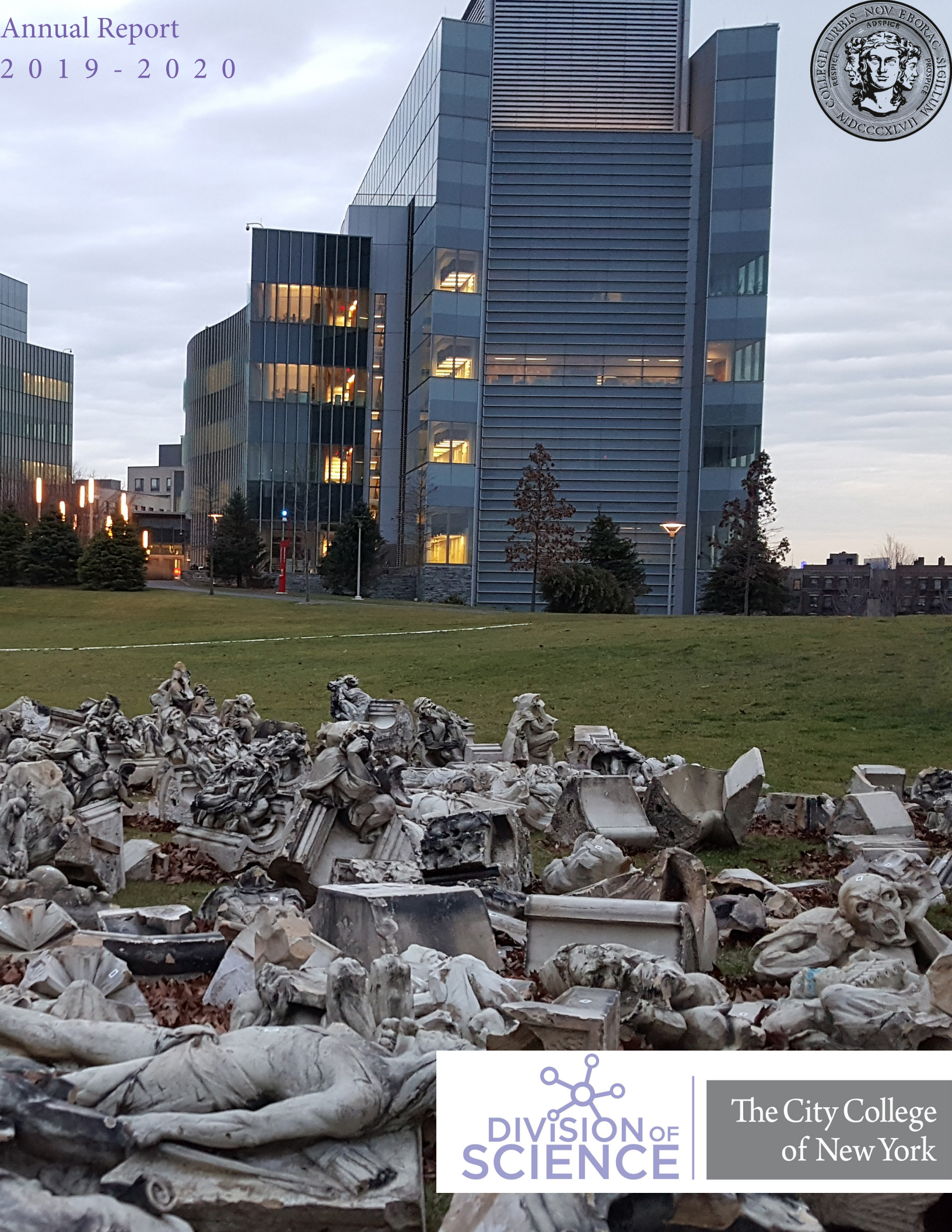
Annual Report
2019-2020



DIVISION OF SCIENCE

The City College of New York

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Message from

The Dean's Office

A MESSAGE FROM THE DEAN TEAM

Susan Perkins began as the Martin and Michele Cohen Dean of Science in January 2020, succeeding Distinguished Physics Professor Parameswaran Nair, who had so competently and graciously served in that role as Interim Dean since March 2018. The first few months were an exciting whirlwind for the new Dean as she tried to get to know our office and the staff, the other deans and administrators and learn about the priorities, strategies, and challenges of the College. She scheduled "meet and greets" with small groups of faculty to also get to know them and their work and to hear the things that they loved about City College – and the things that they struggled with.

And then a global pandemic, the likes of which we've not experienced in almost anyone's lifetime, struck, with New York City its American epicenter. Everything quickly changed in troubling ways. Within a span of days, our faculty had to transform their courses, including our many sections of laboratories, into online formats. Research in the Division ground to a halt, with only a tiny fraction of work that involved the viral culprit itself continuing. All of our work immediately was converted to a virtual format. We had meetings and seminars via Zoom, adapted processes once done on paper to a digital format, and tried to keep as productive and functional as we could, hoping it would quickly be over. And yet, it dragged on – and with it, the budgetary challenges mounted as well. What was perhaps most heartbreaking to all of us was having to do all of our graduation events virtually as well. The Departments and the College tried their very best, but it just could not replace the live, in person pomp and circumstance with family and friends. This year's report will lack the many photos of events such as these from previous years and we eagerly look forward to being able to get to the point where they are part of our year again.

After some months of shuttered labs, In June 2020 we were able to implement processes and protocols to bring a large number of our faculty, staff and graduate students back onto campus to continue with the important research that they

do. It's not been perfect, but it's worked very well and we've been able to keep people safe. While online teaching can be frustrating and feels somewhat impersonal, it's also helped us all to hone what is crucial to deliver in our courses and to think critically about what the laboratory experiences bring in terms of teaching students how science is actually done. We've picked up new skills that allow us to do our jobs better and rely less on outdated workflows. Because our seminars and events are virtual and anyone around the world can tune it, we've been able to share our science and other accomplishments to a far broader audience than ever before possible.

The challenges from this pandemic and its associated economic toll are far from over, but the resilience of our faculty, staff, and students continues to impress me. Grants keep getting submitted, and funded (!), papers keep getting published, data are still collected, and our students keep advancing towards degrees and careers in Science. We will get through this.

Dr. Susan Perkins
Martin and Michelle Cohen Dean of Science
Dr. Laurent Mars
Associate Dean
Dr. Millicent Roth
Deputy Dean for Undergraduate Programs
Dr. Elizabeth Rudolph
Assistant Dean for Graduate Programs & Assessment
Frank Pace
Finance Manager
Michael Boydston-White
Science Facilities Manager
Daniel Fimiarz
Core Facilities Manager
Cindy Gonzalez
Administrative Assistant

About the New Dean of Science

Susan Perkins

Dr. Susan Perkins assumed the position of the Martin and Michele Cohen Dean of Science on January 6, 2020. She came to City College after a fifteen-year career as a Curator and Professor of Microbiology at the American Museum of Natural History (AMNH). At the AMNH, Perkins fulfilled many roles including running an active and externally funded research laboratory, mentoring students in the Richard Gilder Graduate School at the Museum, and serving in leadership positions such as the President of the Curatorial Senate and chairing numerous committees for the institution. Being a major center for informal and public education, the AMNH also afforded Perkins opportunities to engage with learners of all ages through exhibits and a diversity of programs, including the exhibit, The Secret World Inside You, which educated visitors about the vital roles of the human microbiome.

Perkins conducts research on the parasitic and commensal microbial symbionts of wild animals. A major focus throughout her career has been the haemosporidian, or malaria, parasites of non-human hosts. Through field work of her own and collaborations with numerous scientists around the globe, she has been involved in species discovery and description, phylogenetic studies of the evolutionary history of these parasites, and studies to understand their genetics and evolution. She has also worked on trypanosomes of several groups of hosts, as well as virus genomics and the development of markers for population genetic studies. More recent work has involved studies of the patterns and processes of the gut microbiomes of bats, birds, and insects. She served as President of the American Society of Parasitologists from 2017-2018.

