives at three large campuses located across Singapore. Driving them are staff representatives from ITE HQ, ITE College Central, ITE College East and ITE College West who sit on the Environmental Sustainability Initiatives (ESI) Committee. The more than 28,000 students enrolled at the three colleges are learning beyond vocational courses by participating in eco practices on campus, environmental education in classroom and outdoor as well as green advocacy/outreach to the community. In the process, ITE students learn how to save the planet for a sustainable future. After graduating, they continue to learn about environmental sustainability (ES) and responsibility at institutes of higher learning, practise green habits and/or advocate sustainable living to others.

The ITE ES story is about its three campuses, three successive ES committees drawing up and navigating three consecutive five-year green roadmaps since the institute officially embarked on its ES journey in 2010. ITE's achievements in the earlier years were documented in three e-books that it published in 2012, 2015 and 2017. Today, ITE's past and present ES initiatives, impact on the environment, students and community, and innovation as exemplified by its activities, events, programmes, projects, teachers, staff, leadership and partnerships, reflect scale, scalability and sustainability. The 2014 recipient of the President's Award for the Environment continues to enlarge its green footprint through its colleges, clubs and classes for a sustainable Singapore.

ITE is scaling greater heights in environmental sustainability and responsibility, as depicted by the green walls at ITE College Central. (Photo: Joachim Sim)

ITE scales up initiatives across three campuses in environmental sustainability practices, education and advocacy

"Our new Environmental Sustainability (ES) Roadmap aims to prepare ITE students as future eco-practitioners and advocates in the new green economy. Learning about ES at ITE goes beyond the classroom and will inspire students to work on applied projects to benefit the community and industry. Our graduates will be taking up various jobs and work opportunities at government agencies and industry partners. Such exposure is invaluable in enhancing their understanding of the knowledge and skills needed in the green economy for a sustainable future."

– Low Khah Gek, CEO
Institute of Technical Education

Many reasons to teach environmental education

With more than 28,000 students enrolled each year at its three campuses located across Singapore, the Institute of Technical Education (ITE) has more reasons than most other local educational institutions to teach environmental education (EE) to its students. However, what compelled ITE to start on its environmental sustainability (ES) journey officially in 2010 were not just the potential impact numbers but the qualitative benefits as well. These have spurred ITE to do more for the environment in its continuing commitment to the green cause. In the process, it is teaching the young to help save our planet through its ES practices, education and advocacy with responsibility, resourcefulness and resilience. These three qualities were particularly crucial since early 2020, when the Covid-19 global pandemic became a local problem for every country.

How and when ITE started on ES journey

The three ITE campuses opened in 2005 (ITE College East), 2010 (ITE College West) and 2013 (ITE College Central/ITE HQ). ITE first started its ES practices at ITE College East when the campus was being built. After the college was opened in 2005, it received the Green Mark Gold Plus certification from the Building Control Authority for its buildings that year.

2010 was the year when environmental sustainability was identified as one of ITE's key programmes in its strategic plan for 2010-14. That year, ITE officially embarked on its ES journey as a green practitioner, educator and advocate. Today, ES may be considered a common niche area of excellence among its three colleges, which have different niche areas of excellence in technical trade education.

What ITE has achieved in ES practices

The green walls at ITE College Central are but some of the many green features on ITE's campuses that include rooftop gardens, solar panels, rainwater-harvesting systems, energy-efficient chillers and green data centre. Some of them serve as learning facilities for students.

ITE College West and ITE College Central received the BCA Green Mark Platinum Award certification for their buildings in 2009 and 2012, before their campuses opened in 2010 and 2013, respectively. ITE College East received the Platinum award in 2018, following the upgrading of its chiller system.

As an environmentally responsible institution, ITE has adopted similar green practices for all its buildings, infrastructure, facilities, teachers, staff and students. The three colleges may, however, work with different external partners located near them. For example, ITE College Central would partner the Community Development Council (CDC) in the Central Region, ITE College East with South

East CDC and ITE College West with South West CDC, based on the CDCs' different areas of focus and activities.

ITE staff and teachers serve as role models in green practices for students to follow and learn from. One of them is ITE College East's staff advisor to its Green Ambassadors Club Saadiah Bawany, a technical officer in the Environmental Services Department who is 3R educator, mentor and advocate to students.

Some green projects or activities involved ITE staff and students working together. Its success in such collaboration may be illustrated by the 105.5-metre-long 48-piece horizontal mural created by 48 classes of ITE students with their teachers' guidance and encouragement, to celebrate 48 years of Singapore's nation-building in 2013. Recycled materials were used for the whole project, which took much creativity, time, effort, coordination and discussion to complete. (See photos on page 46 of Green Footprint e-book.)

ITE's green practices have impacted water and energy consumption, recycling of paper, food and other waste, and waste and e-waste collection. In 2017, close to 50,400 kg of scrap metal and waste paper were recycled across ITE HQ and the three colleges compared to 27,000 kg in 2016. In 2018, total amount of waste recycled was 45,175 kg. At ITE College East, the 24-bed wormery recycles food waste into plant fertiliser. Scaling up the wormery to include the two other colleges is a possible next step.

As an ES practitioner, ITE celebrates eco events at all its three colleges, including the annual Youth Environmental Day, Singapore World Water Day and International Biodiversity Day.

Implementing green practices at ITE HQ and the three colleges means overcoming various inherent challenges and those encountered along the way. Common challenges include reaching out to a large number of students on each campus

through effective communications, while changes in the cohort each year with students attending nearly 100 two-year courses may affect the continuity of projects and activities initiated.

What ITE has achieved in ES education

As an educational institution, ITE's fundamental principle in environmental education is the provision of a "holistic education for the future, more action-based activities" and personalised experiences, instead of basing it on a curriculum. For example, its eco orientation programme for new students include playing games on recycling instead of attending classroom lessons, 'hunting' for animals in the zoo, camping outdoor to appreciate biodiversity, going on overseas trips to learn, and participating in campus and community clean-up activities.

ES topics are infused in ITE's curriculum for all its academic courses since 2019. For example, students learn about renewable energy and the use of solar panels in their Electrical courses.

In addition, ITE College East offers two two-year full-time green courses that prepare students for employment – Nitec in Urban Greenery and Landscape and Higher Nitec in Landscape Management and Design. These are conducted in collaboration with the National Parks Board (NParks) and the Landscape Industry Association Singapore to provide learning beyond the classroom. Applicants may be admitted into the courses under the Direct School Admission scheme based on their past green achievements. Upon successful completion, they may progress to ITE's Work-Study Diploma in Arboriculture and Horticulture programme for 2.5 years. Graduates are eligible for certification as professionals by the International Society of Arboriculture and the Australian Institute of Horticulture.

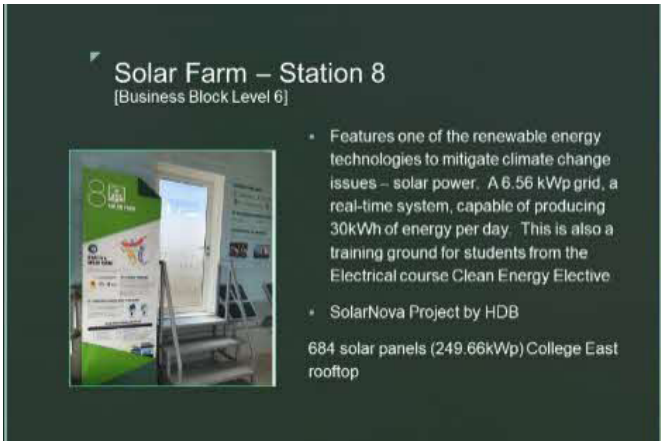
All ITE students are enrolled in the LifeSkills programme with its core module on inculcating an eco-mindset, individuals' role in contributing to sustainability,

workplace waste and recycling, among other topics. The eco sustainability elective is for students who wish to learn more. Students also learn through projects and competitions. The LifeSkills Academic Management Committee comprising representatives from the three ITE colleges would propose and develop the core and elective modules with ITE HQ's Curriculum Development Division.

ITE has about 30 teachers and other staff involved in teaching ES at its three colleges. Some of them also develop the ES modules.

Green learning facilities on two ITE campuses include the Eco Trails, each comprising 10 thematic stations. The trail at ITE College East includes an eco park on waste management, landscape courtyard on biodiversity topics, and solar farm, among others. The last station not only serves as a training ground for the students, it also helps to cut down energy usage on the campus by harnessing natural resources. At ITE College Central, the trail features green wall on eight blocks, green roof, community garden, eco pond, recycling and five other stations.

Some of the thematic stations on the Eco Trail at ITE College East. (Photo: ITE)



The solar farm is one of the thematic stations on ITE College East's Eco Trail. (Photo: ITE)

At ITE College West, the Green Ambassadors Club organises tours of eco-friendly companies to learn about their green practices. Staff IC Phua Chiew Kheng shared that the club has also invited the National Environment Agency (NEA) to stage a skit on environmental issues on campus for students.

Other ES learning opportunities for ITE students include many ITE-wide events, such as the bi-annual Eco Conference launched in 2011, with the three colleges taking turn to host it. Other events include the twice-yearly Environmental Camp since 2012, and ESI Learning Journey since 2018 that involves nature walks, visits to waste management facilities and sustainable development initiatives.

What ITE has achieved in ES advocacy

ITE's ES outreach activities impact ITE students, other students and the community. For example, ITE College East students conducted workshops for students from other schools to teach them how to create useful items from recycled materials, such as tote bags from recycled umbrellas and plastic flower vases from recycled plastic bottles. Such sharing sessions enabled the students to create these items for their own carnivals and fun fairs at their respective schools.

ITE staff and students from its Green Ambassadors Club conducting a workshop on creative recycling for members of the public during the South East Clean and Green Singapore Carnival co-organised by the National Environment Agency and South East CDC in 2018. They are shown making tote bags from recycled umbrellas. (Photo: ITE)

At South East CDC's Recycle Craft workshop at Wisma Geylang Serai's first anniversary event in 2020, ITE students shared what they had learnt about recycling of various materials with residents. (Photo: ITE)

Another example is ITE College East's workshops by its students to teach members of the public how to obtain compost as organic fertiliser for plants from worm casting, using the worms given to them.

At ITE College West, the Green Ambassadors Club would involve students in outreach activities on themes like litter-free environment, 4Rs (reduce, reuse, recycle, refuse), community that does not spread bugs, and energy efficiency and climate change. According to its Staff IC Phua Chiew Kheng, students picked litter in the neighbourhood and organised a 'kNow Cleaners' Day to show their appreciation to the cleaners on the campus. The club collaborated with the Food Bank to distribute canned food that its members collected from staff and students for the needy. They also helped the Food Truck, which collected discarded vegetables from wholesalers at the Pasir Panjang Wholesale Centre, to give them to needy residents in Teck Whye. Its roadshow on campus advocated zero food waste to students. Club members visited residents in Choa Chu Kang to create awareness of dengue prevention. Those who attended the programme by YTL Power Seraya on how to reduce energy usage and read electricity bill would share what they had learnt with their classmates, family members, friends and neighbours. In addition, the club participated in NEA's annual South West Clean and Green Singapore Carnival where its members set up a game booth for members of the public and volunteered at National Environment Agency's (NEA) booths to help publicise the agency's green messages.

How ITE students learn from green practices on campus and in community

ITE's green practices provide opportunities for students to learn about ES through hands-on experience, based on its policy to "use our skills and resources to care for our community and build a sustainable environment". This in turn is underpinned by its "hands-on, hearts-on and minds-on" philosophy. This may be illustrated by the example of students from the School of Electronics and Info-Comm Technology creatively recycling electronic cables into key chains and other useful items.

For Kelven Teo, who graduated from ITE College Central with a Higher Nitec in Electronics Engineering (Marine) in 2021, even the simple act of picking up

rubbish outside the campus meant a lot to him, as he could empathise with cleaners who keep public places free of litter. He was also concerned about how pigeons could mistake rubbish for food and suffer from its harmful effect.

As a student at ITE College East, Tay Lin Zhen found the college's Bridge Warrior Initiative had the most learning impact on her. She explained: "If the CCA clubs did not volunteer to pick up litter and cigarette buds once a week, the drains around the campus would be clogged. When it rains, water will overflow into surrounding areas." Members of the Green Ambassadors Club that she was leading wanted to show other students and the public that they were taking ownership of their environment and to influence them to follow their example.

Among the different green activities that Rachael Lum had participated in while studying at ITE College Central, the Tzu Chi Foundation's recycling project had the most learning impact on her. Although she knew of the importance of recycling plastic and using more biodegradable materials, she was pleasantly surprised to see so many people of different races and ages donating recyclable items and organising those collected to create novel items.

As a student at ITE College West, 2015 ITE Higher Nitec graduate in Electronics Engineering Daniel Ravindran learnt how small steps such as reducing food waste and proper disposal of e-waste like batteries and ink cartridges could help to protect the environment.

How ITE students learn about ES in classroom and outdoor

Many ITE students have been participating in green competitions as part of their hands-on learning, submitting 12 to 15 projects each year. These included the Green Wave Environmental Care Competition organised by Sembawang Shipyard, NEA's iContribute Energy Challenge and ITE's own Creative Waste to

Craft with Technology Competition. They conceived and developed the projects by applying knowledge and skills learnt in their ITE trade courses, with the guidance and encouragement of teachers as their resource persons. For example, in 2020 students from ITE College West's School of Engineering created a rice-growing system with guidance from their lecturers after doing their own research, applying their Internet of Things knowledge and several attempts, for the Green Wave Environmental Care Competition, during the pandemic. Students' Green Wave projects that were awarded prizes featured vertical farming, home aquaponic system, water conservation, upcycling of plastic bottle and recycling of plastic waste into fuel.

ITE College West's School of Engineering students with their rice-growing system in 2020. They are shown with the college's principal Alice Seow (front row, fifth from left), members of ITE Environmental Sustainability Initiatives Committee Tan Hwee Siang and Ng Chun Kee (front row, first two from left), and other staff. (Photo: ITE)

Students also participated in many projects not meant for competitions, like the vegetable-washing system, Reptile Incubation System with Wildlife Reserves Singapore and the design and fabrication of bat and nest boxes in collaboration with NParks. These were useful projects that involved both current and new skills, with staff guiding the students who found them fulfilling and motivating.

While studying at ITE College Central, Kelven Teo learnt how to re-use coffee powder as plant fertiliser and the importance of reducing waste to extend the lifespan of Singapore's only landfill, among other things.

From a leadership camp that she attended in 2019, Higher Nitec graduate in chemical technology Tay Lin Zhen from ITE College East learnt that food bought from the grocery store would affect our carbon footprint. For example, transportation of eggs produced in another country to Singapore contributed to higher carbon emissions. This could be avoided when we buy from a local supplier.

As a recipient of the HSBC-NYAA Environmental Care Award in 2017, ITE College Central graduate Rachael Lum attended a research expedition to Costa Rica, where she learnt about the importance of pollination in the food chain. The trip helped her to understand and appreciate how climate change is causing a decrease in the number of fruits harvested. Some places have become too cold for bees, butterflies and birds to survive and pollinate the flowers that bear fruits. While staying in the camp on a mountain, she saw how the people there made their own cheese, sustained their own agriculture in the cold climate and created their own fuel using human waste.

ITE College East alumnus and 2018 HSBC-NYAA Environmental Care Award recipient Muhammad Faaiz had the opportunity to learn about Switzerland's green efforts during a study trip there. He noticed the many fountains in the city that provided free natural spring water for quenching thirst. There's thus no need for people to buy portable water in plastic bottles. He also learnt about water recycling in Zurich, which aimed to convert sewage water into clean water, similar to what Singapore's NEWater plants are doing to supplement rainwater, imported and desalinated water. He noted the paradox that although Switzerland is surrounded by other countries, it is water-abundant with its natural springs, underground reserves and surface reservoirs, while Singapore is water-scarce although it is surrounded by water.

ITE College West's Daniel Ravindran shared that the fields trips to photograph animals in their natural habitats for a photography competition had the most learning impact on him, as he became more interested in wildlife. He attended the Earth Watch study trip to Acadia National Park in Maine, USA as a recipient of the HSBC-NYAA Environmental Care Award in 2015 and helped with research in the Dragonfly Mercury Project. It was an eye-opening experience for him to learn that the amount of toxin found in insect species like the dragonflies would indicate the toxin level in the ecosystem and the damage that had been done to it. "Similar research could be conducted in Singapore to map out the atmospheric toxin deposition," he suggested.

ITE students learning about waste recovery from water during a Green Ambassadors Club's investiture activity in 2018 – kayaking to clean up the waters near the Kallang River conducted by Waterways Watch Society. (Photo: ITE)

How ITE students learn through ES advocacy on campus and in community

When we teach, we learn twice. In reaching out to others to advocate ES practices, ITE students reinforce what they have learnt.

Under Kelven Teo's leadership, ITE College Central's Greenery Club members reached out to fellow college students and the community on their own or through

NEA's events like gardening and terrarium workshops. He remembered the sharing sessions on gardening, making of terrarium and practising the 3Rs for students of APSN Chaoyang School as particularly meaningful and impactful. "It was a nice change to be able to conduct quizzes with them," he recalled.

Among ITE College East's Green Ambassadors Club's community outreach activities to advocate eco-friendly habits, Tay Lin Zhen thought its Little Green Dots workshops conducted for pre-schoolers was the most meaningful. She had the chance to teach K1 and K2 kids how to recycle their used milk/drink cartons by following three simple steps – flip, flap and flatten – and to turn used beverage cartons into useful items like stationery holders or even toy cars! The workshop also taught them how paper was sourced from responsibly managed and certified forests.

In 2018, members of the Green Ambassadors Club led by Lau Jia Liang at ITE College West reached out to the community with green messages at the Clean and Green Singapore Carnival and World Water Day event. Not only was he surprised by the large turnout at both events, he was happy to see more youths attending. The national serviceman, who is studying engineering part-time at Ngee Ann Polytechnic, could still remember vividly the little girl who came up to him at the club's booth showing water usage in a household, to ask how much water was used whenever she flushed the toilet bowl as she was concerned about water wastage.

For Muhammad Faaiz, who graduated from ITE College East with Higher Nitec in Electronics Engineering, his participation as a volunteer in the college's Bridge Warriors project to patrol and keep the overhead bridge, bus stops and walkways around its campus litter-free each week had the most learning impact on him. The experience made him realise the amount of trash thrown on the pavements although rubbish bins were within walking distance. "We are better than that," he had thought to himself while noting that the cleaners were unable to cope. He and his team of Bridge Warriors were motivated by a desire to keep public

places free of unsightly cigarette butts as a service to the community, with the hope that others would follow their example. "It's preferable to start small than not to start at all," he explained.

As chairman of ITE College West's WWF Eco Campus Student Committee in 2014-15, Daniel Ravindran advocated eco-friendly habits to fellow students with various initiatives as he wanted them to know about the possible detrimental effects of human activities over time.

How ITE alumni continue to champion ES

Eddie Leow graduated from ITE in 2013 and enrolled at Ngee Ann Polytechnic for its Diploma in Clean Energy Management course. The HSBC-NYAA Environmental Care Award recipient went on an expedition to the rainforest in Borneo with scientists from Earthwatch Institute. He subsequently joined the Building and Construction Authority's Build It Green Club, where he continued to organise green activities for youths.

It was a desire to make a difference in people's living spaces that motivated Rachael Lum to enrol in Nanyang Polytechnic's Diploma in Sustainable Architectural Design course in 2018, after graduating with a Higher Nitec in Space Design Technology from ITE in 2017. This personal goal stemmed from her appreciation of nature and wish to do something about global warming. "I believe it always begins with a small step of what you are able to do within your grasp," she shared. She wanted to learn and explore the integration of greenery and living spaces. "Living in a sustainable and clean environment, where we co-exist with nature, is what I daydream about," she explained. In her design projects at Nanyang Polytechnic, Rachael tries to imagine and dream of buildings that could contribute to Singapore's environmental sustainability. She is exploring how people and nature could be integrated in the design of new or existing buildings through the use of natural ventilation, green wall, water-harvesting system and other solutions. She and her family, who had started to use metal straws, reusable food

containers and less plastic before the Covid-19 pandemic, are glad to contribute in their own small ways to the green cause while saving money. As a volunteer tour guide at the HortPark, Rachael had the chance to understand how it was contributing to environmental conservation.

