NSPA Artist of the Year Nominee for *The Scientific Marksman*- James Shiao

Working on *The Scientific Marksman* this year has been challenging, but I feel that all of our work has been rewarding nonetheless. As the co-editor-in-chief with Ishan Gupta, my contributions on the magazine consisted of delegating tasks to our staff, ensuring the writing and design processes ran smoothly, and addressing concerns that our staff or the science department faculty sponsors had for our publication. In addition to being in a leadership position, I created art for the publication.

In contrast with other publications at our school, *The Scientific Marksman* has a relatively short history, so we do not have many past issues to reference. In addition, our publication staff is not sponsored by a teacher specialized in journalistic media. All this is to say that *The Scientific Marksman* is a student-run publication that has the difficult task of depending on our current staff without much faculty help.

On top of this qualification, the situation surrounding our magazine this year was unique to past years; in October 2019, our school was devastated by a tornado which prevented students from gathering at school for about a month, then the COVID-19 pandemic ended the school year early in March 2020. Our time creating the magazine was cut short, resulting in a loss of momentum and a re-evaluation in our publication.

Why do I include all of this information, which seems to not relate to art? At first, I planned on making a lot of art for this publication at the beginning of the school year, but as uncontrollable obstacles arose, I shifted my attention from focusing on art to guiding my staff members. Because the 2019-2020 school year would be my last at my school, I realized that training younger students to write, design, coordinate and follow through with a plan was crucial to the future success of the organization. During our break from school after the tornado, we couldn't gather the staff together to work, so Ishan and I agreed to up the ante on design nights. Our staff came to work on the magazine after school until around 8 PM every week, and I stopped working on my own graphics and started focusing on helping them with their design.

At the end of the day, our organization has created an amazing issue against all odds, despite all the hardship facing them, and I am more proud of them for pulling through than anything. I learned that education is the key to pushing forward, not just in academics but in extracurricular endeavors, such as this, as well. I have included the staff page of our magazine not just to show my artwork in the background, but also to show how many students were involved with the design process. I pride myself on the fact that almost all of our staff participated in designing spreads, and some even created their own artwork for spreads, like Jeremy Yu and Morgan Chow.

The Scientific Marksman is unique because we combine journalism, science and art to spread information and educate, but more than that to inspire change. And that is the ultimate goal behind my work this year.

Artwork Descriptions (in order)

Cover and Back Cover: This piece was inspired by the hopelessness that many people of my and older generations feel about climate change. The front cover has an overall greyscale and low-saturation tone with a dark man representing society spreading disaster as he walks to visually convey this hopelessness. The back cover has much brighter scenery featuring children who are creating green technology and practices to show that there is still hope; the cartoon children stand out from the more realistic background for a jovial atmosphere.

Pages 2-3: The background of this spread was created in conjunction with and almost a direct reflection of pages 66-67. A scientist stands on a beach facing the ocean, which represents the issue's theme, and the rising sun, which signfies a new beginning, in particular the opening statement of the issue beginning the rest of the magazine.

Pages 26-27: The "Dysphotic Zone" is the second section of the magazine, and as the magazine progresses the section openers become darker, representing diving deeper into the ocean. Each section opener has information about the real-life light zone of the ocean and organisms that reside in the respective zone. In its own unexpected way, the section openers together create a narrative of how weird the ocean is, and that can be considered its own scientific story.

Pages 44-45: This article about Nobel Prize Laureates features hand-drawn vignettes of each winner. I felt that the simplified caricatures featured on the Nobel website did not sufficiently convey the sophistication that these scientists possessed, so I opted for a more realistic drawing for each individual. While many elements of these vignettes were traced from photographs, such as overall shape and wrinkle details, the shading was added using reference of the photos.

Page 66-67: The background of this spread was created in conjunction with and almost a direct reflection of pages 2-3. A different scientist stands on a beach facing the ocean, again representing the theme, facing the moon's sparkling reflection in the water. This piece represents the end of the magazine, but more personally, the end of a year-long journey.

the scientific marksman

Volume 08 2019-2020

OPENING

The polymath—scholar of math, engineering, anatomy, geology, astronomy, paleontology, architecture and more.

