



ISSUE

1

JUN 2020

i saw the
SCIENCE

OF SOWING:

By **EUGENE WAMBECK**



We started the year with jubilant expectations for a new decade of change. In recent months though, an obscure virus has dominated the news and our thoughts, foreshadowing the joy of major events around the World such as the Tokyo 2020 Olympics. Despite the gloom, and desperate measures most countries have been forced to take to contain the virus, the human spirit remains strong. We've seen great examples of neighbourliness and sacrifice to help one another tide through this crisis. On the scientific front, there is a silver lining as well. Whilst conditions are tough for every one and some fear prevails, there has been an unprecedented effort to increase scientific communication. These efforts are crucial to explain what we know about the virus and illustrate how preventive personal hygiene measures can help to lower the risk of spread. We have also witnessed increased information sharing and collaborative research among research institutions to spur a faster development of solutions to combat the virus.

This year should have been the year to cast our sights on the future. Sustainability was the prevalent

topic last year. It should be a recurring theme to guide our efforts to develop society even as we push through this decade. It is fitting then that the United Nations has declared 2020 as the International Year of Plant Health. The UN General Assembly see this year as an opportunity to raise awareness on protecting plant health in order to end hunger, protect the environment and sustain economic development. It is a clarion call for measured stewardship!

In this maiden edition of *I Saw the Science*, we echo the United Nations' 2020 theme and cast the spotlight on plants. They inhabit the Earth with us, but we often take plants for granted. 2019 saw vast swathes of the Amazon burnt. Our green lungs diminished and alongside the devastation, biodiversity was lost. Our articles bring out the simplicity of plants as a precious resource and remind us that our actions bear. We are inextricably linked to nature. Take this step to stoke your curiosity of plants. When you see these green miracles in a new light, you will undoubtedly wish to protect them. After all what is a green planet without its plants? 🌱

I SAW THE SCIENCE

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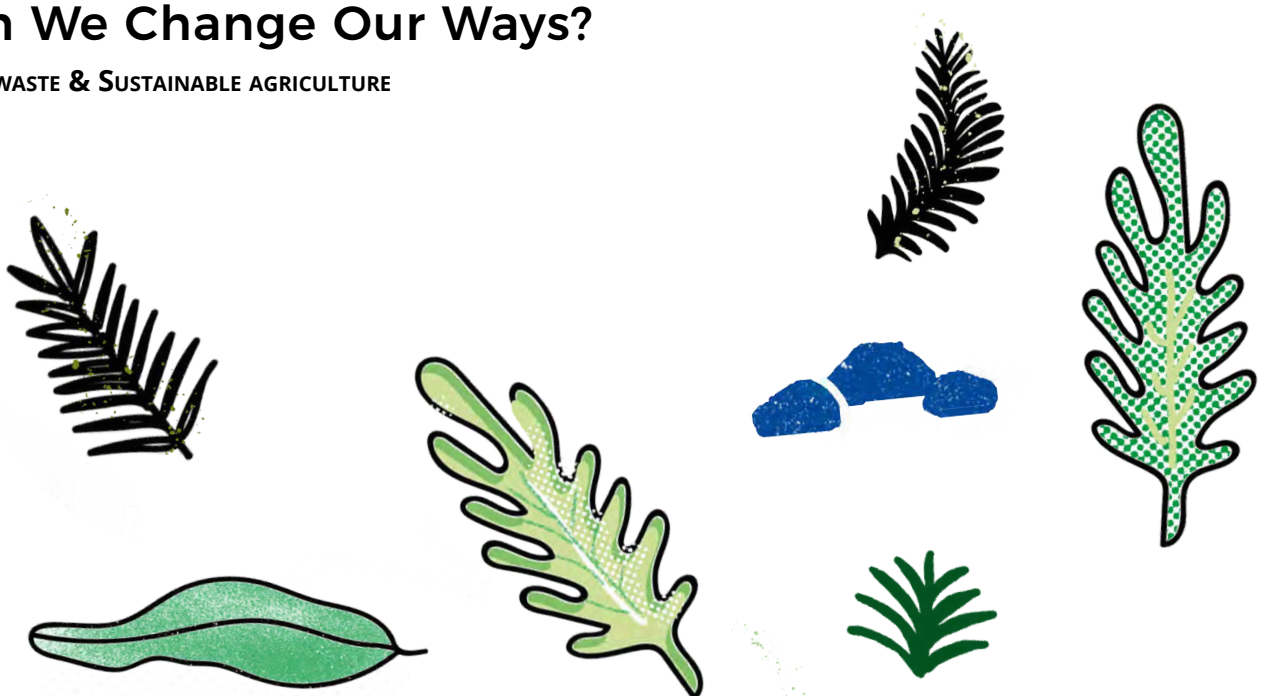
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NEVER ENOUGH FOOD:

Can We Change Our Ways?

FOOD WASTE & SUSTAINABLE AGRICULTURE



1 A STICKY SITUATION

Written by **RAPHAEL NG**

Illustrations by **TOH BEE SUAN**



Food was always something that inspired me. The way flavours and textures opened a world of experiences captivated my younger days. Most intriguing to me was the humble rice grain, which is actually the seed of a type of grass. This staple food for a large part of the world's population held culinary wonders. My interest in science led me to marry science and rice; to use science to learn about what gave rice its unique taste and texture.

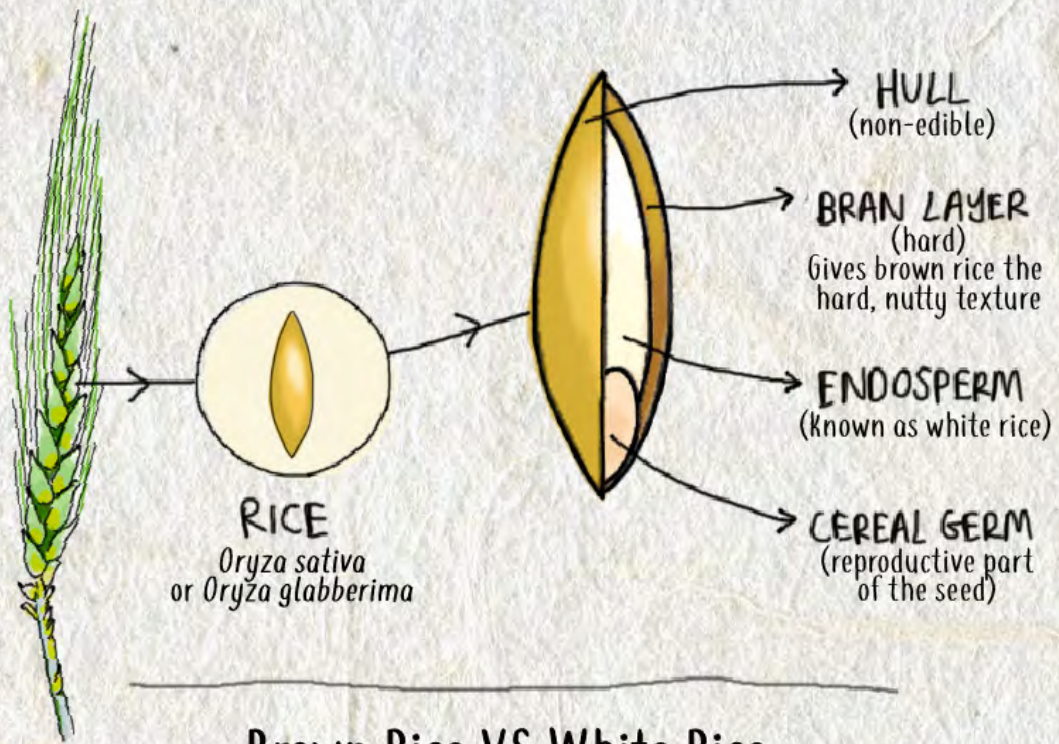
I used to be under the impression that brown rice and white rice tasted different as they were different types of rice, but I was wrong. Brown rice and white rice can be the same variety, even the same species. The only difference lies in the coating. Brown rice is a rice grain with only the inedible hull removed via milling, leaving the starchy endosperm, cereal germ and bran layer behind. White rice is, in fact, brown rice that has undergone further milling to remove the cereal germ and bran layer. The bran layer is the key to the harder texture, nuttier taste, and higher nutritional content of brown rice.