A 2020 ITE graduate Xavier Ang, who was president of ITE College East's Green Ambassadors Club, had wanted to apply his skills learnt from his ITE course to create a 'Dragon' playground with recycled materials for his GIC Study Grant project. He initiated the project on his own and volunteered to work with Visual Arts students. He is still championing ES projects and activities while serving in the Rivervale Court Residents' Committee's Youth Chapter. He is also a student member of Temasek Polytechnic's eco interest group.

Muhammad Faaiz is currently studying for the Diploma in Clean Energy at Temasek Polytechnic. He sees using technology while caring for the environment as "getting the best of both worlds" during the pandemic. Testing and making the solar panels work after learning to build them for a multi-storey car park as his project was a most satisfying experience for him.

For Faaiz, using such alternative sources of renewable energy would help to conserve the environment. He hopes to find ways to improve the efficiency of solar panels in collaboration with NEA after graduation. For now, his team is working on improving electric vehicles as their final-year project. To jumpstart the process, the team decided to improve on a "scratch-built" Go-Kart that was a previous final-year project by incorporating a rapid-recharging and longer-lasting lithium battery.

Daniel Ravindran had since pursued further education at Singapore Polytechnic, where he obtained his engineering diploma in 2018, and at Nanyang Technological University (NTU), where he completed an engineering degree programme in 2021. In 2020-21, he spent his indoor time watching documentaries on ES to update himself on current practices. He had planned to explore other ways of contributing to the green cause after his final-year examinations at NTU.

How Covid-19 disrupted ES plans since 2020

After the Covid-19 pandemic started in early 2020, many of ITE's planned ES programmes, projects and competitions were either postponed or cancelled. Its signature Youth Environmental Envoy Programme (YEEP) involving camping in the zoo and an overseas trip could not be implemented. Before Covid-19, over 1,500 students from all three colleges had been engaged in environmental stewardship through workshops, biodiversity awareness camps, and eco leadership camps and conservation trips overseas since YEEP's launch in 2013. Among the outreach/advocacy activities planned but not carried out were the annual Youth Environmental Day commemoration, Keep Clean Singapore event and the Clean and Green Singapore Carnival.

2019 was the year Tan Hong Ming of ITE College Central had planned to reduce the use of disposable items for food packaging on its campus. In the following year, ordering food for taking away or delivery was the way to go for more people. That put an abrupt end to his plan. Other planned activities at the college that were postponed or cancelled included commemorative events like Youth for the Environment Day and Singapore World Water Day, and engagement sessions with other schools.

Many of the Greenery Club's planned activities since 2020 were disrupted due to the restrictions imposed by the safe management measures. Its Staff IC Soh Hwee Ling disclosed that field learning trips to the OCBC Treetop Walk, NEWater plant and Botanical Gardens were not held. Students could not take part in Tzu Chi's monthly recycling project and conduct sharing sessions at Chao Yang School, she added.

With the ongoing pandemic, ITE College East's Staff IC of Green Ambassadors Club Karen Loh noted the less personal touch and interaction brought about by the move to conduct workshops and talks online. The safe management measures in 2020 meant that on-campus events were attended by fewer students while some out-of-campus activities were cancelled.

Most of ITE College West's Green Ambassadors Club's physical events on its own or with external partners were put on hold, its Staff IC Phua Chiew Kheng said. Plan to grow the next batch of rice with the rice-growing system created by its engineering students in 2020 did not materialise for the same reason.

Overcoming other challenges along the way

To overcome the Covid-19 disruption, ITE colleges turned to webinars to conduct some of their workshops and online meetings to discuss projects, among other options. The ISO Internal Auditor training at ITE HQ was conducted virtually, according to Edmund Tan, Manager for Venue Management in its Campus Development & Estates Division.

For Tan Hong Ming at ITE College Central, ES workshops and talks had to go online. The college's Staff IC of the Greenery Club Soh Hwee Ling had noted that most ITE students were either disinterested or uninformed about ES, which might be perceived as a distant concept that did not seem to impact their daily lives significantly. To raise their awareness of ES and cultivate recycling habits among them, she decided to organise workshops and field trips for Greenery Club members, with the hope that they would in turn share what they have learnt with their peers.

For LifeSkills lecturer Wee Yin Ping, the experiential learning process let her see the change in students' attitude towards the environment, from reluctant learners to eager advocates. While they might be reluctant to leave the air-conditioned comfort of the classroom to visit a farm in the hot and humid weather while wearing sunglasses and holding umbrellas, she was happy to note that they would often leave it with laughter and enthusiasm. According to her, the fun would usually start when students got their hands dirty and their shoes wet. In her view, going through such experiences would enable them to understand food security and waste management first-hand. It was heart-warming for Yin Ping to see her students progressing to polytechnic and telling her how much they appreciated what she had taught them.

ITE students visiting a farm as part of their LifeSkills learning. (Photo: Wee Yin Ping)

ITE College East had to postpone the opening of its Eco Trail to the public as part of its community outreach to advocate ES in 2020. It has trained student members of its Green Ambassadors Club to take visitors on a tour of the trail. When the college partnered SembCorp Industries to establish the joint Sustainability Solution Centre in 2020, the agreement was signed virtually to avoid a mass gathering. How did Catherine Soh, who is driving ES initiatives at the college, influence her family members who had no interest in climate change and were "impossible" to convert to adopt environmentally friendly practices? "Lead by example and win them over one by one," was her reply. Staff IC of Green Ambassadors Club Karen Loh wants to recruit as many green ambassadors on campus as possible so that the green club can influence as many youths as possible to adopt green habits. When students need to attend internships, the college's LifeSkills Course Manager Jean Koh would arrange with the respective schools for them to follow a flexible class schedule. Like ITE's trade courses, her team had to implement home-based learning in place of face-to-face teaching from 2020. "We also improvised with hybrid or virtual activities whenever possible," she shared.

From Tan Hwee Siang's experience at ITE College West, it was challenging to convince students of the need to protect nature in return for the goodness that it brings. One way to do this is to let them taste the natural goodness of fresh vegetables, he suggested. The college's Staff IC of its Green Ambassadors Club Phua Chiew Kheng shared that students attended home-based learning with minimal disruption and could submit assignments for assessment online via ITE's portal. She also overcame disinterest in the eco elective by sharing actual events and explaining how these could affect them. For example, she mentioned how food prices have increased due to fluctuation in crop production that was caused by extreme climate conditions, how eating more meat could affect the climate adversely, and how global warming causes mosquitoes to breed faster and infect more people with dengue.

Kelven Teo, president of ITE College Central's Greenery Club in 2020, remembered having to cancel many events that year due to Covid-19. Some activities were conducted with more sessions for small groups of students in the same classes while others were held online.

Tay Lin Zhen's Green Ambassadors Club at ITE College East used online platforms to continue engaging both members and other students in 2020. For example, the team created quizzes for them to learn about deforestation and human impact on the environment. Commemorating the Youth Environmental Day that year could not be done with skits, games and information booth unlike previous years. Instead, the club produced posters encouraging students and staff to bring their reusable containers and cups when ordering take-away food and drinks, to counter the rise in the use of disposable containers and cutlery.

Where ITE is going and how and when it is getting there

In 2020, ITE envisioned "an active green community equipped with competencies ready for the green economy". This broader view went beyond its ES 2012 vision of becoming well-tuned to topical issues, including environmental and community sustainability.

The 2020-24 ITE ES Roadmap spells out how its ESI Committee intends to achieve its vision by 2024. Its programmes cover food security, which surfaced in 2020, and use of green energy to reduce carbon emissions, to align with the Singapore Green Plan 2030. There were already plans for paperless processes and virtual meetings, included in a programme to reduce carbon footprint, before 2020. Covid-19 had expedited these new developments.

In another programme, students are expected to come up with innovative ways to turn trash into treasure through projects developed for competitions, like the Green Wave Environmental Care Competition. The programme promoting eco habits among students, staff and community would involve the Green Ambassadors Clubs organising campaigns and participating in the Clean and Green Singapore Carnival every year. Another area of focus is clean transport.

Values underpinning ITE's commitment to green cause

ITE's provision of technical trade education is underpinned by integrity, teamwork, excellence and care. These values underpin its environmental responsibility and drive its ES initiatives, which are supported by its environmental policy of using its resources and skills to care for the community and build a sustainable environment.

What contributed to ITE's extraordinary ES journey and achievements

ITE's success in ES practices, education and advocacy over the past 11 years may be attributed to its whole-of-organisation approach, top management's support, evolving five-year plans that built on previous plans, leadership by example, teamwork across campuses, hands-on culture, passionate and committed staff, teachers and student leaders, among other factors. These are supported by a strong foundation built through many ground-up initiatives over the years.

The institute's more than 100 partnerships with other schools, government agencies, the community, businesses and non-profit organisations have helped it to multiply its initiatives and amplify its impact through ongoing programmes and one-off projects. These partners have provided ITE's staff and students with opportunities to learn how they have embraced ES and built a green culture.

Achieving more through five-year green plans

Since 2010, ITE has been enlarging its green footprint through its five-year roadmap, which aims to make things happen at many levels – ITE, college, school, club, class and student. Each of the three plans proposed by the ESI Committee was approved by ITE's senior management that included the three colleges' principals, who supported its implementation with the necessary resources.

The ES Framework (with Culture, Competency and Collaboration as key goals) adopted in 2010 was expanded in 2015 to include a fourth "C" for Care, which was replaced by "Commitment" in the 2015-19 ES Strategic Roadmap. This change signified ITE's whole-of-organisation commitment to care for the environment. Implementing the roadmap across three large campuses with many staff and students who "come and go" had its challenges, notably coordination of efforts among them. The ESI Committee overcame this by using both top-down and bottom-up approaches that leveraged on existing organisational structure and framework.

With the 2020-24 ITE Environmental Sustainability Roadmap, the "4C" strategic green plan has evolved to "ABC" (Adopt, Build and Cultivate) with a national focus but with the entrenched 4Cs remaining as its core thrusts and foundation. It was developed by the ESI Committee in the midst of the Covid-19 pandemic in 2020.

The ESI Committee's Chairman Alfred Tan recalled having to take a cautious approach for everyone's safety and to adopt virtual meetings to discuss and review the strategic plan, instead of the usual face-to-face deliberation. However, this approach required his team to overcome a number of challenges. For example, relying on voice response only meant that views needed to be confirmed verbally in the course of a discussion. While the committee did not encounter any 'roadblock' due to institutional constraints and other factors, it broadened the roadmap to include the 30-30 goal for food security as a milestone, following feedback received from ITE's top management.

In addition to leadership at various implementation levels – committee, campus, club and class – Alfred Tan sees the process of developing the curriculum with sustainability goals and contents in teaching materials as critical to implementing the ES roadmap successfully, after its review and approval by ITE's top management. Another factor is the acceptance and adoption by ITE staff and students. He also recognises the importance of industry players as external partners who can help to increase its ES initiatives and impact, as they are often at the frontiers of new technology application.

ITE's ES team leadership starts at the top

Initiating, implementing and scaling up ES programmes, projects and activities across the three colleges require team leadership at all levels. Whole-of-organisation teamwork at the top and on the ground in and outside the campuses is critical.

Since 2010, the ESI Committee has been spearheading ITE's green efforts as practitioner, educator and advocate. The committee comprises directors and management staff of ITE HQ, ITE College Central, ITE College East and ITE

College West, with ITE CEO Low Khah Gek setting the strategic direction and focus for its ES roadmap as advisor.

Current ESI Committee's Chairman Alfred Tan is Director of the School of Engineering at ITE College East since 2020. Four members of the committee drive ES initiatives at ITE – Edmund Tan at ITE HQ (since 2011), Tan Hong Ming at ITE College Central (since 2014), Catherine Soh at ITE College East (since 2012) and Tan Hwee Siang at ITE College West (since 2013 until 2021). They are responsible for executing the five-year roadmap at ITE HQ and the three colleges and ensuring that ES activities adopted are aligned with it while allowing for some flexibility in how activities are conducted.

ITE's never-ending green journey involves whole-of-organisation leadership and teamwork on the ground in and outside its three colleges. Its Environmental Sustainability Initiatives Committee's Chairman Alfred Tan (on extreme right) and his colleagues are seen outside ITE College East during a Keep Clean, Singapore event. (Photo: ITE)

In 2020, Alfred Tan led ITE College East's Engineering School in partnering SembCorp Industries to set up the ITE-SembCorp Sustainability Solution Centre for ITE staff and students to learn about solar panel technology and maintenance. He wanted to prepare students for green jobs in future. Ten years ago, he convinced a multinational corporation making solar panels to donate 150 units to ITE for training purposes at its three colleges. He was the ITE team leader in developing electric, solar- and hydrogen-powered cars to participate in the Sustainable Mobility Challenge at Shell Eco-Marathon Asia for a number

of years. He shared that ITE staff from different engineering fields coached students to infuse classroom knowledge in creating fuel-efficient cars for the races.

Achieving more through leadership at HQ/college level

Edmund Tan, Manager of ITE HQ's Venue Management, Campus Development & Estates Division and a member of ITE ESI Committee who is driving ES initiatives at IT HQ, thinks he is fortunate to be part of a passionate and dedicated team. He is proud to be involved in ITE's third five-year green roadmap after helping to see through two earlier plans. He found his contribution to the setting up of ITE's Environmental Management System that achieved ISO 14001 certification to be particularly satisfying as he had the opportunity to work across the whole ITE organisation. In the process, he gained a better understanding of the various operations and functions at ITE HQ and the three colleges. He believes more can be done to help conserve our planet's limited resources and to inculcate a green culture among ITE staff and students. However, he recognised that it's always difficult to push for processes that challenge the status quo. People need encouragement and time to go green, he added.

Keep Clean, Singapore! exercise in 2017 at ITE College Central, with its principal Suresh Natarajan (fourth from left) and members of the ITE Environmental Sustainability Initiatives Committee doing their part. (Photo: ITE)

Tan Hong Ming, who is driving ES initiatives at ITE College Central, recalled the earlier years when ES awareness was low and it was considered an optional

CCA for students. Coupled with budget constraint and not many like-minded colleagues who shared the same green passion, the road ahead had appeared long and uncertain. His team had to organise regular activities to raise awareness among students. To generate interest in ES participation, he encouraged students who were already members of green clubs to share what they know and the importance of what they were doing, and to influence other students through their personal examples.

Hong Ming attributed his passion for ES to his parents' example. Their frugal lifestyle when he was growing up comfortably with ample educational and recreational opportunities had a deep and lasting impact on him. He learnt not to waste food, water, electricity and other consumable items and has cut down on use of plastic. As Head of Electronics Engineering at the School of Electronics and Info-Comm Technology at ITE College Central, it was not surprising that he singled out the e-waste recycling initiative on its campus as his most satisfying achievement. He had noted that many electronic devices and equipment were lying around unused. "These can still be recycled for others to use," he commented. The 2017 NEA EcoFriend Award recipient is exploring how to 'marry' technology with ES to help advance the green cause.

Although Catherine Soh, Deputy Director, Sustainable Engineering at the School of Engineering at ITE College East, joined the ESI Committee in 2012, she was already involved in the college's ES initiatives before the first ESI committee was formed in 2010. She had foreseen an urgent need to educate the students in ES and to inculcate a green culture among staff but found the progress "too slow". "We started from almost nothing," she recalled. Back then, most of the projects were ground-up, like the green club that was set up by passionate staff. On her own initiative, Catherine proposed to the college's management the formation of a staff ES team to organise activities to promote ES awareness on the campus. Her plan was accepted and laid the foundation for ITE College East's ES development today. She added: "We have been using action-based activities to teach, doing instead of telling so that our students can internalise the related environmental issues and develop a desire to mitigate them. For example, during our eco orientation, students

learn about waste and recycling through games. In community engagement, they learn how to strip wires, twist and turn them into accessories, tear apart unwanted umbrellas and stitch them into tote bags. They then teach these skills to the community as volunteers through workshops conducted during public events."

For Catherine, the most satisfying achievement was the implementation of a waste management system in ITE College East, where its green ambassadors visit the staff room regularly to collect waste paper for recycling. In the process, the students learn about proper recycling of paper, which is not soiled in a general recycling bin and wasted! When she was recognised as an Environmental Champion at the Clean and Green Singapore 2014 Carnival, the occasion brought back memory of the college's collaboration with South East CDC and NEA South East Regional Office. They were leveraging on one another and tapping each other's green events to bring sustainability messages across to ITE students and the south-east community. "That was how ITE College East started to support the annual South East Clean and Green Singapore Carnival till today," she shared.

ITE College East's principal Dr Yek Tiew Ming and Catherine Soh, a member of the ITE Environmental Sustainability Committee who is driving its ES initiatives, leading by example outside its campus during a Keep Clean, Singapore event. (Photo: ITE)

When Tan Hwee Siang was nominated by ITE College West, where he was Director for Colleges Services until 2021, as an ESI Committee member in 2013, he was glad as he had wanted to volunteer for the role. His passion for ES and sense of responsibility motivated him to want to contribute through the committee. As someone from a "very humble background", it was also his way of showing his appreciation for what he had been given. He wanted to help to "conserve the limited resources in the natural ecosystem that are so essential to our survival and well-being". He remembered the hydroponic cage project to grow green vegetables that he started. It was his most satisfying initiative as it benefited many batches of seniors who attended the hydroponic course at the facility. "We often heard students wanting to join the Green Ambassadors Club so that they could learn about hydroponic farming," he shared.

Achieving more through leadership at club level

The Green Ambassadors Clubs for students at the three colleges are overseen by their respective Staff ICs – Tan Chor Heng at ITE College Central, Karen Loh at ITE College East (since 2011) and Phua Chiew Kheng at ITE College West (since 2014). In addition, ITE College Central has its Greenery Club with Soh Hwee Ling as Staff IC since 2014.

According to Soh Hwee Ling, the Green Ambassadors Club and Greenery Club at ITE College Central started as separate CCA clubs with different objectives. The former focuses on environmental activities like beach clean-up (for participating students to learn of the need to keep trash where it belongs) and One Less Straw campaign implemented at the food court, which stopped providing straws for drinks. "This campaign was significant as it involved a small change in lifestyle but has a big impact on the environment," Hwee Ling explained. The Greenery Club cares for plants and maintains the garden on the campus. The two clubs are managed by different schools in the college to reach out to different groups of students.

Although Hwee Ling teaches electronics engineering as a senior lecturer at ITE College Central, her love of nature had sparked her desire to help sustain the

environment and cultivate an appreciation for nature, as well as inculcate the habits of reducing, reusing, recycling and refusing to minimise wastage. She remembers the terrarium workshops as the most satisfying activity that she has initiated for students. Back in 2010, she developed her own method of creating a unique terrarium after attending a workshop at the Botanical Gardens. She then organised workshops for many students and trained them to conduct workshops at eco conferences, Thye Hua Kwan Old Folks' Home, Chao Yang School and the ITE Fiesta. In her view, receiving NParks' Community In Bloom recognition in consecutive competitions since 2014 was significant for the Greenery Club, as its team of students and lecturers were not trained professionally in horticulture and landscaping. "However, we attended gardening courses as a team and spent many hours in designing and maintaining the garden."

For Karen Loh, her most significant achievement as Staff IC of ITE College East's Green Ambassadors Club was grooming the club's 2018 president Muhammad Faaiz into a "green citizen" student leader, under ITE's Green Citizen Programme to inculcate a green mindset in students. She had nominated him to attend leadership camps, public speaking and other workshops, as well as handpicked him for an overseas competition to showcase his Smart Irrigation System, to boost his self-confidence and enhance his leadership skills. She also gave him many opportunities to organise and lead his club's members as a role model. It came as no surprise to her when Faaiz received the HSBC National Youth Achievement Award in 2018 and was named NEA's EcoFriend in 2019. As a 2017 EcoFriend recipient herself, Karen knew what it's like to be encouraged and motivated to do more for the environment through her actions and examples to others, including her family and friends.