Though new to City College, Perkins was part of the CUNY system for many years as an adjunct faculty member of the Graduate Center and a member of the subprogram committee in Ecology and Evolutionary Biology. A native of Massena, New York, she attended SUNY Potsdam, majoring in Biology and minoring in Chemistry and received her Ph.D. at the University of Vermont. She has also held a faculty position at the University of Colorado and served as a Program Director at the National Science Foundation.

As the new Cohen Dean of Science, Perkins is poised to use her background in science outreach and communication and her experience as a practicing scientist and educator to help to promote the outstanding research and teaching being done in the Division by faculty, staff, and students.

> “It’s important for undergraduates to understand the progression and to see what the graduate students and postdocs are experiencing." "They need the role models", she said.

At A Glance
2019 - 2020

273
BACHELORS DEGREES AWARDED

14 UNDERGRADUATE & GRADUATE DEGREE PROGRAMS
*Biochemistry *Biology
*Biotechnology *Chemistry
*Earth & Atmospheric Sciences
*Mathematics *Physics

112
FULL-TIME FACULTY

1652
DECLARED MAJORS IN SCIENCE

15.9 million
GRANT DOLLARS

52
GRADUATE DEGREES AWARDED

06
COMBINED BS-MS OPTIONS
* Biology *Biochemistry
* Biotechnology
* Chemistry *EAS
*Math

1951
SCIENCE UNDERGRADUATES

06
PH.D. PROGRAMS
* Biochemistry * Biology
* Chemistry * Earth and Environmental Sciences
* Mathematics
* Physics

03
DISTINGUISHED PROFESSORS

71%
MEDICAL SCHOOL ACCEPTANCE RATE

10%
SCIENCE MAJORS CONDUCTING RESEARCH

Students Achivements

ABRCM Awards

The Annual Biomedical Research Conference for Minority Students (ABRCMS) brings together one of the largest communities of underrepresented minorities in science, technology, engineering and mathematics (STEM). Students attend this conference to present their research, enhance professional development skills, explore graduate schools, and most importantly to network. During the four-day conference, more than 2,500 students from over 350 colleges and universities deliver poster and oral presentations in twelve STEM disciplines.

This 18th running of the ABRCMS conference took place in Anaheim, California, November 13-16, 2019. This was one of the last in-person events before the pandemic struck. Approximately 5300 participants filled the venue over the four days of the conference, which represents an almost 13% increase since the previous event, and demostrates the popularity and impact of ABRCMS and the American Society of Microbiology, the conference manager. There were over 425 exhibit booths including our very own City College booth.

Fourteen CCNY students, eight from the Division of Science, attended and presented their research in poster or oral format. Five CCNY students came home with awards.

Congratulations to all participants and winners!

Student Achievements

CCAPP Poster Presentation

The Annual City College Academy for Professional Preparation (CCAPP) Poster Presentation was held in person on November 21, 2019. As is customary, President Boudreau, and Dr. Roth greeted the participants and guests. Among the audience were Provost Liss, interim Dean Nair, incoming Dean Perkins and Dr. Badal, Director of Diversity for the Associated Medical Schools of New York. Many CCNY faculty, administrators, advisors and program directors were also in attendance.

A total of 34 CCNY undergraduates, mainly from the Division of Science, made oral presentations to visitors at their posters, which ranged from topics in environmental science, immunology, public health, structural biology, nanotechnology, ecology and conservation, neuroscience, genetics, chemistry, physiology, biochemistry, microbiology and biomedical engineering. A sampling of the research can be seen in the accompanying photos. Congratulations to all for another highly successful event!

Student Achievements

Division of Science Valedictorian

Shelly Zou is without question a Division of Science superstar who among her many achievements has earned the esteemed position of Division of Science Valedictorian for 2020. Shelly graduated *summa cum laude* with a bachelor's degree in Biology with a staggering GPA of 3.95! She won multiple scholarships and awards: The Family of Irving J. Brenner Scholarship; The Olivia McKenna Award for Neurobiology; and the Macaulay Community Service Award to name a few. She is also the inaugural winner of the Harry Lustig Award, a prestigious Division of Science award.

Shelly is a first-generation college student. Her parents emigrated from a small village in Fujian, China. They have very traditional values. As a child of traditional, middle school-educated first-generation immigrants, Shelly's life has centered only around two foci, family and academics.

Her love for the sciences began early in elementary school. She enjoyed the hands-on nature of science; it challenged how she thought and provided hypotheses and explanations for natural phenomena. Shelly was always fascinated by and appreciative of science's role in deciphering the natural world. Over time, science became her language. She used science to convey her thoughts and feelings to others, especially to her parents and relatives. However, she learned that simply expressing her feelings and values was not enough to cross the cultural divide. Instead, she was often dismissed as young, naïve, and ignorant compared to those who were older and had more life experiences. But, over time, Shelly found that by using her knowledge scientific information, she was able to formulate informed opinions.

With all that she has learned through her journey at CCNY, Shelly strives to become a physician who not only excels at her craft, but is also empathetic, dedicated, and passionate about providing the best care and support for every person she meets. As a doctor, she will give back by advocating for quality healthcare and helping people make informed decisions regarding their health and wellbeing. While working towards this dream, Shelly will also continue the work she began with *Humanizing*, an outfit that partners with local food banks, providing care packages to the homeless. Ultimately, her goal is to expand and create chapters of *Humanizing* across the CUNY campuses, to inspire more students to get involved and give back to their communities and how

"I am extremely thankful for the voice and confidence I have found, having chosen to major in biology at CCNY" exclaims Zou. I've challenged myself academically, persevering through obstacles in class and in research.

> "I am extremely thankful for the voice and confidence I have found and grown by choosing to major in Biology and studying the sciences in college as well."

Student Achievements

Jonas E. Salk Scholarship

Morales leaves CCNY with honors and a 3.7 GPA. The double major from Queens has earned a B.S. in Biotechnology and a B.A. in Jewish Studies. She will attend Brandeis University on the neuro-science Ph.D. track.

Jazmin Morales, from the Class of 2020, is a Division of Science recipient of the Jonas E. Salk Scholarship awarded by The City University of New York. The Salk Scholarship is named for Dr. Jonas Salk, a 1934 graduate of City College, who developed the first polio vaccine in 1955. Dr. Salk turned down a tickertape parade in honor of his discovery, and asked that the money be used for scholarships instead. New York City provided initial funding for the scholarships that year. The scholarship recognizes exceptional students who plan careers in medicine and the biological sciences. Morales, who is the daughter of two City College alumni, will receive a stipend of $8,000 to be allocated over three or four years of medical studies.

Morales was a year old when her mother, graduating *magna cum laude* with a B.S. in Education, carried her onto the stage at CCNY to receive her diploma. Morales' father had graduated *summa cum laude* in 1994 with a B.S. in Biology. Following in her parents' footsteps, Morales leaves CCNY with honors and a 3.7 GPA. The double major from Queens has earned a B.S. in Biotechnology and B.A. in Jewish Studies. She will attend Brandeis University on the neuroscience Ph.D. track.

Among her undergraduate accolades were the Sharon D. Cosloy Scholarship in Biology and the Pearl S. Rosenthal Scholarship; the National Institutes of Health's RISE Scholar award, and the Michael and Irene Ross Scholar award. She also placed first in the NYS CSTEP Statewide Research Conference.