Another way in which rice can vary lies in the proportions of the type of starch it contains. Rice contains two forms of starch, amylose and amylopectin. The shorter the rice grains, the more amylopectin it contains, which makes the rice stickier when cooked. Likewise, the longer the rice grain, the more amylose it contains, making the rice less sticky when cooked. This stickiness in turn affects the texture of the cooked rice. So the next time you bite into the sticky glutinous rice that makes up your ba zhang or savour the fragrant basmati rice of your nasi briyani, appreciate the little things of rice which gives us life! 🍚

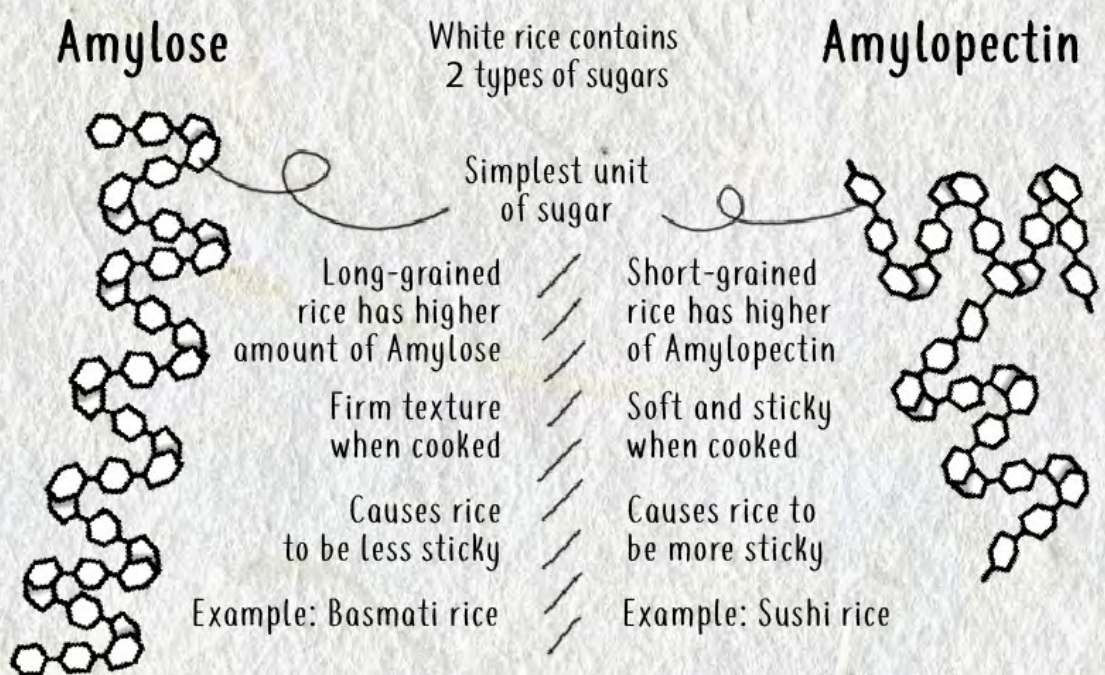
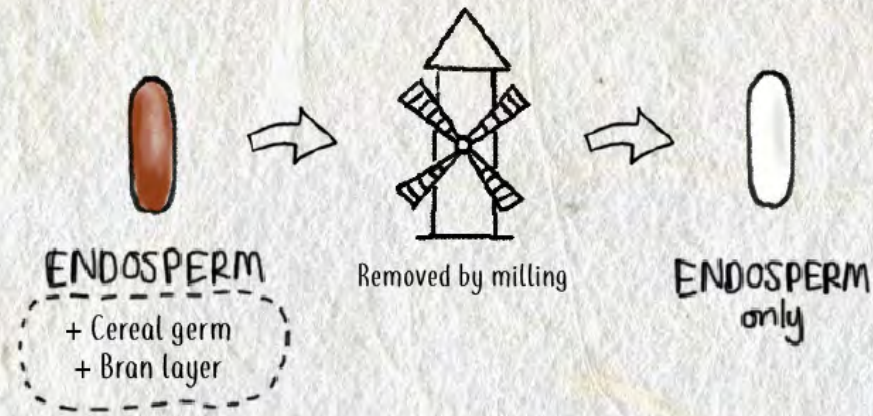


FUN FACT:

Rice is actually the seed of a type of grass!



Brown Rice VS White Rice



2 IT'S ALL GREEK TO ME

Written by **LIM MENG HWEE**
Illustrations by **TOH BEE SUAN**

Every species of living things has its own unique scientific name, following a system laid out by Carl Linnaeus in his book "Systema Naturae" in 1758.

The rules to naming a new living thing are very vague, it just has to be in Latin and follow a 2 name system with a genus and species name. This allows for some interesting backstories to sneak in according to the whims of the scientist who first described and named the genus. Here are some plants which carry with them beautiful Greek stories along with some pretty petals.

