BUILDING THE FUTURE:
Why Engineers Matter

Illustrated by IVAN REVERENTE Written by WENG CAHILES

this book belongs to

FUTURE ENGINEER

Please direct all inquiries to CANVAS:
No. 1 Upsilon Dr. Ext. cor. Zuzuarregui St., Old Balara, Quezon City, Philippines 1119
info@canvas.ph

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Text by Weng Cahiles
Illustrations by Ivan Reverente
Book and layout design by Kevin Candelaria
Editing by Ergoe Tinio
Proofreading by Annette A. Ferrer

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BUILDING THE FUTURE:
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PART 1

Builder to Doer

"Scientists dream about doing great things. Engineers do them."
—James A. Michner

Close your eyes and think of a world without cars, bridges, electricity, drinking water, the internet, cellphones, and computers. Can you imagine how life would be different and difficult without these? What you are doing is imagining a world without engineers. It is impossible to go through our daily activities without relying on something that an engineer has made.

We can fly on airplanes, have roads on mountains, have light even when it is dark, charge our phones, talk to someone on the other side of the world, and even go to outer space. Humanity has gone from doing simple tasks to achieving what seemed to be impossible feats—all thanks to an engineer.

What is an Engineer?

Engineers are an integral part of the modern world. They are problem solvers, creators, leaders, innovators, doers, builders, dreamers, and believers.

Everything around you that is human-made has an engineer's involvement in one way or another. They design and build just about anything: machines, systems, and structures to help solve a specific problem. They are important in creating the world around us—from how we communicate, how we travel, where we live, and even what we eat.

If you want to help make the world a better place, be an engineer.

Choose Your Own Adventure as an Engineer!

Whether you are interested in the idea of building infrastructures like airports, bridges, railways, and skyscrapers or you are curious about how things such as electronic circuits work, or maybe you want to design better pathways for people in wheelchairs and design safer vehicles—the possibilities are endless—with the many branches of engineering.

Almost anything man-made has an engineer's touch—from its design, creation, maintenance, and improvement. This makes engineers an essential member of society. It is almost impossible to picture the modern world without engineers. The door to engineering is wide open with all the possibilities it has to offer.

CORE DISCIPLINES OF ENGINEERING

A Concrete Choice: Civil Engineering

Have you always been amazed with how tall buildings are made? Or how roads are carved into remote mountain ranges? Or how mile-long bridges connecting one point to another remain strong and steady? Thinking of ways to create better cities is what a civil engineer does.

A civil engineer can build or design incredible structures like buildings, highways, airports, bridges, and dams. They make sure that these structures are safe and built to last. Their role involves understanding how materials behave, building strong foundations, and ensuring that what they build improves the lives of those who use them.

Banaue Rice Terraces: Harmony with Nature

A look at the Banaue Rice Terraces would make one wonder how the Ifugaos managed to hand carve about 20,0000 kilometers of rice paddies into the Cordillera Mountain Range. Often called the Eighth Wonder of the World, its massive scale is long enough to stretch halfway around the globe. Believed to be over 400 years old, these vast rice fields on the steep mountain slope are considered one of the world's greatest engineering wonders and have been awarded the International Historic Civil Engineering Landmark Award.

Using only minimal equipment and relying on manual labor, the Ifugaos were able to grow rice and crops through the terraces they built on the mountains. They also came up with a unique irrigation system from the rainforests above the terraces that kept the land fertile. The paddies were made with stones and mud that were manually laid out to create what looks like a stairway to the heavens.

INDUSTRIES:

Spark Your Curiosity with Electrical Engineering

Electrical engineers power the world. Everything around you that produces and runs on electricity, needs to be plugged in, or relies on a battery has been created or designed by an electrical engineer. Just imagine how much we rely on electrical devices to entertain us (television), make things easier to do (appliances), keep us safe (security cameras), and even keep us healthy (medical devices).

Electrical engineers harness the potential of electricity from batteries and large power stations to transform society. They design robots, cellphones, computers, radars, wiring, lighting, and navigation systems that bring to life what needs to be used in our everyday life.

1831 – Dynamo

Michael Faraday invented dynamo which led to the invention of other electric-powered devices.

1879 – Light bulb

Thomas Edison patented the incandescent filament light bulb and continued to develop other inventions including the first electric meter.

1887 – Motors

Nikola Tesla invented an induction motor that uses alternating currents (AC). His partnership with George Westinghouse led to the nationwide use of electricity in America.

1928 – Television

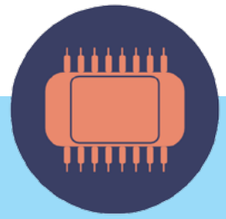
Philo Farnsworth was just 15 years old when he invented the first all-electronic television.

1935 – Radar

British physicist Sir Robert Watson-Watt developed the first practical radar system that helped Britain during WWII.

1941 – Computer

Konrad Zuse developed the Z3, the world's first programmable, fully automatic digital computer.



1968 – Microprocessor

Marcian Hoff of Intel invented the microprocessor which led to the development of personal computers.

1981 – Internet protocol

Much of the internet today relies on the TCP/IP protocol developed during this year.

INDUSTRIES:

Gear Up for Mechanical Engineering

Mechanical engineers look at things differently. They see something and immediately think "What are the components that make this work the way it is working?" This fascinating field is all about researching, designing, developing, building, and testing engines, machines, and equipment that carry out work that make our lives easier. It also involves building, operating, and maintenance of smaller parts of big machinery like tanks, vessels, pumps, and compressors. The magic of a mechanical engineer is taking even the tiniest screws and other small details to create a whole machine and make something so complex appear so simple.

RoviDoc: Pinoy Robot VS. COVID

The robot doctor is in! Giving our medical frontliners an extra pair of robotic hands is Robot Roving Doctor or RoviDoc. Invented by the Institute for Innovation in Business and Emerging Technologies (IIBET) of Bulacan State University External Campuses, RoviDocs were built to reduce the exposure of doctors and nurses to patients with communicable diseases like COVID-19. It is equipped with a camera to allow doctors and nurses to monitor the movements of patients. It also has a thermal scanner to detect fever, a tray for medicines, a nozzle spray, and a liquid tank for disinfection. RoviDocs made their rounds at the Bulacan Provincial Quarantine Facility to help with the COVID-19 pandemic.

Life-like, Real-life: Robots are Here to Stay

If you are a natural tinkerer who spends a lot of time building all sorts of robots out of Lego blocks, mechanical engineering is a field you should pursue to take your childhood inventions to life. Robots were something we only saw in movies (think C-3PO from Star Wars) and TV shows, but mechanical engineers are real-life builders of these high-tech intelligent machines.

Replicating humans seems to be the goal of a lot of robot makers. Through the years, they are getting closer and closer to the future of humanoid robots. Here is a look at how the robots of the future have finally arrived.

Actroid Acting Robot
It is programmed to read a number of scripts and languages, which makes it ideal for theatrical use. It has smart sensors and actuators that allow it to react to touch. Plus, it is equipped with different motors that simulate breathing.

Kodomoroid TV presenter
This robot works at Tokyo's National Museum of Emerging Science and Innovation, ready to give visitors directions or weather reports. She can read the news, explain scientific topics, and can speak in different voices and languages.

Robo-C
Called the world's first autonomous android, this android clone can be made to look like anyone. It has an artificial intelligence system with more than 10,0000 speech modules and can be a companion robot at home or perform workplace tasks in offices or airports.

Sophia
This popular humanoid has had thousands of public appearances including TV shows. She can express an immense number of emotions through her facial features and can gesture with full-sized arms and hands.

INDUSTRIES:

Positive Reactions to Chemical Engineering

Think of a popular brand of bath soap. A lot of work goes into making a single bar of soap: the right scent, how it bubbles, its color, and whether it is safe to use for sensitive skin. Now, think of this process and multiply it a hundred thousand times for it to be sold in stores nationwide. This is what a chemical engineer does—they take small product development in laboratories and replicate it on a mass scale in the most consistent, safe, and economical way possible.

Their work is all about processes and products. They transform raw materials into safe and useful products such as refining crude oil into gasoline, purifying drinking water, recovering raw materials, and processing food. They are often employed by large-scale manufacturing plants, research laboratories, and pilot plant facilities. Chemical engineers can oversee the design, manufacturing, or operation of plants and machinery, or they can be involved in the development of new substances or the improvement of existing ones.