Karen shared that her passion for environmental sustainability is driven by her desire to do her part for the environment, mitigate climate change and influence others to do the same. The senior lecturer in Electronics Engineering has initiated many green events and activities for students to "take the first step to give it a try", in her efforts to encourage them to join the green club. "After participating in a few activities, most of them found the experience fun and meaningful," she shared. She singled out the annual Youth for the Environment Day commemoration that the

club organised as her most satisfying. "I really feel that this event can create more awareness among students on our campus," she enthused. On that day, students are encouraged to bring their own reusable containers and to waste less food, for example. She thinks influencing them is important as they are in the more active age group who will be able to spread the green messages to more people.

Overseeing the Green Ambassadors Club at ITE College West as Staff IC since 2014 is Phua Chiew Kheng. Like ITE's other Staff ICs of green clubs, Chiew Kheng loves nature and likes to see the environment protected. For her, playing her part can start with "little things" like switching off lights to reduce burning of fossil fuel and reducing food wastage to use less resources for producing food. When the college received the Green Schools@South West Sustainable Achievement Award (Gold) again from South West CDC in 2015, she found it particularly meaningful as it recognised the college's training and empowerment of students to take leadership and ownership in caring for the environment. These were achieved through the green club's themed activities promoting a cleaner and greener environment in schools and in the community.

As Staff IC, Chiew Kheng has initiated many events and activities within and outside campus for students. When asked what was the most satisfying among them, she identified it as the Youth for the Environment Day commemoration on campus. She explained: "The student leaders got to practise their leadership and organisational skills in an actual event. They also had to research before sharing the eco-related information with fellow students."

Achieving more through passionate and dedicated teachers

ITE College Central's LifeSkills lecturer Wee Yin Ping enjoys nature, growing plants and being a steward of the environment. As a teacher, she is happy to share her green passion with students and to influence some of her colleagues to become "plant parents". This may explain why she was given various roles in ES education at the college since 2015. Until 2017, she was developer and coordinator for the Down-to-Earth elective module, constructing lesson objectives and planning

learning activities in collaboration with "edu-farmers" to deliver authentic learning. For example, she would bring students to Onesimus Garden that could cater to the diverse learning needs of ITE students. From 2018 to 2019, she designed and developed the curriculum for the unit on eco sustainability mindset of the Personal and Professional Development 2 core module. While teaching the Applied Learning 1 module in 2019, Yin Ping would plan classroom activities like hands-on sessions or workshops on growing plants and reusing cardboard for laser cutting, thus infusing green elements in her lessons although the module did not have any eco units. As chief coordinator for the Applied Learning 2 module from 2019 to 2020, she also collaborated with farmers for delivering her lessons.

Teaching the Down-to-Earth elective module was a particularly satisfying experience for Yin Ping, as it's not graded and students could explore, discover and learn new things without fear of making mistakes along the way. "Every lesson could involve hands-on activities related to its objectives," she explained. These included making planters from plastic bottles, propagating money plants and visiting farms. Such experiential learning provided students with opportunities to practise the 3Rs and upcycling, she added. She even invited a local glass artist to talk on upcycling of unwanted glass and let students learn that reducing waste could be exciting and done in an artistic way. "As a LifeSkills lecturer, I like to help my students see eco sustainability as an everyday issue and not just a module or a propaganda message," she shared. She has also helped to mentor them for ES conferences, workshops and competitions.

As LifeSkills Course Manager at ITE College East, Jean Koh leads a team of section heads and lecturers in developing LifeSkills curriculum and lessons for students across all schools in the college. She also helps to review all LifeSkills modules, including the eco sustainability elective, as a member of ITE's LifeSkills Academic Management Committee. When resources are stretched during peak periods, she teaches some modules as well. She sees the importance of fostering awareness of ES issues among students as "young people are our future".

Phua Chiew Kheng is also responsible for environmental education at ITE College West and was previously Chief Coordinator for Eco Sustainability (previously called Down-to-Earth) module. As Senior Lecturer for LifeSkills, she teaches its core modules Personal and Professional Development 1, 2 and 3, as well as electives such as Eco Sustainability, which covers causes and consequences of climate change, individual efforts to mitigate climate change, 3Rs, renewable energy and government green initiatives. In developing the eco elective with a colleague, Chiew Kheng thought through the process of convincing students that the climate issue is real and how individuals could help to mitigate climate change. She shared that imparting transferable skills to students that could help them in any situations was the most satisfying achievement for her as a LifeSkills teacher.

Achieving more through passionate and dedicated student leaders and alumni

Student leaders of the Greenery Club at ITE College Central and Green Ambassadors Clubs at ITE's three colleges are appointed by the respective Staff ICs.

Kelven Teo graduated from ITE College Central with a Higher Nitec in Electronics Engineering (Marine). He became president of the college's Greenery Club in 2020 as he wanted to influence the club's future development and people's lifestyle in practising green habits and keeping Singapore clean. His deep interest in greenery and the environment stemmed from his love of nature. He felt honoured to lead the club and was satisfied to see its members "growing and learning" how to conserve the environment better. "This is something very meaningful and important for future generations," he shared.

Growing up with her grandparents, Tay Lin Zhen developed her passion for ES from watching them grow their own vegetables, fruits and herbs, and collect empty cans and plastic bottles for recycling. They also told her to donate used textbooks, reuse paper, and recycle used paper and cardboard boxes. She decided

to lead ITE College East's Green Ambassadors Club as president in 2020 as she wanted to contribute to society in a meaningful way in and outside school by advocating ES to students, staff and members of the public. As a youth, she sees children as the next generation and believes in educating them on recycling and other green habits from young. The Higher Nitec graduate in chemical technology found the club's collection of cardboards, beverage cartons and paper from staff rooms and school rooms to be its most impactful initiative. During collection, Lin Zhen took the opportunity to explain its purpose to teachers and staff, tell them where to dispose electronic waste and encourage them to recycle. Slowly but surely, she could see an increase in the number of recyclables collected. "It gave me a sense of satisfaction to see people putting in the effort to do their part in saving the environment," she shared.

For Higher Nitec graduate in service management from ITE College West's School of Business Lau Jia Liang, his passion for ES was ignited when he participated in a beach clean-up as a primary 4 student. He recalled seeing the huge amount of rubbish washed up by seawater or left behind by visitors. The teacher present told the students the rubbish was dangerous for marine animals as they might mistake it for food. That remark spurred him to start learning more about the environment and what youths could do to protect it. While studying at the college in 2017, he decided to take up the challenge of leading its Green Ambassadors Club and bringing it to the next level. "I felt that the club could be my stepping stone, a place where I can contribute as its president, raise ES awareness not just in school but in the community and even overseas," he shared. When he received the HSBC-NYAA Environmental Care Award (Merit) in 2018 for his achievements, the recognition motivated him and his team to want to do more as green leaders.

Jia Liang recalled the club's commemoration of the Youth for the Environment Day in 2018 with animal conservation as the theme in the college as its most impactful initiative. Its exhibition booths featured air pollution, marine conservation, animal poaching and deforestation. At booths set up by SEA Aquarium and WildlifeReserves Singapore, students learnt how human activities like deforestation and pollution could affect native animals and their habitats

and how they could help. For him, he felt a personal sense of satisfaction in grooming the next batch of students with the knowledge, responsibility and passion to lead the club from 2018.

Other green champions who are ITE alumni and mostly former members of its green clubs are contributing to their alma mater by mentoring current club members. One of them is Rachael Lum, who graduated in 2017 at ITE College Central, where she had the opportunity to contribute to the learning journeys of fellow students as president of its Greenery Club in 2016-17. She singled out the club's participation in the Inter-School Gardening Competition as a "moment" when she felt all the greenery students were working together as one.

"If no one is going to take action, then who else will?" This was a question that Muhammad Faaiz had asked himself many times. He saw the need to educate people, especially the younger generations, on what is happening to our planet and what can be done to save it. He saw the opportunity to do just that for fellow students at ITE College East through its Environmental Club (now known as Green Ambassadors Club). When he was leading the club as its president in 2018, his team came up with the Food Treasure initiative to reduce food waste among students and staff. The club asked them to donate any excess or unwanted food items with at least one-month shelf life by placing them in a box on the campus. Collected items were distributed to the needy or sold at monthly bazaars with all profits going to the college's various financial assistance schemes. The team also created an automated water sprinkler system that members designed to gauge soil humidity and activate only on dry days to save water.

From leading the green club, the ITE graduate with Higher Nitec in Electronics Engineering learnt first-hand the importance of teamwork and the support of its members, teachers and advisors in sustaining ES efforts. For Faaiz, his passion for helping the environment "is already a reward in itself". Receiving the NEA EcoFriend Award in 2019 thus came as a surprise and spurred him to want to do more for the environment.

Daniel Ravindran became passionate about ES while he was studying at ITE College West, where he learnt how people's daily activities could pollute the earth. He started to act more responsibly by drinking less bottled water and minimising waste by recycling. However, he felt these were not enough. He explored various environmental activities on campus that he could take part in and was introduced to ITE staff who were in charge of various green projects. Chairing the college's WWF Eco Campus Student Committee in 2014-15 exposed him to like-minded youths from polytechnics and universities. He learnt how they implemented ES activities and overcame the challenges faced. Together they set up the Rover 360 exhibit of uncommon animal species for ITE students. As the committee's chairperson, he conducted reviews and developed action plans with the college's management. Reviews included the biodiversity of plants on campus, while actions taken included the creation of a QR code linked to information on these plants.

Achieving more with external partners

NEA is among the many external partners that have been collaborating with ITE to multiply its ES initiatives and amplify its impact on the environment, students and the community at large. The government agency has been helping ITE to groom young leaders and initiate ES activities through its Corporate and School Partnership (CASP) Programme. Activities included competitions, workshops and projects and are not limited to only those involving NEA. According to ITE, CASP encourages its partnership with various parties like other schools, businesses, non-profit organisations, other government agencies and non-government organisations.

Senior Assistant Director for Community Engagement and Relations at NEA Wai Hui Kian noted that ITE has been supporting the agency's nation-wide and localised initiatives for many years. For example, ITE students engaged as NEA's Litter Free Ambassadors learn to be role models and inspire others in the community to adopt green habits. A localised example was ITE College East co-organising the Waste-To-Craft Creativity Competition with NEA, South East CDC and Tetra Pak SEA in 2014. At this event, the college's Green Ambassadors

Club hosted recycling craft workshop, recycling vehicle race and children's learning corner for students from schools in the south-east district. They were given the opportunity to work on and learn from green initiatives based on its theme, with outstanding entries displayed at the annual South East Clean and Green Singapore Carnival that year.

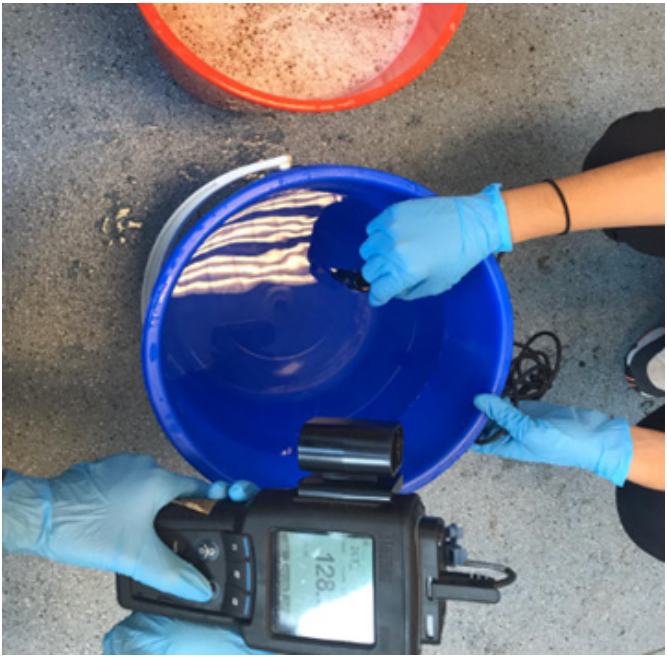
In 2020, ITE partnered SembCorp Industries for the installation of solar panels in ITE College Central and ITE College East under the SolarNova Programme, as one of ITE's initiatives to tap renewable energy while using them for teaching engineering students to monitor energy consumption.

Solar panels at ITE College East. (Photo: ITE)

ITE is one of the National Youth Achievement Award (NYAA) Council's partners since 1993. It joined NYAA Youth and the Environment Programme in 1998. What had motivated NYAA to partner ITE's three colleges in its environmental initiatives was the students' keen interest in environmental education and projects, according to its executive director James Soh. Among other events, ITE students had participated in the inaugural National Youth Environment Forum, National Youth Forum on Water Conservation International Water Forum, and Singapore World Water Day. In addition, they took part in the HSBC Clean Water Project and Youth Eco-Concert to commemorate the 40th Anniversary of Earth Day. James noted that such learning experiences had laid the foundation for many ITE alumni

to become environmental champions at polytechnics and universities. Some went on sponsored trips to Germany to study environmental technology as recipients of the Bayer Environmental Award. Others had the opportunity to work with and learn from world-renowned scientists on climate change during overseas trips as recipients of the HSBC/NYAA Youth Environmental Award, he added.

Another real-world hands-on ES learning opportunity offered by the ITE-NYAA partnership was a pilot project in 2020. ITE students worked with selected local small and medium-sized enterprises on sustainable solutions to their operational problems. James shared that the NYAA Council appointed Prof Jeffery Obbard, a climate change specialist, to mentor the students on environmental audit and oversee the project.



ITE students learnt from working on project at a coffee shop that was facilitated by NYAA Council in 2020 that a stall owner could save time, water and detergent by reducing wastage in the use of resources. (Photo: ITE).

Siloso Beach Resort (SBR), a pioneer in using wormery to recycle organic waste into worm casting for use as fertiliser, had helped ITE College East to set up its own wormery. This is one of the 10 thematic stations on the college's Eco Trail that enables students to learn about food recycling, after it was scaled up as a learning facility for students.

SBR managing director Kelvin Ng thought the wormery was a "win-win initiative", as it was difficult for food waste management in Singapore to take off due to insufficient knowledge and people willing to do this "dirty job". He saw ITE as the perfect partner as it's a much larger organisation managed by passionate people, and the wormery there would serve as a good educational showcase for the community around ITE College East. For Kelvin, the wormery was SBR's most satisfying project among its other past initiatives with ITE. "They stayed the course for so many years without wavering and with timely expansion," he explained. He added: "Students get to use their five senses to understand the whole food cycle. No books can do better."

Some of the ITE interns at SBR were trained as "wormery technicians" so that they could be job-ready upon graduation. According to Kelvin, training started with the basics such as harvesting worm casting, visually checking for mold and adding water to the top layers that have dried up, before progressing to sorting and setting up of new wormery beds. When they were able to take care of the wormery independently with minimum weekly audit by the SBR manager, they had the opportunity to take visitors on a tour of the wormery.

One of them was Nah Yi Xian, who showed exceptionally keen interest in learning about wormery. On returning to ITE, he volunteered at the wormery in ITE College East. In 2020, a landscape company sponsored Yi Xian to attend ITE's two-year Work Study Diploma in Arboriculture and Horticulture programme. This was after he graduated from ITE with Nitec in Facility Technology (Landscape Services) and Higher Nitec in Landscape Management and Design earlier that year.

ITE College East student caring for its wormery, which is a 3-in-1 example of an ITE's ES initiative – as a facility for recycling organic food waste collected from the fruits stall in the college into worm casting to fertilise plants on its campus, as a green learning resource for students, and as a showcase to advocate food recycling to members of the public. (Photo: ITE)

Scaling up environmental education beyond ITE campuses

Like the green walls at ITE College Central that were scaled up and are being sustained across eight buildings, the scalability and sustainability of the institute's green plan are very much evident at its three campuses. With its 2020-24 ES Roadmap firmly in place and driven by passionate leaders, staff and students with the support of MOE and external partners, it is conceivable and therefore achievable that ITE's green plan could be scaled up further to more campuses. "Certainly," was ESI Committee's Chairman Alfred Tan's confident reply when asked about this possibility. "The roadmap is scalable logically. This very much depends on leadership and committed stakeholders to make it happen."

As part of its ES advocacy effort, ITE has shared its current roadmap on its website for other organisations to adapt and implement according to their needs and goals.

Marsiling Secondary School

Marsiling Secondary School (MSS) started in 2000 and prides itself in "providing a holistic education that develops our students into respectful, responsible and resilient individuals". This over-arching philosophy underpins its commitment to environmental sustainability (ES) as part of its holistic education. The school's environmental education (EE) mission is to "provide quality Applied Learning Programme curriculum with emphasis on eco-sustainability through inquiry-based approach, quality being defined as providing opportunities for students to develop 21st century competencies". These include critical thinking and creative skills for problem solving and collaborative skills for group work. MSS' EE vision is to nurture "self-directed learners who care for the environment". This is being realised by instilling eco-friendly habits among students through constant green practices on campus and at home, ES education in classroom and outdoor, and outreach activities to advocate ES to the community within and outside school. The recipient of the 2012 President's Award for the Environment believes students' EE should continue after graduation as part of their lifelong learning.

This outline of a tree depicting humankind's interconnectedness with nature for a sustainable future is one of the three yarn artworks placed on the wall of the central stairway used by students in Marsiling Secondary School. The artworks were made from upcycled T-shirts and are accompanied by green messages. (Photo: Marsiling Secondary School)

Making its mark in training students to care for Mother Earth for their children's future

"The young can play their part in protecting our earth today for their children's tomorrow. On our part, we are making a constructive difference in school by teaching our students to save our planet through our environmental sustainability practices, education and advocacy."

– Goh Aik Choon, Principal
Marsiling Secondary School

Staying the course in environmental education

2021 was an especially challenging year for Singapore schools. The disruption to their education of students was unprecedented. Yet the schools showed resourcefulness and tenacity in coping with it. At Marsiling Secondary School, it was a time to persevere with its environmental education through alternative initiatives. Its Applied Learning Programme (ALP) Committee and Environment Council came up with another way to conduct the monthly sharing at the morning assembly to commemorate Earth Day that year. It was done online through a video that's lively, fun and engaging. The council's president Danish Waiz and vice-president Muhammad Aufa were in their elements as they presented the programme virtually.

First, the student leaders expressed the school's appreciation to the support staff for "maintaining a beautiful, clean and conducive school environment" and ensuring smooth operations despite the pandemic. Next, they shared about climate change and sustainability issues and why everyone should take action now. They also touched on how the Singapore Green Plan 2030 will tackle the challenges ahead,

before other student environment councillors (ECs) introduced the school's green features. After this, the ECs suggested how anyone can contribute to the Singapore Green Plan. What followed was a special "Earth Day Stomp" performance by a group of ECs who used reusable pails, bottles and plates to create music, as a creative way to drum up support for reusing and recycling household items. That done, they urged everyone to start practising green habits and to become proactive in helping to build a green and sustainable world by first writing a "pledge to the environment". In response, school leaders, teachers and ECs led by their examples. Indeed, their actions shared through the video spoke volume beyond words!

Drumming up support for recycling: To commemorate Earth Day in 2021, environment councillors brought their 3R messaging across in a fun and engaging way by showing how recyclables like pails could be used as musical instruments. (Photo: MSS)

The 2021 virtual Earth Day commemoration programme included students writing Earth Day pledges as a class activity. (Photo: MSS)

How and when MSS started on ES journey

MSS officially embarked on its environmental sustainability (ES) journey as an environmentally responsible educational institution as practitioner and educator in 2004, and as advocate in 2007. The school's ES practices were initiated by its then principal Loke Chee Pheng, who was motivated by his belief that ES was important and "everybody has a part to play". As principal, he wanted to do something to start developing green habits among the young. The 2009 recipient of the National Environment Agency's (NEA) EcoFriend Award was recognised for leading staff and students in transforming the school into a green educator and advocate. According to the school's Vice-Principal (Academic) Tay Kim Seng, a key milestone was the opening of its Energy Conservation Learning Centre in 2005, following MSS' partnership with Singapore Polytechnic and National Semiconductor Foundation between 2002 and 2005.