In addition, Morales leaves CCNY with extensive research experience. This ranges from a stint at Syracuse University studying function of the actin cytoskeleton to a Summer Research Opportunity award in molecular, cellular, and organismic biology at Harvard University. She also participated in numerous research conferences around the country. (From CCNY news)

Faculty Awards

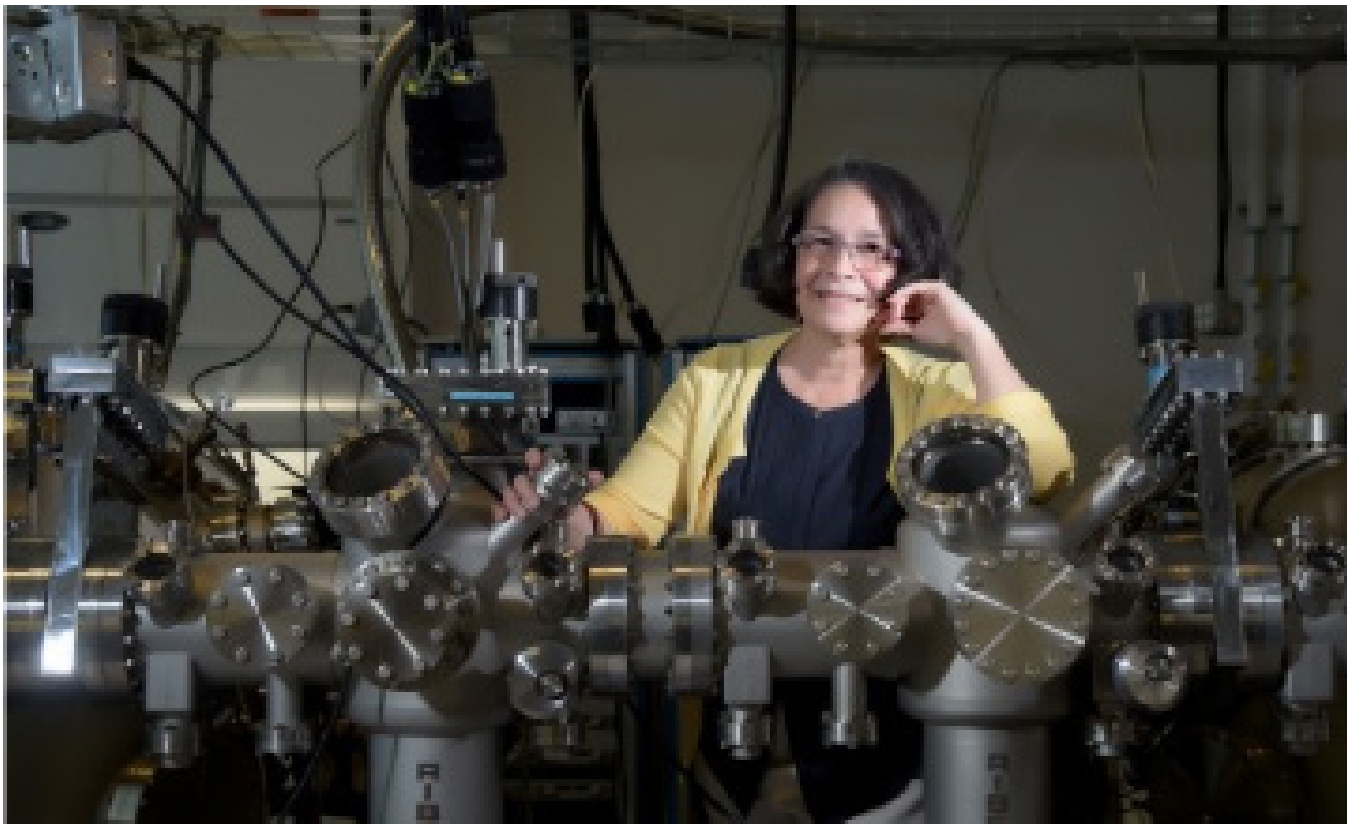
Maria Tamargo Named Member of the National Academy of Engineers

On October 4th, via a virtual ceremony, Department of Chemistry & Biochemistry Professor Maria Tamargo was inducted in the National Academy of Engineers. Dr. Tamargo was recognized for both her outstanding research contributions in the field of materials science as well as for her continuing dedication to broadening the fields of engineering and science and creating a more inclusive environment. Dr. Tamargo is the Principal Investigator of a major training program from the NSF, the Center for Interface Design and Engineered Assembly of Low Dimensional Systems (IDEALS). Tamargo is one of three women faculty members from CCNY to be elected to one of the National Academies. Dr. Myriam Sarachik, Distinguished Professor Emerita of the Physics Department (National Academy of Sciences) and Dr. Gilda Barabino, former Dean of the Grove School of Engineering (National Academy of Engineering) were also inductees.

Membership to the National Academies is indeed a very high honor. One cannot apply for membership. Members are elected to the National Academy of Engineers (NAE) by current members. The NAE website states that "Members must have distinguished themselves in business and academic management, in technical positions, as university faculty, and as leaders in government and private engineering organizations. "I did not seek the nomination, in fact I never thought that I would be nominated. I am very honored and humbled that some of my most distinguished colleagues decided to nominate me and extremely flattered that they were successful."

Tamargo is a Cuban American. Although she was born in this country, she left before age one, and spent the first 11 years of her life in Cuba living with her parents and a large (and noisy) extended family. Spanish was her first language and she went to school up to the 5th grade in Cuba. In 1962 her family left Cuba as political refugees and came to and settled in the US. They lived for several years in Milwaukee, WI and then moved to San Juan, Puerto Rico, where she did her undergraduate studies. After obtaining a Bachelor's in Chemistry at the University of Puerto Rico, Rio Piedras, she went to Johns Hopkins University for her doctorate, also in Chemistry. Her first employment after the Ph.D. was at AT&T Bell Labs, where she worked on semiconductor materials and technology. There, her career shifted from pure chemistry to applied science and engineering. After nearly 15 years in Bell Labs and Bellcore, Tamargo joined City College as Professor of Chemistry, where her research area has continued to be at the boundary between science and engineering.

When Tamargo accepted her first job she truly expected to be there only for a short time, since it was quite a change in direction from what she had done in her Ph.D. work. Tamargo also had always thought that she wanted to be in academia, and the industry experience would be only a short interval.



Faculty Awards

Maria Tamargo Named Member of the National Academy of Engineers

However, her outlook quickly changed when she became fascinated by the world of semiconductor physics and device applications. The environment at Bell labs and Bellcore was very stimulating and it was an incredibly rich learning experience. There, Tamargo's independent research career really took off. Unfortunately, changes in the way industrial research was being supported forced her and many of her colleagues to leave Bellcore, and seek other employment, and thus the academic possibility became attractive once more. But, ultimately, the topic of Tamargo's research, and her discipline was largely shaped by her early experience in those laboratories.

One of the most successful projects that Tamargo has recently been involved with is the development of a highly sophisticated and high performance semiconductor laser structure using wide bandgap II-VI compounds, a class of materials that her research group has investigated over the years. Their materials enabled them to design novel devices known as quantum cascade lasers and quantum cascade detectors, with properties that exceeded those made of conventional materials. They demonstrated lasers with shorter wavelength infrared emission, and detectors with a large broadband detection range using the II-VI semiconductor materials and the technique of molecular beam epitaxy. More recently the Tamargo group has embarked on a project to grow a new class of materials known as topological insulators, or TIs, which have unique and highly promising electrical transport properties. They have demonstrated the growth of new nanostructures made from these materials by molecular beam epitaxy. By carefully designing ultra-thin layered structures of two different TIs their electrical properties could be tuned leading to totally new materials with improved transport characteristics.

The overall goal of the Tamargo group research is to apply the sophisticated crystal growth technique of molecular beam epitaxy to grow thin films of crystalline materials with new and imporved properties that may have practical technological applications. They also seek to understand the properties of the materials they grow, and to learn how to enhance their properties by better control of the growth process.

Tamargo's teaching approach is to instill in students the desire to learn and apply their learning to solve real world problems. "I hope to provide students with some basic tools and instill curiosity so they can pursue their own career goals and be the best they can be," says Tamargo about teaching. She continues, "I do not consider myself a 'born' teacher. I started teaching at a late time in my career, and I always feel as if I am learning more than the students do whenever I teach a class." Tamargo used to think that she should not allow the students to see through these feelings, but she has come to realize that students may benefit from that awareness. She concludes, "I no longer try to hide it from them, and instead try to use it as motivation for them to feel empowered to learn."