Cheers for Chemical Engineers

Chemical engineers transform raw materials into products that, in return, have changed the world.

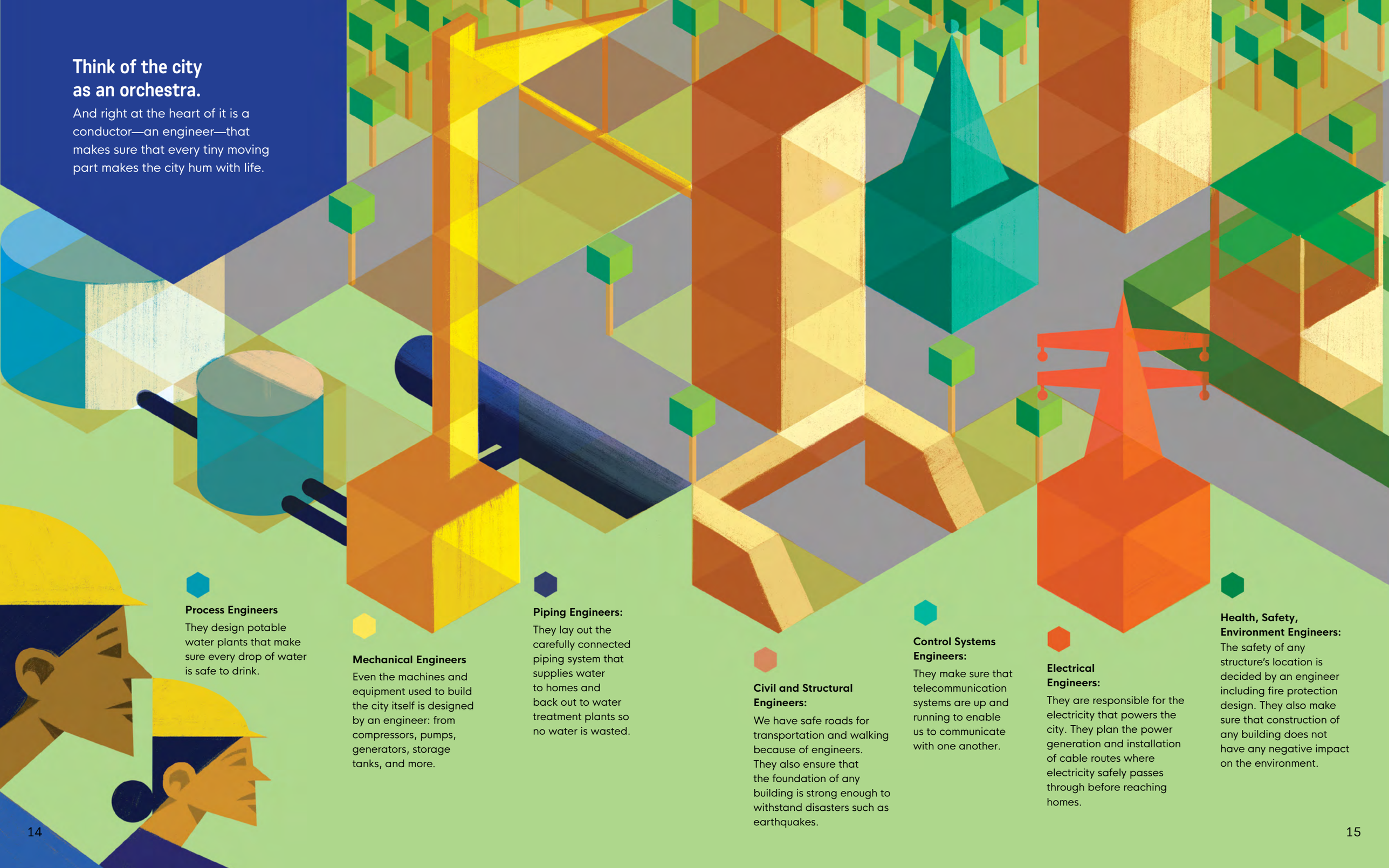
Potable water:
Chemical engineers make it possible for the world to have a stable supply of safe drinking water through processes such as filtration, sedimentation, distillation, or chlorination.

Petrol or gasoline:
Crude oil becomes petrol through distillation. When petrol is heated at different boiling points, products such as liquid petroleum gas (LPG), diesel, and kerosene are made.

Vaccines:
Humans are able to survive pandemics because of vaccines. Production of vaccines is a lengthy and complex development that relies on chemical engineering processes such as ultrafiltration and column chromatography.

Think of the city as an orchestra.

And right at the heart of it is a conductor—an engineer—that makes sure that every tiny moving part makes the city hum with life.



Process Engineers

They design potable water plants that make sure every drop of water is safe to drink.

Mechanical Engineers

Even the machines and equipment used to build the city itself is designed by an engineer: from compressors, pumps, generators, storage tanks, and more.

Piping Engineers:

They lay out the carefully connected piping system that supplies water to homes and back out to water treatment plants so no water is wasted.

Civil and Structural Engineers:

We have safe roads for transportation and walking because of engineers. They also ensure that the foundation of any building is strong enough to withstand disasters such as earthquakes.

Control Systems Engineers:

They make sure that telecommunication systems are up and running to enable us to communicate with one another.

Electrical Engineers:

They are responsible for the electricity that powers the city. They plan the power generation and installation of cable routes where electricity safely passes through before reaching homes.

Health, Safety, Environment Engineers:

The safety of any structure's location is decided by an engineer including fire protection design. They also make sure that construction of any building does not have any negative impact on the environment.

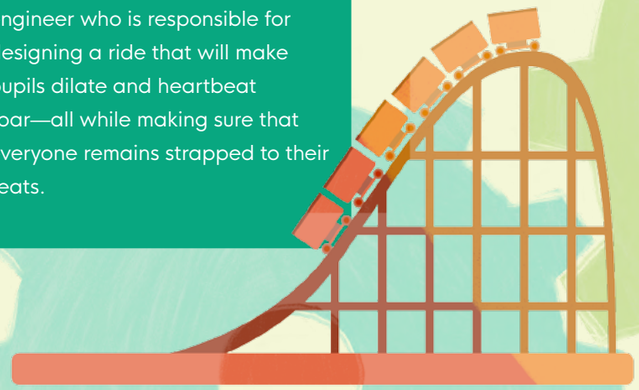
INDUSTRIES:

Engineers are Cool!

We don't usually think of the words "fun" and "cool" when we talk about engineers. They are often depicted as serious men and women who wear hard hats in construction sites, spend all day inside laboratories, or inspect the blueprints of their inventions. In reality, engineering covers vast fields and industries that include unique, cool, fascinating, and fulfilling career options.

Roller coaster engineer

Life is a thrill for a roller coaster engineer who is responsible for designing a ride that will make pupils dilate and heartbeat soar—all while making sure that everyone remains strapped to their seats.

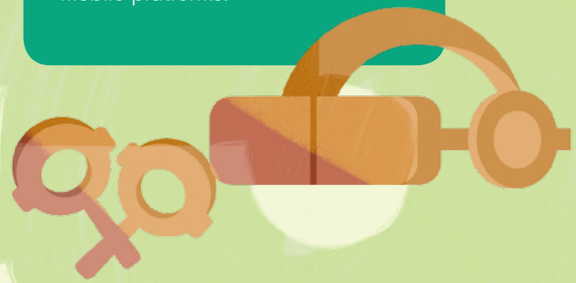


Aerospace engineer

The sky's the limit for aerospace engineers! You can design and develop any machine that flies—from aircraft, spacecraft, satellites, and missiles. You can also specialize in the specialized fields of aerodynamics, thermodynamics, flight mechanics, propulsion, and control systems.

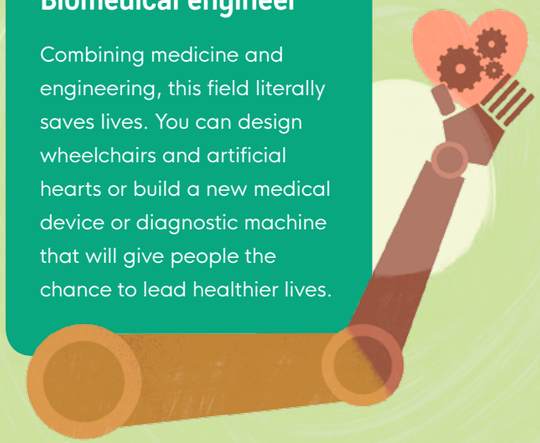
Game engineer

Level up when you work as a game engineer. Be responsible for the design, programming, and development of video game software. Build the next gaming craze whether it be for console or mobile platforms.