The school also wanted students to learn about ES and participate in its green activities. What started as the Environment Education Committee was later renamed as ALP Committee. Instead of focusing on any particular aspects of ES, the committee decided on a different theme for each year. Many of the issues or themes are seasonal and relate to events, like Earth Hour for climate change and carbon footprint, and World Water Day for water conservation. The school wanted to reach out to other schools and the community to advocate ES as it believed that students would relearn about ES in the process. Back in 2005, it had a committee to identify potential partners to join its green cause.

Strategy for long-term ES development

MSS plans to develop its ES initiatives further by providing direction and opportunities for teachers to improve green practices in and beyond the school, and engaging students, staff and the community as partners in the school's environmental education efforts. It also aims to forge quality partnerships with local institutes of higher learning and STEM Inc.

What school has achieved in ES practices

MSS' Green Procurement Policy for products and services ensures that printing paper is sourced from sustainably managed forests, eco-friendly soap is used in toilets and canteen, tissue paper was 100% made from recycled paper, detergent and marker refills are bought in bulk, and printers, photocopiers, refrigerators, air-conditioners and electrical appliances are energy-efficient, among others. The school uses non-chemical and non-toxic methods for maintaining its green features. At the vertical farm, for example, organic repellent made from crushed garlic, oil and chilli is being used.

Since 2018, 48 solar panels installed on rooftop and corridor outside Environment Education Hub are powering the clock near the school porch, equipment, lights along corridors, fountain and waterfalls in the solar alcove eco garden. At the environmental corner (ECHO) where students gather to study and hold discussions, glass walls provide natural lighting while natural ventilation reduces energy consumption. The glass ceiling at the concourse enables sunlight to light it up naturally.

Rainwater harvesting tanks are part of the automatic irrigation system to water flowering plants and fruiting trees in gardens and on bridge and green walls. The school saves water by installing thimbles in all water taps and waterless urinals, and using foam for washing hands in toilets. Students are also encouraged to conserve water through the messages on posters and information sharing by environment councillors during the morning assembly.

To save paper, printers are set to print on both sides by default and teachers use digital platforms like Student Learning Space, Google Forms and Padlet for creating and distributing teaching and learning materials. Students also use them for completing and submitting assignments. Online forms are being used and documents are filed electronically in the school's shared folders.

Used furniture that are redundant are either donated or refurbished for reuse. Getting donated furniture from other schools using the Ministry of Education's (MOE) online facility is being explored before buying new ones. Reusable cutlery, plates and bowls are being used in the canteen, where efforts to minimise food wastage included reminders, campaigns and morning assembly sharing by environment councillors.

Past efforts to encourage proper recycling habits in school included a lesson package shared by all form teachers with their students on the first day of school in 2019. Recycling bins are placed outside classrooms at every level, on staircases and in the canteen, with posters promoting recycling. In addition, every classroom has a bin for recycling plastic items. Collection of pre-loved items (such as files, books and stationery) from students for the Treasure Trash corner in the library to reduce waste and encourage reusing was put on hold during the pandemic, with plan to revive it when the situation improves. There are bins placed in the staff room for e-waste collection.

MSS is the only secondary school (with existing old buildings) that has received the Green Mark Platinum (in 2019) to date. It selected the mass engineered timber, which produces less dust during construction and hence minimises air pollution, for building its Indoor Sports Hall. It has been certified as a Water Efficient Building by PUB since 2008 and was conferred the Watermark Award in 2010.

What MSS has achieved in ES education

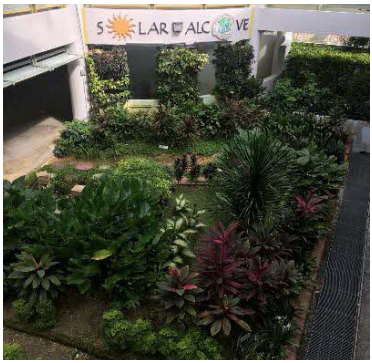
MSS has been raising ES awareness among students through its elective modules, Values in Action Programme involving projects, and Lifelong Learning Programme with overseas expeditions. The school's Applied Learning Programme (ALP) was developed over many years of refining the curriculum based on students and teachers' feedback. Its ALP in eco-sustainability through inquiry-based learning caters to the needs, interests and abilities of students.

At Tier 1, assembly sharing and other activities create general awareness and interest in ES in the whole school. At Tier 2, the two-year Environmental Science curriculum for all lower secondary students revolves around Project Work lessons and application of STEM concepts in real-world environmental issues. At Tier 3, students with the aptitude participate in advanced elective modules conducted by polytechnics, external competitions, work attachments and overseas trips.

The ALP team conceived the Environment Education Programme (EEP) framework in 2005, before developing the prototype for the EE modules for secondary 1 in 2006 and for secondary 2 in 2007. The first-generation modules on air and water were developed between 2007 and 2012, and the second-generation modules on energy and waste management in 2013 and 2014. Development of the third-generation modules on clean energy and waste management began in 2015. The modules on science and technology for secondary 1 and 2 are taught during Project Work lessons, while secondary 3 and 4 students learn about projects and advanced elective modules that MSS co-developed with polytechnics.

Topics for the secondary 1 Science syllabus are related to sustainability and therefore relevant to energy and waste management in Project Work lessons. For example, students learn how knowing the different physical and chemical properties of materials can help in making products that are environmentally friendly. The modules are being reviewed and updated annually and introduced to more classes by customising them for Express and Normal (Academic) students.

Other academic courses include ALP in Sustainability for secondary 1 to 3, and Environmental Science and Sustainable Living Programme. The Lesson on Biodiversity Trail at the solar alcove had served as a teaching resource. It was created by a teacher who was in charge of the trail, after modifying a worksheet from National Parks Board (NParks) based on the biodiversity present on MSS campus.



The solar alcove at the school serves as a green learning facility. (Photo: MSS)

The school was identified as a Cluster Centre of Excellence for Environment Education in 2007 for its Environment Education Hub, interdisciplinary Environment Education Module, teacher training and development, and impact on students' learning. In 2010, MOE recognised MSS with its Niche Programme in Environment Education, granting it up to 5% of secondary 1 student intake through the Direct School Admission scheme.

Non-academic courses and other learning opportunities included: Learning for Life Programme (LLP), which was integrated with the Applied Learning Programme (ALP) in 2018, with visits to green buildings/features included in overseas trips; training in environmental issues for students, teachers and other school staff; MSS events to raise awareness of and provide updates on biodiversity; and field trips in Singapore and overseas.

The Environment Education Hub, opened in 2009 and refurbished in 2017, comprises an exhibition centre and a teaching and learning room, with static displays and interactive booths for learning about green issues. The hub supports the teaching of the EE module and is open to environment student leaders and other students from primary schools. The exhibition centre's energy, water and environment trails each consists of static displays, interactive models and IT stations for students to learn in a fun and engaging way.

The exhibition centre is part of the school's Environment Education Hub. (Photos: MSS)

The vertical farm, solar alcove, butterfly-attracting landscape, rainwater-harvesting system and rooftop solar panels also serve as green learning facilities for students. According to the school, the vertical farm has the most impact on students' learning, as they learn about food security, food waste and reducing carbon footprint, apart from growing and harvesting vegetables for an elderly home. In the process, they learn first-hand about responsibility and resilience.

What school has achieved in ES advocacy

The Environment Club for students started many years ago was succeeded by the present Environment Council as MSS' only green interest group. Its environment councillors (ECs) serve as environmental and STEM ambassadors who organise environmental activities for the school and community. School activities include the Sparkling Canteen Movement. Potential student leaders in secondary 1 and 2 who have expressed interest in environmental issues attend an annual interview for selection as ECs. In the 2021 secondary 1 batch, a student who had benefited from environmental education in primary school was admitted through the Direct School Admission scheme.

Staff IC Teo Boon San considers the Environment Council's ability to sustain its beliefs and efforts since 2007 as its most significant achievement. "Advocating environmental consciousness is not easy. I am very thankful to be given the opportunity to develop like-minded students as eco stewards who do their part for the environment and to influence others around them," she shared.`

The school has been hosting learning journeys to its campus and conducting sharing sessions for visitors from N5 cluster schools, primary schools in Marsiling and Woodlands, as well as other schools. For example, in 2019 it conducted a 3R workshop for Innova Primary School. This included sessions on upcycling pre-owned jeans into mobile phone pouches and making coin purses with Tetra Pak cartons.

Among other community activities, MSS had organised the Solar City Competition in conjunction with the annual Clean and Green Schools Carnival organised by NEA from 2005 to 2008. The school co-adopted Yishun Pond with Khoo Teck Puat Hospital in 2011, with environment councillors serving as "Litter Free Ambassadors" who picked litter in the vicinity to help spread anti-littering messages to residents. From 2010 to 2014, secondary 1 students cleaned the Sembawang Beach and East Coast Park as part of their community service under the Seashore Life Programme.

How and what students learn from green practices on campus and in community

MSS' green practices provide opportunities for its students to learn about environmental sustainability through hands-on experience. The vertical farm, for example, involves all students working with staff in planting seedlings and growing vegetables for harvesting. It shows how space constraint could be overcome. Students get to "taste their hard work" and learn about food security and food waste in the process. The butterfly-attracting landscape expands the biodiversity and greenery on campus, and students can observe its life cycle. They also learn about other wildlife, including grasshoppers, bees, birds and garden lizards.

Students planting seedlings before they are transplanted in the vertical farm. (Photos: MSS)

What secondary 2 students have learnt could be seen in their project proposals and prototypes, students' feedback received through the annual Student Evaluation of Modules (SEM) survey, and environment councillors' sharing of student-initiated outreach projects for the SEC School Green Awards.

For 2019-20 Environment Council president Tea Lila, the Treasure Trash corner in the library had the most learning impact on her as a student. Students' donation of used items for collection by the financially disadvantaged among them showed that limited resources could be conserved by reusing them while encouraging them to be generous to those less fortunate, she noted. During the school's e-waste recycling drive, another former student leader Danish Waiz learnt that electronic products could be stripped apart, and the different parts made useful again. From planting trees as part of NParks' One Million Trees movement, EC Mohamed Syafiq learnt how trees help to replace carbon dioxide with oxygen while providing shade to reduce global warming.

Students participating in the One Million Trees movement. (Photo: MSS)

Teachers serve as role models in green practices for students to follow, as the school provides them with non-disposable cutlery, plates and bowls to use at meetings. Some of the staff would pack food in their own reusable containers, reduce the use of straws and switch off fans and lights when not using them. An example is Teo Boon San, who prints her worksheets with two pages on each side of the same paper. She would also ask her form class students to think of upcycling ideas like using plastic waste to make filing trays for keeping worksheets. Another is Kong Hui Ai, who is passionate about plants. She exemplifies resilience and perseverance in leading environment councillors in caring for the vertical farm, come rain or shine.

How and what students learn about ES in classroom and outdoor

Since 2012, MSS' ongoing Sparkling Classroom campaign has been encouraging students to keep their classrooms clean at all times. Classes that show efforts in maintaining cleanliness and conserving resources by reducing, reusing and recycling are recognised through the Sparkling Classroom award. After leaving school, students' ES learning is evident when they pursue environment-related courses at polytechnics and other institutes of higher learning and participate in ES-related competitions. One such alumnus is Tea Lila, who is studying architecture at polytechnic and hopes to work on green buildings after graduation. At MSS, she learnt that everyone has a part to play in ES and was encouraged to do what little she could daily. She also learnt the importance of taking action early to mitigate climate change before it is too late. Another former Environment Council president, Danish Waiz learnt to make recycled paper during Project Work lessons in secondary 1 and 2. He also experienced virtual reality apps through the use of Google Cardboard.

During the Hong Kong Expedition in 2018, students trekked up mountain paths to experience nature and biodiversity and visited the Wetland Reserve Nature Park

and Science Centre there to learn how they addressed environmental issues. In 2019, students learnt about alternative sources of energy like geothermal energy and how STEM concepts were applied in real-world environmental situations when they visited Taiwan. They were able to discuss environmental issues related to energy with the knowledge gained from the project-based secondary 2 module on energy. They also visited the Beitou Public Library, Taiwan's first green library.

Other ES learning opportunities for MSS students included green competitions and projects as part of their experiential learning. Teachers guide students on the thinking process and outline what they need to prepare and research on. They also direct students to relevant information sources and help to resolve issues with their prototypes, if required. An MSS team's project on optimising the school's air-conditioner pre-cooling system as a testbed submitted for the 2013 Greenovate Challenge was recognised with the first prize. Working with the energy service company that audited the school's energy usage has enabled students to learn more about energy-efficient methods and to create an action plan to reduce MSS' consumption of energy, water and other resources.

Students participating in the MSS Grow Your Greens project. (Photo: MSS)

There were projects not meant for competitions, like planting of vegetables at the vertical farm, caring for the Gelam Tikus tree gifted to MSS in 2019 and the Seashore Ardisia in 2020 under the Greenwave Project in partnership with NParks, and the Green School Project in collaboration with Republic Polytechnic in 2017. Teachers briefed students with an overview of each project and clarified its purpose.

EC Mohamed Syafiq learnt the importance of food sustainability from growing and harvesting vegetables at the vertical farm while giving back to the community. He was surprised to learn from participating in an upcycling activity that waste materials like unwanted T-shirts could be used to make beautiful yarn art pieces.

How and what students learn through ES advocacy on campus and in community

MSS' environmental champions who advocate ES in school and in the community become more aware of its importance through their participation in programmes, promotion of EE and pursuit of green knowledge on their own. They become more engaged when they apply what they have learnt. Their sense of achievement from their leadership roles and experience gained from competitions and programmes encourages them to want to learn and do more for the environment.

At MSS, students are trained to become environmental champions and advocates of green consciousness in school and the community. (Photo: MSS)

How MSS alumni continue to learn and champion ES

One MSS alumnus enrolled for a diploma course in Sustainable Built Environment at Republic Polytechnic in 2020, while another was working at NParks.

Tea Lila, 2019-20 Environment Council president, enrolled at a local polytechnic to study architecture after leaving MSS as she wanted to become an architect to help improve how people live and how buildings utilise natural resources and keep their spaces cool. She cited Architecture 2030, which revealed that buildings contribute nearly 40% of global emissions of greenhouse gases. “It does not have to be that way,” she commented, and plans to play her part in making infrastructure more sustainable by tapping renewable energy and using eco-friendly construction materials. It helps that she enjoys landscaping and the greenery. As an architectural student, Tea has learnt that green buildings require “more thought and consideration” in their design and construction. She feels a sense of responsibility for future generations in doing what she can for the environment today.

Overcoming Covid-19 disruption since 2020

During the full home-based learning period in 2020, the Environment Council uploaded a podcast to share their views and experiences with schoolmates during class assembly. One podcast presented by two environment councillors shared about good toilet practices during the pandemic. In addition, the school arranged for students to attend EE events through videoconferencing, among other alternative ways to reach them when they were home-bound.

Instead of the usual workshops conducted for primary students that could not be held in 2020, MSS repurposed its Grow Your Greens package for their schools to upload onto their School Learning System. This comprised:

- Background information on why there is a need to grow our own food and how importing food could enlarge carbon footprints

- Investigation template for linking growing of plants to science
- Reflection template for students to share their experiences in growing, harvesting and eating the vegetables they have grown.

The Grow Your Greens project also promoted food security, upcycling habits like making planting pots from discarded recyclables, and a low-carbon lifestyle in the MSS community, together with the school's participation in NParks' Gardening with Edibles initiative.

Overcoming other challenges along the way

Minimising the dust and noise from the many public housing construction projects around the school required the air-conditioners to be turned on. To reduce energy consumption, the temperature is being maintained at 25-degree Celsius, fan speed is set lower, and they switch off automatically after 45 minutes of use.

Sustaining the ALP Committee's capabilities was a challenge due to staff movements and changes in their portfolios, according to its chairperson Nur'ian Hamzah. There is thus a need to engage the team continuously and to have regular communications for its members to understand the long- and short-term goals. "Committed and passionate teachers serve as role models to their younger colleagues in sustaining and deepening the impact of environmental education in school," she added. Another challenge Nur'ian shared was sustaining interest in STEM among upper secondary students. To achieve this, the committee works with MSS' Education and Career Guidance team to brief them on possible ES courses at institutes of higher education. Before the pandemic, it leveraged on the advanced elective modules conducted by polytechnics and work attachments offered by Gardens by the Bay to engage them. It also ensures that there are enough environment councillors to advocate ES to the school community, with at least one EC in each class.

In teaching ES as part of the curriculum, using coding in Project Work lessons was a problem initially due to teachers' different competency level. This was overcome

by teachers attending training workshops at Singapore Polytechnic and other learning centres. They also attended workshops in school to familiarise themselves with Arduino and micro:bit coding methods.

Teaching ES through projects using the design thinking process had its own challenges. Most teachers were not familiar with this teaching method due to the nature of their main teaching subjects. The Design and Technology teachers were mobilised to guide them along.

When it came to teaching ES through competitions, students' current affairs knowledge sometimes became a constraint. That was when teachers' guidance was often required, and students were motivated to improve their knowledge after the exposure to students from other schools.

Values underpinning MSS's commitment to green cause

MSS' provision of secondary education is underpinned by growth, resourcefulness, innovation, tenacity (GRIT). Its tenacity is being shown by its continuing environmental education despite the disruption caused by Covid-19 and other challenges. For example, its ALP Committee teachers and environmental councillors led the school through their example by packing meals in reusable containers at the canteen to reduce waste. The school has also shown resourcefulness in adapting its green messaging and other initiatives, such as having extra safety procedures when conducting project work lessons.

What contributed to school's extraordinary ES journey and achievements

According to MSS, teachers who believe strongly in the green cause have been initiating projects and sustaining its ES efforts since it started on the journey. For many years, committed and passionate teachers in the ALP team continue to be role models and inspire other teachers. There is good team spirit among members who share a common vision.

The school's comprehensive work plan covers knowledge and skills gained through EE curriculum and enrichment modules that prepare students to pursue environment-related studies after graduating, and values cultivated through engagement and leadership roles.

Flexibility in arranging for alternative events or alternative delivery platforms is another key factor.

Achieving more through MSS' green plan

In Nur'ian's view, the ALP Committee's adaptability and creativity in embracing and implementing changes in the school's response to the Singapore Green Plan 2030 will be critical in realising MSS' future green plan. Sustaining the school's culture of care and concern for the environment and contextualising ES learning beyond the classroom through the green features on campus are important, she added.

MSS is being guided by MOE's Eco Stewardship Programme in building on its current ES efforts holistically through the 4Cs (curriculum, campus, culture and community).

School's ES leadership starts at the top

When Goh Aik Choon became the new principal in 2017, he introduced food sustainability through urban farming to the ALP team with the installation of the vertical farm that year. He wanted all the students to experience vertical farming before they leave school. He keeps himself updated on MSS' EE impact on each cohort through the annual SEM student survey.

Aik Choon's leadership by example was apparent on Earth Day in 2021, when he pledged to "intensify my recycle effort" in the video that was shared online to mark that day in place of the usual morning assembly.

Achieving more through leadership at school level

Tay Kim Seng, Vice-Principal (Academic), advises the school's ALP Committee that oversees environmental education. As advisor since 2018, Kim Seng oversees the annual ALP work plans and ensures they align with MSS' strategic development and are reviewed according to changes in STEM education. He also suggests opportunities for applying its environmental education (EE) in the real world and for developing 21st century competencies. He noted that MSS' ES achievements to date were made possible by the efforts of succeeding school leaders.