When asked about outside interests, Tamargo shares, "I guess my number one interest outside of CCNY is my family. My husband, my three children and their families are always present even when they are physically far away, and we seem to enjoy and rely on each other's company and input for most of our amusement." She is keen on keeping close with her extended family, too: brothers and sisters, in laws, uncles and aunts, cousins, etc., from which she became geographically separated from the early days of her career. This is also a constant source of enjoyment for Tamargo. Lastly, Tamargo also loves and has tremendously enjoyed traveling all her life. She hopes that she can get back to do more traveling soon again, since there are so many places that she would really like to visit. However, she expects that some of the constraints that are being imposed on traveling due to the pandemic and to the impact air travel has on climate change and pollution, will encourage her to travel to places that can be reached by land, and nearby places that she has previously taken for granted. (From CCNY news)

> "I am very honored and humbled that some of my most distinguished colleagues decided to nominate me and extremely flattered that they were successful."

Faculty Awards

Alfano wins Gold Medal in Optics and Photonics

Distinguished Professor of Physics Robert Alfano was recognized for his outstanding, seminal achievements and contributions to advancement of knowledge on fundamental properties of the materials and their interaction with light in areas of biology, condensed matter, semiconductors, tunable lasers, and biomedical optics by receiving the 2019 Gold Medal from SPIE, the International Society for Optics and Photonics. "Alfano is, and has long been, one of the most widely respected and influential figures in laser physics," said SPIE Vice President David Andrews, Professor of Physics at University of East Anglia.

Among his most notable and crowning achievements, Alfano discovered and subsequently developed supercontinuum light produced with an ultrashort pulsed laser. The supercontinuum is used in diverse areas of science and engineering. Alfano also contributed to the burgeoning field of biophotonics in the 1980s and 1990s, work that resulted in development of techniques for optical cancer diagnosis, the optical biopsy. His work on cancer diagnosis with fluorescence, Raman spectroscopy and time-gated diffusive and ballistic light propagation in tissue during the same time period also helped develop the fields of near-infrared spectroscopy and imaging in random media.

"The impact of these advances is clear to see," says Andrew Forbes, Professor of Physics at University of the Witwatersand, Johannesburg. "There are entire conferences dedicated to these themes."
More recently, Alfano has applied his efforts to the study of structured light, where he has also made seminal contributions, including the theoretical construction of a new Poincaré sphere for the total angular momentum of light. According to Forbes, "It is no small feat to reinvent a concept so ubiquitous in optics."

When he heard he had won the highest honor from SPIE, Alfano was elated and proud that his research stands out with and among the best in the field. He gives credit to the CCNY administration from the 1970's who initially hired him as Assistant Professor and to those in the 1990's who helped build the best, first-rate Ultrafast Laser lab facility in the world at CCNY. The IUSL (Institute for Ultrasound Laser and Spectroscopy) helped transform a traditional teaching college that supports poor and diverse communities into a more cutting-edge research institution that competes with the elite colleges and universities.

"My research motto is be innovative, first, and elegant to attack and explain a research area. My teaching philosophy is to teach on level that make complex material easy and basic to understand - like knowing the ABC."

Faculty Awards

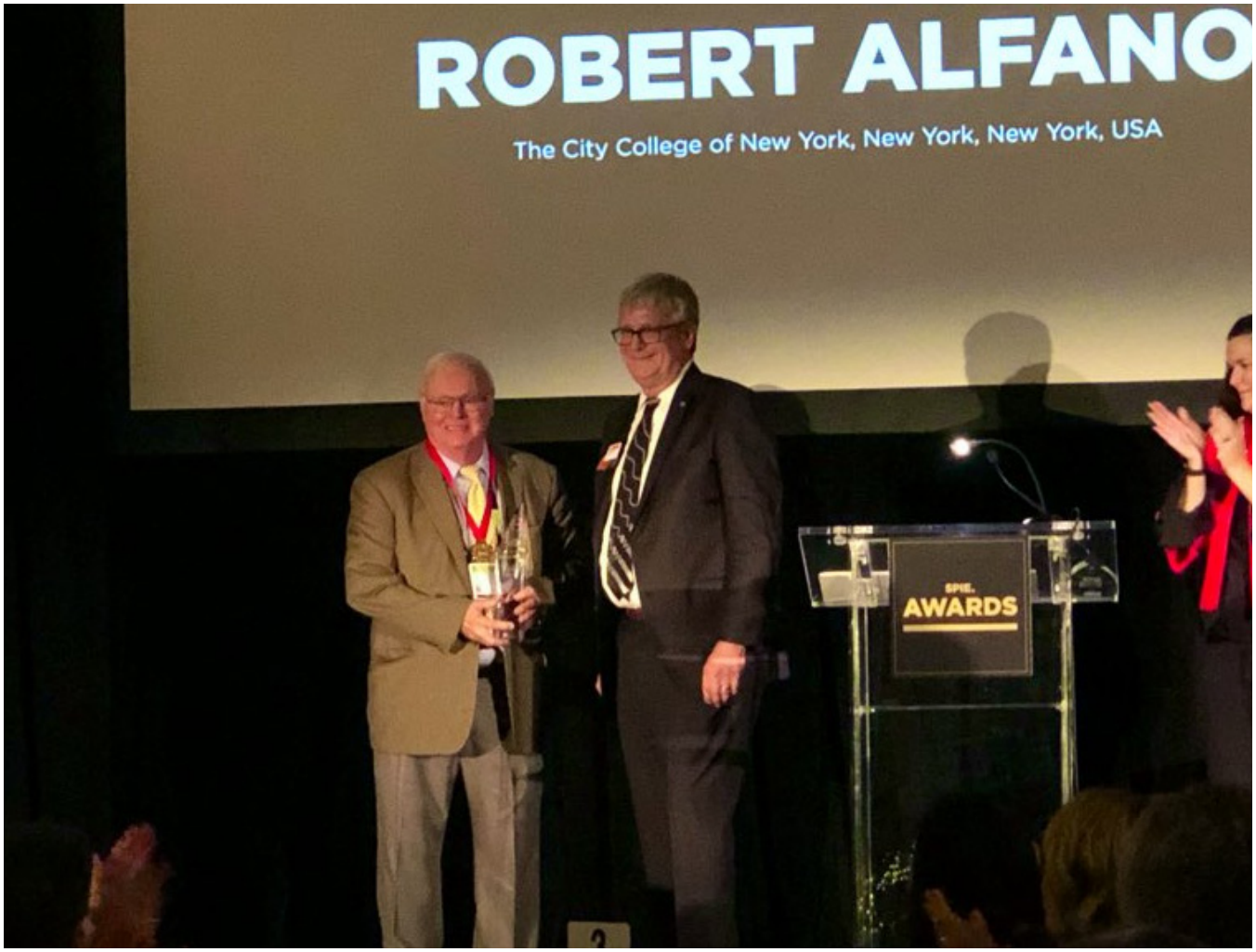
Alfano wins the Gold Medal in Optics and Photonics

Alfano is an Italian-American born in Harlem, New York City. His grandparents and mother came to the United States in 1925 from Avellino, a town near Naples, Italy. Alfano attended Teaneck High School and went to college mainly because his father thought it was important (though his parents hadn't had such advantage).

Alfano chose Fairleigh Dickinson University (FDU) because it was close to his childhood home in Teaneck, New Jersey. He started his college education thinking he'd end up an electrical engineer like his uncle. But, at FDU he discovered he was able to build upon his natural abilities, and his life took a different direction. Having a knack for mathematics, Alfano took all the math classes he possibly could and found a way to have them count towards his liberal arts requirements. Determined to avoid the electrical engineering curriculum's lab requirements, Alfano switched his major to physics, which required far fewer. He finds it a bit ironic that he hated the lab requirements for his physics degree as he is now an experimentalist.

Alfano earned both bachelors and masters degrees at FDU and his doctorate from New York University and found his way to CCNY in 1972. There he created a significant avenue for contributing to scientific discovery by founding and becoming the Director of the IUSL. Since its launch in 1983, IUSL has grown to become a major academic center for biomedical optics and ultrafast optical science research.