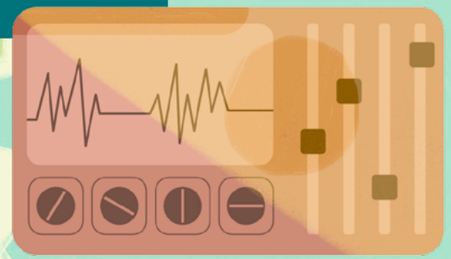
Biomedical engineer

Combining medicine and engineering, this field literally saves lives. You can design wheelchairs and artificial hearts or build a new medical device or diagnostic machine that will give people the chance to lead healthier lives.



Sound Engineer

Who said you can't be an engineer if you are musically inclined? Sound engineers work with the mechanics of recording, mixing, and reproducing sound. Work with the biggest names in the music industry and help give their work the sound that can rake in record-breaking sales and Grammy awards.



Formula One race car engineer

Feel the need for speed? As a Formula One racecar engineer, you need to guarantee efficient performance and vehicle safety. You may not be behind the wheel, but you are the backbone of every race car.

Part 2: A BRIEF HISTORY OF ENGINEERING IN THE PHILIPPINES

There were no Filipino engineers during the 333-year rule of the Spaniards in our country. Those who were skilled in designing and building any type of structure were merely considered Maestro de Obras (master builders) which is equivalent to what we now call a construction foreman. There were also no engineering schools and only the Spaniards were the ones with academic degrees. Ilustrados (Spanish elite) required the help of Filipino Maestro de Obras mostly in building structures in villas and mansions.

Liceo de Manila, the first private school to offer academic titles to Maestro de Obras, was established. In 1904, the Escuela de Ingeniera y Arquitectura offered a five-year course in architecture and civil engineering but stopped operations just after a year. In 1907, University of Sto. Tomas – School of Civil Engineering was established, making it the oldest engineering school in the Philippines. In 1910, University of the Philippines soon followed when it established its own College of Engineering.

Along with its establishment, the Philippine Revolutionary Government created four departments including the Department of War and Public Works. Its main function was to build and maintain roads, bridges, and other public work structures. When Spain turned over its rule of the Philippines to the United States, all public works and activities were placed under the U.S. Army engineers.

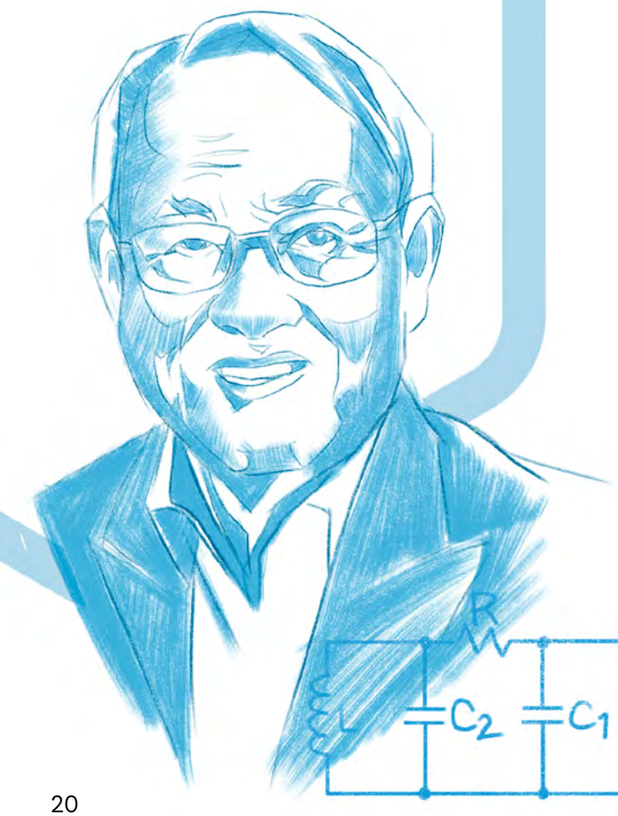
Who is the first registered engineer in the Philippines?

Marcial Kasilag, a civil engineer, is the first registered engineer. Under the Pensionado Act of 1903 that allowed qualified Filipino students to study in the United States, Kasilag graduated from Purdue University in Indiana, USA in 1908. He holds the first slot in the Professional Regulation Commission (PRC) Registry of Civil Engineers and is the first President of the Philippine Society of Civil Engineers (PSCE), the first civil engineering organization in the Philippines.

SOURCE:
https://www.dpwh.gov.ph/dpwh/about/history

PART 3:
IMPORTANT PINOY ENGINEERS

Filipino engineers are outstanding innovators. The following figures played a significant role during their time and created invaluable advancements that will inspire the minds of tomorrow.



Dr. Leon Chua

This electrical engineer is a Mapua Institute of Technology alumni who taught at prestigious institutions like Purdue University and UC Berkeley. He is recognized as the father of nonlinear circuit theory and cellular neural networks used to solve image processing problems. He was the first recipient of the 2005 Gustav Kirchhoff Award—the highest Technical Field Award given by the Institute of Electrical and Electronics Engineers (IEEE), the world's largest association of technical professionals. He was also awarded the prestigious IEEE Neural Networks Pioneer Award in 2000 for his contributions to neural networks.

Diosdado Banatao:

This Cagayan native and electrical engineer is considered the Bill Gates of Asia and runs his own company in Silicon Valley. He is credited for the invention of numerous semiconductor technologies including the first single-chip graphical user interface accelerator that made computers work a lot faster. Multinational tech company Intel is using Banatao's chips and technologies, proof of just how important and widely-used his inventions are.

Dr. Gregorio Zara:

This Batangas native was an academic powerhouse, graduating valedictorian both in elementary and high school. After finishing a degree in UP Manila, he studied Mechanical Engineering at the Massachusetts Institute of Technology. He graduated summa cum laude at University of Michigan for his master's degree in Aeronautical Engineering. In 1930, he discovered the physical law of kinetic resistance, known as the Zara Effect, which involves the resistance to the passage of an electric current when contacts are in motion. In 1955, he invented the videophone, the first two-way electronic video communicator. In 1978, he received the National Scientist award.

Engineers: A Man for Others

We've seen just how much engineering changed the world as we know it. But engineering isn't all about grand advancements in modern technology or great big leaps towards the unknown. Many Filipino engineers exhibit their unwavering passion for their field by using their knowledge to create a direct and immediate impact on communities.

Planting a Better Future for Filipino Farmers

Growing up as the son of a coconut farmer in Leyte, Dr. Ricardo Orge experienced firsthand the toil of farmers. This inspired him to pursue a career as an agricultural engineer at the Philippine Rice Research Institute and improve the processes in farming and support alternative livelihoods for farmers. His main invention, the Continuous-type Rice Hull Carbonizer, helps farmers cut their expenses and dependence on fossil fuels by using renewable energy through the machine.

From Waste to Winner

Dr. Evelyn Taboada is a chemical engineer who spearheaded a team of scientists and engineers to transform mango wastes into high-value products such as flour and animal feed. This invention allowed for job creation as it led to the construction of a processing plant that employs people in the community.

Yes to Disaster Preparedness

Dr. Enrico Paringit, a geodetic engineer, and Dr. Joel Joseph Marciano Jr., an electrical engineer, are both UP Diliman professors who worked to lessen people's vulnerability to natural catastrophes. They used maps to predict flooding and created technologies to monitor areas that are prone to landslides.

The Future is Female: Women Engineers Will Rebuild the World

Engineering remains to be a male-dominated field. An estimated 15% of the world's engineers are women. In the Philippines, just two in seven engineering students are female according to the 2017 statistics of the Commission on Higher Education. Of the total number of STEM (science, technology, engineering, and mathematics strand) enrollees, only 43% are women.