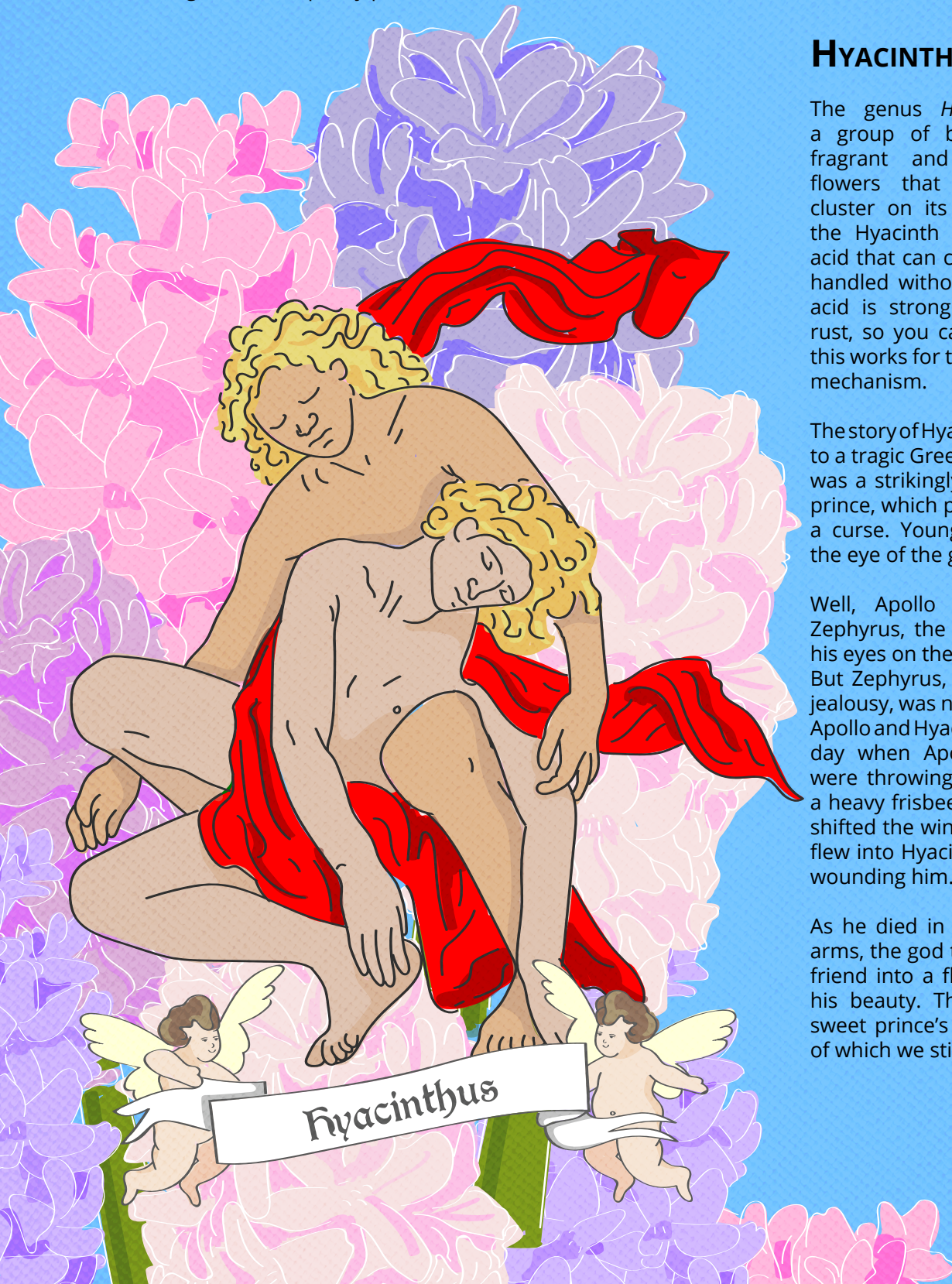
HYACINTH

The genus *Hyacinthus* refers to a group of bulbous plants with fragrant and brightly coloured flowers that group in a tight cluster on its stalk. The bulbs of the Hyacinth plant contain oxalic acid that can cause skin irritation if handled without protection. Oxalic acid is strong enough to remove rust, so you can imagine how well this works for the plant as a defence mechanism.

The story of Hyacinthus can be traced to a tragic Greek legend. Hyacinthus was a strikingly handsome Spartan prince, which proved a blessing and a curse. Young Hyacinthus caught the eye of the god, Apollo.

Well, Apollo was not alone as Zephyrus, the west wind, also had his eyes on the strapping young lad. But Zephyrus, bitten by the bug of jealousy, was not at all happy seeing Apollo and Hyacinthus together. One day when Apollo and Hyacinthus were throwing the discus (imagine a heavy frisbee) together, Zephyrus shifted the winds so that the discus flew into Hyacinthus head, mortally wounding him.

As he died in the grieving Apollo's arms, the god transformed his dear friend into a flower to immortalize his beauty. This flower bears the sweet prince's name of Hyacinthus of which we still call it to this day.





DEADLY NIGHTSHADE

One of the most toxic plants is the *Atropa belladonna*, known as the Deadly Nightshade. Every part of this plant is poisonous, the roots being the deadliest, followed by the flowers and the sweet-looking berries. Ingesting just five of its berries can kill a child while 10 – 20 can kill a man.

Such is the potency of *Atropa belladonna*. Unbelievably, this deadly plant was once used in cosmetics to dilate pupils and make them seem more beautiful. Overuse of this plant could cause hallucination, blindness or even

death. Looks to die for?

Where did *Atropa belladonna* get its name from? Both the plant and the toxin found in it, atropine, get their name from an equally deadly being in Greek mythology: Atropos. She is 1 of 3 sisters collectively known as the Moirai, also known as the fate sisters.

Each one of the sisters had a specific role in governing the lives and destinies of mortals. There is Clotho who spins out the thread of life for all beings, governing over when one is born. Lachesis, who

measures out the thread with her measuring rod, determines what fate shall befall the individual. Lastly, Atropos, who cuts the thread of life with her shears, decides when and how one's life ends.

Also known as the "inevitable" or "unturnable" one, there was no bargaining or reasoning with the fate Atropos meted out. When she cuts off a life thread, that life will end. A fitting name for a plant (*Atropa belladonna*) that can do just the same.

GRAPES

Let us move on to something less deadly, grapes. The scientific name for this fruit is *Vitis spp*, but where does the Greek part come in? Grapes on their own are harmless, but after some processing, they become something else entirely: wine. Wine has been widely consumed and beloved by all cultures, even until today. For the Greeks, wine was associated with the god Dionysus who was literally the god of wine, among other things. The scientific names of other living things have sprouted from the humble grape and wine owing to the adventures of our Greek party god, Dionysus.

In his travels to spread the joys of winemaking to the rest of the European world, he went to the country of Assyria (in modern-day Iraq). There, he visited King Staphylos, Queen Methe and their son Botrys. Being a great guest that brought his own bottle, Dionysus wowed the royal crowd with his wine and proceeded to have a smashing party. Unfortunately, King Staphylos passed on the next day. In his honour, Dionysus named various aspects of the grapes and wine after the royal family. A bunch of grapes was called Staphylos, the state of drunkenness was called Methe, and the grapes themselves were called Botrys.

Fast forward to modern-day, when biologists in the 19th century looked into their microscopes to view bacteria that clumped together like a bunch of grapes. They named that genus of bacteria *Staphylococcus*, after the round-shaped bacteria (coccus) and Staphylos. These bacteria are responsible for a range of ailments including food poisoning, cellulitis and impetigo, with the latter two being skin infections caused by certain types of bacteria.



Methe we would know from methanol, a compound we label as an alcohol. The scientists named methanol after wine, though wine itself does not contain methanol, and the prefix "meth-" has stuck ever since. By the way, methanol is poisonous!