Alfano maintains that to be successful in science, one must be innovative first and foremost. His teaching philosophy is to teach on a level that makes complex material easy and basic to understand. The key is to understand the material, not memorize it. It is his strong belief that most people can learn a topic if they work hard to learn it. Ultimately, a great scientist is born from hard work.



Faculty Awards

John Lombardi receives the 2019 Gold Medal Award from the New York Society for Applied Spectroscopy

Congratulations to Professor John Lombardi of The Department of Chemistry and Biochemistry for being named the 2019 Gold Medal winner from the New York Society for Applied Spectroscopy. This award was established in 1952 to recognize outstanding contributions to the field of applied spectroscopy. He received the medal at a special award ceremony in Princeton, New Jersey, this past November. The event coincided with the society's Eastern Analytical Symposium.

Lombardi's research in Raman spectroscopy spans more than four decades. Although normal Raman spectroscopy is inherently a weak effect, it can be considerably strengthened by the proximity of a molecule to a metal or semiconductor surface. Thus, this field is called "surface-enhanced Raman spectroscopy" (SERS). This enormous enhancement enables the design and construction of molecular sensors that are selective and highly sensitive.

In addition to various experimental contributions, such as extension of the useful surfaces to semiconductors, papers by Lombardi and his CCNY collaborator Ronald Birke have established a theoretical basis for understanding the SERS mechanism.

This combination has allowed development of schemes to optimize the sensitivity of sensors based on the SERS effect, which has practical applications to detection of trace quantities of molecules. This has led to important advances in both the field of cultural heritage studies (in collaboration with the Metropolitan Museum of Art) as well as in a forensic context -- in collaboration with scientists at John Jay College of Criminal Justice. Lombardi has had more than 250 articles published in peer-reviewed journals.

On the faculty in City College's Division of Science since 1975, Lombardi studied chemistry at Cornell University (A.B.) and Harvard (M.A., Ph.D.). Lombardi hails from New York State. He became interested in optics and spectroscopy and attempted to build a telescope from war (WWII) surplus parts.

He is currently working with colleagues at the Metropolitan Museum of Art to explore ways of using surface-enhanced Raman spectroscopy (SERS) for non-destructive detection of dyes and pigments used in paintings and textiles. This work can be used to identify forgeries or for developing techniques for restoration of authentic works. Lombardi is also working with forensic scientists at John Jay College of Criminal Justice to use SERS for the detection of trace evidence.

Lombardi's teaching philosophy includes arranging for ample time for meeting outside of class with small groups of students to work on problem sets. This stems from his support study groups which he strongly urges the students form.

Outside of research, Lombardi enjoys opera and travel to Europe and Asia. (From CCNY news)

Faculty Awards

Beyond Adsorption-II:
New Perspectives and Challenges for Nanoporous Carbons

Teresa Bandosz leads workshop: Beyond Adsorption-II: New Perspectives and Challenges for Nanoporous Carbons

On July 20, after the Carbon 2019 conference, and on a very hot day in New York City, the scientists and engineers with interests in porous carbons met at the Beyond Adsorption-II workshop. The event was organized for the second time at the City College of New York, following a great success of the gathering in 2016. The workshop, led by Professor Teresa Bandosz of the Department of Chemistry and Biochemistry attracted scientists from 14 countries and had a strong industrial presence. Such companies as Morgan Advanced Materials, Asbury Carbons, Ingevity, Immutrix Therapeutics, Inc. and Pine Research sponsored the event. It was also supported by the American Carbon Society. The workshop topics covered recent advances in synthesis of new forms of porous carbons, in applications of carbons for energy storage, as supercapacitors, electrocatalysts, visible light active photocatalysts, adsorbents for advanced water and air cleaning, and chemical warfare agent's decontamination media. The fundamental research on the modification of carbon chemistry, advanced characterization methods, porosity control, and the effects of porosity on physicochemical phenomena was also covered. During very fruitful and stimulating discussions, recommendations towards the standardization of experimental approaches, results' discussion and limitations of experimental techniques were formulated. The results of the discussion were published in a recent Carbon paper (Carbon 164 (2020) pp. 69-84)

Professor Bandosz, front right (white dress)

Faculty Features

Covid Research in the Division of Science

Professor Hernan Makse

Professor Hernan Makse of the Physics Department and Levich Institute is working on a COVID-19 project on digital contact tracing using Artificial Intelligence (AI) and network theory to optimize quarantines. The Makse team has successfully deployed their algorithms in a contact tracing App in the State of Ceara, Brazil. This work is featured in a white paper under review in the journal *Nature*, an is a remarkable achievement. See more details in the web page of the project at https://kcore-tracing.com.

State of the art network theoretical tools and AI developed in the Makse lab is used to develop the digital contact tracing algorithm aimed at stopping the pandemic in the most optimal way, meaning performing directed quarantines rather than instituting indiscretional mass quarantines on all of society. The algorithm will allow the isolation of just few people to break the chain of transmission of the SARS-2 coronavirus. The Makse team proved mathematically that if a mass quarantine of 15 days is followed by a directed quarantine based on their contact tracing algorithm, the transmission chain of the virus can be disintegrated in a month or so and the pandemic be stopped in its tracks.

Makse is originally from Buenos Aires, Argentina. When he was a kid, his father would come back late from work and sometimes asked him to solve a 'difficult' (at that time he was eight years old) trigonometric problem. Makse's father was building big machines for ships and needed help in the design. "I was quite terrified to receive one of those 'problems'," shared Makse, "but over time I was always getting the solution right." These experiences helped to shape Makse's future. "I started to think, hmmm, perhaps math is something interesting after all...," remarks Makse. "From there to get a Ph.D. in Physics was a one-way highway." Makse earned his bachelors degree at the University of Buenos Aires and his Ph.D. in physics at Boston University. In 2000 Makse came to CCNY as an assistant professor.

At the onset of the pandemic, around March 12, Makse decided to put together a team of seven top-of-line researchers across the world to develop an algorithm to find the optimal quarantine plan to stop the pandemic.

Makse got involved in COVID-19 research because it reminded him of the story of Picasso and the millionaire lady in Central Park buying one of his paintings. The lady asked, 'But Mr. Picasso, why does your painting of a single black cube in a white canvas cost one million dollars? How long did you take to do this painting?' to which Picasso responded: 'my whole life...'

Makse is not trying to compare himself to Picasso, but indeed, he has spent his whole life building up his algorithms for COVID-19. He has published several papers in *Nature* and *Nature Physics* where he and his team developed theoretical algorithms to optimally destroy a network with a targeted quarantine. Then, COVID-19 was his call to save the world by using these algorithms to break the chain of transmission in the most optimal way, not quarantining the entire society, but isolating only those few selected people that are at the center of the spreading, the super spreaders.

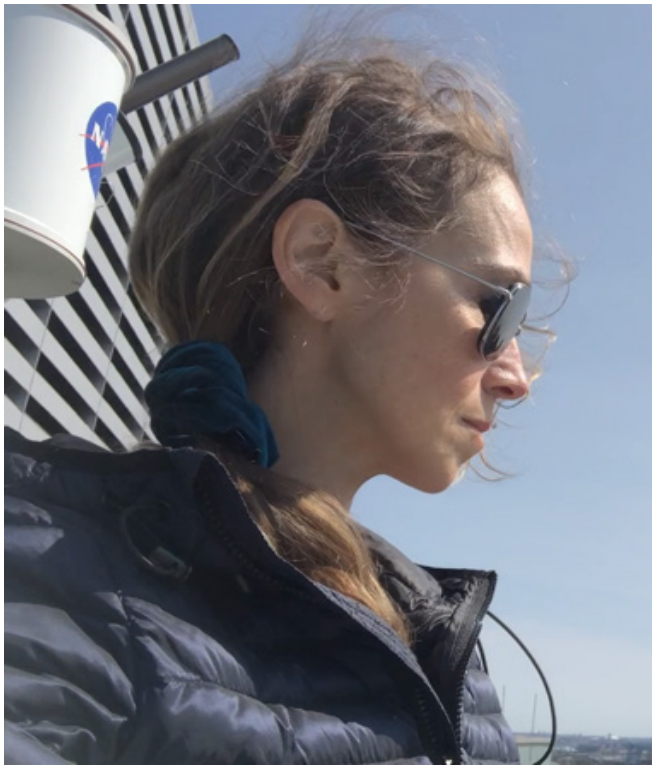
"Indeed, our algorithms worked quite well, the paper is now in review in *Nature Physics*. We pitched the algorithms to hundreds of governments at the federal, state and city level across all Latin America. Unfortunately, policy makers were not interested in acquiring these high-tech technologies," remarks Makse. As a consequence, Latin America had not yet reached the peak of the pandemic, six months after implementing exhaustive mass quarantines. The Makse team was able to convince only one government to implement the algorithm, the Government of the State of Ceara in Brazil. However, bureaucratic forces again conjured up against the liability of the project.