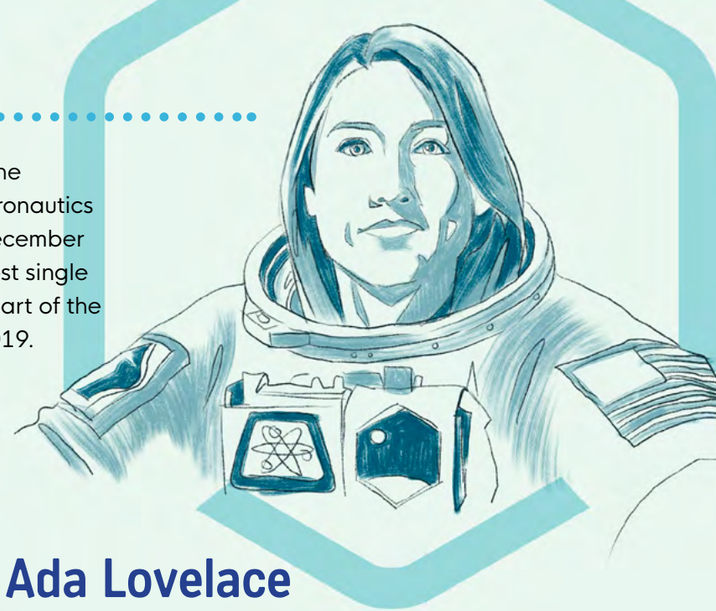
But engineering is not just for men. History is full of women engineers who, despite the odds, went on to change history with their incredible achievements and inventions. Here are female trailblazers that every budding engineer can look up to for inspiration as we build a girl's generation of engineers.

Edith Clarke

She was a woman of many firsts in the field of engineering. She was the first woman recipient of a master's degree in electrical engineering from the Massachusetts Institute of Technology, one of the most prestigious universities in the world. She was the first woman to present a paper before the American Institute of Electrical Engineers, the first female electrical engineering professor in the United States, and the first woman fellow of the American Institute of Electrical Engineers.

Christina Koch

Her electrical engineering degree was the foundation of her career at National Aeronautics and Space Administration (NASA). In December 2018, she broke the record for the longest single spaceflight by a woman. She was also part of the first all-female spacewalk in October 2019.



Ada Lovelace

This brilliant mathematician wrote the world's first machine algorithm, making her the world's first computer programmer. Her work on the Analytical Engine is considered the first computer program.

Marissa Mayer

In 1999, she joined Google as the company's first female software engineer. She designed the search interface of Google's homepage and had a crucial role in the development of Google's flagship programs such as Gmail, Chrome, Maps, Earth, and Street View.

June 23 is International Women in Engineering Day

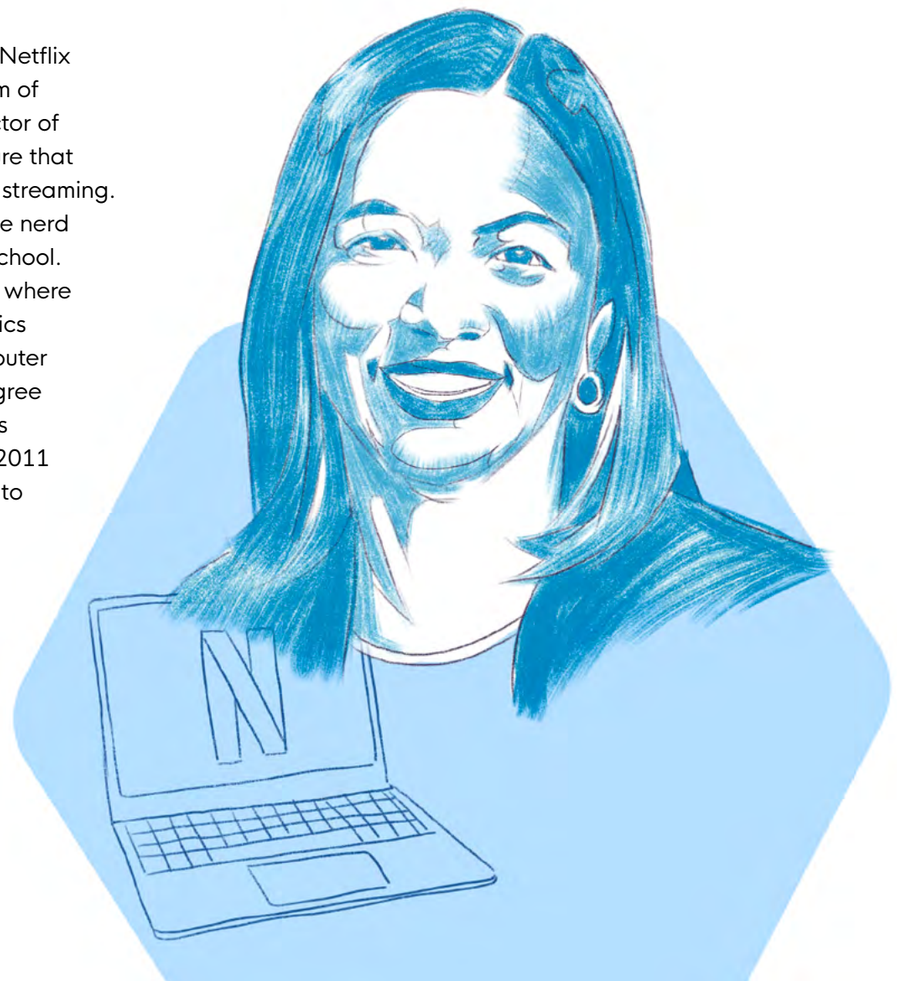
This yearly event is an international awareness campaign that puts the spotlight on the work and achievements of women engineers. They highlight women engineers to inspire and encourage girls to get into this career. This event was launched first in the United Kingdom by the Women's Engineering Society and has spread to countries all over the world.

Fly High, Pinay: World-class Engineers

You will be amazed at what Filipina engineers have achieved in a global setting. Let's take a look at powerful Filipina engineers who are leading important technologies in their careers:

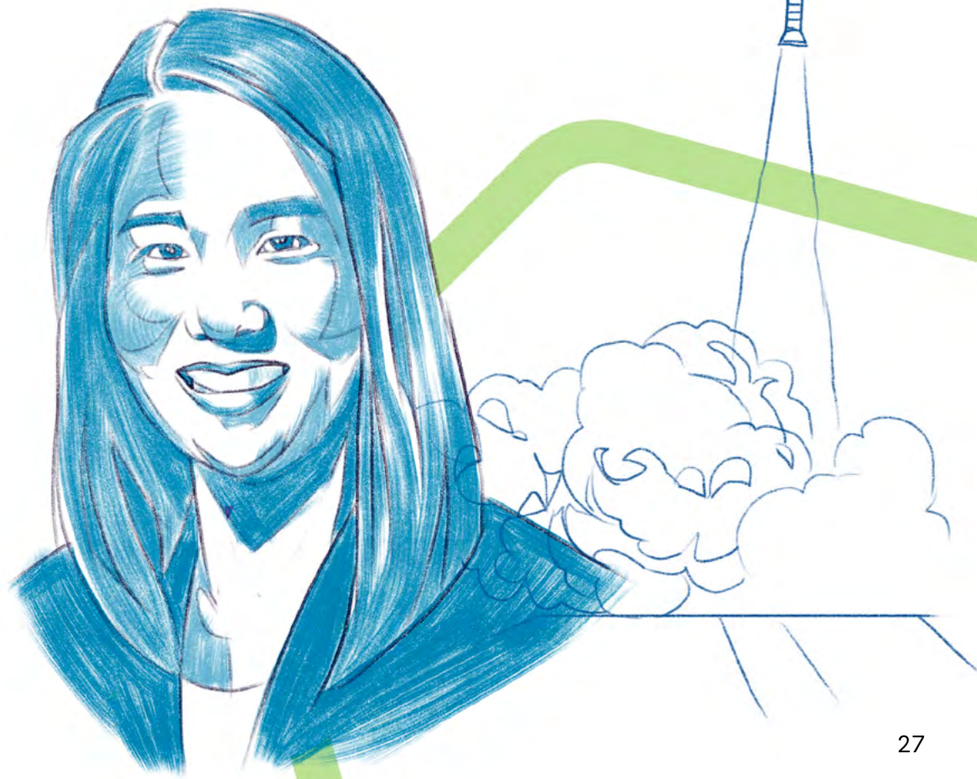
Anne Aaron

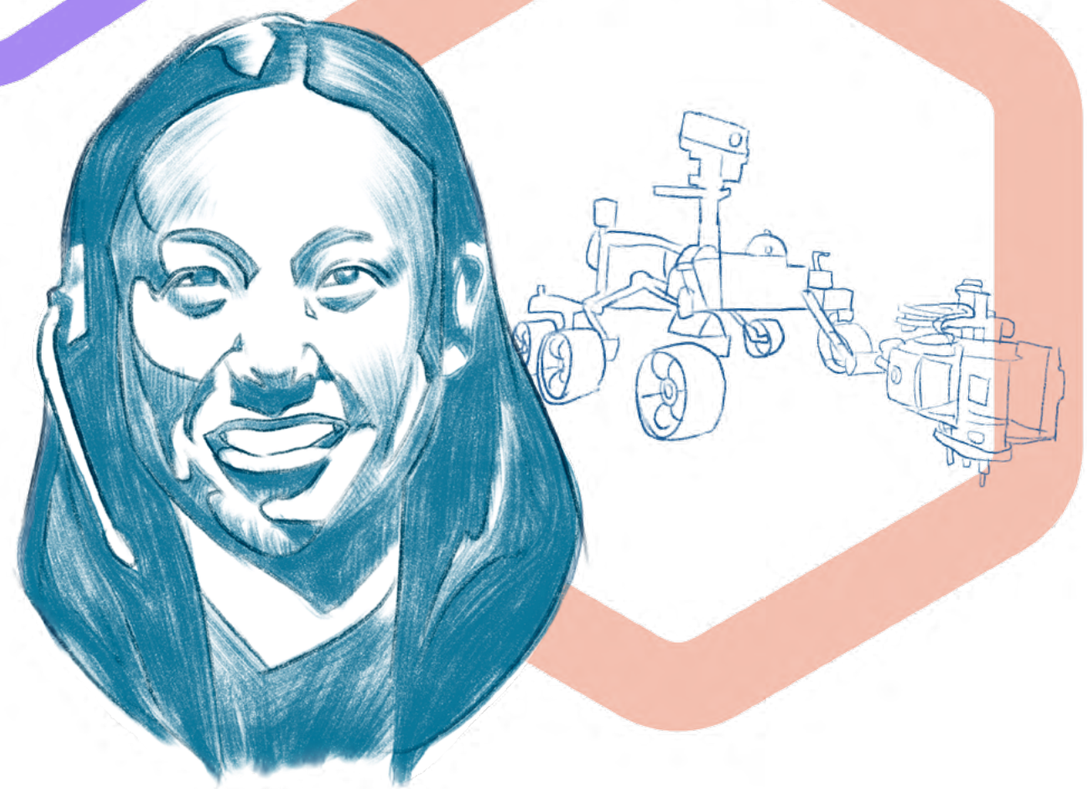
Next time you binge-watch your favorite Netflix show, you have Anne Aaron and her team of software engineers to thank. As the Director of Video Algorithms at Netflix, she makes sure that every user enjoys smooth and buffer-free streaming. She is a self-proclaimed math and science nerd who studied at Philippine Science High School. She entered Ateneo de Manila University where she first graduated with a degree in Physics before pursuing a second degree in computer engineering. She earned her master's degree in electrical engineering at the prestigious Stanford University. She joined Netflix in 2011 as a senior software engineer, moved up to manager of video algorithms in just three years before her current role as director in 2016. She leads a team of 16 people who work on video encoding and algorithms to create a seamless streaming service at optimal speed.



Josephine Santiago-Bond

After graduating as a scholar at the Philippine Science High School, she didn't know what to take up in college. A former schoolmate, who was an Electronics and Communications engineering freshman at University of the Philippines, urged her to pursue the same course. She was accepted as a graduate intern at National Aeronautics and Space Administration (NASA)'s John F. Kennedy Space Center in Florida. She is currently the chief of the Advanced Engineering Development branch and leads a team of engineers at NASA. She has been with the space agency for over two decades and has been involved with several projects including the Space Shuttle program, Ares I-X (a 327-foot tall unmanned rocket for space exploration), and Regolith (lunar exploration mission). As a Filipina-American in NASA, she actively participates in diversity and inclusion programs. She previously served as the chair of Kennedy Space Center's Asian Pacific American Connection Employee Resource Group.





Genevie Yang

The brilliance of Filipina engineers reached Mars, literally. Genevie Yang, a Laguna-native, is part of the NASA team that helped the Perseverance rover successfully land on the red planet. Yang is a data management engineer at NASA's jet propulsion laboratory whose task involved testing Perseverance's flight software. She made sure that the software is at par with the requirements and assisted the uplink team to generate commands to strengthen the spacecraft. Before this, she also worked on the science rover Curiosity which landed on Mars in 2012.

PART 4:

Think Like an Engineer

The world is full of problems and an engineer is someone who isn't afraid to tackle them headfirst. The field of engineering builds on a person's natural problem-solving skills and prepares you to become a future critical thinker.

Testing, Testing, 1, 2, 3: The Engineering Design Process

The engineering design process is a series of steps that engineers use to come up with a solution to a problem. This process is iterative, meaning that they often go through the process several times as needed to come up with the right solution. This is okay because encountering failures and learning from them makes their inventions better. The steps are not strictly followed in sequence as well. The process is flexible and can be applied to different kinds of problems.

1

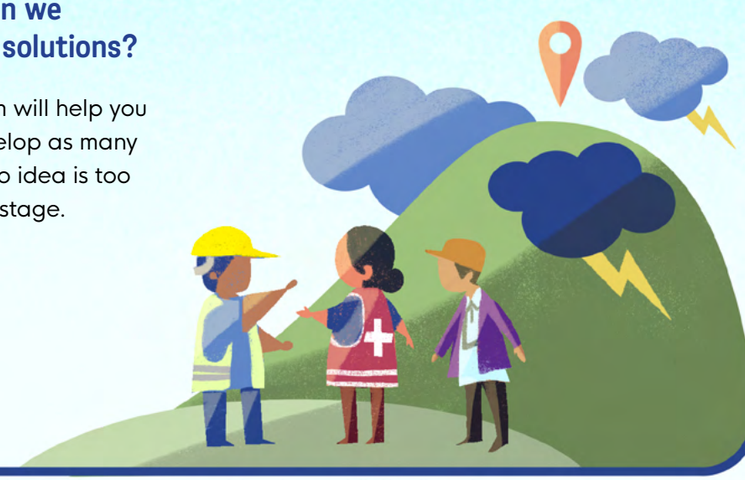
Ask. What is the problem?

Begin by pinpointing the problem that needs to be solved. During this step, they ask the following questions: What is the problem to solve? What do we want to design? Who is it for? What is needed to make the project possible (requirements)? What might hinder us in the process of building it (constraints)?

2

Imagine. How can we develop possible solutions?

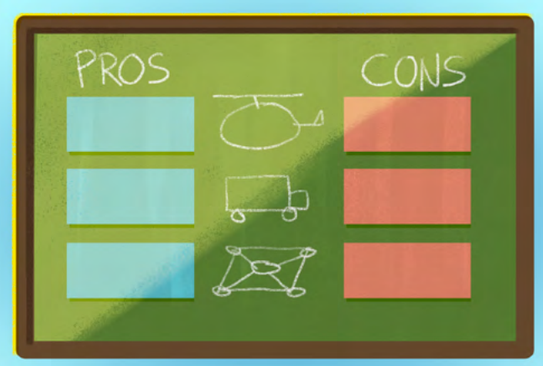
Working with a team will help you brainstorm and develop as many ideas as you can. No idea is too wild or crazy at this stage.



3

Plan. What looks promising?

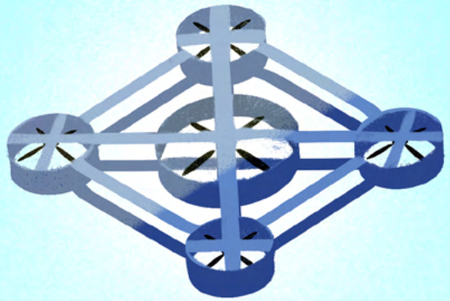
Compare all the ideas gathered during the brainstorming process. Select the best design that you will make a prototype of.



4

Create. Can I make my ideas real?

Building a prototype or a working model lets you see if the design works around the requirements and constraints identified in the first step.



5

Test. Does the design work?

The prototype must be tested and evaluated to see what works and what doesn't. Analyze data and talk about the strengths and weaknesses of the prototype.