Botrys is a fungus that is commonly found on grapes called *Botrytis cinerea*. Under the right conditions, infected grapes can produce a sweet concentrated wine known as botrytized wine. This fungal growth on the grapes is also known as the noble rot.

The extent of Greek mythology's influence on scientific naming of some badass botany must have been quite the surprise! Interestingly, this influence lives on in modern life today – in science, arts, literature, language and brands.

Until next time, eat wisely and drink moderately.

Cheers! 🍷



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PLANT HEALTH: A High-rise Container Gardener's Journey

Written by **SAMUEL EIO**

Illustration by **JASREEL TAN**

My journey as a high-rise container gardener started about eight years ago. It was a thoroughly unremarkable beginning: after buying two adorable potted ivy and arrowhead plants from the nursery to 'beautify' our apartment, we (the wife and I) discovered to our horror that watering our new 'acquisitions' would cause water and soil material to drip out from the base of their pots!

Unwilling to damage furniture, wet flooring or risk dengue spread by placing a tray beneath the pots, we opted to position the plants outside our apartment along the common corridor (where we noticed most of our neighbours did the same). In a curious way, the first two plants we affectionately named "Jimmy" (the arrowhead) and "Albert" (the ivy), seemed to grow on us.

The original Jimmy is no longer there today, but I have Jimmy's great-great-grandson sitting in my office, right above my workstation. (Fun fact: he has travelled with me to four previous workplaces!) Sadly, Albert did not survive after we gave him away to a relative. Yet from these two plants, our lives have been positively changed in many ways. Something happens when keeping plants, or rather when plants are keeping you.



A foray into the world of plant keeping with (L to R): Albert, Jimmy, Scindy, Dracki and Tom.

OVER-WATERING

Shortly after starting with two plants in the corridor, I ventured to purchase a few more ornamentals and some herbs from the nursery: sweet basil, mint and thyme. Thus, I divided my little container garden into non-edibles and edibles. Around the same time, I bought a small planter tray which could be clamped to the corridor ledge so that the herbs received more sunlight. The edibles proved more challenging to upkeep. I didn't really have much success with thyme – my guess is that I must have over-watered it due to inexperience. The other two, basil and mint, simply flourished with the corridor's sunlight and my (over?) generous watering – or so it seemed.

PESTS & PLANT DISEASES

A little later, I noticed some sticky black streaks starting to form at the basil's stem. Initially (and being a total noob), I thought nothing of it. Little did I know, I was paying the price for my over-zealous watering. Some brown-grey patches appeared on the leaves, withering them! I still am unsure what exactly 'blasted' the basil, but some fungus or mildew was likely the culprit. A knowledgeable neighbour (Thanks, Uncle!) taught me to water the roots only, not overhead. The attack on the mint was more subtle – its leaves would appear unnaturally curved or curled with yellowish

patches, and the entire plant would look dry and under-watered, despite being regularly-watered. Boom! That was when I got my crash course in disease management in plants. It dawned on me that plant health was part of the whole gardening experience.

APHIDS

The tormentors of my plant – aphids – come in a few different species of winged and wingless pests. A quick search online will tell you that they have rather complicated life cycles, starting "life as eggs, laid on the host plant or on other plants. The eggs hatch into immature females, called nymphs, which shed their skins as they outgrow them, finally becoming wingless adults. They are viviparous, producing living young, which in time produce more young. Finally, winged females are produced which can migrate to other plants and lay eggs there." Okay, that made sense; now I know how these creatures got onto my healthy plant.

"Aphids feed by sucking the sap of plants, usually attacking young shoots and leaves." Check. Choice, tender parts – opportunistic pests.

"Some aphids cause extreme leaf curling. Some cause distortion of shoots, stems and flowers. Some cause galls and swellings. Some infest roots." Ugh. How disgusting. I hate aphids.



Close up 'post-mortem' of a cactus with aphid cast skins.

"Aphids also open wounds which may allow certain diseases to attack. Aphids excrete honey which attracts sooty moulds and these weaken and disfigure plants." Double-check. Now I know what is going on. However, the plot thickens.

"Also, certain virus diseases are spread by aphids feeding on diseased plants and then carrying virus-infected sap to healthy plants. As aphids are a serious pest, they must be controlled." Yes, I agree. But how? That particular source then went on to list a whole bunch of chemicals "suitable for the amateur" like dimethoate, formothion, rotenone just to name a few – which I had absolutely no experience with!

The thought of myself eating leaves which had been sprayed with weird chemicals (however diluted) made me feel very uneasy. As I contemplated abandoning my afflicted plants at the void deck, I resisted the urge to actually do so, telling myself that that was not the way as a responsible plant owner. I was determined to find a better solution to deal with the aphids.

MEALYBUGS

As if the aphid attack was not bad enough, things simply have a way of getting worse. A new enemy – soft-bodied and wingless, appeared as an insidious white cottony mass on the underside of the leaves and young stems.

"Mealybugs," says Ian Walls, "are particularly difficult to control "because of their waxy impervious covering, and because of their habit of gathering inside curled leaves...and in other hiding places." In my own experience, I have seen mealybugs attack plant stems and even on shallower roots. Both young and adult mealybugs feed by sucking plant sap from long mouthparts called stylets (think miniature drinking straws) and weakening the plants by depriving them of sap.

Mealybugs also excrete a sweet sticky substance called honeydew, that some species of ant find irresistible and 'milk' them for more of the liquid. Honeydew, in turn, attracts unsightly black moulds (known as 'sooty moulds') to grow on the plants, interfering the plant's healthy growth.

The solution to mealybugs' infestation? Apparently, alcohol is one of them. Dipping cotton-buds in rubbing alcohol and dabbing it on these critters is suggested; otherwise, there is the hassle-free option to prune out light infestations. Another control measure is to introduce natural predators like ladybugs and lacewings and the famed Mealybug Destroyer (*Cryptolaemus montrouzieri*).

Other control measures include using a stream of pressurised water to hose off the pests, or regularly washing leaves with a leaf shine emulsion made from neem oil. I experimented with cooking oil or olive oil mixed with dishwashing detergent (Mama Lemon), and that has worked in place of the expensive neem oil spray.

I really hope that my story and pictures of plant diseases do not discourage anyone from taking up high-rise container gardening! 2020 is the UN International Year of Plant Health. Living in Singapore, we may not take plant health as seriously as communities whose very subsistence depends on it. Still, we can all do our part to understand and promote a cleaner and greener Garden City. Sincerely wishing any prospective gardener – green fingers, thumbs or none – much satisfaction and enjoyment that plants bring! 🍀



Mealybug infestation on a hibiscus plant, a challenge for any plant enthusiast.

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4 NEVER ENOUGH FOOD: Can We Change Our Ways?

Written by **RAPHAEL NG**
Designs by **TOH BEE SUAN**

I'm sure you must have heard this saying: "Waste not, want not". As kids, our parents taught us the values of consuming only what we need. Who would blame them? In times past, food was not so abundant, and certain foods counted as "luxuries". These luxury food items were only consumed on special days such as New Year celebrations, birthdays and weddings. What were these foods, a curious me asked? Chicken came the response.