Faculty Features

Covid Research in the Division of Science

Professor Maria Tzortziou

In addition to health and safety concerns, the global coronavirus (COVID-19) pandemic has fundamentally changed the way we move within our communities, from business and school closures to stay-at-home orders. The situation has created a completely novel and large-scale 'human experiment' in how sudden changes in socio-economic behavior and mobility patterns may influence the environment. Funded through NASA's Rapid Response and Novel Research in Earth Science (RRNES) initiative, Professor Tzortziou has been studying the environmental impacts of this pandemic since March 2020, during the COVID-19 shutdown and as we gradually transition out of it. Their study focuses on the New York metropolitan area, a coastal urban environment that was particularly hard hit by COVID-19 and where atmospheric deposition is a significant source of nitrogen for terrestrial and aquatic ecosystems. Tzortziou and her team have been using long-term measurements from ground-based instruments and satellite air-quality and ocean color sensors, to capture changes in both atmospheric and water quality conditions, and investigate air pollution's influence on water quality. Results will help address a gap in our fundamental understanding of air-water exchange of nutrients and pollutants, and how this impacts and is impacted by environmental regulations, socioeconomic policy responses and decision making.



Recently, Tzortziou received additional funding from the National Science Foundation to expand this study. In a collaborative effort with Prof. Dianne Greenfield (Queens College and Advanced Science Research Center), Tzortziou and her team will focus on quantifying the responses of phytoplankton and bacterial assemblages in Long Island Sound to COVID-19 related shifts in nutrient quality. Researchers are measuring key biogeochemical (nutrient) and ecological (phytoplankton, bacteria) metrics to assess how sudden changes in nutrient amounts, quality, and source distribution in an urban estuary could translate to regime shifts in microbial assemblages and biogeochemical processes.

"Growing up in a large city on the coast of the Mediterranean Sea, I witnessed, from a young age, the negative ecological and socio-economic impacts of increasing coastal urbanization, overdevelopment, air pollution and water quality deterioration, remarks Tzortziou, "These experiences motivated me to pursue a career in environmental research and Earth System Sciences."

Tzortziou's research program focuses on understanding human-ecosystem interactions across temporal and spatial scales and assessing impacts of anthropogenic pressures and environmental hazards on inland, coastal, and open ocean biogeochemical cycles and ecological processes. Specific environmental stressors and global environmental issues addressed in ongoing projects include urban development, human population shifts, air and water pollution, eutrophication, rising temperatures, sea level rise, coastal habitat destruction, loss of biodiversity, and extreme weather events. The Tzortziou team has been conducting research in the New York coastal waters and Long Island Sound over the past three years, studying changes in estuarine water quality, ecological processes, and ecosystem stressors, including development of algal blooms, eutrophication, and hypoxia.

Thus, they were particularly interested in studying potential environmental impacts of the COVID-19 pandemic on this coastal urban environment.

Faculty Features

Covid Research in the Division of Science

Professor Daniel Keedy

Professor Keedy arrived at CCNY in the spring of 2018. He has a dual appointment in CCNY's Department of Chemistry and Biochemistry and the CUNY Advanced Science and Research Center (ASRC). Keedy grew up in rural TN, and was always interested in biology — at the organismal level: snakes, lizards, crawdads, etc. In high school he learned about the central dogma of molecular biology and the genetic code, which he remarks, "blew my mind and shifted my interests toward biology at the molecular level". As an undergraduate at Rhodes College, Keedy combined his love for molecular biology and biochemistry with a nascent interest in physics, which ultimately led him to a biophysics and structural biology Ph.D. program at Duke University. Keedy's research training later continued at the University of California, San Francisco, where he learned to combine experimental and computational approaches to explore the fundamental connections between protein structure, dynamics, and function. Keedy explains, "Now I am fortunate to be able to operate my own laboratory at the CUNY Advanced Science Research Center and City College of New York, integrating trainees at many levels, including undergraduate students, into our research." He is thrilled to be able to work on a project involving the SARS-COV-2 coronavirus which is responsible for the current COVID-19 Pandemic.

Keedy's work examines a key step in the viral life cycle that occurs just after viruses enter a human host cell and the viral membrane dissolves. At this stage, a long 'polyprotein' is broken down into 16 individual viral proteins that hijack the human cell's machinery, switch off its defense mechanisms, and otherwise enable viral replication. The enzyme that breaks down the polyprotein into these pieces thus plays a critical role in the success of the virus. This enzyme is called the main protease, or Mpro (also known as 3C-like protease or 3CL protease).

Mpro is perhaps the most promising antiviral drug target for the SARS-CoV-2 coronavirus, since a drug molecule that inhibits its function would disrupt the overall viral life cycle, allowing the human immune defenses to recover and overwhelm the virus. Efforts are underway to develop drug-like Mpro inhibitors using computational modeling, some of which have revealed promising lead compounds. This modeling is based off of the static three-dimensional protein structure of Mpro: the exact positions of all the atoms that make up its shape.

Although those efforts are progressing well, the team has thus far focused only on structures of Mpro obtained from X-ray crystallography at cryogenic temperatures -- significantly colder than Earth's polar regions. By contrast, Mpro actually invades our cells at physiological or body temperature. Previous work on other proteins has shown that varying temperature during structure determination can reveal alternative conformations (or shapes) of proteins that better explain how they function, by providing insights into how they move -- not just what they look like while sitting still. Keedy notes, "In our lab, we have now used variable-temperature X-ray crystallography experiments to identify alternative conformations of Mpro that the enzyme may sample during its catalytic motions. Although our results are still preliminary, as our data analysis progresses, we do observe subtle differences in the protein structure as a function of temperature. Such alternative states may serve as 'hidden weak points' to assist ongoing computational modeling and drug design efforts."

Although these laboratory perturbations may seem (artificial), they have been shown to shift other proteins into biologically relevant states that would otherwise not be observable. Any such conformation or state has the potential to then be successfully targeted by a novel inhibitor or drug. Before COVID-19, the Keedy lab's interests lay in using avant-garde experiments like variable-temperature X-ray crystallography to explore connections between protein structure, dynamics, and function. They focused on another, very distinct family of medically important enzymes (tyrosine phosphatases). A huge benefit of these methods is that they are generally applicable to a variety of protein systems. When the COVID-19 viral outbreak prevented access to their ASRC lab for many months, the Keedy team turned to collaborators at Brookhaven National Lab for remote experiments on Mpro, to hopefully play a small part in combatting the pandemic.

Faculty Features

Covid Research in the Division of Science

Professor Ronald Koder

Ronald Koder and his team at CCNY form a collaboration of clinicians and scientists whose goal is to develop a noninvasive real-time sensor that measures human cytokine levels. Cytokine release syndrome (CRS), more commonly known as the 'cytokine storm', is common in patients with COVID-19 and elevated proinflammatory cytokine levels correlate with respiratory failure, ARDS, and adverse clinical outcomes. However, there is currently no method to rapidly assess CRS, nor are there strategies to rapidly evaluate patient response to treatment. The early assessment of risk and timely measurement of disease progression/CRS would markedly increase survival rates in overburdened healthcare systems.