Engineering the Future

Going Green: Engineering a Sustainable World

Climate change, pollution, dirty sources of energy, overpopulated cities. The natural world is in crisis because of these man-made causes. The need for sustainability has become a focus for many, including engineers. According to the United Nations Environment Programme, sustainability is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Imagine a magical cookie jar that keeps refilling itself no matter how many times you take a cookie from it. In this scenario, the cookie is sustainable. This means you can keep enjoying your sweet snack without worrying that it will run out. It doesn't matter how much you take out of the jar because it will have cookies in it no matter what. The problem, though, is that there is no such thing as a magical cookie jar. In the real world, taking cookies all the time and not putting new ones in is not sustainable. The jar will eventually become empty.

This cookie jar analogy of sustainability can be applied to the environment. The world's resources aren't exactly unlimited but if we find a way to make them sustainable, it means we can keep using them for a long time.

What is Sustainable Engineering?

The United Nations Educational, Scientific and Cultural Organization or UNESCO defines sustainable engineering as "the process of using resources in a way that does not compromise the environment or deplete the materials for the future generation."

Here are examples of planet-saving solutions that involve the work of engineers:

Solar Energy: Here Comes the Sun

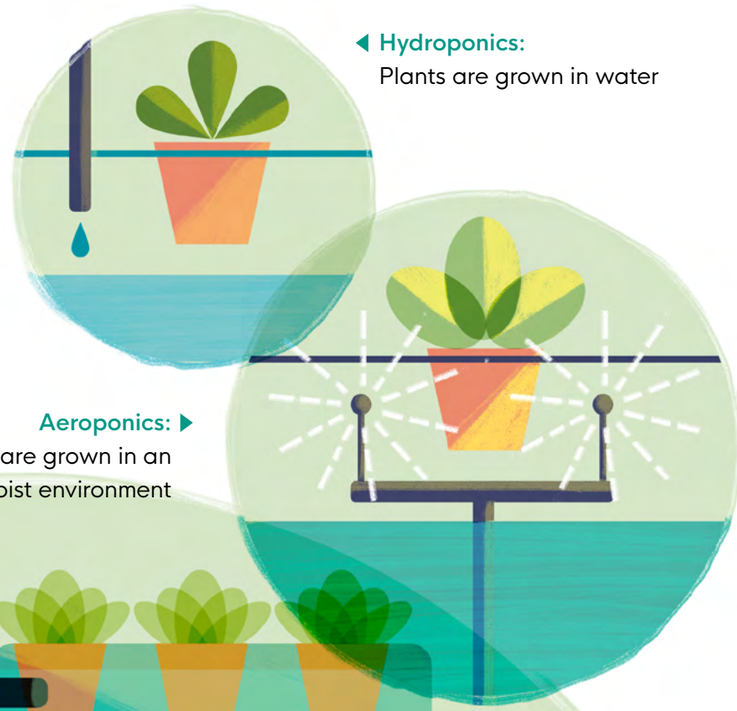
Have you seen houses with big shiny panels on the roof? This means that the house is using the sun for its electricity! The sun is the source of solar energy—a clean, safe, and limitless source of renewable energy. Solar cells turn light from the sun into electricity and do not harm the planet. It does not create pollution like the energy we generate from coal and oil. The work of solar engineers helps make solar projects happen.

The Future is Fantastic Without Single-Use Plastic

Every minute, a garbage truck's worth of plastic ends up in the ocean. Some experts believe that there will be more plastic than fish in the oceans by 2050. Globally, engineers are busy developing innovations such as massive machines that take the rubbish out of the ocean, recycle plastic into useful materials, or prevent plastic from entering the oceans in the first place. Another solution is the invention of bioplastics which are biodegradable materials that come from biological and renewable sources such as fermented vegetables, starch, and protein.

Agricultural Engineering: No Land, No Problem:

Overpopulation means needing more food sources. We have less and less land where we can grow our food because of development. Agricultural engineers are like magicians because they can develop methods of growing plants for food without the need for soil such as:



◀ **Hydroponics:** Plants are grown in water

Aeroponics: ▶ Plants are grown in an air or moist environment

▲ **Aquaponics:** Plants are grown using both hydroponics and aeroponics techniques

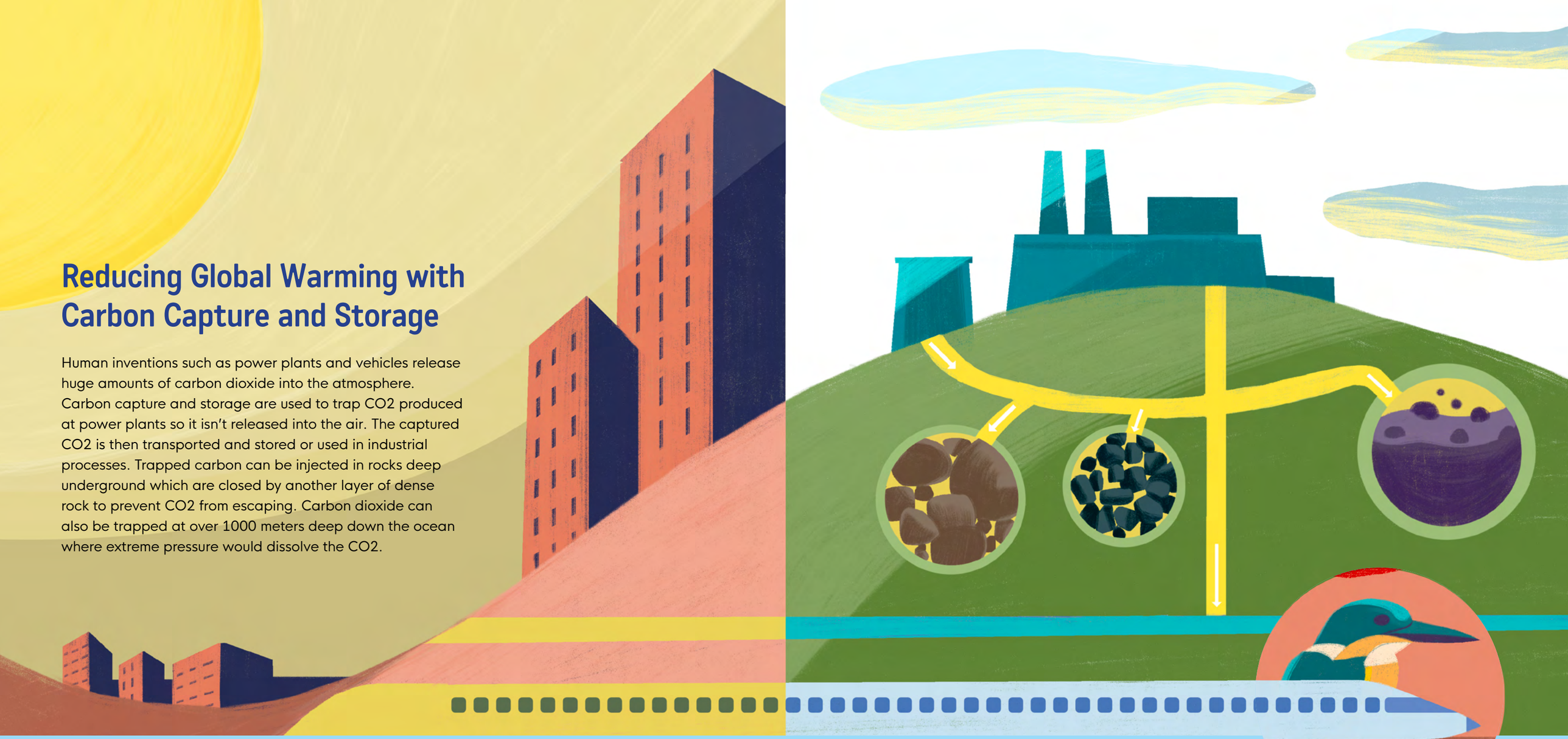
Biomimicry: Life Imitates Nature

The term **biomimicry** comes from the Greek words bios, meaning "life", and mimesis, to "imitate". Put together, it means "to imitate life or nature."

Engineers often use the natural world as an inspiration for design. Plants and animals do things differently from humans and have their own unique way of solving a problem. By closely observing them, engineers were able to come up with creative solutions to mind-boggling problems.