Throughout history some of the most influential thinkers did not restrict themselves to a singular field: Aristotle, Leonardo da Vinci, Nicolaus Copernicus, Benjamin Franklin.

A few hundred years later, the same can't be said about even our greatest minds. As all areas of knowledge are getting more complex, STEM is becoming a narrower, more defined set of fields.

The 8th edition of the Scientific Marksman aims to give a look into the modern scientific world, no matter how interested you are in STEM. Just like the levels of the ocean—from the surface level, Euphotic, to the middle level, Dysphotic, to the deepest level, Aphotic—the articles in this issue get increasingly complex the deeper you read.

Climate change has become a defining issue for this generation. The world is in a deep, divided discussion - some people believe there is no threat to humanity while others believe global warming is the greatest threat to this planet. At the beginning of every section, we have created a special four-page story that dives into modern-day climate change, its impact and our work to fight it, to hopefully show you how and why you should be active in the discussion.

Although production was delayed by the impact of the Coronavirus, we hope you still enjoy the writing and design within the pages of this magazine. With that said, it is our great honor to present to you the 8th edition of the Scientific Marksman.

DYS·PHO·TIC

1. having enough light to see, but not enough to carry out photosynthesis.
2. term used to describe the Twilight zone

The Dysphotic section is the realm between the surface-level science and the deepest, most complex discoveries. Covering topics similar to the ones found previously, the articles in this section dive deeper into the subject matter.

Cookiecutter Shark
Species name: *Isistius brasiliensis*
Size: 40 to 60 centimeters
These tiny sharks aren't named "cookiecutter" for their size, but rather for their feeding habit of biting off small circular chunks from their prey, as if using cookiecutters on a tray of dough. While their bites aren't deadly, they are certainly painful and certain to leave an eerie scar behind.

Lovely Hatchetfish
Species name: *Argyropelecus aculeatus*
Size: 70 millimeters
Lovely hatchetfish have a silvery coloration and bioluminescence, which allows them to hide from predators and prey in the low light of the twilight zone.

Yellow Sponge
Species name: *Aplysina fistularis*
Size: 0.3 to 1 meter
Sponge cells do not have specialized purposes—each of a sponge's individual cells can transform to complete the job of any other cell in the body. In fact, in laboratory settings, a sponge that is destroyed in a blender can reform itself as cells take on the form and job needed for recovery.

Despite how ambitious educators and students can be, one school can only do so much to analyze and fight global warming.

But a city can do much more.

Looking through the damage the tornado caused the city of Dallas in October 2019, we wondered if there was anything the city could do to prevent tornado damage and if tornadoes could be contributing to the overarching problem.

The truth is that meteorologists predicted the storm would cause a tornado but couldn't estimate the damage. Many people in the city were in a state of shock at the storm's aftermath.

Despite our research, we found that there is still much mystery surrounding the cyclones known as tornadoes. Is is possible to find a connection between the weather phenomenon and climate change?

▶

2019 Nobel laureates in the fields of science

■ **Story** by James Shiao ■ **Graphics** by James Shiao
■ **Extended Reporting** Paul Sulivan and Rishab Siddamshetty

Introduction

What exactly earns a scientist a Nobel Prize?

The Peace Prize is given to outstanding activists and people who defend others' rights or fight for the wellbeing of those in need, but what constitutes a significant achievement in the sciences?

The will of Alfred Nobel, the wealthy inventor who posthumously founded the Nobel Prize, does not seem to provide a sufficient answer for a scientist's importance.

"My remaining realizable assets are to be disbursed," his will says. "One part to the person who made the most important discovery or invention in the field of physics; one part to the person who made the most important chemical discovery or improvement; one part to the person who made the most important discovery within the domain of physiology or medicine."

If the original founder's instructions are this general, then how are the prizes awarded? Looking at the laureates of this year's Nobel Prizes in Physics, Medicine, Chemistry and Economic Sciences, the answer can be summarized in one word.

Impact.

From the theoretical discovery of exoplanets to methods of increasing access to education for the impoverished, these Nobel Prize winners have shown how their achievements have shaped the world.