This collaborative project conducted by a team of investigators combines a clinician with expertise in CRS, Robert Schwartz at Weil-Cornell, a protein engineer who designs supercharged cytokine recognition proteins, Ronald Koder, and a nanomaterials engineer who synthesizes microneedle array nanosensors for cytokine detection, Dan Heller at Memorial Sloan Kettering Cancer Center, seeks to develop this point-of-care device. The goal is to develop a noninvasive sensor patch to predict CRS in COVID-19 patients by continuously and remotely monitoring proinflammatory cytokines such as interleukin 6. This approach has the potential not only to provide an important diagnostic/prognostic tool for CRS and many hyperinflammatory diseases, but it is a promising new platform to benchmark treatments.

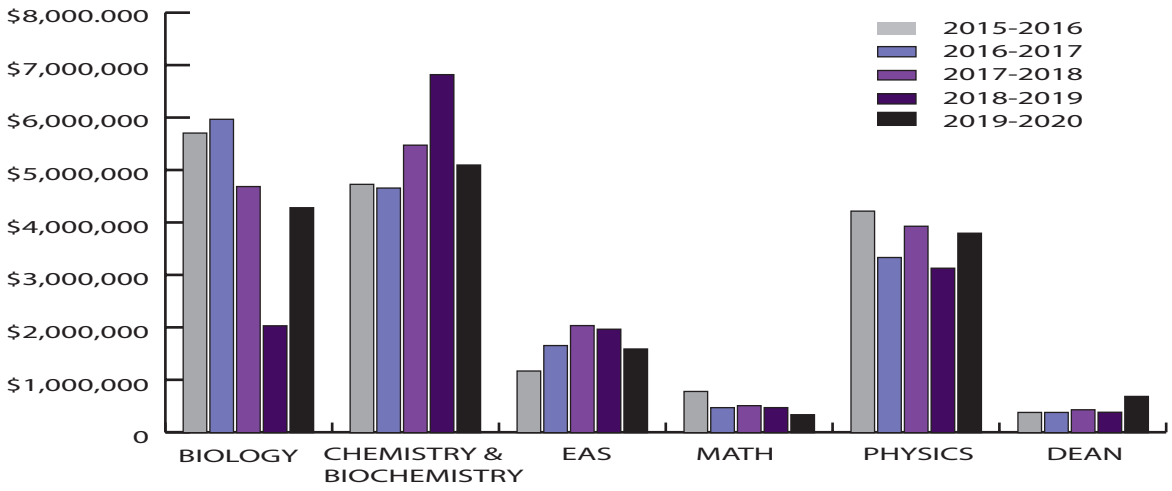
Koder's team is working to make a microneedle patch that quantifies in real time the systemic concentrations of a number of proinflammatory cytokines important in COVID-19. The microneedles have at their tips supercharged proteins that his lab has designed that recognize these cytokines and, when they bind to them, undergo a large-scale conformational change which changes the fluorescence emission wavelength of carbon nanotubes to which they're attached. The hope is that early detection of elevated cytokine levels can predict the need for treatment before the onset of symptoms. The work of the Koder lab is in designing the proteins. The underlying technology for protein work was just published in the Proceedings of the National Academy of Sciences (PNAS). The team has created a working sensor for the cytokine most correlated to fatal outcomes in COVID - Interleukin-6 (IL-6). "We've shown we can quantify IL-6 in solution, in patient fluids, and in mice," Koder explains, "we're currently expanding this to several other cytokines. Robert Schwartz, a clinician at Weil-Cornell, is currently working with his IRB to start testing this on patients."

Professor Koder grew up in St. Louis, Missouri and earned a degree in Chemistry at the University of Missouri. He conducted research in enzymology in Peter Tipton's lab at the medical school and did an internship in synthetic organic chemistry at Monsanto Chemical Company. "While I liked synthetic chemistry, especially the aspect of building new molecules, I felt like the most exciting research in chemistry at the time was in enzymatic catalysis," says Koder, "so I worked on a Ph.D. in Biophysics with Anne-Frances Miller at Johns Hopkins studying the physical chemistry and structural biology of electron transfer enzymes." There he worked on a form of enzymatic chemotherapy, antibody-directed enzyme-prodrug therapy or ADEPT which led him to a postdoc at the University of Pennsylvania in P. Leslie Dutton's lab at the Johnson Foundation in the Biophysics department at the Hospital of the University of Pennsylvania. While there he worked in a new field, biodesign, developing the technology to computationally design proteins and enzymes. This allowed Koder to connect his interests in biophysics with his love of building things. Koder explains, "I came to CCNY because it has among the world's best facilities for protein structural analysis at the New York Structural Biology Center (NYSBC), and because I'm surrounded here by the some of the best physicists and structural biologists in the world." Koder iss one of a group that founded HackManhattan, a maker space on 14th street that has allowed him to build different types of things, including a number of electronic devices currently in use in the Koder lab. This came together in the team's recent enlisting of CCNY's 3D printers in March, April and May to create PPE for hospitals during the COVID-19 crisis.

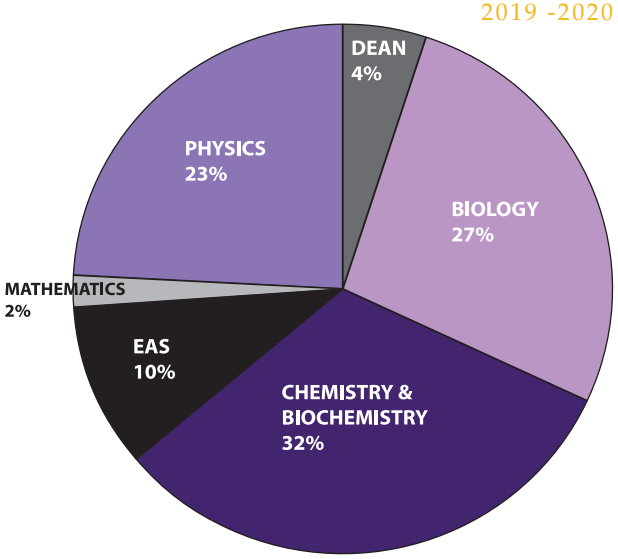
Another of Koder's lines of research is working on an implantable sensor for ovarian cancer with Dr. Heller at MSK-CC. It was detecting cancer biomarkers, one of which was IL-6. Robert Schwartz, who is both a Biophysicist working on viruses and a clinician at Weil-Cornell at the forefront of the COVID-19 crisis, told the Koder team that he'd really like a real-time IL-6 monitor, as the traditional tests take days too long to be clinically useful. So after talking it through, they came up with the microneedle approach.

Research

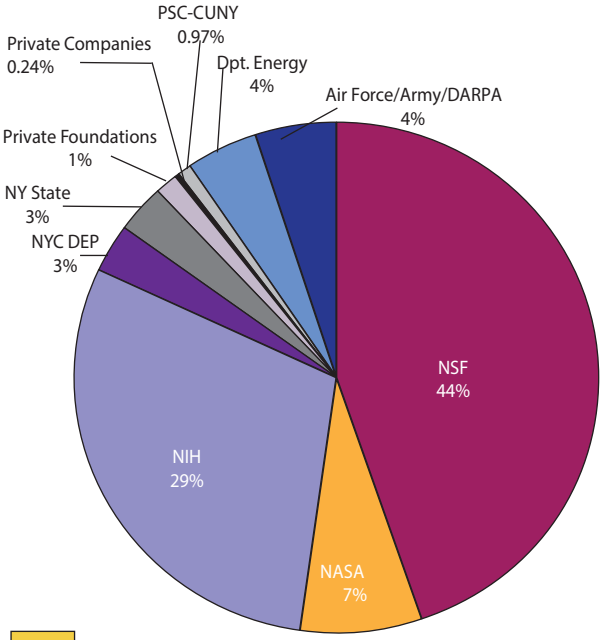
RESEARCH FUNDING BY DEPARTMENT: 2015 -2020