Reducing Global Warming with Carbon Capture and Storage

Human inventions such as power plants and vehicles release huge amounts of carbon dioxide into the atmosphere. Carbon capture and storage are used to trap CO2 produced at power plants so it isn't released into the air. The captured CO2 is then transported and stored or used in industrial processes. Trapped carbon can be injected in rocks deep underground which are closed by another layer of dense rock to prevent CO2 from escaping. Carbon dioxide can also be trapped at over 1000 meters deep down the ocean where extreme pressure would dissolve the CO2.



Biomimicry: Life Imitates Nature

The Shinkansen bullet train travels along high-speed railways, changing the way Japanese commute. Its first design, though, was a problem. The build of atmospheric pressure at the front of the train caused a loud "tunnel boom" when it exited tunnels which disturbed those who lived in residential areas.

It was a bird, the kingfisher to be exact, that helped engineers to create a solution. Engineers noticed that when kingfishers slice through the air and dive into the water to feed, they do it almost without any noise at all. What they did was redesign the front of the bullet train to imitate the shape of the kingfisher's beak. This bird-inspired idea reduced noise, eliminated the deafening tunnel booms, and even allowed the Shinkansen to travel 10% faster using 15% less electricity.

Engineer Chats

Have you reached the end of the book thinking "Now, I want to be an engineer!" Let us convince and inspire you a bit more by letting a few of them talk to you about their job, journey, and joys of engineering.

Jill Manapat

Materials Engineering and Humanitarian Engineering

What made you decide to become an engineer?

I grew up in a family of engineers (my father, brother, and great grandfather all took up engineering) but I didn't plan on becoming one. I wanted to go into chemistry, but my test scores didn't cut it. I chose engineering courses that had lots of chemistry in it and wound up in materials engineering.

After college, I wanted to do something that would combine my engineering training with community service. That's when I found out about humanitarian engineering which uses engineering to co-create solutions with underserved communities. The turning point came when I visited an island in Palawan where Indigenous People (IPs) lived. It was right after Typhoon Yolanda and I remember when our boat reached the shore, I saw children running towards us without clothing. I found out that they didn't have proper sanitation facilities on the island and that there was no stable source of drinking water. It was eye-opening for me, and I felt ashamed because even though I graduated with honors from the country's top university, I had no idea at that time how to apply all the equations I learned to help make people's lives better.

In 2017, I co-founded a group in UP Diliman called Humanitarian Engineering, Entrepreneurship, and Design (HEED), which offers a program focusing on how students can apply what they've learned in their respective fields to create positive social impact, specifically in underserved communities.

What is the best thing about being an engineer?

On a personal level, I feel like I have the best of both worlds—science and application. My materials engineering training provided me with the 'science' part while humanitarian engineering allowed me to focus on the application and bring science and technology to society to create a positive impact on people's lives.

Can you describe to us how your typical day as an engineer usually goes?

A typical day in the academe would include preparing for class (teaching), lab work (research), and meetings (administrative work). But my favorite part is the one that gives the most variety in my day-to-day life in the university – extension work. These involve service to the university or the larger community and working with people from outside our department, college, or university. The HEED projects formed the bulk of my extension work and allowed me to immerse myself in communities, organize HEED workshops, and build authentic relationships locally and internationally.

What advice will you give to those who want to be a future engineer like you?

Don't let other people decide your college course for you. If you have relatives who are engineers or you know people who can connect you to one, ask them about their experience and see if it is a field that sparks something in you. Gauge whether you enjoy science and math. You don't have to be a science and math whiz but you will be encountering a lot of it if you pursue this path. It won't be a walk in the park but it's all worth it!

Be an engineer not for the money or prestige but for the impact you want to make in society. Be intentional about your choice. You don't necessarily need to have a crystal clear "why" right now. You can keep figuring out that along the way. At the very least, please make sure that your decision to take engineering is aligned with your values.

That's it! I look forward to working with you in the field!

What made you decide to become an engineer?

Back in high school, I was really interested in Math. My father recognized this and persuaded me to take up engineering.

What is the best thing about being an engineer?

I get to practice my engineering profession through teaching and research. As a teacher, the best thing is seeing how my students become curious about a concept—why metals are strong, why glass breaks a certain way, why some plastics are transparent, etc.—and really put an effort to learn more for themselves.

As a researcher, I get to develop new materials and test them for their intended application. It is quite interesting to see how a small change in composition or fabrication process can have an impact on material properties! I also get to do material and sample characterization, particularly water quality, and do research that could help members of the community have access to clean water and a safer environment.

John Kenneth Cruz
Materials Engineering

Can you describe to us how your typical day as an engineer usually goes?

I spend my day either in the classroom, especially during pre-pandemic, or in the laboratory. My classes would usually start at 8:30 in the morning so I make sure I'm already at the university an hour earlier. I then spend my afternoons in the laboratory, training my students on the use of equipment or brainstorming on how to implement their design or research ideas. After a day of classes, meetings, or experiments, we at the lab usually go out for a walk around the campus to destress or to eat merienda. Some days, I am out doing fieldwork and collecting samples. This allows me to do engineering work, appreciate different places, talk to people, and view things from a different perspective that I could use back in the classroom or the laboratory.

What advice will you give to those who want to be a future engineer like you?

The most interesting question is "how." How does a battery work? How can I improve the strength of glass? How can I lessen the environmental impacts of a car? How can I determine the heat response of a new material? How can I reuse plastics and other waste materials? How can I redesign a product, like a cellphone, so that it is accessible to everybody—even those with different abilities? How can I make an impact on my community, even in my own small ways? Ask 'how' and you will see a world of endless opportunities.

Aniceto S. Guiyab Jr.
Civil Engineering

Can you describe to us how your typical day as an engineer usually goes?

Being an engineer means you are continuously presented with different problems that you have to solve each day. This means you also get to use your creativity every day. You have to come up with solutions to problems that others may have not thought of.

What is the best thing about being an engineer?

The best thing about being an engineer is that I know that whatever I am working on will surely help to make people better, or save lives.

What made you decide to become an engineer?

I decided to become an engineer because I grew up watching my dad being able to fix anything. I basically wanted to become like him. I've also always had this fascination in building things and discovering how things work. Taking up engineering was the logical career to take to continuously satisfy my never-ending fascination.

What advice will you give to those who want to be a future engineer like you?

To become an engineer, you should not only have the passion to make a difference in the world but the technical know-how to achieve it. It's very important that engineers have a solid background in math and science. That means you really have to study hard! Becoming an engineer can really be difficult. But like anything else in life, things get easier with practice. We didn't automatically dive in a pool and know how to swim or jump on a bike and know how to ride it, it took a lot of practice to get it right. Engineering is the same. You'll notice that the math, science, and other difficult stuff gets easier in time with practice.

Tara Lim
Sound Engineering

What made you decide to become an engineer?

I was always a tinkerer as a kid, and growing up, I was really interested in how things were put together and I got a kick out of troubleshooting technical problems. But it was really my love for movies and TV that pushed me into sound engineering.

What advice will you give to those who want to be a future engineer like you?

Never stop learning! Technology is always evolving. It's impossible to know everything at any point and I think that's part of what makes it exciting and fulfilling. Your growth is limitless.

Can you describe to us how your typical day as an engineer usually goes?

If starting a new project, my day usually starts with me reviewing boards and scripts, or studying pegs. Pre-pandemic, we would start with recording talents. Post-pandemic, I just get recordings sent to me and I edit them for timing so editors and music arrangers have something to work with. After that I either clean up live sound from the shoot and compile sound effects that I think I might need. Once I receive the video I assemble everything and mix it with music.

What is the best thing about being an engineer?

The best thing about being an engineer is just figuring out how to make things work. Sound engineering requires a nice mix of creative and technical skills, and it's really satisfying stimulating different parts of my brain to get a good end result.

Ruby Sullan

Biophysical Chemist, Biomedical/ Materials Engineering Researcher

What made you decide to become an engineer?

Two things. The first reason that made me decide to become an engineer and researcher is the sense of fulfillment that comes from the opportunity to propose solutions to problems of relevance and coming up with a tangible product. For example, in my lab, we engineer nanomaterials (i.e., very small materials, at the nanoscale) that have the potential to target infections caused by bacteria. We design the nanomaterials such that it does not only treat infections but also makes it hard for the bacteria to develop resistance. Antimicrobial resistance is currently a global health threat that overburdens the healthcare industry. The opportunity to contribute to this global effort is one reason I decided to go this engineering-researcher route.