Chairing the ALP Committee is Nur'ian Hamzah, who is HOD Science. In her two roles, she sees the opportunity to synergise the goals of Science and STEM education, specifically in the area of sustainability, as EE falls under STEM ALP. "For example, Project Work extends Science lessons and it is important for our students to learn about today's challenges, such as sustainability of energy supply, and to apply STEM concepts in solving real-world environmental problems," she explained. Nur'ian is also 1st Teacher IC of EE since 2017. She and 2nd Teacher IC Yap Ching Ying work with ALP Coordinator Teo Boon San in reviewing major green events held in school and planning for the new year. Plans may include modifying and refining the three-tier programmes, especially those related to partnership and the roles of environment councillors, in response to new developments in Singapore. From her perspective, she thinks the biggest challenge for Singapore schools' EE in the next five years may be its integration into the formal curriculum, not just in Science but in other subjects like Humanities as well.

As a Science teacher, Yap Ching Ying is acutely aware of the cause-and-effect relationship between human activities and the environment. As a Physics teacher, she believes that technology can be a tool to seek solutions to our problems. "The thought that my students may one day create an innovative product keeps me going," she shared. She was previously a member of the Environment Education Committee before it was replaced by the ALP Committee. In her role as 2nd Teacher IC of EE since 2019, she supports ideas and activities to be conducted

based on suitability of their topics/themes, relevance to students and timeline required. She noted the strong foundation laid and the many structures put in place by previous committees. In her view, it may be a challenge to change students' perspective of using technology for the greater good, as they seek instant gratification made possible by smart digital devices.

As ALP Coordinator since 2015, Teo Boon San plans the overarching ES event taking place throughout the year, with the support of the ALP Committee members and Environment Council students. She also trains the environment councillors (ECs). She conceptualises the Sparkling School Programme comprising Sparkling Classroom campaign, Earth Day commemoration, Get Green sharing and EC Recycling drive. She finds it encouraging and fulfilling to see students participating in all the green activities in the school, as "it was an uphill task to get others to believe in the importance of environmental sustainability and to change their daily habits". She added: "Every small action or contribution by non-ALP staff and non-ECs means a lot to me."

Commemorating Earth Day each year is a key event for the ALP Committee to raise ES awareness in the whole school, with ECs hosting the assembly programme that day prior to the pandemic. Boon San found the line-up of activities for the week satisfying as it involved all environment councillors and ALP Committee members. "Their collective efforts made it even more meaningful for me as I could see the time, hard work and commitment put in by all to make the event a success," she shared.

Achieving more through leadership at green club level

Teo Boon San also serves as Staff IC of the Environment Council since 2011 as 1st IC. She was 2nd IC from 2008 to 2010. The council has four committees – Get Green, Upcycling, Vertical Farm and STEM. At the start of each year, she would ask the ECs to choose one of the four based on their interest and strengths. After engaging them, she decides on how best to develop each EC and deploy them for different tasks based on their interest and strengths. She also creates

opportunities for its committee members to lead and mentor ECs. In addition, she tasks the council's president and vice-presidents to conceptualise ideas, plan projects and lead the ECs in implementing them.

Boon San believes in inculcating values like respect, responsibility and gratitude in students through environmental education. "Education is not only about students acquiring knowledge and skills. It is also about inculcating the right values in them and preparing them for the future," she explained.

Achieving more through passionate and dedicated teachers

The ALP Committee members include teachers of Project Work (PW) at secondary 1 and 2 levels. There were 10 PW teachers who taught environmental education part-time in 2020. Most of them were teaching Science, with one teaching Information and Communication Technology and Mathematics, and another Design and Technology.

The teachers were trained "just in time" by MSS to teach environmental education during the weekly PW meetings. The ICs of the various PW modules would provide feedback on past lessons and take them through the upcoming lessons before letting them try out the hands-on activities. During the ALP meeting in 2020, Teo Boon San led the team in going through the Sustainable Singapore Blueprint and brainstorming various environmental issues, mitigating methods and local solutions in smaller groups. In 2021, they discussed sustainable living in the context of the Singapore Green Plan 2030. They also brainstormed how to integrate sustainability into the school experience through the 4Cs as spelt out in the Eco Stewardship Programme. She is involved in reviewing the secondary 2 PW module on energy and is the 1st IC for the secondary 1 PW module on waste management. The latter module is refined each year after she and the 2nd IC have reviewed the teachers' comments/feedback and decided on the changes needed.

Boon San stays abreast of the latest developments and innovations in ES education by reading updates provided by NEA, North West Community Development Council, Ministry of Sustainability and the Environment, Zero Waste Singapore, Building and Construction Authority and NParks.

MSS teachers aim to "nurture students to help trail-blaze the school's environmental education efforts to the community and beyond" through their teaching and examples in and outside the classroom. As most teachers involved in EE teach Science and Geography, they connect readily with environmental conservation and see the importance of raising ES awareness among students. Previously, teachers in the then Environment Education Committee initiated a research project to study how the EE modules had helped to instil self-directed learning in students. Their findings were presented at the Redesigning Pedagogy International Conference in 2015.

Achieving more through passionate and dedicated student leaders and alumni

For Danish Waiz, he is passionate about ES and sees it as one of the most important issues in the world today. "I feel for the animals and plants that are affected by human activities," he shared. He was motivated to join the Environment Council as he's driven to be "part of the solution". It was one of the best decisions he had made, he added. He took up the role of president in 2020-21 as he saw it as a good opportunity to lead a group of like-minded peers. He wanted to contribute more to the council in its efforts to advocate the green cause to more people. Shy by nature, he wanted to improve his communication and interpersonal skills while interacting with others and to increase his self-confidence in the process.

Being a student leader and role model, he led his classmates by his example during the Sparkling Classroom campaign, influencing them to keep their classroom clean by showing how it could be done. As the council's president, Danish shared the

school's experience in environmental education with primary 6 students during an open house for them. Seeing their happy faces made him feel good that the time and efforts were well spent. In the 2021 Earth Day video, Danish pledged to "encourage my friends to use tote bags instead of plastic bags".

Former Education Minister Lawrence Wong (left) visiting MSS in 2020, with Principal Goh Aik Choon (centre) and Environmental Club's then president Tea Lila (extreme right) and vice-president Danish Waiz. (Photo: MSS)

Tea Lila decided to lead the Environment Council as president in 2020-21 as she wanted to serve MSS students and the school. She thought that the vertical farm was the council's most impactful initiative under her leadership, as students from different councils worked together and learnt first-hand the efforts and time required to grow vegetables before harvesting them. They also learnt to come out of their comfort zones. "A schoolmate told me her best experience in school was spent at the vertical farm," Lila shared. The vertical farm became her most satisfying achievement as president, as students learnt about the difficulty of obtaining food and how spatial constraint could be overcome. They also learnt about social responsibility, as the vegetables they harvested were given to the nearby Sunlove Marsiling Senior Activity Centre. She found it meaningful for the

council to host primary school pupils at the vertical farm, where they could plant seedlings, and teach them about going green. She was passionate about ES at MSS and still is today, as "it makes me feel like I have control over my future, and generations ahead of me will be able to enjoy what the world has to offer".

Mohamed Syafiq served as an environment councillor when he was in secondary 1 in 2019, after completing his primary education at Marsiling Primary School (MPS) the year before. At MPS, he participated in newspaper collection, spring cleaning, recycling of Tetra Pak cartons, plastic bottles and old clothes, as well as disposal of food and electronic waste. He was inspired by his older sister who had also studied at MPS and was an EC at MSS. She had shared with him her interesting role and he wanted to encourage his peers to recycle as a daily habit. As an EC, Syafiq helped to organise the Sparkling Classroom campaign and found it meaningful as he could mobilise his friends to keep their classrooms clean. Both he and his sister were influenced by their mother to help conserve the environment. She taught them from young the importance of not wasting limited resources and asked them to upcycle unwanted items instead of throwing them away, such as using empty plastic bottles as pencil holders. Syafiq also showed his passion for ES at home, where he encourages family members to reduce, reuse and recycle whenever possible. While his sister's interest is in handicraft and upcycling projects, he would sort the paper waste and Tetra Pak cartons. He feels sad whenever he sees people discarding things that could be used again. "I may want to work on a prototype to help resolve this issue during my design and technology course in 2022," he shared.

Amplifying reach and impact with external partners

In 2021, MSS students attended the Science Centre Singapore's Young Sustainability Champion programme. Another partner SEC facilitated its environment councillors' learning journey to Sungei Buloh Wetland Reserve in 2018. The school

co-organised the annual Alternative Energy Car Challenge – Solar Prix with NEA at the Clean and Green Schools Carnival from 2009 to 2013.

Environment councillors on biodiversity trail at Sungei Buloh Wetland Reserve. (Photo: MSS)

Pei Chun Public School was looking for alternative programmes for its Science and Gardening Club students in 2020 as they could not gather for physical co-curricular activities. When it learnt of MSS' Grow Your Greens package, it jumped at the opportunity. According to the primary school's HOD Science Tan Hwee San, the students learnt that different plants grow well in different conditions, like the amount of water and sunlight, from growing their own vegetables at home. "They also learnt the value of patience and responsibility while bonding with their family members who joined them in the activity," she shared.

What a student of Pei Chun Public School's Science and Gardening Club grew in a cut Tetra Pak carton at home with MSS' Grow Your Green package in 2020. (Photo: Pei Chun Public School)

In 2019, MSS environment councillors conducted a 3R workshop themed "Towards a Zero Waste Nation" for primary five and six students who were green monitors from Pei Chun Public School. The event included talks on the 3Rs, quiz, upcycling pre-owned clothes to make mobile phone pouches, planting seedlings at MSS' vertical farm, and visit to its Environment Education Hub's exhibition centre. It deepened the green monitors' understanding of the 3Rs while exposing them to other green initiatives. In turn, these green ambassadors would help to raise awareness of environmental issues among their peers through the recycling boxes in classrooms and activities during World Water Day and Biodiversity Week back in their school. Newly recruited green monitors also benefited from the environment-themed visits to MSS at the start of the year when they engaged with MSS' environment councillors in 2018 and 2019.

MSS was collaborating with STEM Incorporation on the third-generation EE modules on clean energy and waste management from 2015. The company supported the school's redesign of its Project Work lesson package by including more STEM elements. It also introduced tools like the Piteba oil expeller (extracting oil from food waste that could be purified to form biofuel) and Peltier modules (using thermal energy to produce electrical energy). A STEM staff was attached to the school during the development work.

Marking next milestones with 4Cs

Like the interconnectedness with nature depicted in the yarn art piece of a tree outline formed by connecting strings made from upcycled T-shirts, MSS treasures its close connections with the school community and nature on its campus and beyond. In reaching out to the wider community, it searches deeper within as it continues to make its marks on its green journey as ES practitioner, educator and advocate, while being guided by the 4Cs of the new Eco Stewardship Programme.

In the process, MSS students grow up as environmental champions for a sustainable future, one cohort after another.

Ngee Ann Polytechnic

Ngee Ann Polytechnic (NP) teaches all its students to be environmentally responsible as green ambassadors/advocates through co-curricular activities such as the Environmental Rangers Club. The polytechnic also prepares many students to become green professionals in an increasingly green economy through environment-related diploma programmes at some of its schools. At least three schools have their own green clubs to engage students and the community in environmental sustainability (ES) practices and education. On their own initiative, NP students are interning at environmentally responsible organisations and volunteering at non-profit organisations and advocacy groups to champion sustainable living. The 2014 President's Award for the Environment recipient started on its ES journey in 1992. Today, it has embarked on the new NP Green Plan with its 2030 targets for energy, water, carbon emission and waste management guided by the Singapore Green Plan 2030. Its Sustainability@NP microsite sets out its green goals for the years ahead.

Pond at Block 56 of Ngee Ann Polytechnic, with floating wetland in foreground, is filled naturally by recycled water from nearby drainage canal. The polytechnic aims to nurture a growing pool of green professionals through its environment-related programmes for the green economy. (Photo: Ngee Ann Polytechnic)

Taking 'Xtra' steps in educating the young as green vanguards and professionals for advancing green economy and sustainable living

"Sustainability is fast becoming an integral part of how we live and do business. The Covid-19 pandemic has accelerated this trend globally. At Ngee Ann Polytechnic, we will intensify our efforts in shaping an eco-campus, instilling a collective responsibility in environmental sustainability, driving green research and solutions, and grooming environmental vanguards and professionals for a green economy. We seek to create new opportunities and build a strong industry nexus to advance towards a sustainable future."

– Lim Kok Kiang, Principal & CEO
Ngee Ann Polytechnic

Spark to start it all by polytechnic and partner

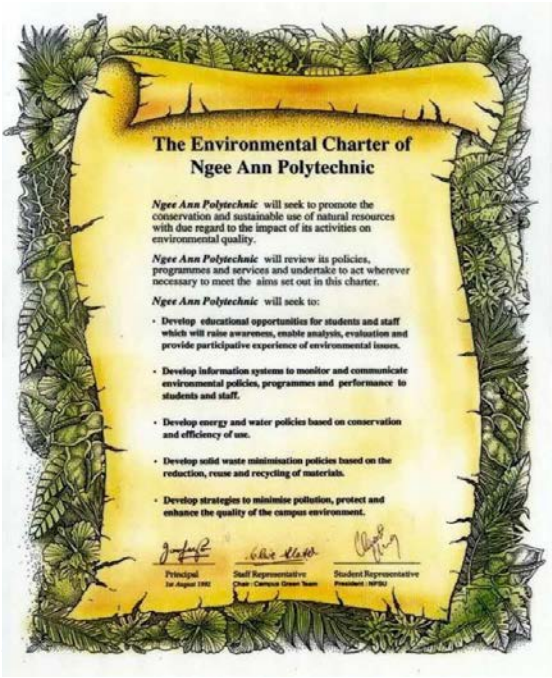
The students at Ngee Ann Polytechnic's (NP) School of Design and Environment were excited. It's not often that they were given the chance to give back to Mother Earth in a direct way. Their latest opportunity was the CNA Green Economy project that NP participated in with furniture maker Scanteak Singapore as its partner. When the students learnt that they could apply their design knowledge and practise their skills to upcycle 1,000 kg of used and unwanted furniture into new furniture for sale at Scanteak showroom, their imagination and creativity went into high gear. During design and prototyping, they were mentored by Scanteak's master craftsmen. They also attended a workshop to learn about the green economy and starting a green business.

The collaboration helped towards raising public awareness of sustainable living. In the process, the project directly reduced waste by recreating new products out of discarded items and saving some trees. The participating students learnt that recycling could be realised through upcycling by design in a green circular economy. They also learnt about environmental and social responsibility, as proceeds from the sales of the furniture would go to the Choa Chu Kang Town Council's Community Development Welfare Fund for its green initiatives and the underserved community. (Watch early part of video and hear what NP students and Scanteak staff shared about the project.)

Example of an upcycled used furniture – before (left) and after NP students worked on it. (Photos: NP)

How and when NP started on ES journey

NP officially embarked on its ES journey as an environmentally responsible educational institution – as practitioner, educator and advocate – in 1992, when it released its Environmental Charter. This sought to "promote the conservation and sustainable use of natural resources with due regard to the impact of its activities on environmental quality". The polytechnic had aimed to communicate and review existing policies as well as develop policies for energy, water and solid waste minimisation that are still applicable today, as conservation of resources remains the core of its ES efforts.



The Environmental Charter of Ngee Ann Polytechnic

Ngee Ann Polytechnic will seek to promote the conservation and sustainable use of natural resources with due regard to the impact of its activities on environmental quality.

Ngee Ann Polytechnic will review its policies, programmes and services and undertake to act wherever necessary to meet the aims set out in this charter.

Ngee Ann Polytechnic will seek to:

- Develop educational opportunities for students and staff which will raise awareness, enable analysis, evaluation and provide participative experience of environmental issues.
- Develop information systems to monitor and communicate environmental policies, programmes and performance to students and staff.
- Develop energy and water policies based on conservation and efficiency of use.
- Develop solid waste minimisation policies based on the reduction, reuse and recycling of materials.
- Develop strategies to minimise pollution, protect and enhance the quality of the campus environment.

Principal
1st August 1992

Staff Representative
Chair - Campus Green Team

Student Representative
President - NPSU

Environmental efforts spanning > 20 years:

- *Project Competitions*
- *Beach cleaning*
- *Recycling – green bazaars*
- *Raising funds through sales of recycled goods – for Grace Haven, East Timor with NYC*
- *Clean rivers*
- *Park adoption for conservation*

- Establish an environmental management system that includes indicators and targets for sustainability that will enable monitoring, reporting and continuous improvement
- Embrace and put into practice the tenets of "Reduce, Reuse, Recycle" on campus by minimising waste production while increasing recycling and reuse within NP
- Build a healthy ecosystem and maintain or increase the diversity and abundance of native species across the campus
- Develop educational opportunities for students and staff to raise environmental awareness and encourage the NP community to develop a sustainable approach to their work and lifestyle
- Adopt a more environmentally responsible policy for procurement
- Work with the local community and partners to help Singapore become more sustainable.

What support polytechnic in the long run

NP's institutional mission is "to nurture lifelong learners who are imbued with 21st Century competencies and valued at the workplace and by society" while its institutional vision is stated as: "Passion for learning. Values for life. Graduates who are ready for a global workplace".

The polytechnic is committed to advocating environmental stewardship and driving environmental sustainability by:

- Reducing its environmental impact
- Fostering a more socially responsible community of students, staff and stakeholders
- Adopting sustainable solutions and practices on campus.

It aims to shape a green, sustainable campus by harnessing smart technology, actively driving sustainable solutions and adopting innovative strategies.

Strategy for long-term ES development

NP is being developed at three strategic levels – polytechnic education, environmental sustainability and responsibility (ESR) and environmental education (EE). ESR involves environmental practices, education and advocacy/outreach. At the first level, it has adopted five strategic pillars – sustainability opportunities, polytechnic for all ages, future-ready campus, multiple peaks for success and learning beyond the classroom. For the first pillar, the polytechnic adopts a renewal strategy based on its limited resources, with an eco-campus as one of the desired outcomes. It has lined up projects to develop sustainable infrastructure, such as replacing existing street lamps with solar-powered lamps and high-mast lights with LED lights, and installation of mini-cooling district system. More toilets will be upgraded and the main water pipes replaced to save water.

NP focuses on sustainability outcomes for energy, carbon emission, water and waste management (plastic, paper, food waste and e-waste) for more impactful learning outcomes.

Lessons in ES practices for NP students

About half of NP's 34-hectare campus has been "greened up", with more than 1,000 trees planted and over 100 tree species introduced together with 250 species of shrubs as of 2020. The polytechnic plans to increase their numbers by 15%, 50% and 35% respectively by 2030. It has adopted landscaping ideas like topiaries and vertical walls, as well as created new nature areas like the butterfly garden (in front of its Convention Centre) and eco-pond (at Block 22) that attracted squirrels, kingfishers, sunbirds and other birds and long-tailed macaques.

Every tree matters – NP took 'Xtra' step to save a tree by digging below it and building footpath lower to create enough headroom for pedestrians to pass, with sign to warn them of the height restriction. (Photo: NP)

NP's green practices provide opportunities for students to learn about ES through immersive or hands-on experience. For example, Diploma in Landscape Design & Horticulture students are attending classes at a facility in Clementi Woods that the polytechnic has adopted. Interactive and participatory green spaces around the campus include a pond at Block 56, community garden and rainwater garden

at Block 51. It is embracing biophilia design features as it undergoes campus rejuvenation through Green Mark certification, installation of LED lights, use of natural ventilation, introduction of green walls and conversion of 'hardscape' to 'softscape'. This can be seen in the lush greenery that has replaced the roads around Blocks 27, 31 and 33.

From grey to green: How a road on NP campus was converted into lush greenery. (Photos: NP)

To tap new technologies in advancing the green cause, NP has set up green facilities such as the Environmental & Water Technology Centre of Innovation (EWTCOI) in 2006 and the Solar Technology Centre in 2008. These are involved in research and development on green technologies and are being used as green learning facilities for NP students. Its "brown-field building" was the first to be retrofitted with distributed pumping system, which was developed by EWTCOI. This has a series of small pumps to better regulate the pumping capacity of the central chiller system according to demand and reduce its total energy consumption.