How times have changed! Chicken is consumed by most daily without a thought. Fast forward a few decades into our present times, humanity seems not to have spared a thought about consuming just what we need to sustain us. One of our country's leaders used to say: "Elegant sufficiency, not elephant

sufficiency"! Are Singaporeans consuming what we need? Or are we guilty of "elephant sufficiency"? It would seem we are guilty.

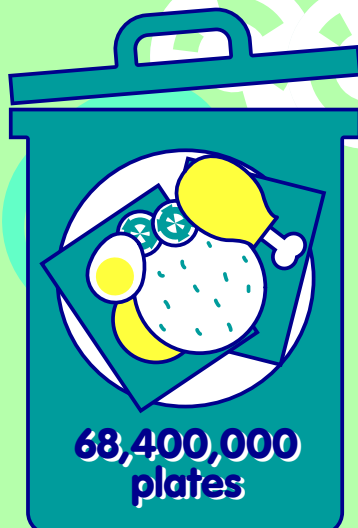
Singaporeans simply love our makan. But we do waste a lot too. We throw away S\$342 million dollars worth of food annually. To help visualise this, a Singapore Environment Council study equates this wastage to disposing a whopping 68.4 million plates of Nasi Lemak. You can just hear my heart shattering. So how do we square up with other countries? Perhaps the bigger question is with global consumption and wastage of food on the uptrend, can food production match up? Can agriculture still be sustainable?

So just what is sustainable

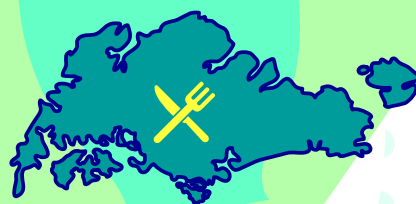
agriculture and why is it important? Sustainable agriculture can be thought of as agricultural practices or methods which ensure that our food needs are continuously satisfied, and are economically viable, while sustaining, or even improving the natural environment for future agricultural uses.

Our ancestors once relied on agriculture, or farming for a continuous food supply. In the modern era, farming is playing an increasingly impossible catch-up game with the needs, or should I say wants of us humans. To understand who is at fault, we just need to look at ourselves in the mirror. How many times does the food provided exceed the food consumed at buffets? I have walked past the tray disposal stands at eateries, seeing plates of half-consumed, wasted food. Humanity now asks for more food than we actually need. Perhaps this is a wake-up call to us to only consume what we need.

In order to catch up with the increased demand of food, agriculture has to turn to technology for help. This often involves the use of chemicals and machinery to help us clear land faster, plough fields faster and grow crops faster. Sounds good, doesn't it? However, the use of technology is a double-edged sword. These methods basically cause two problems. One, they cause long lasting damage to the soil. Two, they destroy the natural habitat of animals which are natural predators of crop pests around the farms.



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**Enough food to feed
whole of Singapore
for a week.**



We can literally feed the world from the 'trash' we generate. This food is still perfectly fit for consumption.

With these two combined, it makes it even harder for us to grow crops on the land in the future, causing us to use more chemicals, resulting in even more damage to land... Well, you know how that will turn out. With so many chemicals used, some of those chemicals leach into the groundwater, eventually finding their way into the sea and marine ecosystems. This also becomes our problem when the crops we grow take in that polluted groundwater. The chemicals then find their way into our stomachs when we eat the crops and they definitely aren't good for our health.

So, what's the deal behind all these practices? We want more food than we actually need. Demand for food increases. Farming corporations need to meet these demands (or they want to make more money). Those corporations use unsustainable practices to produce food faster. The environment gets damaged, and this wicked cycle repeats itself unabated. Due to unsustainable farming practices, up to 24 billion tons of fertile soil is lost every year. That is the weight equivalent to 4 billion elephants! This is the sad reality of unsustainable modern agriculture methods.

Fortunately for us, science has also helped us to more or less, reinvent the wheel, with some improvements too. Farmers of the past utilised a method called crop rotation. They practiced a cycle of growing crops, where after growing and harvesting one type of crop, they grew another type of crop on the same plot of land, without affecting the ability of

the soil to nourish crops many years down the road.

Of course, back then the farmers had no in-depth understanding of science. Science today has let us discover how the cogs work behind the idea of crop rotation. Scientists have uncovered the properties of various agricultural crops accurately, therefore allowing us to group crops that can be grown within an annual crop cycle. We can alternate nitrogen-fixing crops such as legumes with nitrogen-depleting crops to ensure that the soil is always rich in nitrogen, an element necessary for plant growth. We can also alternate deep-rooted crops such as alfalfa with shallow-rooted crops like cereals to ensure the soil structure is open, allowing for good drainage of water.

Fertilisers break down into nutrients and other chemicals

Plants take in the nutrients they need



Unused, harmful chemical mixes with the air, soil and groundwater

Environmental pollution results

Harmful chemicals enter our body when we breathe polluted air or consume polluted water and food

Technology has also allowed us to develop vertical farming. Imagine instead of one open

The infographic is set against a light blue background with a pattern of darker blue dots. At the top left, a circular diagram with a yellow center and blue border shows a clockwise cycle: 'Light Consumption' at the top, 'Soil Enriching' on the right, 'Heavy Consumption' at the bottom, and 'Light Consumption' on the left. To the right of this are three columns of crop icons. The first column, 'Crops that do not need much nutrients to grow well', includes Onion, Garlic, Potatoes, and Peppers. The second column, 'Crops that consume large amount of nutrients', includes Tomatoes, Broccoli, Corn, and Peas. The third column, 'Crops that enrich nutrients in soil', includes Beans and Peanuts. Below these is a comparison: '1 vertical farm' (represented by a stack of four trays with plants) is equal to 'Up to 10 regular farms' (represented by a large field of plants and a watering can). To the right, a crossed-out apple icon is equal to '24,000,000,000 kg of fertile soil lost every year', which is further equal to '4 billion elephants!' (represented by an elephant icon).

“Elegant sufficiency, not elephant sufficiency”

field, we now have stacks of crops growing on top of one another. These vertical farms can also be housed in greenhouses where green methods are used (pun intended). Vertical farms also utilise methods like crop rotation within the farm, and do not use chemicals or machinery that damage the environment. With vertical farms, we can now grow a larger number of crops simultaneously on the same plot of land. This reduces the need to clear land for agriculture, thereby reducing the damage done to the environment.

Vertical farms are on the rise in our homeland of Singapore, where food is not a natural resource, and land for farming is scarce. Packet Greens, a vertical farm in Singapore, only takes up the space of two 3-room HDB flats, and can produce 30kg of vegetables daily, while requiring only three people to harvest the produce. Larger companies of vertical farming in Singapore include Sky Greens, where they can produce up to 10,000 kg of vegetables a day. The vertical farms of Sky Greens tower at nine metres in height and are capable of producing up to 10 times the amount of crops compared to regular farming methods given the same area available.