Second, the extensive research you need to do before you dive into creating a solution. Doing research is like reading a book. It transports you to virtual labs all over the globe and gives you a glimpse of the more accurate and detailed information into how other people across different disciplines approach a particular problem and conduct their experiments. For example, how did they design their experiment, what research tools did they use, how do they analyze their results? Doing research transcends travel restrictions as you can always immerse yourself in research by going to the library and reading scientific publications and books.

What is the best thing about being an engineer?

The thrill of new discoveries, new products, and creative solutions to existing problems—that can have real impact. As mentioned above, the opportunity to contribute to real-life problems.

Can you describe to us how your typical day as an engineer usually goes?

Nothing unusual I must say. You get to work, you check the items in your agenda that you want to accomplish in the day. Usually for me, it's either reading up on a topic that will push our research forward and/or writing scientific articles or research grants. Often, the day includes meetings with students or fellow researchers and engineers. With students, we discuss their research progress to date and areas where they get stuck and we brainstorm for a potential solution. From time to time, I go to the bench (i.e. lab bench) myself if I want to try out an experiment.

What advice will you give to those who want to be a future engineer like you?

Be curious. Curiosity fuels action. If you are curious, you don't mind the effort that goes into accomplishing the task. You often enter into a state of flow, you enjoy doing your work without being mindful of the time. Do the things that make you happy and in the state of flow.

About the Writer

Weng Cahiles is the author of five children's books and a two-time winner of the National Children's Book Awards. Her first book, *What Kids Should Know About Andres and the Katipunan*, won in 2014. *Si Kian*, supported by The PCIJ Story Project, won in 2018 and was also selected for the prestigious White Ravens, an annual catalogue of the best 200 kids and young adult books from around the world. It was the only book from the Philippines in the list that year.

About the Illustrator

Ivan Reverente is an illustrator and graphic designer from Manila. He graduated cum laude from the University of the Philippines, Diliman with a bachelor's degree in Fine Arts. He illustrates for books, advocacy projects, and children's literature; doing creative collaborations that involve projects about social entrepreneurship and initiatives that help others. In his personal work, he likes to draw stuff that tells little stories about people, focusing on mental health and the daily struggles of the human condition. You can find more of his work in his IG account **@ivan.reverente.art.**

Message from Fluor

"To the Filipino youth, may this book provide an introduction to the world of engineering—the various roles engineers play in nation-building and some examples of their notable accomplishments. More importantly, we hope this book inspires the next generation of engineers to create, innovate, and, like others before them, help build a better world."

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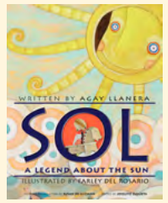
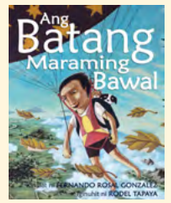
Adaptation by Augie Rivera
Art by Romeo Forbes

THE ROCKING HORSE
Story by Becky Bravo
Art by Elmer Borlongan



SOL: A LEGEND ABOUT THE SUN
Story by Agay Llanera
Art by Farley del Rosario



ANG BATANG MARAMING BAWAL
Story by Fernando Rosal Gonzalez
Art by Rodel Tapaya

EARTH TALES: 3 ECO-FABLES FOR CHILDREN
"The King and the Royal Trees," *by* Paul Aird *and art by* Ivee Olivares-Mellor
"The Hummingbird," *art by* Plet Bolipata
"The Star Thrower," *art by* Liza Flores

MESSAGE IN THE SAND
Story by Charmaine Aserappa
Art by Roel Obemio

TAHAN NA, TAHANAN
Story by Maria Isabel Alarilla-Arellano
Art by Don M. Salubayba

DOLL EYES
Story by Eline Santos
Art by Joy Mallari

RIZALPABETO
Poems by Vim Nadera
Art by Elmer Borlongan

NADIA AND THE BLUE STARS
Story by Francesca Nicole Chan Torres
Art by Liv Romualdez Vinluan

A FISH TALE
Story by Becky Bravo
Art by Daniel dela Cruz

HERE BE DRAGONS
Story by Victor Fernando R. Ocampo
Art by Jon Jaylo

MY BIG SISTER CAN SEE DRAGONS
Story by Rocky Sanchez Tirona
Art by Liza Flores

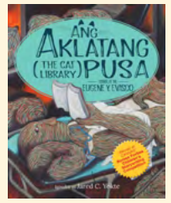
INANG KALIKASAN'S BAD HAIR DAY
Story by Recle Etino Vibal
Art by John Paul Antido

BENCAB'S ACTIVITY BOOK FOR CHILDREN
Activities written by Karen Joy Desamparado-Foronda
Art by Benedicto Cabrera

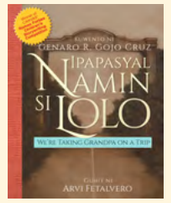
PANYÁAN: THREE TALES OF THE TAGBANUA
Stories by Rhandee Garlitos *and* Annette Ferrer
Art by Sergio Bumatay III

THE WEIGHT OF WORDS: AN ALPHABET OF HUMAN RIGHTS
Edited by CANVAS
Artworks by Electrolychee, Dan Matutina, Gerilya, John Ed De Vera, Jom Masolabe, June Digan, Keith Dador, Kevin Roque, Lala Gallardo, Meneer Marcelo, Palma Tayona, Wesley Valenzuela

KARAPAT DAPAT
Written by May Tobias-Papa
Art by I.N.K.



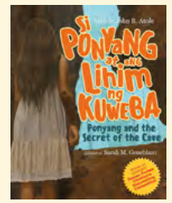
ANG AKLATANG PUSA
Story by Eugene Y. Evasco
Art by Jared C. Yokte



IPAPASYAL NAMIN SI LOLO
Story by Renato R. Gojo Cruz
Art by Arvi Fetalvero

RENATO BARJA'S CHILDREN'S STORIES
Stories written by Daniel Palma Tayona *and* Gigo Alampay
Art by Renato Barja

LOOKING FOR JUAN: A CANVAS ACTIVITY BOOK FOR CHILDREN
Activites written by Annette A. Ferrer *and* Gigo A. Alampay
Art by John Paul Antido

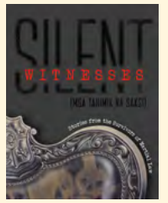


SI PONYANG AT ANG LIHIM NG KUWEBA
Story by Melvin John B. Atole
Art by Sarah M. Geneblazo

ANG ANGHEL NG SANTA ANA
Story by Josephine de Dios
Art by Johanna Helmuth

MGA MUNTING PATAK NG ULAN
Story by Jessica Luciano Olmedo
Art by Alee Garibay

MAMITA'S GARDEN: AN ACTIVITY BOOK
Story by Nicolas Gabriel Garcia
Art by Pam Yan-Santos



SILENT WITNESSES
Stories retold by Gigo A. Alampay
Art by Renz M. Baluyot

WHY WORDS MATTER
Sinulat ni Jose Y. Dalisay Jr.
Dibuho ni Marcel Antonio

ANG KAHON NI LOLA
Story and artworks by Ioannis Sicuya

DAUGHTER AND THE GREAT FISH
Story by Loren Peria
Art by Jeho Bitancor

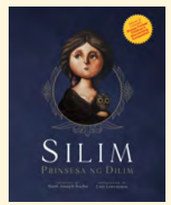
I AM THE STORYTELLER
Educational Consultant:
Ana Maria Margarita Salvador
Art by various artists

MY SUPER HANDS
Written by Annette A. Ferrer
Artworks by BLIC

SAFE SPACE
Written by Gigo Alampay
Art by Liza Flores, Abi Goy, Fran Alvarez, and Jamie Bauza

#YOUTHINK
Written by Gigo Alampay
Designed by Studio Dialogo

A BRIDGE FOR SILAY
Written by Agay Llanera
Art by Ronson Culibrina



SILIM, PRINSESA NG DILIM
Written by Mark Joseph Bacho
Art by Luis Lorenzana

I AM THE CHANGE IN CLIMATE CHANGE
Written by Alyssa M. Peleo-Alampay, Ph.D.
Art by Ang I.N.K

I LIKE WEARING RAINBOWS
Written by Agay Llanera
Art by Lui Manaig

KAKATOK-KATOK SA BAHAY NI BENOK
Written by Mon Sy
Art by Faye Abantao

AGAWAN BASE
Written by Jez Martin De Veyra
Artworks by Jericho Moral

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CANVAS, *a non-profit organization,*
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