Nobel Prize in Physics

The Nobel Prize in Physics was awarded "for contributions to our understanding of the evolution of the universe and Earth's place in the cosmos," as read on the Nobel Prize's website. The award was divided into two halves, one given to James Peebles and the other given to Michel Mayor and Didier Queloz.

Peebles, a Canadian- American astrophysicist and astronomer, currently teaches at Princeton University. Peebles won his Nobel Prize for discovering that the cosmic microwave background's radiation could identify dark energy and dark matter.

"James Peeble had revealed how, by looking back in time at the cosmic microwave background radiation, a radiation which has been travelling toward us for almost 14 billion years, in that radiation you can read off the contents of our universe," Ulf Danielsson, Member of the Nobel Physics Committee, said.

In addition to this theory, Peebles has made many noteworthy contributions in the areas of primordial nucleosynthesis, dark matter and the formation of galaxies and other structures in space.

The other half of the Nobel Prize in Physics was given to two scientists, Swiss astrophysicist Michel Mayor and Swiss astronomer Didier Queloz for their discovery of an exoplanet that orbited a solar-type star.

Mayor currently teaches astrophysics at the University of Geneva's Department of Astronomy. He has made considerable contributions in astronomy but focuses on finding other habitable planets like Earth.

Queloz, who won the award concurrently with Mayor, serves as a professor at the University of Cambridge. He and Mayor's discovery championed a field of star detection using various astronomical techniques.

"If you look at a star and carefully measure its color, you can see that the star is wobbling along the line of sight," Danielsson said. "Then you can calculate the effect of a planet which is doing that. That was the technique created and used in this particular case."

Nobel Prize in Chemistry

While the lithium-ion battery has been around since the 1970s, the Nobel Prize in Chemistry is awarded to three figures who contributed to its beginning stages of development: John Goodenough, M. Stanley Whittingham and Akira Yoshino.

Currently, lithium-ion batteries power almost all portable electronics that people use on a daily basis.

"The benefit of this battery is that it actually enables the revolution of the mobile world," Olof Ramström, member of the Nobel Chemistry Committee, said.

Whittingham is a pro- fessor of chemistry and Director of the Institute for Materials Research at Binghamton University. Whittingham first started work on the battery during the 1970s energy crisis by researching ways to achieve fossil-fuel-free technologies.

He found that the compound titanium disulphide made an effective cathode, a negatively charged terminal through which electricity can enter a device that could house lithium ions. The anode, or a positively charged terminal, was partially made of metallic lithium.

Goodenough, professor of mechanical engineering and materials science at the University of Texas at Austin, believed that the cathode could be improved by using a metal oxide over a metal sulfide and found that cobalt oxide could be a better anode to house lithium ions. This was a breakthrough that led to more powerful batteries.

Yoshino is a professor at Meijo University in Nagoya. Using Goodenough's cathode, Yoshino created the first commercially-viable lithium-ion battery in 1985. He replaced the metallic lithium inside the anode with a material made of carbon. The product of this was a light, durable battery that could be used many times before losing its effectiveness.

These batteries resulted in a wireless revolution, empowering many of the devices we use now in our daily lives.

"Lithium-ion batteries are now dominant and are really enabling the renewable energy situation," Whittingham said in his Nobel lecture. "What energy storage is going to enable is renewable energy that is cleaner, more sustainable, and allows us to mitigate global warming."

Nobel Prize in Medicine and Physiology

The 2019 Nobel Prize in Medicine was given to William G. Kaelin Jr., Peter J. Ratcliffe and Gregg L. Semenza for their discoveries of how cells sense and adapt to oxygen availability.

"The prize is for sort of a thermostat for the oxygen levels or a damper that you'd have on your furnace to let in more or less oxygen at any given time so that the flame burns just right," Randall Johnson, Member of the Nobel Medicine and Physiology Assembly, said.

Kaelin, currently a pro- fessor at Harvard University, utilizes a lab there to study tumor suppressor proteins and continues to make contributions in the field of oncology. He spoke about his work on sensing oxygen usage in von Hippel Lindau disease, a tumor-suppressor gene which is mutated in a cancer syndrome, in his Nobel lecture.