Science and technology can provide some solutions to unsustainable agriculture. Ultimately, human choices are the key to shifting agricultural practices to the sustainable sort. How so? Remember how the increased demand for food results in a shift to unsustainable agricultural methods to suit the demand? We can start off by limiting our food consumption and purchases to what we need.

How we shift our consumer spend might also help in supporting a shift toward sustainable agriculture. We can use our spending to support the push behind sustainable agriculture by buying food from corporations or farms that use sustainable practices. When we create more demand for foods based on sustainable agriculture, it is only a matter of time before farming corporations also make the change.

Together, we can build a more elegant and efficient agriculture worldwide.

So the next time you find yourself at a buffet line or other chow down spot, remember elegant sufficiency, not elephant sufficiency. Certainly helps the waist line, if not your wallet too! 🍷

5 GOLDEN SUNLAND INTERVIEW

Interview with **DAVID CHEN** By **RAPHAEL NG**
Illustrations by **TOH BEE SUAN**



Golden Sunland is a company that is built on the principles of harmony between businesses and individuals to ensure profitability and progress within the rice industry. David Chen, the COO of the company, entered the hybrid rice industry with Golden Sunland in 2008. His passion for meaningful partnerships and his entrepreneurial abilities have helped achieve the company goal and vision of "Growing Rice, Growing Lives", where balance and growth of the rice industry and rice farmers are in harmony.

Here we meet David for several questions on his passion and his love for rice.

Q1: IN YOUR OPINION, WHAT ROLE CAN SINGAPORE PLAY IN THE GLOBAL AGRICULTURE OR AGRITECH INDUSTRY?

A: At first glance, it is easy to look at Singapore as an agritech incubation hub, but we have the potential to be much more. Singapore is the nexus of technological innovation and financial markets. We are in the best position to provide an inclusive solution for the global

agriculture sector despite our urban environment. We are equipped to reshape smallholder farming, a struggling sector that produces majority of our food, yet is frail against the unstoppable force that is climate change. All it takes for us to make a change is a mindset shift.

Q2: WHAT INSPIRED YOU TO JOIN THE HYBRID RICE INDUSTRY?

A: I could not understand why the technology of hybrid rice scientifically works, but still has such a checkered past. Soon it became clear to me that the traditional business model was the limiting factor. I was lucky to find people who were equally passionate about bringing technology to ground and bringing about real impact. We did not join the hybrid rice industry per se, we are here to innovate how business is done in this sector.



Q3: WHAT DO YOU THINK ARE THE PRESENT AND FUTURE CHALLENGES IN THE RICE INDUSTRY?

A: In the rice industry, culture, environment, politics and many other factors are intertwined. The status quo is unsustainable. Rice, which is the staple for more than half of the global population, is being produced by people from the bottom of the pyramid. When the supply is vulnerable and threatened, our future is bleak. It is unrealistic to assume we are going to switch staples in a big way, therefore rice will remain both contributor and victim of climate change. The future of rice starts with quantification of environmental and social impact, followed by series of mitigation or adaptation.

Q4: WHAT 3 POINTS ABOUT RURAL RICE FARMERS WOULD YOU WISH THE WORLD WOULD KNOW ABOUT?

1) A rice field about the size of a soccer field feeds about 40 Singaporeans for a year (assuming that there is 40kg per person consumption per year and a yield of 3,000 kg of rice per hectare).

2) It takes about 5 months from preparation to sowing to harvest and selling the produce in the market. Now imagine working for 5 months without wage. Next, imagine how devastating it would be if crops are destroyed in the 4th month.

3) They are hardworking, passionate people who deserve our gratitude. It does not take much, we can all start by not wasting rice.



It takes about 5 months from preparation to sowing to harvest and selling the produce in the market.



Q5: GOLDEN SUNLAND'S VISION IS "GROWING RICE, GROWING LIVES". IN YOUR OPINION, HOW DOES RICE CONNECT THE LIVES OF FARMERS AND CONSUMERS?

A: 粒粒皆辛苦, every grain is hard work. If consumers take a moment to appreciate the 150 days of hard work and emotional stress farmers go through to produce that mouthful of rice, we hope it will trigger enough empathy and appreciation to stop them from throwing away what is left on their plates. Food security is not just a matter of increasing production, but also about waste reduction.

Q6: IN 50 WORDS, CAN YOU DESCRIBE THE SCIENCE BEHIND GOLDEN SUNLAND'S RICE?

A: The three-line hybrid system creates F1 that have stronger traits than its parents, mostly in the department of productivity. These parents are distant relatives unlike traditional self-pollinating inbreds.

The hybridisation process happens in the field and this is a non-GMO approach. *Refer to Glossary

Q7: WHAT ARE YOUR TOP 3 FAVOURITE RICE DISHES AND WHY?

1) Plain Brown Rice – Not just any brown rice, but freshly harvested unpolished rice from our partner-farmers' fields. It has a unique barley fragrance and it is my own blood and sweat.

2) Briyani – Globamatsoul Kitchen serves one of the best Briyani I have eaten. I have high regards for the chef simply because he refused to use our brown rice to cook his briyani, insisting on using only basmati rice. Basmati rice can soak up the essence of the spices and meat. It is truly a guilty pleasure.

3) Minced Pork Rice (Taiwanese style) – I was born in Taiwan, 肉燥饭 is literally a national dish. In my opinion, the minced pork is

important, but not as important as using the right rice. The rice should be fluffy and sticky enough to hold the gravy but not mashed together to the point where you can't feel the shape of the grains in your mouth. The subtle fragrance from the rice balances the rich pork broth, making it a simple, yet hard to master dish. 🍚

Glossary

Smallholder farmers – Farmers who own small plots of land where they grow one or two crops to make money. These farmers rely almost exclusively on family labour to plant their crops.

Checked – Characterized by shifts in fortune, can be good or bad.

F1 – First generation of offspring from parent plants or animals.

Hybridisation – A process where different varieties of plants are allowed to cross pollinate, resulting in the offspring plant having traits of both parent plants.

Non-GMO – Non Genetically Modified Organism. Usually used for crops, this means that the crop has not been modified genetically using artificial means.



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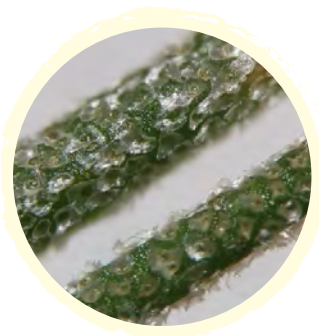
FIVE THINGS YOU NEED TO KNOW ABOUT AIR PLANTS

Written by **LIM HUAN**
Illustrations by **CHUA JIA QI**

1. AIR PLANTS CAN'T SURVIVE ON JUST AIR

Tillandsia, commonly nicknamed as 'air plants', need water too. Sure, they may not need as much watering like other plants, but they still require moisture. As their nickname suggests, they can obtain moisture and nutrients through the air thanks to the tiny structures present on their leaves called trichomes. These trichomes may look like fine hairs or scales to the naked eye, but a closer look would reveal that they look more like little cups that help to take in water.