NP considers its reduction in consumption of energy and water on campus as the single most significant milestone in its ES practices to date. In 2020, it exceeded

the target of a 25% reduction in electricity and water consumption over the actual 2013 figures by 14%! It was the first local polytechnic in Singapore to participate in the Housing and Development Board (HDB)/Economic Development Board-led Solar Nova programme to install solar panels to generate renewable energy in 2019. To date, 15 blocks are fitted with 4,000 solar panels, which have been providing 8% of NP's energy needs since January 2021. In the first two months, the campus' carbon footprint was equivalent to planting 30,000 trees. Another 2,700 solar panels are expected to be installed at 10 more blocks in future.

The polytechnic has stopped using straws and replaced Styrofoam with biodegradable packaging and plastic cups with paper cups. Since the "Bring Your Own Tumbler" campaign targeting staff and students was introduced in 2019, all its food courts have been serving cold beverages in paper cups. To encourage plastic recycling, a reverse vending machine was installed at the atrium of Block 1 in 2020. Its users earn credit points or vouchers for drink containers deposited. These are collected by the waste management contractor.

Reverse vending machine installed at atrium of Block 1 to encourage plastic recycling in 2020. (Photo: NP)

The polytechnic commemorates annual eco events such as Earth Day, World Environment Day and Farmer's Market.

On World Environment Day in 2016, its theme "Go Wild for Reducing Waste" was highlighted by an art installation depicting the amount of waste generated on campus. (Photo and posters: NP)

Before the pandemic in 2020, NP was operating the Telegram NPShare Channel to enable staff and students to donate used or new items, before suspending it temporarily.

Green courses for the green cause

NP has enrolled secondary school students who show passion or aptitude for environmental studies in its environment-related courses even before they sit for the 'O' Level examinations, through its discretionary Early Admissions Exercise.

The School of Life Sciences & Chemical Technology's (LSCT) Diploma in Landscape Design & Horticulture (LDH) programme, launched with NParks' support, provides training in landscape design, plant science and horticulture management. Topics being taught include sustainability and biodiversity issues, such as caring for the natural environment and park management. Among its ES-related modules are Urban Ecology & Conservation, Leisure & Park Management and Urban Horticulture Technology. Students learn to design, develop and maintain the green spaces in Singapore. The school's Diploma in Environmental & Water Technology (EWT) course was launched with the support of national water agency PUB and

the National Environment Agency (NEA). Students learn about water technology, waste management and resource conservation, as well as pollution monitoring and control, environmental science, engineering and technology. ES-related modules include ABC Waters Management and Water Pollution & Reclamation Technology.

At the School of Engineering, its Diploma in Electrical Engineering programme's specialisation option in clean energy management (previously offered as a separate diploma course) prepares students for work in the sustainable energy sector. They learn about solar photovoltaic systems and energy audit process and measurement techniques.

Rain garden at Ngee Ann Polytechnic. (Photo: NP)

NP's green-related academic programmes and curriculum-based courses involve the use of green spaces as outdoor classrooms and learning excursions to "sites of environmental importance", such as Clementi Woods for its LDH students. The pond at Block 56 serves as a learning laboratory for LSCT students and as a source of water samples for EWT students to analyse. It has a floating wetland where students can study how the roots of plants can remove pollutants like nitrates and phosphates from the water and reduce the risk of algae bloom. Another outdoor classroom is the rain garden at Block 51 for learning hydrology and water purification. There are plans for LDH and EWT students to study its effectiveness in improving water quality.

The polytechnic's ES education programmes, projects and other learning opportunities impact students during school and after they have graduated. Two of its schools teach students to become green professionals. Several of their graduates started their own businesses in arboriculture or landscaping. One of them is Boo Ghim Yew, a 2003 alumnus who studied Landscape Design and Horticulture. He is the managing director of ArbSolutions Asia, which provides tree health and maintenance services. Another is Alika Ho, a 2012 graduate in Environmental & Water Technology and owner of Seed Folks who started the regenerative farming service in 2021 after working as an urban farmer at Edible Garden City. She graduated with a Bachelor of Science degree in Coastal and Marine Science from Curtin University in 2017.

What polytechnic has achieved in ES advocacy

In the past, NP's staff and students had promoted ES to the community with partners like SembCorp Industries, Keppel Club and Jurong Town Corporation.

Since 2008, its LSCT school has been co-organising the annual Singapore Junior Water Prize national competition with the Lien Foundation and SembCorp Industries to promote awareness of and interest in water and environmental issues among young people. The event was held online in 2020 and 2021 during the pandemic. The winning team represents Singapore at the Stockholm Junior Water Prize international competition in Stockholm. Each year, NP organises workshops to provide participating students from secondary schools, junior colleges and institutes of higher learning with examples of environmental issues and how they can design their research to tackle them. The polytechnic also conducts workshops to help them refine their project ideas, scope of research and presentation. Participants are encouraged to adopt a research-oriented approach and apply scientific methodologies to address water shortage/scarcity, worsening rainfall intensity/flooding issues, rising sea levels and increasing carbon dioxide emissions.

The polytechnic's green club is the Environmental Rangers Club (ERC), which has members from all nine academic schools. Three of the schools have their own green clubs – School of Business & Accountancy (BA), School of Design & Environment (DE) and School of Life Sciences & Chemical Technology (LSCT). Most members of the LSCT Green Volunteers Club are students taking the Environmental & Water Technology course. BA Green Club has committee members who organise webinars and other events to raise awareness on resource and marine conservation, screen documentaries on recycling, and arrange visits to Tzu Chi Eco Awareness Centre to learn about recycling and Citizen Farm to see how urban farming works. DE Green Group has volunteers who help to promote environmental awareness among students and staff in the school.

Green volunteers from NP School of Design & Environment taking part in kayaking and Kallang River clean-up in 2020. (Photo: NP)

How and what students learn from green practices on campus and in community

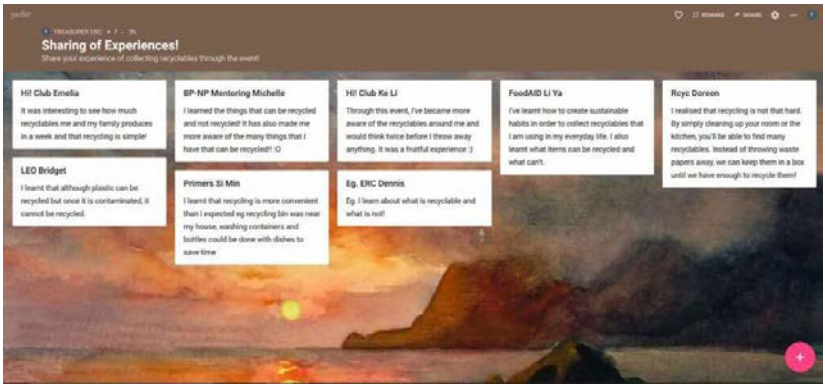
Teachers and other staff serve as role models in green practices for students to follow. For example, a staff interest group plant vegetables, herbs and fruit trees in plots of the community garden and meet every week during 'White Space' time to exchange gardening tips.

How and what students learn about ES on and outside campus

Students also learn about ES from non-academic courses by participating in activities conducted by co-curricular clubs like the campus-wide Environmental Rangers Club (ERC) and various schools' green clubs. For example, LSCT Green Volunteers Club's members attended an outdoor workshop to learn about the floating wetland ecosystem and its importance in improving water quality and providing a natural habitat for birds and fishes. They also learnt how to measure the quality of water bodies and from the practical session on constructing a floating wetland as their project.

Green Volunteers Club members learning how to construct a floating wetland through hands-on experience. (Photos: NP)

In 2020, ERC members took part in a recycling competition that it co-organised with other community service clubs. It aimed to raise awareness of recycling and encourage reusing to reduce wastage and pollution. The clubs competed to collect as many recyclables as possible over four days. Students picked up useful knowledge of what can and cannot be recycled. They learnt to challenge their daily habits and rethink their lifestyles, while recognising the need to be environmentally friendly, in a fun way.



NP students' sharing of their experiences in the recycling competition co-organised by Environmental Rangers Club and other community service clubs in 2020. (Photo: NP)

LSCT Green Volunteers Club members attended the North West Youth Forum 2020 organised by North West Community Development Council (CDC) with the theme 'The Sustainability Landscape in a Post-Covid World'. Students became more aware of the problems caused by single-use plastic during the pandemic and recognised that this issue could not be addressed simply by getting users to pay for the plastic and packaging. They realised the implications of online shopping and how it has increased plastic usage. They learnt how each individual has to play a part in environmental sustainability in different aspects of life, such as dining, shopping and fashion.

The GV club also organised the student environmental project competition EcoSciz for all EWT students in 2020/21. Students conducted research on issues that might impact ES and evaluated options and proposed solutions. The experience enabled students to understand eco issues and encouraged them to innovate and come up with possible solutions. They realised the significance and severity of climate change and its impact and how everyone could play a part. The competition also encouraged peer learning, by allowing students to learn from each another's project. Two projects, Our Blue Garden and Novel Green Sponge, represented EWT in the PUB Splash Lab competition.

NP students participate in green competitions and projects as part of their experiential learning. In the process, they discovered ways to improve waste management efficiency using a mobile smart robot they created to sort waste into different types of recyclable items, among other innovations. Another group of students invented a smart collapsible cup that could be scanned for collecting loyalty points, as a green alternative to take-away and disposable food container.

Smart collapsible cup invented by NP students. (Photo: NP)

There were projects not meant for competitions, like the EEO-HMS Service Learning Project involving an online game with green messages in 2020, and the Gardens@NP project organised in collaboration with South West CDC.

NP students also learn from field trips in Singapore, like the excursion to Siloso Beach Resort to learn about nature preservation in the resort's construction, food waste recycling in its operation and rooftop greenery in its design.

While serving the BA Green Club as president, Yasmin Sim stepped out of her comfort zone once again and interned at various companies and learnt more about ES from her involvement in their sustainability efforts. At a semiconductor company that advocates water sustainability, she was

asked to make its cafeteria more sustainable. Interning at a multinational corporation exposed her to how corporate communications could promote ES.

How and what students learn through ES advocacy on campus and in community

In 2018, the BA Green Club's members led by NP staff cleaned the beach at Changi Point on World Water Day. In 2019, they organised an upcycling workshop at Ngee Ann City to support Singapore's 'Year Towards Zero Waste' campaign.

LSCT Green Volunteers Club's members and other students volunteer in Clean and Green Singapore activities organised by NEA. Past activities included Tray Return Campaign, NEA Food Cycle Event at Chong Zheng Primary School, Clean and Green Carnival and YED Youth Planning Team (NEA's youth capacity-building programme for youth to carry out an environmental project at a national level). Participants learnt about NEA's recycling and public hygiene programmes and how to improve their interpersonal skills when interacting with the community.

In 2019, LSCT volunteers collaborated with the National Youth Achievement Award Council in collecting e-waste from West Coast residents and promoting e-waste recycling among them. From the experience, they learnt about recycling different types of e-waste.

During the circuit breaker in 2020, Environmental Rangers Club's members guided by a staff advisor produced a series of videos on green habits for healthy living during the pandemic. These were shared with the community through the club's Instagram account and WhatsApp broadcast. The initiative with "Zero Waste" as its theme aimed to help club members and residents continue with a sustainable lifestyle. Green habits learnt included composting food waste at home, reusing of food scraps, saving water with self-watering garden and cooking home-grown vegetables. They also created an online game 'Call of the Wild' to raise awareness of the challenges faced by park rangers patrolling the jungles of Malaysia, with

the guidance of a staff advisor. NP students learnt what rangers did to conserve the park's ecosystem and wildlife during patrol.

How NP alumni continue to learn and champion ES

After graduating from NP with a business diploma in 2020, Yasmin Sim led a project to analyse the carbon footprint of a local salad shop's food items as an intern before entering university. What she learnt from the experience influenced her to buy local ingredients, eat more healthily and adopt a more plant-based diet. While interning at a fund management company in 2021, she learnt that investing in businesses that were high in environmental, social and governance (ESG) responsibility could yield healthy returns. She shared: "Internships in the real world opened my eyes to how individuals can help drive sustainable initiatives in organisations and how businesses can help individuals to become more environmentally responsible." She felt fortunate that she was given the opportunity to support and advocate issues that she strongly believed in. Yasmin is pursuing a business degree at Singapore Management University (SMU), where she is an analyst with SMU Impact Investing and a member of SMU Verts green club while volunteering at Plastic-Lite Singapore. She plans to take sustainability as her second major, with a view to specialising in environmental management and gaining overseas exposure in future.

A NP graduate in landscape design and horticulture Eunice Phua pursued horticultural studies at a university overseas before returning to work at Gardens by the Bay.

Values underpinning polytechnic's commitment to green cause

NP's institutional values are upholding integrity, striving for excellence, embracing innovation and serving the community. Its sense of community and service underpins its environmental responsibility and drives its ES initiatives.

What contributed to NP's extraordinary ES journey and achievements

NP takes pride in its "very committed staff who are passionate about the environmental cause". They serve as advisors in green committees and student groups, among other ways of showing their support.

The Estate, Eco and Safety Office (EES) headed by Alan Thng drives eco and sustainability projects on campus. Its 2021-25 environment roadmap had sought to reduce energy and water consumption, increase tree and shrub diversity, obtain Green Mark certification for all buildings, increase awareness of recycling of paper, plastic, aluminium and e-waste, as well as reduce food waste.

Achieving more through NP Green Plan

NP's 2013-20 plan under the Public Sector Taking the Lead in Environmental Sustainability (PSTLES) 2.0 was succeeded by EES' 2021-25 environment roadmap. This has been updated as the NP Green Plan, which is guided by the Singapore Green Plan 2030 for its 2030 targets for energy, water, carbon emission and waste management:

- Reduce electricity consumption by 20%, by upgrading ACMV equipment and using energy-efficient lights, among others
- Reduce water usage by 25%, by upgrading more toilets and main water pipes, and reviewing ways to channel condensate water to cooling tower and for landscape irrigation
- Reduce waste generation by 30%, by using melamine instead of paper cups at food courts
- Reduce carbon emission by 15%, after installing solar panels on 15 building blocks.

The plan sets out new targets for plant diversity, Eco Office certification and Green Mark certification. Up to 140 new species of trees and shrubs will be

introduced to boost their diversity. Among the 27 offices in its schools and departments, 13 have received the Eco Office certification by the Singapore Environment Council, with the remaining 14 by 2023. It aims to obtain the Green Mark Gold Plus for 14 blocks and the Green Mark Super-Low Energy certification for its Convention Centre by 2023. Such buildings are rejuvenated with more efficient air-conditioners/chillers, LED lightings, green walls and double-glazed windows (to reduce heat absorption), among other features.

In addition, the polytechnic aims to reduce paper purchases by 30% and increase e-waste collection by 400% (up from 300 kg in 2020) by 2025.

Achieving more through leadership at polytechnic level

NP's Principal & CEO provides the institutional vision and strategic direction for its environmental sustainability development. It has been tapping a "network of staff who have passion and expertise in this area to drive our green journey". The polytechnic is setting up an ES committee to lead its future ES initiatives campus-wide.

Achieving more through leadership at green club level

Staff IC of Environmental Rangers Club (ERC) since 2017 is Foo Wan Chun, Manager of Student Development Office. In her view, ERC's most significant achievement to date is the platform it provides for students "who are passionate about environmental conservation or other issues to become advocates and try out their ideas". She cited the example of ERC members and NP staff working together at a terrarium workshop to engage and educate seniors from the Senior Activity Centre on what they could do collectively to keep the environment clean and sustainable.

NP's Technical Manager Eng Boon Hwee became an advisor to the Green Volunteers Club (GVC) at the School of Engineering's Building Division in 2008 and was

appointed advisor to the LSCT GVC in 2012. He recalled the club's two-day eco-camp at the Underwater World Sentosa (UWS) for participants to learn about marine conservation and pollution issues in 2016 as particularly memorable. "During the camp, student leaders also organised bonding activities on Sentosa for students from all three levels," he shared. His "next highlight" was the annual kayaking cum Kallang River clean-up that the club started in 2018. It was conducted by the Waterways Watch Society, which provided the kayaks and training of participants. "The students were always amazed by the amount of trash that we could collect on our river bank and waterways," he noted.

Despite the challenge of introducing new and exciting environmental activities on a small island like Singapore each year, Boon Hwee is driven by his passion for environmental sustainability. He explained: "We are merely borrowing resources such as water and air from Mother Earth and we need to return them so that our descendants can continue to borrow from her." If we exhaust these resources, what will we leave behind for our children, grandchildren and great grandchildren? The 2016 recipient of NEA's EcoFriend Award shared that it was a recognition of his team of green volunteers. "As GVC advisor, I am gathering more passionate youths to join me on this green mission and journey," he said.

Soon after Boon Hwee became its advisor in 2012, the LSCT club started the first floating wetland workshop for green volunteers, who were mainly EWT students, in the former Chinese Garden in Jurong. From 2017, it began holding the workshop on NP campus after launching it at the pond near Block 56. A speaker from HDB was invited to explain the technical aspects of the wetland. During the workshop's practical session, constructing a wetland was the participants' project and it became their learning outcome. NP was recognised with the Merit Award (Corporate) for the project at the Environmental Sustainability category at the Cities of Love Awards in 2017.

Yasmin Sim, who was president of BA Green Club in 2017-20, attributed her successful revival and revitalisation of the club to the "trust, freedom and support"

given by the Staff IC and NP lecturers throughout the journey. "They were there with me throughout my ups and downs, fully supported every initiative I proposed and provided feedback. They went around publicising the club and were present at all its events, for which they had obtained NP top management's support," she shared.

Achieving more through passionate and dedicated teachers

Saiful Anuar Said, LSCT's LDH Senior Lecturer, has been teaching Urban Ecology & Conservation since 2019. Although she was not trained to teach the module, she was driven by her interest in and passion for environmental conservation and biodiversity enhancement. She strongly feels the need to impart the knowledge for students to understand, mitigate and adapt to climate change, as Singapore transforms into a City in Nature. Growing up close to nature in a 'kampung' led her to want to work with nature and plants. The experience has helped her to understand the importance of and the need for preserving and protecting the environment. Through the module, Saiful hopes to prepare students to care for the natural environment through their understanding of its functions and how it is affected by urbanisation. This, she hopes, will encourage them to lead a sustainable life and inspire them to help reduce the damages to the planet. As a teacher, she feels a sense of satisfaction when her students choose to work in the landscape industry "because they believe in the importance of greening Singapore".

Prity Subhasish Mukherjee is LSCT's EWT content developer for the Water Pollution & Reclamation Technology module. She graduated from the National University of Singapore with a Master of Chemical & Environmental Engineering degree and was attached to PUB and Sembcorp Industries. The module on the water cycle and NEWater process teaches students to develop the skills required to work as a water/used water technician, to help preserve quality surface water. Developing the closed loop module – water from reservoir returning to reservoir – was Prity's most satisfying achievement as EWT content developer. "It is a

sustainable water cycle with minimum wastage of precious water resource," she explained. She also feels a sense of satisfaction from knowing that her former students are working on ES issues in the water/environment sector. "Nothing can be more satisfying than passing the ES baton to students – the next generation who will make the world more environmentally friendly and sustainable," she added.

As an educator who believes that students learn best when they experience things first-hand, Prity wanted to arrange field trips for all students to see the different operations in a water reclamation plant. However, given the limited curriculum time and other constraints, it was not always possible to do so. Instead, she sourced for videos to help students see and better understand the different stages of the water treatment process. Overcoming challenges has been part of her job as she strives to teach the young to be environmentally friendly in school and later at work as green professional, practitioner or advocate. Prity's passion for ES may be traced to her childhood, when she observed how her parents were reducing, reusing and recycling their limited resources. "They always emphasised that even the little that we waste could have been a useful resource for someone else in this world," she shared. In her view, "sustainability is a mindset and it starts from young and at home". It's the same passion that drove her to serve as an institutional expert and hosting lead in Water Technology Trade at the 2021 WorldSkills Singapore Competition co-organised by SkillsFuture Singapore, ITE and the five local polytechnics. She revealed that the skills and learning points essential to the water process industry were being incorporated in the EWT curriculum for the various modules, to ensure students are exposed to them.