Ratcliffe is a physician and scientist. He was trained as a nephrologist, a doctor who specializes in kidney treatment and medicine. His primary focus is renal oxygenation, and he and his team uncovered a process that animal cells use to measure oxygen that was disrupted in numerous tumours. This process is known as "hypoxia" and its discovery is the reason that Ratcliffe was awarded the prize.

Semenza is a professor at Johns Hopkins College. Semenza has made contributions in radiation oncology-- the treatment of tumors using targeted radiation, a typical alternative to chemotherapy-- as well as the studies of biological chemistry, medicine and tumors.

"This discovery affects people's lives because it is already helping people develop new medicines," Johnson said. "Finding different ways to influence this fundamental process has already shown itself to be potentially very useful in medical applications."

While animals use oxygen to make food and energy for their body, scientists did not understand how cells alter their conditions to work with oxygen until this discovery. These scientists discovered how molecules help regulate gene activity in the presence of oxygen and how oxygen levels affect cellular metabolism and physiological functions in the body.

"For example, if you want to increase the levels of your red blood cells, you want a signal to tell your body to make more blood cells," Johnson said. "A drug that can raise the levels of this can trigger new blood cell production."

Their work has furthered many branches of medicine and has paved the path to find treatments for cancer, VHL, and for anemia--a condition in which the blood has a reduced ability to carry oxygen.

Timeline of the Nobel Prizes in the Sciences

1901- First winners of the Nobel Prize

1903- First woman to win is Marie Curie

1915- First year with no prize in Medicine

1916- First year with no prize in Physics or Chemistry

1939- 3 German scientists are unable to receive the prize due to WWII

1962- Linus Pauling wins a prize for Chemistry, then one for Peace

1969- First year the Economic Science prize is awarded

2009- Total of 5 women win Nobel prizes

Nobel Prize in Economic Science

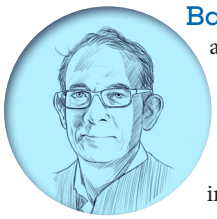
The Nobel Prize in the Economic Sciences was given to three people for their scientific experimental approaches to solve a major global issue: poverty.

Abhijit Banerjee, Esther Duflo, and Michael Kremer were honored with the 2019 Nobel Prize in Economics for their work enhancing the world's ability to combat poverty. Essentially, what they have done is divide the issue of poverty into smaller, easier to handle questions that are best answered by specific experiments on those in poverty. As a direct result of their studies, more than five million Indian children have access to remedial tutoring and education in schools.

"This prize is about a new approach in development economics," Jakob Svensson, member of the Prize Committee for Economic Sciences, said. "It's an approach that helps us better identify ways or policies that we can use to reduce global poverty."

When asked to explain the technique, Svensson used a metaphor: to find the causes of poverty in a particular place, the technique has an economist first ask broad questions and narrow down the questions as he/she answers them with more and more detail, so that he/she can use empirical reasoning to deduce the causes and effects leading up to poverty.

Kremer is an American development economist and the Gates Professor of Developing Societies at Harvard University. In the 1990s, Kremer found just how effective this technique really is, conducting experiments with the intent to test different methods for improving school results in Kenya.



Banerjee is an economist and is currently the Ford Foundation International Professor of Economics at the Massachusetts Institute of Technology. Borrowing from medical research, Banerjee implemented field experiments to great effect in the fields of economics research.

"Field experiments, sometimes known as RCTs (randomized control trials), look at interventions to the comparison of random treatment of control groups-people who are randomly chosen to get an intervention and people who are randomly chosen not to get an intervention, to compare them to know what impact the intervention had," Banarjee said.

Duflo is a Professor of Poverty Alleviation and Development Economics at the Massachusetts Institute of Technology. Like Kremer, she performed studies of issues related to poverty. The two economists' methods are now widely used within the field of development economics.

The work of these laureates has improved the ability of the world to fight poverty. Their findings haven't only helped relieve poverty today, but they also offer a great possibility to further improve the lives of those in need.

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