Trichomes are made up of both living and dead cells. When trichomes are dry, the dead cells resemble scale-like wings pointing slightly upwards. In contact with water, these swell up like a sponge and become clear as they stretch out flat along the surface of the leaf. Water and dissolved nutrients are trapped between



the trichome and leaf, facilitating the absorption of water into the living cells of the leaves and transporting it to the rest of the air plant.

Now that you know how air plants get their water and nutrients, how do you actually 'water' them? You can water your air plants by misting thrice a week and soaking the leaves weekly for 30 minutes. After soaking, shake off excess water and allow them to dry entirely with good air circulation. Otherwise, they will rot, and you do not want that. You may use rainwater or tap water that has been left overnight. But never give them distilled water; they do not appreciate it as we do.

*Note: Do not soak your air plants when they are blooming, the flower will dissolve!

Some of you may wonder, 'but not all air plants are the same.' Yes, you are right! Different air plants have different needs and preferences. So how do you know what is best for your air plant? The secret lies in the size and quantity of trichomes. Air plants with an abundance of trichomes, usually whiter and fuzzier in appearance, grows well in bright and dry conditions. These air plants prefer mists to soaks. In other words, less water and bright light recommended! For smoother and greener air plants that are usually found in wet and humid conditions, more water and less light would be preferred.

2. AIR PLANTS NEED SUNLIGHT TOO!

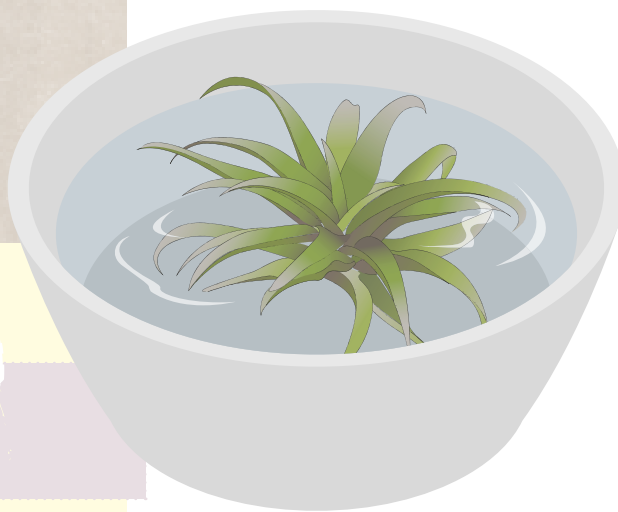
As a general rule of thumb, air plants require several hours of bright indirect light – be it sunlight or artificial light (from fluorescent bulbs). Most air plants have

trichomes on their leaves that help to reflect intense light and harmful radiation from the sun. However, these little beauties should not be placed in an enclosed space under direct sunlight for prolonged periods as it could be very drying for them. They don't appreciate being trapped in a greenhouse oven; they enjoy some shade and breeze as well.

3. AIR PLANTS DO NOT GROW WELL IN SOIL

Air plants are the rebels of plants – they do not absorb water and nutrients from the soil through their roots like most plants do. Instead, air plants use their roots to anchor themselves on tree branches, rocks or basically anything they can grab on to.

These plants are epiphytes in nature, which means that they grow on other plants or objects merely for physical support without relying on their hosts for survival. However, not all objects are suitable for the attachment of air plants – copper materials may rust and kill your air plants, as well as the two commonly found toxins in fertilisers, boron and zinc. Be sure to keep these in mind when searching for a perfect home for your air plants!



4. AIR PLANTS LOVE WARM TEMPERATURE!

Air plants are native to the Southern US, Mexico, Central and South America, where they are widely distributed across the tropical and subtropical states. These areas have a warm climate with high humidity and precipitation. For these air plants to be happy, mimic their natural environment with warm temperatures ranging from 10°C to 32°C. Temperature fluctuations, simulating nightfall, allow air plants to thrive and feel at home.

5. AIR PLANTS BLOOM ONCE IN A LIFETIME

Flowering is the peak of the air plant life cycle, and also marks the beginning of the plant's old age. Depending on species, these little air plant blossoms may last from a few days to several months. When air plants start to flower, the uppermost leaves turn bright red and produce delicate tube-like flowers with bright violet petals that are absolutely bloom-tiful! How to water air plants in bloom? Instead of submerging them entirely in water, you may mist them or rinse them under gently flowing water without wetting the delicate flower. More water may be needed than usual to keep a blooming plant happy and healthy as it uses all of its energy on the blooms, and eventually the pups.

Air plants reproduce by yielding two to eight 'pups' (also known as offsets or babies) before, during or after flowering to continue the life cycle. These 'pups' or baby air plants start out very small but eventually grow till they are about the same size as their mother. Once they are about half the size of the mother plant, propagate them by carefully plucking the 'pups' off and place them in a new home!

Now that you know all you need to know about air plants, adopt one of these captivating plants and give it a new loving home! But remember, low maintenance doesn't mean no maintenance! ☘



Written by **BEATRIZ FERNANDEZ**
 Designs by **TOH BEE SUAN**

I was enjoying lunch at a hawker centre when I heard a familiar, shrill sound near my feet. A few seconds later, a Javan myna, hopped onto my table and eyed my food curiously. Not wanting to share my yummy meal, I quickly gobbled it up, thinking 'Wow, these birds are becoming increasingly common'. Javan mynas have adapted to urban environments and can be found in many public spaces. However, did you know that these animals are not native?

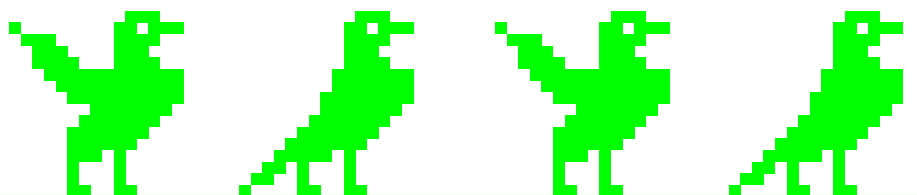
So how do we differentiate native and introduced species? A native species is found naturally in that region. An introduced animal does not originally live there. It was brought to that area by humans, who may have released them into the wild, or unwittingly transported these hitchhikers during travel. An introduced animal may then be considered invasive when they cause harm to the environment or to native animals.

HOW DO INVASIVE ANIMALS OR PLANTS CAUSE HARM?

When a new animal is brought to an area, it is unfamiliar to the animals there, and it would not have any natural predators. The animal multiplies quickly without a predator keeping its numbers low. Invasive animals are often generalists – they do not have specific requirements, but can thrive in a range of environments. This means they can do better than the native animal would in a short time. Thus, invasive animals often cause the decline of native animals.

Invasive plants, like animals, adapt easily to new environments. They grow quickly, covering vast areas of forest floors or water bodies in a short time, smothering native plants. Areas where invasive plants are abundant often leads to a reduction in plant biodiversity.

Many common animals and plants in Singapore are, in fact, not native. What were their journeys here? Our first culprit is the food thief that I mentioned earlier – the Javan myna.