Achieving more through passionate and dedicated student leaders and alumni

Yasmin Sim was admitted into NP through its discretionary Early Admissions Exercise before her 'O' level examinations at Bukit View Secondary School (BVSS). She attributed her success to her strong aptitude and interest in business, leadership skills, enterprising spirit and passion for environmental sustainability,

which was evident when she was leading a green club at BVSS. She recalled taking part in NP's National Youth Business Challenge, which promotes green entrepreneurship and requires participating students to come up with new green products. "At that time, I was deeply in love with the idea of green entrepreneurship and the impact it could create and believed that business can be the biggest green influencer in sustainable development," she shared. As a business student, she thought that she would be in a better position to convince top management to adopt more sustainable policies and practices. This motivated her to take the business course at the polytechnic while pursuing her passion for the environment through her involvement in its green club, volunteer work in the community and internship at various companies.

When Yasmin took on the role of reviving and leading the BA Green Club as president in 2017, she faced many challenges along the way. As a first-year student, she was not familiar with managing a club at a polytechnic. She had to learn from scratch. Recruiting new members single-handedly was most challenging before the green club committee was formed. Some student leaders became inactive and left the committee. Those who stayed believed in the cause and walked with Yasmin to reform the club. Despite the initial low sign-up rates for some events, she was not discouraged and told the committee that every new member recruited would make a significant difference through the ripple effect. She was heartened to note that students' perception of joining the BA Green Club improved significantly during her leadership.

When asked in 2021, Yasmin remembered her successful revival and rebranding of the then dormant BA Green Club after she became its president as her most satisfying achievement. "This was because I strongly believe that a green club is a place and an opportunity to educate our peers on pressing environmental issues and convince more of them to be part of the green movement," she explained. She subscribed to the club's mission of inspiring students to become business leaders who spearhead sustainable initiatives in the workplace. This was the reason the

club chose to collaborate with businesses to organise learning journeys or invite business speakers to share about their sustainable initiatives, she added. In Yasmin's view, "any professional with a passion for sustainability would be able to create an impact because sustainability development can be implemented in almost any area of a business", not just green professionals and business managers. The 2019 NEA EcoFriend Award recipient was not expecting another public recognition for her green achievements. "I was just doing what I loved and am passionate about, doing my small part for Mother Earth," she shared. For her, the recognition marked another milestone on her environmental journey, after starting it in secondary school. She hopes her continuing journey will inspire more young people to do more for the environment.

Soh Jin Wen was admitted into NP through its Early Admission Exercise based on his green achievements at Compassvale Secondary School (CVSS). The former CVSS Environment Club's chairperson chose to study clean energy management for his course at NP as he was interested in learning about solar energy and wind turbine. After enrolling, he joined NP's Environmental Rangers Club before contributing as a committee member. He planned to practise what he has learnt at NP in the green industry, possibly as energy auditor or solar technologist, after obtaining his Diploma in Clean Energy Management.

In secondary school, Eunice Phua learnt about reducing, reusing and recycling and from excursions to pick up litter at public areas. Her first choice in polytechnic was optometry as she had a strong interest in science. However, she was attracted to the City in the Garden concept at that time and wanted to learn about plant biology, which is related to science. She therefore decided on the Landscape Design and Horticulture diploma programme at NP. After graduating in 2012, she was sponsored by Gardens by the Bay (GB) to pursue horticultural studies at the University of Queensland in Australia. She worked as an intern at GB, which was under development at that time. "It was quite a different concept to have a botanical attraction in Singapore with plants from all over the world. This got me

wanting to learn more," Eunice shared. Upon her return to Singapore with her degree in 2016, she started her career at GB. There she was recycling leaves and reusing display materials as much as possible.

Amplifying reach and impact with external partners

According to LSCT Green Volunteers Club's advisor Eng Boon Hwee, NEA and Tzu Chi Eco Awareness Centre have been providing opportunities for NP students to reach out to the community. For example, they served as event helpers and guides in the annual NEA's Clean and Green Singapore Carnival and participated in recycling events organised by Tzu Chi.

Singapore furniture maker Scanteak sees its collaboration with NP as a way to give back to the community through projects that add value to the polytechnic and its students. A few years ago, NP's design students upcycled cardboard from Scanteak's packaging to create fun and quirky products for the home. These were displayed at a public exhibition to promote the 3Rs (reduce, reuse and upcycle) at Ngee Ann City. "We believe that sowing the seeds of sustainable living in designers can help them internalise its importance to the environment," said Scanteak's CEO Jamie Lim, who donated her table for the CNA Green Economy project. Seeing how the partnership has benefited students, NP intends to repeat its collaboration with Scanteak, possibly on a larger scale in future.

Reduce, Reuse, Upcycle exhibition at Civic Plaza, Ngee Ann City, where NP's design students created fun and quirky products for the home with cardboard upcycled from its industry partner Scanteak's product packaging. (Photos:NP)

Always coming up with something 'Xtra'

Ngee Ann Polytechnic's Design and Environment (DE) team's design of a public toilet that was inspired by the pandemic for NEA's 2021 Iloomination competition reflected its value of embracing innovation in education. It is conceivable that future DE students will be "re-imagining public toilets" with NP Green Plan-inspired designs that reduce energy and water consumption while processing waste more efficiently. Such an outcome would also exemplify a culture of innovation among its students, who will contribute to the green economy.

Hot on the heels of NP's long ES journey and achievements is a new-found vigour on its campus. This may be evident on its newly launched Sustainability@NP microsite, which is a work-in-progress.

Qihua Primary School

Qihua Primary School (QHPS) saw the Covid-19 pandemic as an opportunity to develop its pupils as independent learners. The school's EAGLETS programme introduced in 2020 aims at "Empowering All Growing Learners To Soar" by "setting goals, organising their time, acting responsibly and reflect deeply", before 'flying off' to secondary school and beyond. The same spirit of teaching students is applied to its environmental education, one of the school's three thrusts for building their character under its Values-in-Action framework. QHPS started in 1938 as a 'kampung' school surrounded by nature. It was where pupils grew up learning about plants and wildlife from personal encounters. Today, the multiple-times recipient of the Singapore Environment Council's School Green Awards is poised to do and achieve much more for its students at the campus, curriculum, club, class and community levels. This is being realised through the Green Plan Committee guided by a senior teacher who has 20 years of experience in leading a secondary school's extraordinary green journey. The school's green impact is being amplified by students and alumni who are growing up as green champions.

The Greenarium represents the 'Third Teacher' at Qihua Primary School as a place for deeper development in environmental education with potential for farther growth in future. (Photo: Qihua Primary School)

Teaching primary students to soar higher and farther as independent learners and environmental champions

"Our roots go back to the farming community in 1938 and we endeavour to build on our heritage to serve society. The school aims to nurture a culture of innovation, care and learning in our students with the environment as their 'Third Teacher'. They are learning about sustainability through science taught in classroom and from the green features on campus. We see them growing up and soaring as environmental champions through more green learning opportunities initiated in partnership with the community."

– Lee Hui Feng, Principal
Qihua Primary School

First of new environmental learning packages to come

While reviewing the water trail lesson package that they have drafted, members of the Green Plan Committee at Qihua Primary School (QHPS) were excited. It was the result of their long discussion and deliberation, with much more work to be done on its implementation to ensure the best learning outcomes. The lesson package would be the first of more green-frontier projects to come. Besides interdisciplinary trails providing experiential learning opportunities for students through both physical and virtual platforms, the committee has identified smart urban farms for development as new green learning facilities. These will feature biodiversity, water and energy conservation, waste management and green building. Students will learn how technology in these sustainability areas is enabling the cultivation of a large number of edibles in a small area. This will contrast with the sprawling farms found in the countryside community where QHPS started as a 'kampung' school in 1938.

How and when QHPS started on ES journey

QHPS started using the recycling bin in 2001. In 2003, environmental topics like energy and water consumption were included in teaching science. However, it officially embarked on its green journey as an environmentally responsible educational institution as practitioner in 2005, as educator in 2013 and as advocate in 2018. The Green Club was set up in 2005 to propagate environmental conservation messages to all students. In 2008, the then Eco-Drive Committee started to look into ways to conserve resources, including rainwater-harvesting tanks for watering plants in the school.

What support school's long-term ES development

At QHPS, environmental education (EE) is part of character and citizenship education (CCE), which it considers to be as important as academic learning. According to the school, EE teaches students to respect and care for nature, to be responsible global citizens and to be aware that their actions will have an impact on the planet. EE also provides the context for teaching academic subjects like English, Mathematics and Science.

The school's ES initiatives are aligned with and supported by the school's values, mission and vision in providing a holistic education for students to acquire 21st century skills and competencies. QHPS envisions itself as "a school with a conducive and vibrant learning environment, serving as an educational platform for students to learn, inquire and experiment with, and develop innovative ideas and products that will bring benefits to the community". Towards this end, its Green Club Committee is working with the Applied Learning Programme Committee to develop its green advocates as confident and articulate communicators.

The Green Plan Committee's vision is for students to become curious learners, innovative leaders and sustainability champions. The school has been enhancing

its programmes, curriculum and facilities to develop them as ES champions with the necessary knowledge and leadership skills. It is creating student development opportunities for students to gain leadership experience by organising recycling competitions, presenting at green events and leading green trails during QHPS' open house.

For the school, the continued support of partners and the community is crucial in advancing and sustaining its ES programmes, events and activities.

Organising for long-term ES development

The school has identified internal stakeholders on its green journey as primary drivers who support and execute the Green Plan Committee's initiatives, and secondary drivers who work with the committee to achieve its goals. The first group comprises Green Club's teacher ICs and student leaders (green ambassadors). The latter consists of various departments – utilities management and school administration, curriculum-based teaching and learning, and marketing and partnerships teams as well as National Education and Values-in-Action (VIA) committees for liaison with external stakeholders. The core group of staff and students plans and executes ES initiatives while the rest of the school supports and aligns their activities where possible.

The Green Club plans and drives activities on campus and manages its resources. Its student leaders may give suggestions to the teacher ICs on how to implement planned activities better. Since 2019, green ambassadors appointed by form teachers for the classes help to coordinate activities organised by the club. They plan and execute activities within the class with guidance from their form teachers.

How QHPS students learn about ES and responsibility

Students learn about ES through participation in the school's green practices on and outside its campus, environmental education that is curriculum-based and

offers other learning opportunities, and ES advocacy/outreach to the community in and beyond school. QHPS' goal since 2021 is to enable students to graduate after six years with "a sense of ownership, care and responsibility towards the environment". They are expected to "feel empowered to make a positive impact, possess social and life skills through participation in a variety of projects relating to the environment" and articulate on environmental issues within the school and in the community.

What school has achieved in ES practices

QHPS placed recycling bags in all classrooms in 2013, adopted Singapore Environment Council's Kickstarter recycling programme for schools with its coloured bins in 2014, and has been using recycling bins for plastic and paper since 2018. In 2020, it replaced recycling boxes made from recycled paper with those made from plastic in classrooms, with a bigger box on every level.

Students making recycling boxes for classrooms (left) and viewing video on school's recycling points that was screened during recess. (Photos: QHPS)

The school's green features include motion sensors in toilets (since 2012), LED lights in general office and staff room, food waste digester (since 2018), recycling bins (including those for electronic waste) and a recycling corner.

What QHPS has achieved in ES education

The school started its environmental education in 2013, when "the syllabuses, programmes, activities and students' involvement at co-curricular activity (CCA), subject, class and school levels were all in place". Its EE curriculum developed from various sources over the years covered climate, energy, food, biodiversity, waste (3Rs, upcycling and littering), water and public health (tray/utensils return, dengue and toilets) for all six primary levels. The curriculum was strengthened with more science topics in 2021. Programmes and activities covered the same areas of focus as the curriculum. Those involving the whole school were VIA-related and held throughout the year, once a year or on an ad hoc basis. Others related to the Green Club, outreach to community and leadership development.

The school adopted the 3E approach (Engage, Enable, Enrich) in 2019 for developing and teaching its EE programmes, which are focused on climate change/weather awareness, energy and green technology, food, biodiversity, waste, water and public health. Students are engaged through school-wide VIA, event-based and ad hoc programmes, enabled through level-wide curriculum-based and Green Club activities, and enriched through leadership development and outreach programmes. The programmes and activities were developed progressively over time from 2000.

The school-wide Engage programmes cover all seven areas of focus and involve VIA, events and ad hoc activities held within and outside the school. One major activity is identified each year to generate interest among students and promote awareness of Singapore's current environmental concerns, such as recycling and food waste minimisation. It is complemented by other activities where possible. For example, the focus on waste minimisation in one year was accompanied by

weekly recycling efforts in every class and supplemented by an Appreciate Our School Cleaners Day event and upcycling projects.

The level-wide Enable programmes involve curriculum-based topics (under the seven areas of focus) and Green Club activities (within and outside the school). A few areas of focus are selected each year. Activities organised by QHPS and its partners involved competitions, learning journeys, sharing sessions, exhibitions and cleaning of public places.

The Enrich programmes involve leadership development training courses and outreach activities. The training courses for green ambassadors conducted by Green Club teachers currently cover food and waste management. The outreach activities conducted by the Green Club for QHPS' students, their parents and kindergarten pupils relate to topics under biodiversity and waste management.

QHPS' curriculum-based environmental education includes Applied Learning Programme (ALP) developed by the ALP Committee comprising English Language, Mathematics and Science teachers and chaired by HOD Mathematics, infusion of green contents by Green Club teachers in their subjects and learning journeys outside school.

Green features such as the eco-garden, eco-pond, greenhouse, vegetable farm, fruit garden, central garden, pond and rainwater-harvesting tanks are being used as learning facilities. The greenhouse is used to teach primary 3 students life cycle of plants.

The Greenarium opened in 2015 has separate zones for different types of plants – ferns, herbs, fruit trees and climbers. These provide first-hand learning experience for primary 3 students studying the diversity of plants and for learning about reproduction of plants at the primary 5 level.

Central garden (left) and greenhouse. (Photos: QHPS)

Primary 3 students studying the diversity of plants. (Photo: QHPS)

What school has achieved in ES advocacy

QHPS started the Green Club as a CCA from primary 3 onwards in 2005 to propagate environmental conservation messages in the school. Green Club's chairperson for 2021 Lee Sai Hoon recalled taking part in an exhibition in 2019, when the school reached out to pre-schoolers, parents and the public to share how

to use the food digester to recycle food waste and how plastic was endangering marine life. Since 2011, green advocates/ambassadors in each class have been helping to implement the Green Club's programmes and activities.

The school initiated its green advocacy and outreach to the community in 2018 with activities like neighbourhood and beach clean-ups. During its Innojoy open house, it hosted kindergarten students and their parents as well as members of the public. They attended the Green Club's presentations by student leaders on biodiversity and demonstrations of gardening and upcycling methods. In 2019, QHPS organised a Zero Food Waste campaign for its students, staff and canteen vendors, with Green Club members composting food waste and green ambassadors advocating clean plate and use of recycling bins. It informed students about forthcoming events through announcements during the morning assembly and posters on campus.

Beach clean-up by QHPS students. (Photo: QHPS)

Little Skool-House's kindergarten pupil learning from QHPS' students during its Innojoy open house. (Photo: QHPS)

Zero Food Waste campaign at QHPS canteen. (Photo: QHPS)

How and what students learn from green practices on campus and in community

Teachers serve as role models in green practices for students to follow. Such practices include switching off lights and fans when the classroom is not being used and recycling paper and empty bottles.

Students using old newspaper to wrap vegetables harvested in school (left) and reusable cleaning cloth for every student to use in classroom instead of wasting disposable paper towels. (Photos: QHPS)

The school also commemorates green events like Earth Hour, Earth Week, World Water Day and Youth for Environment Day with students' participation. For example, Earth Week in 2018 was marked with a 'no cleaners' week, two-week recycling programme in classroom, photography competition on reducing waste and carbon footprint, and sharing by Green Club members at morning assembly. In 2019, activities included cleaning of school's compound, Green Club's presentation at morning assembly, upcycling games during recess and movie screening after school.

World Water Day in 2018 was marked over two days with activities during assembly and recess. In 2019, an exhibition on reducing plastic waste was held on that day.

Morning assembly presentation by students to mark Earth Week. (Photo: QHPS)

How and what students learn about ES in classroom and outdoor

QHPS does not have a formal curriculum for environmental education based on MOE's guidelines. ES contents are "covered or used as context in as many areas as the school can think of". They may be taught through science lessons, morning programmes and form teacher's guidance periods, which are weekly one-hour CCE lessons. The morning programme covers recycling, water and energy conservation, and significance of ES events like World Water Day, Youth for Environment Day and International Day of Biodiversity. In science lessons, students learn about life cycles of animals and insects, water cycle and ecology (habitat, population, community, food chain, food web and pollution).

Posters explaining the symbiotic relationship between animals and the plants behind them. (Photos: QHPS)

Every class of primary 3 students learning about the life cycle of plants grows a batch of seeds in the greenhouse and gets to harvest the vegetables. Every week, students observe how the seedlings grow. The experience keeps them engaged and instil a sense of ownership in them.

Pupils using seeds from the previous harvest for planting in the greenhouse. (Photo: QHPS)

Green Club members grow vegetables such as sweet potatoes, lady's fingers, brinjals, chilli, lime, 'kangkong' (water spinach), beans and bitter gourds. From the experience, students learn that labour is required to cultivate food before it can be harvested for eating. "Pupils realised the hard work and 'heart work' put in by farmers," the club's Teacher IC Shirley Vanishri shared. They are being taught that food cannot be wasted as much effort has been spent on it.

Student learning to care for sapling in pot made from recycled plastic bottle by a Green Club member. (Photo: QHPS)

Inter-class recycling competitions and morning talks on ES continued during the pandemic when the school was not on full home-based learning. Two groups of students, each for three levels of classes, collected recyclables on alternate weeks for the recycling competition.

Overcoming challenges along the way

According to the school, many efforts in green practices are incremental and experimental. Its ES achievements to date resulted from "years of baby steps". To encourage students' participation and adoption of green habits, it has initiated fun activities, sent out green messages frequently throughout the year, and included competitions and rewards.

Competition for primary 4 students involving sail cars made from recyclable items. (Photo: QHPS)

Leadership transition due to staff movements means that planning for ES efforts in the shorter term would be more practicable. As some of the ES initiatives were implemented by different teachers who might have left the school over the years, ensuring their continuity may sometimes pose a challenge.

Values underpinning QHPS' commitment to green cause

QHPS' provision of primary education is underpinned by respect, responsibility, integrity, teamwork, care and resilience. What underpin its environmental responsibility and drive it ES initiatives are respect, responsibility, teamwork and care. The school believes that nature or ecosystem and biodiversity are intertwined.

Students and staff learn to work together to respect and care for other living things while co-existing in a common space in a responsible manner, so as to live in harmony with nature. The former 'kampung' school is thus continuing with its heritage in farming and food security and sharing the fruits of its labour with the community where it belongs.

Achieving more through school's three-year green plan

The school's Green Plan 2012-16 adopted a "Structured Value Inculcation" strategy that looked at six key areas for measuring the impact of its programmes and activities:

- Percentage of students participating in green activities
- Percentage of students who gave favourable feedback on EarthCare activities
- Percentage of students who received the Young Environmentalist badge
- Number of partnership projects with the community
- Number of awards received from national green competitions
- Number of ideas adopted by school to conserve resources.

The current three-year plan prepared in 2021 included elements of the Singapore Green Plan 2030. It aims to augment the existing programmes by firming up the calendar of green events for each year, creating awareness of the events among staff and students, and strengthening the environmental education (EE) curriculum. The Green Plan Committee plans to open thematic green trails on water and energy conservation, recycling and biodiversity in phases, among its new initiatives to strengthen the EE curriculum. It will also enhance the school's green features and practices by:

- Increasing the number of bird- and butterfly-attracting plants
- Adding more water plants to attract frogs and other amphibians
- Labelling plants and trees in school for students and staff to know the different species

- Recycling Tetra Pak cartons and e-waste
- Placing more recycling bins for paper, plastic and cans at strategic locations on campus.