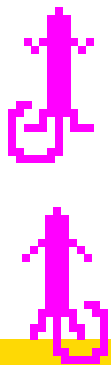




JAVAN MYNA



COMMON MYNA



Which bird do you see more commonly? The Javan myna is indeed more common than the Common myna (before you roll your eyes at the irony, let me explain why). The Javan myna is native to Indonesia and was first brought to Singapore in the 1920s, via the pet trade. These birds made their way into the wild by escaping, or pet release.

The Common myna, on the other hand, is a native bird and therefore used to be more common. However, as the Javan myna is more easily adaptable to urban environments – they even build their nests behind air-con ducts! – it has driven the Common myna to less urban areas. This is how an introduced animal, being more readily adaptable, can cause the decline of its native counterpart. But the Javan myna is not our only foreign invader.

How many of you are guilty of calling this animal a chameleon? This is a Changeable lizard, also capable of changing its colour for camouflage. The changeable lizard is native to Thailand and Malaysia and has made its way to Singapore in the 1980s. It has since been

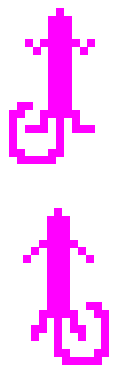
widespread and has outcompeted our native green-crested lizard. Like the Javan myna, the changeable lizard is highly adaptable to urban areas, unlike the Green-crested lizard, which can only be found in forested areas.



CHANGEABLE LIZARD



GREEN-CRESTED LIZARD





**GOLDEN APPLE
SNAIL**



**EGGS OF GOLDEN
APPLE SNAIL**



After a jog in Bishan Park one day, I chanced upon a pink clump growing on a rock near the water. Thinking that it looked suspiciously like a sea cucumber, I went closer to investigate. I found out that these were eggs of the Golden apple snail.

The golden apple snail is named so, because of its gold-green shell that looks like a golden apple. Yup, I hear you, biologists are not very

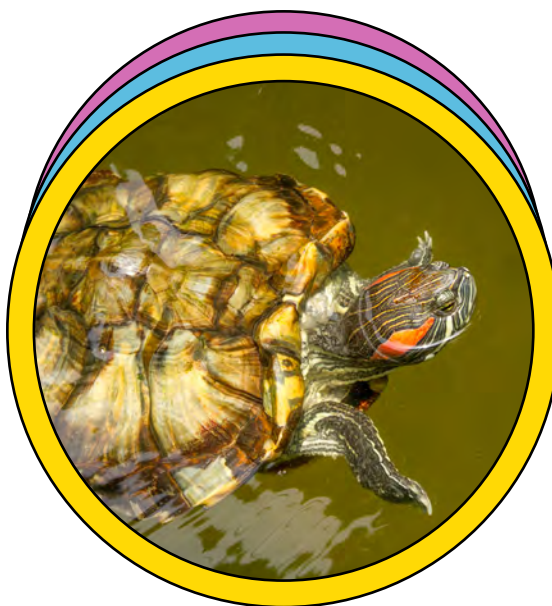
creative when it comes to naming species. A freshwater snail, it lays its eggs in clusters, which can range from 100 to 1000 eggs, on plants or rocks above the water, to decrease chances of predation. The snail eggs contain a toxin, further protecting them from being eaten.

The golden apple snail (*Pomacea canaliculata*) has made a long journey here from South America.

It was brought to Singapore via the pet trade and is now unfortunately found in many reservoirs and parks such as Lower Pierce Reservoir and Bishan Park. It has outcompeted our native apple snail, *Pila scutata*, that can only lay about 100 eggs in a cluster. Elsewhere, the golden apple snail is causing economic losses too – by destroying agriculture such as rice. Pretty aggressive for a seemingly innocent creature, huh.

Have you ever kept a terrapin before and happily called it a turtle? This animal is the Red-eared slider. Its home range is in the southern United States, and (as you have guessed by now) came to Singapore by the pet trade. These creatures are quite cute when they are small, but what happens when they get too big? Sadly, many often release them into the wild.

You may think that releasing a pet into the wild is an act of kindness, but you are causing more harm, for both the animal and the environment. A released pet may not know how to fend for itself, or as we have seen, an introduced



**RED-EARED
SLIDER**

animal would cause the decline of a similar native species. In this case, our native Malayan Box Terrapin is becoming increasingly rare because of the slider's rapid proliferation.

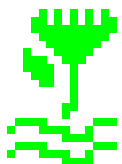
Although these animals are not presently listed as invasive, we do know that they cause substantial harm to the ecosystem. This is why releasing pets – any pet – does more harm than good. 'Operation No Release' is organised by NParks annually in May, where volunteers visit parks and reservoirs to raise awareness about the dangers of releasing animals into the wild. Besides harm to the environment, pet release is also against the law.

The Water hyacinth (*Eichhornia crassipes*) is an aquatic plant with beautiful purple flowers. It seems harmless at first sight. After all, how much harm can a plant, a relatively immobile thing, cause the environment, right? Well, you would be surprised.

The water hyacinth is native to the Amazon river basin. It was first brought to Singapore from Hong Kong in the 1890s but was confined to a private garden. It was soon introduced to Botanic Gardens, and later made its way into reservoirs. In the 1970s, water hyacinths became a huge problem at the Kranji Reservoir, as hundreds of water hyacinths would clog the waterways. Moreover, since it was a reservoir, the use of herbicides was banned, hence officers had to physically remove the hyacinths by boats. These mounds of water hyacinths were then transported to pig farms to be used as fodder.

Due to its extremely quick reproduction, the water hyacinth is able to swiftly cover rivers and reservoirs within a short period of time. With the entire water surface covered by hyacinths, they block sunlight and oxygen from reaching submerged plants. The water hyacinth also takes up a lot of nutrients, hence depleting nutrients for other aquatic plants. Water hyacinth overcrowding can drastically reduce biodiversity in the water body.

In fact, the water hyacinth is so pervasive that it is listed in 'Top 100 Invasive Alien Species' list by the International Union for the Conservation of Nature (IUCN). See, we told you it was a rebel.



WATER HYACINTH

Credits

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KOSTER'S CURSE

Have you ever seen a plant with hairy leaves? How about hairy berries? 'Koster's curse', also known as hairy clidemia (*Clidemia hirta*) is one such plant. Its leaves are covered with soft hair, and so are its small, dark blue fruits. In Singapore, it can be found along forest edges, and parks such as Kent Ridge Park.

But who is Koster, you may ask, and why did he curse? Well, Koster was the man who accidentally introduced this plant to coffee plantations in Fiji, between 1880 – 1886. The plant grew rapidly and destroyed the plantations and caused damage to neighbouring coconut plantations as well. Even today, this plant is causing damage to many forests across the world. It quickly occupies gaps in the forest undergrowth, preventing native plants from regenerating, and forms thickets that smother other vegetation. This is another notorious plant that has made its way into IUCN's Invasive Species List.

The next time you are at a hawker centre and an annoying myna eyes your lunch, or spot other invaders, remember that it is human actions that have brought it here. Yes, humans are the leading cause of many current environmental problems, but we are also capable of becoming something much more powerful: the solution. ☘

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