For 2021, the plan shown below was updated as and when necessary, in response to new external developments. Only the water trail was not implemented that year.

Month	Activities/Events	Level	Remarks
January	SIR 30 minutes on procedures/processes on use of recycling bins	Whole school	Awareness through talks Competition on recycling
February	Food waste	Whole school	
March	22nd – World Water Day Water-rationing exercise Earth Hour (last Saturday of March) – electricity	Whole school	Awareness through Posters, TVs outside general office and in canteen
April	22nd – Earth Day (focus on recycling)	Whole school	
May	22nd – International Day for Biodiversity NParks Green Wave	Whole school Putting compost around trees - P4	
August	Water trail	P5	Cancelled - to work on the activities
October	Recycling (Clean and Shine) Collection of used files, etc	Whole school	

Achieving more through leadership at school level

QHPS' ES initiatives are being led by the Green Plan Committee, which was formed in 2013 to set the direction and plan for its environmental education, with members appointed by the principal. Chairing the committee since 2020 is Science teacher Shirley Vanishri as Teacher IC. She is assisted by three mathematics and language teachers who handle ICT-related matters and recycling activities. The committee plans and executes activities on Earth Day and World Water Day as well as conducts sharing sessions during the morning assembly. Recalling QHPS' participation in SembWaste's Ezi Recycling competition in 2021,

Shirley thought it was particularly satisfying, as it enabled the school to reach out to the students' parents and families and the community. Not only did the students collect recyclables from their homes and bring them to school every week, their efforts were recognised with the school receiving the bronze award from SembWaste.

Students lugging bags of recyclables to school and placing them into designated bins for SembWaste's Ezi Recycling competition. (Photo: QHPS)

HOD-ICT Heng Chong Yong, who is also a form teacher teaching Mathematics and Science, serves as advisor to the Green Plan Committee. The 2017 NEA EcoFriend Award recipient guides the committee on the direction, programmes and activities for advancing environmental education at the school. The principal and vice-principals are also advisors.

QHPS' principal sharing the importance and significance of recycling to students during recess. (Photo: QHPS)

Achieving more through leadership at green club level

Shirley Vanishri is also Teacher IC of the Green Club, with three teachers in English and Mathematics assisting to take care of two groups of members. The upper primary students take part in exhibitions and programmes while those in lower primary are involved in gardening and farming. However, since 2020 both groups have been participating in all the activities. In Shirley's view, outdoor learning about plants and hands-on recycling activities have the most learning impact on students. She believes students learn best when they are doing as "the cognitive and active learning is very authentic". She added: "They are able to see the problems before them and to solve them accordingly. Students are able to reflect as individuals and this instils moral conviction."

Green Club activities for lower primary students included growing vegetables (left) and fruits. (Photos: QHPS)

Shirley enjoys the club's activities with students while teaching them about nature, often going beyond the syllabus. She teaches them how to grow their own food. "I am satisfied and happy when I see the pupils feeling very excited to see their vegetables ready for harvest after months of patience and nurturing," she shared. For Shirley, the environment is our home. "We have to educate our future generations on the importance of maintaining a balance in life," she added. "We have to make recycling and urban farming the new norm for a sustainable future."

Achieving more through passionate and dedicated school teachers

All QHPS' teachers, especially form teachers, teach environmental education as part of their responsibilities.

Aernie Sulaiman feels a sense of responsibility to protect the environment for future generations. As a Green Club teacher, she is happy to teach students to appreciate the environment by understanding green issues through participation in gardening, recycling, upcycling, biodiversity and other activities or projects. She also creates contents for EE lessons. In 2021, she developed a lesson on bird biodiversity in Singapore, besides an introductory programme to attract more students to join the Green Club.

Achieving more through passionate and dedicated student leaders

Lee Sai Hoon was motivated by his sense of responsibility to put his leadership ability to good use as chairperson of the Green Club in 2021. He found it satisfying and enjoyable to share his green knowledge with its members. He would explain the process of growing and caring for plants as well as guide them on how to transplant and harvest them. No wonder the school described him as a "very dedicated" green leader. From the leadership experience, he learnt to be more responsible, he shared. He added: "As a student leader, I feel that the school is doing its part through small acts to make the earth a better place. That means a lot to me."

In Sai Hoon's view, the school's recycling programme was the Green Club's most impactful initiative in 2021. He explained why: "We shared with parents QHPS' recycling efforts and encouraged family members to collect and keep recyclables for students to bring to school in recyclable bags." This way, the club was able to reach out to the community outside campus. The recycling initiative was also the most meaningful for Sai Hoon as a green leader, learner and advocate.

"Even during the pandemic, we continued to raise awareness of recycling at home. As a result, our parents became more familiar with what can and cannot be recycled."

When asked why he was passionate about protecting the environment, his reply echoed those of older student leaders: "If I don't do anything, who else would?" He believes in trying his best to lead with example to help mitigate the effects of climate change.

Students transplanting saplings (left) and tending a gardening plot. (Photos: QHPS)

Four primary 6 student leaders of the Green Club – Ain, Irdina, Jin En and Hazwani – were drawn to the club by its "fun activities". As they had gained much from their participation, they wanted to use what they had learnt to make a difference. Although advocating ES was not easy, they believed in leading by example, as their juniors saw them as role models. They felt the need to "be kind to the earth" and to repair the damages already done to it.

Providing more ES learning opportunities with external partners

QHPS' stakeholders include students' parents and the parent support group (PSG). PSG's support for its ES initiatives includes the mobilisation of parents to volunteer

as chaperons to students going on learning journeys, which may involve activities like minimising food wastage, recycling/upcycling and embracing biodiversity in future.

Community, government, non-profit and business partners provide opportunities, programmes and resources for students' learning. They include NParks, National Environment Agency (NEA), PUB, North West CDC (NWCDC), Woodlands Community Centre, Singapore Environment Council, Waterways Watch Society (WWS) and Sembcorp Industries. The first three partners have been providing green contents on waste management, energy and water conservation, and biodiversity protection to supplement those developed by QHPS teachers. Through WWS' Punggol Learning Adventure for Youths (PLAY), students learnt about water challenges arising from climate change, monitoring water quality, appreciating water and water pollution.

At Woodlands Environmental Day Exhibition by Woodlands Community Centre: QHPS student earnestly reaching out to advocate to a younger pupil. (Photo: QHPS)

NEA sees QHPS and other schools as its key stakeholders to drive environmental education and nurture future ES advocates. Nur Shafwaty Sa'at, Manager,

Community Engagement and Relations Department of its North West Branch, shared that NEA has trained the school's student volunteers as food waste reduction ambassadors to drive QHPS' Zero Food Waste campaign started in 2018. She added that the students gave talks during school assembly and guided fellow students on ways to reduce food waste during recess time. They ensured food waste was properly put into bins in the canteen and correctly deposited into the digester to produce compost for the school's vegetable garden.

NWCDC has been providing ES learning opportunities and resources for QHPS students since 2017. These include educational talks, forums, outreach sessions and funding, according to its Manager for Projects Rachel Goh Shan Jin. The CDC sees inculcating green habits during their formative years as "laying the foundation for raising an eco-conscious generation of students". Through the partnership, students learnt proper recycling methods, the importance of waterways through talks, games and learning trails, anti-littering habit and hygiene by picking litter in the neighbourhood, soft skills such as leadership and communication by reaching out to the community at Clean and Green Singapore @ North West Carnival, 3Rs through project funded by NWCDC, and dengue prevention through briefing sessions by NEA.

Students participating in a Clean and Green Singapore exhibition. (Photo: QHPS)

SembWaste of Sembcorp Industries has been collaborating with QHPS since 2015 under its Go-Green School outreach programme to drive recycling efforts in schools that it serves. In bringing their recyclable items to school for recycling, students become more aware of the importance of recycling right, reducing their carbon footprint and adopting good habits in managing waste, according to Yvonne Tan, SembWaste's Project Executive, Corporate Development, Waste Management. She considered the Ezi Recycling competition introduced in 2021 as its most satisfying green initiative to date. "It is heart-warming to see the little ones lugging their recyclables to school and placing them into the designated bins," she shared.

Nurturing students as "Eaglets" to soar higher into the future

The school's Chinese name means 'rousing the learning spirit' of the young. It is nurturing and preparing its fledging pupils through the EAGLETS programme (Empowering All Growing Learners To Soar as independent learners) to "SOAR" (Set goals, Organise time, Act responsibly, Reflect deeply) as they grow up. Before they 'fly off' to secondary school and beyond, students are learning about environmental sustainability and to serve the community where they belong as green ambassadors.

Meanwhile, QHPS is developing its "Green Zone" microsite in earnest progressively, to "provide information for our students to learn independently" and to "encourage them to explore" the new green frontiers. This work-in-progress is in tandem with its real-world journey as green educator, practitioner and advocate for a sustainable future.

About E-Book's Co-Sponsors

Singapore Pools

Singapore Pools is committed to limiting our impact on the environment by optimising our business processes and use of resources, and we aim to be a role model for green practices in the community.

To achieve these objectives, the Green Up! Committee was formed to strategise the company's "green" journey by driving key eco-initiatives with a whole-of-organisation approach.

Some of the committee's key initiatives included waste and water management guidelines, installation of solar panels on the rooftop of Singapore Pools Building to provide renewable energy to supplement electricity supply, and the purchase of electric vans to cut oil consumption, reduce carbon emissions and save costs.

In 2013, Singapore Pools received the Green Mark GoldPLUS award from the Building and Construction Authority of Singapore for the Singapore Pools Building. We were also recognised as one of the pioneer organisations in Singapore to achieve the Singapore Standard 564 Green Data Centre Standard for our energy-efficient data centres. In 2017, Singapore Pools was awarded the Eco-Office Certification, which underscored its commitment to be an environmentally responsible organisation. To further align ourselves with the UN Sustainable Development Goals, we continue to focus on lowering the organisation's carbon footprint through digitalisation and by providing more community support for eco-initiatives.

Singapore Pools was established by the Singapore government on 23 May 1968 to provide safe and trusted betting to counter illegal gambling. As a not-for-profit organisation, all of its surpluses are channelled to Tote Board to fund a wide range

of causes in the social service, community development, sports, arts, education and health sectors. Since 2004, over $5 billion have been channelled to Tote Board.

In addition, Singapore Pools contributes about $2 billion annually to the Government in the form of taxes and duties. Our responsible gaming practices have been awarded the highest level of certification (Level 4) by the World Lottery Association's Responsible Gaming Framework since 2012.

DBS

DBS is a leading financial services group in Asia with a presence in 18 markets. Headquartered and listed in Singapore, DBS is in the three key Asian axes of growth: Greater China, Southeast Asia and South Asia. The bank's "AA-" and "Aa1" credit ratings are among the highest in the world.

Recognised for its global leadership, DBS has been named "World's Best Bank" by Euromoney, "Global Bank of the Year" by The Banker and "Best Bank in the World" by Global Finance. The bank is at the forefront of leveraging digital technology to shape the future of banking, having been named "World's Best Digital Bank" by Euromoney and the world's "Most Innovative in Digital Banking" by The Banker. In addition, DBS has been accorded the "Safest Bank in Asia" award by Global Finance for 13 consecutive years from 2009 to 2021.

DBS provides a full range of services in consumer, SME and corporate banking. As a bank born and bred in Asia, DBS understands the intricacies of doing business in the region's most dynamic markets.

DBS' sustainability pillars

As it works towards becoming the Best Bank for a Better World, DBS' approach to embedding sustainability in the fabric of its business is strategically centred on

three sustainability pillars – responsible banking, responsible business practices, and impact beyond banking.

- Responsible banking: Responsible banking practices support customers' transition towards lower carbon business models, enhance their access to ESG investments, and deliver customised retail solutions to meet their specific needs.

- Responsible business practices: Doing the right thing by its people, and embedding environmental and societal factors in its business operations.

- Impact beyond banking: Being a force for good by championing social enterprises – businesses with a double bottom line – and supporting community causes such as those that are driving positive environmental and social impact.

In doing so, DBS empowers its stakeholders to take meaningful action to build a more sustainable future for all. Of the many sustainability challenges that the world is facing today, the bank is prioritising climate action given its urgency and how climate change is interrelated with other environmental and social concerns. Climate-related risks and opportunities affect how businesses are run, and how investing and financing decisions are made. As such, DBS is committed to and making strides in sustainability from the inside-out.

Responsible banking

Key areas that DBS is focused on include accelerating the transition to a net-zero future and continuing to dial up efforts around climate impact. In 2021, it became the first Singapore bank, and among the first 100 banks globally, to sign up to the Net-Zero Banking Alliance (NZBA), committing to align its lending portfolios with net-zero emissions by 2050.

DBS was also the first Singapore bank to commit to zero thermal coal exposure by 2039. Since 2021, the bank has ceased the onboarding of new customers who derive more than 25% of their revenue from thermal coal and will lower the threshold over time. DBS will also stop financing customers who derive more than 50% of revenue from thermal coal from January 2026, except for their non-thermal coal or renewable energy activities, and lower the threshold as time progresses.

It is also committed to empowering and supporting its customers on their sustainability journeys. In addition to rolling out client education and engagement initiatives, and curating a suite of sustainable portfolios that consider ESG risks and ratings, DBS was among Asia's first banks to integrate MSCI ESG Ratings into its wealth product suite. This is to provide clients with greater transparency over the ESG characteristics of their portfolios and empower them to make more holistic investment choices.

In March 2021, DBS Private Bank announced its ambition to have more than 50% of private banking assets under management in sustainable investments by 2023 – a goal that it successfully achieved ahead of time in just eight months. Given that many private banking clients are business-owners or in positions of influence and are well-placed to drive change, DBS seeks to go beyond ESG investing to also work with them to enact positive impact through other ways, such as the businesses they operate, and their philanthropic or social impact efforts.

DBS is also focused on providing simple and accessible solutions that enable customers to adopt more sustainable lifestyles. These include innovations such as the DBS LiveBetter platform on the bank's digibank app, where users can easily access eco-friendly tips, donate to local green causes, invest in sustainability-themed funds, as well as track and offset their estimated carbon footprints. Within just six months of its launch in October 2021, DBS LiveBetter attracted close to 200,000 unique users and helped many to play a more active role in doing good – more than SGD 8.2 million was channelled into sustainable investments,

and over SGD 673,000 in donations were made in support of various environmental and social causes.

Other recent innovations include the DBS Green Solutions package, a holistic suite of sustainable living solutions that comprises innovative offerings (such as transportation, payments and purchases) for customers to integrate green practices into their lifestyles, and the DBS Live Fresh card, the bank's first eco-friendly credit card that rewards cardmembers when they patronise selected eco-friendly and sustainable businesses.

Responsible business practices

DBS strongly believes in doing the right thing by its people, and embedding environmental and societal factors in its business operations. Key to this is the notion of creating trust in society, which can only be done on the principles of transparency and fairness.

Among the bank's wide-ranging initiatives is its commitment to achieving net-zero operational carbon emissions across its markets by the end of 2022, with its Singapore operations to rely solely on renewable energy by 2030. The bank is also reducing the energy consumed through its operational footprint. For example, in July 2022, DBS announced the opening of the newly refurbished DBS Newton Green, one of its oldest office buildings that has been retrofitted as Singapore's first (and one of only 500 such commercial buildings globally) net-zero energy building.

Impact beyond banking

Cognisant of its responsibility to society, the bank launched DBS Foundation in 2014 with a SGD 50 million fund to mark its commitment to creating impact beyond banking for a more sustainable world. In early 2022, on the back of the pandemic which upended livelihoods and cast a spotlight on a wide range of social issues, DBS set aside an additional SGD 100 million to advance its efforts

in improving lives in Asia, such as by catalysing the work of DBS Foundation and supporting other philanthropic and crisis relief measures.

DBS Foundation is focused on creating impact and improving lives through championing social entrepreneurship and preparing communities for the future.

Under its "Business for Impact" chapter, DBS Foundation enables and nurtures social enterprises in Asia, with the aim of scaling their innovative solutions to address growing social and environmental issues. In addition to its flagship grant programme, the Foundation also provides social enterprises with wide-ranging support in the form of advocacy, skills-training, capacity-building and business opportunities, among others.

In addition, DBS Foundation's "Community Impact" chapter seeks to prepare communities for the future by equipping them with future-ready skills and reducing food waste.

Conint

Conint recognises the impact and importance of sustainability in the built environment. It has adopted green initiatives at all levels, from office operations to site management to industry collaboration. At the workplace, the company reduces its carbon footprint by using less floor finishes and ventilating work areas regularly to ensure good air quality. It has a weekly practice of opening all the windows and turning off the air-conditioners at the office. The company's policy of reducing, reusing and recycling has resulted in less waste and wastage.

Conint's construction practices involve designs and plans to address waste and carbon emission before starting a building project. This is achieved by using only certified green building materials and implementing work processes to reduce

carbon footprint. In addition, the company reuses and recycles, wherever possible, construction waste such as timber, hardcore and reinforcement materials.

For its efforts, Conint has been certified by the Building and Construction Authority (BCA) as a Green and Gracious Builder since 2016. It was awarded BCA's Green Mark Platinum for the proposed construction of Block 22 at Ngee Ann Polytechnic and the Green Mark Gold for the design and construction of a proposed 33-room boutique hotel.

Conint believes that the concept of sustainability should be taught to the young to inculcate values for looking after the earth and cultivating green practices. Children should learn how they impact the environment and how they can help in ensuring a sustainable future. Parents may set examples to raise awareness and encourage their children to adopt green habits in their daily life. In addition, parents' demonstration of respect for and appreciation of nature would go a long way in nurturing children's support for going green. The company believes schools can play a critical role in creating opportunities for students of all ages to connect with nature and engage in projects that help them understand their roles and responsibilities in environmental sustainability.

Conint supports initiatives that advance the green movement.

This e-book features Singapore special education, primary, secondary and pre-university schools' extraordinary environmental sustainability (ES) journeys and achievements. It aims to inspire climate change actions through their examples in ES practices, education and advocacy. The stories include the schools' unique story propositions gleaned from in-depth interviews with their leaders and teachers, student leaders and external partners. They tell how students learn from the schools' ES practices, programmes, projects, partnerships and promotional activities through their participation as learners, practitioners, competitors, innovators, advocates, ambassadors as well as teachers to other students and the community.

What some featured schools' leaders say...

"Everyone can play a part in safeguarding the environment. For persons with special needs, it is even more critical that they receive the right education and guidance to become more aware of how they can contribute to environmental sustainability."

– Subash Lazar, Principal, ASPN Delta Senior School

"The school aims to nurture a culture of innovation, care and learning in our students with the environment as their 'Third Teacher'. We see them growing up and soaring as environmental champions through more green learning opportunities initiated in partnership with the community."

– Lee Hui Feng, Principal, Qihua Primary School

"We want our students to step up from advocating environmental sustainability to creating new knowledge and solutions through design and innovation for sustainable living."

– Ng Boon Kiat, Principal, Commonwealth Secondary School

"The future begins here and now. What we do today will impact our tomorrow."

– Tony Low, Principal (2017-21), Dunman High School

"We will intensify our efforts in shaping an eco-campus, instilling a collective responsibility in environmental sustainability, driving green research and solutions, and grooming environmental vanguards and professionals for a green economy."

– Lim Kok Kiang, Principal & CEO, Ngee Ann Polytechnic

About the author

Joachim Sim is a retired Singaporean who cares deeply for his grandchildren's future. He 'retyred' as an independent writer, editor and publisher and has six books on social and environmental responsibility, lifelong learning and Singapore's future to his name. This is his first book on environmental education, which was inspired by the sections on re-imagining Singapore as a learning and sustainable nation in his 2015 SG50 book 'Beyond 50: Re-imagining Singapore'.

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