RESEARCH FUNDING BY DEPARTMENT 2019 -2020



EXTERNAL FUNDING SOURCE 2019 - 2020



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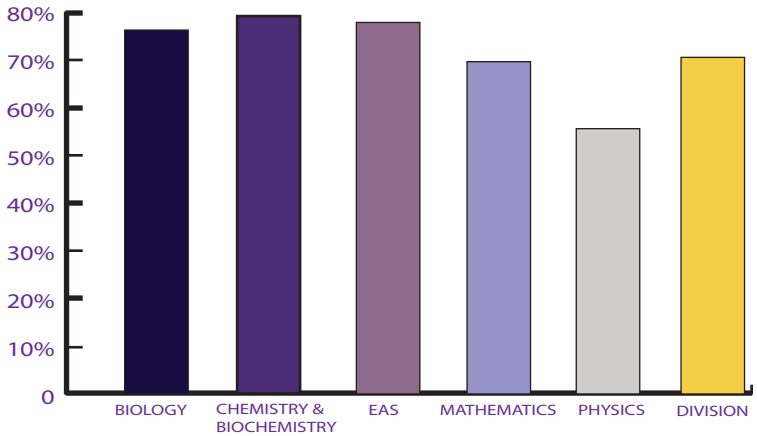


Research

Division of Science Top Awards

PRINCIPAL INVESTIGATOR	SPONSOR	DEPARTMENT	ANNUAL AWARD AMOUNT
Menon, Vinod	National Science Foundation NSF	Physics	$487,058
Bandosz, Teresa	NYC Department Of Environmental Protection	Chemistry & Biochemistry	$472,986
Stark, Ruth	National Institutes of Health NIH	Chemistry & Biochemistry	$423,813
Meriles, Carlos	Army Research Office ARO	Physics	413,828
Roth, Millicent	New York State Education Department - NYSED	Dean of Science	$400,000
Saleque, Shireen	National Institutes of Health NIH	Biology	$392,500
Menon, Vinod	National Science Foundation NSF	Physics	$386,178
Biscoe, Mark	National Institutes of Health NIH	Chemistry & Biochemistry	$307,160
Katz, Francine	Defense Threat Reduction Agency DTRA	Dean of Science	$253,384
Jeruzalmi, David	National Science Foundation NSF	Chemistry & Biochemistry	$236,250
Li, Christine	National Institutes of Health NIH	Biology	$235,500
Tzortziou, Maria	National Aeronautics and Space Administration - NASA	Earth and Atmospheric Sciences	$228,224
Gunner, Marilyn	National Science Foundation NSF	Physics	$225,167
Lazaridis, Themis	National Science Foundation NSF	Chemistry & Biochemistry	$225,000
Ghose, Ranajeet	University of Texas at Austin UT Austin	Chemistry & Biochemistry	$203,315

Top Awards in each Department

PRINCIPAL INVESTIGATOR	SPONSOR	DEPARTMENT	ANNUAL AWARD AMOUNT
Saleque, Shireen	National Heart, Lung, and Blood Institute	Biology	$392,500
Bandosz, Teresa	New York City Department of Environmental Protection NYCDEP	Chemistry & Biochemistry	$472,986
Tzortziou, Maria	National Aeronautic & Space Agency	Earth & Atmospheric Sciences	$228,224
Chinta, Gautam	National Science Foundation NSF	Mathematics	$153,135
Menon, Vinod	National Science Foundation NSF	Physics	$487,058
Roth, Millicent	NYS Office of Higher Education	Dean of Science	$400,000

Retired
2019 - 2020

Daniel Greenberger

We wish Daniel Greenberger the best upon his retirement from CCNY after 55 years of service. Daniel Greenberger graduated in 1950 from the Bronx High School of Science. He then graduated in 1954 from MIT, where he conducted his thesis under Laszlo Tisza. He received his M.S. (1956) and Ph.D. (1958) from the University of Illinois, where his advisor was Francis E. Low.

After graduation, he spent two years in the U.S. Army at a physics research lab connected to the NSA, working as a cryptanalyst, which eventually sparked his interest in quantum cryptography.

From 1961 to 1963 he was a postdoctoral fellow at U.C. Berkeley in Geoffrey Chew's high-energy theory group. In 1964, he became a faculty member at the City College of New York. Greenberger soon became interested in gravity. Around 1970, he went to MIT to see Clifford Shull to test the equivalence principle with neutrons from the university's reactor. As the reactor had been down for maintenance, Roberto Collela, Albert Overhauser, and Sam Werner devised a better way to do the experiment using a neutron interferometer.

During a conference at Grenoble in France in 1978, Greenberger met with Michael Horne and Anton Zeilinger, which—by 1986—would eventually prove to be an important collaboration in the development of the Greenberger-Horne-Zeilinger state, a much improved version of Bell's theorem in quantum mechanics. In 1988, Greenberger won a Humboldt senior scientist award and went to unich in 1988 to work at the Max Planck Institute of Quantum Optics in Garching.

Together with Anton Zeilinger and Micheal Horne, Greenberger wrote the first paper on quantum entanglement beyond two particles. The resulting GHZ theorem (see Greenberger-Horne-Zeilinger state) is fundamental for quantum physics, as it provides the most succinct contradiction between local realism and the predictions of quantum mechanics. Also, GHZ states were the first instances of multi-particle entanglement ever investigated. Such states have become essential in quantum information science. GHZ states are now even an individual entry in the PACS code.

In Memoriam

Valeria Balogh-Nair

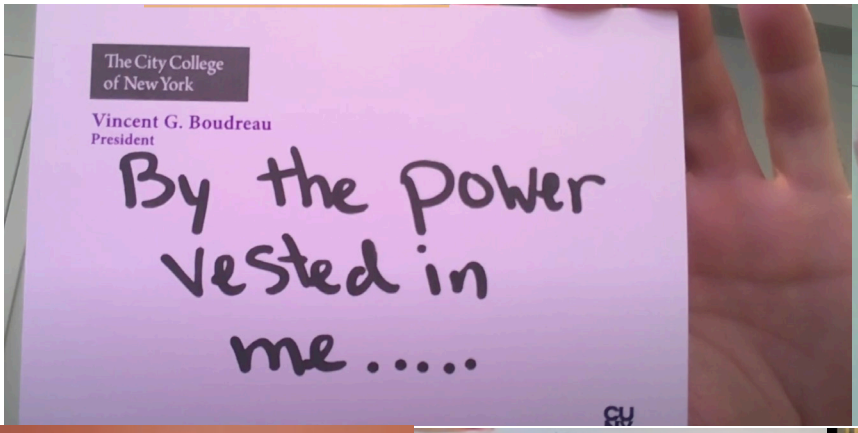
The Division of Science and Department of Chemistry & Biochemistry are saddened to report the passing of our colleague Professor Valeria Balogh-Nair. Valeria began her appointment at the college as Associate Professor in the fall of 1984, achieving tenure and promotion to Full Professor in 1989 and continuing on the faculty until her death. As an instructor for undergraduate Organic Chemistry, she shared her knowledge enthusiastically with thousands of students, recognizing both the challenges of the course material and the need for intellectual rigor. Even as the class sizes swelled and her health status grew precarious, Dr. Balogh-Nair remained our "good soldier," shouldering large teaching loads without complaint and displaying unabashed affection for her "kitties." Her faculty neighbors on the 12th floor of Marshak Hall always knew the timing of her exams: a line of students snaked down the hall, first for tutoring and later for analysis of the results. As a CCNY researcher, Balogh-Nair led teams that ranged from high school interns to postdoctoral scientists for 30 years. She applied her expertise in Organic Synthesis to both biomedicine and materials science, developing a multivalency concept to improve therapeutic drug action against metastatic cancer and opportunistic fungal infections while also designing organic/semiconductor nanocomposites with potential for optical switching devices. Her interdisciplinary scholarly accomplishments, often achieved in collaboration with colleagues from Physics and Engineering, were recognized by publications, presentations, and federal grant support. Finally, as a colleague, Valeria is remembered for her kindness in welcoming new faculty members, her advice that ranged from lab setup to teaching methods, her steadfast commitment to the recognition of women in science, a spirited and feisty demeanor that shone through every interpersonal interaction. She will be missed but not soon forgotten.

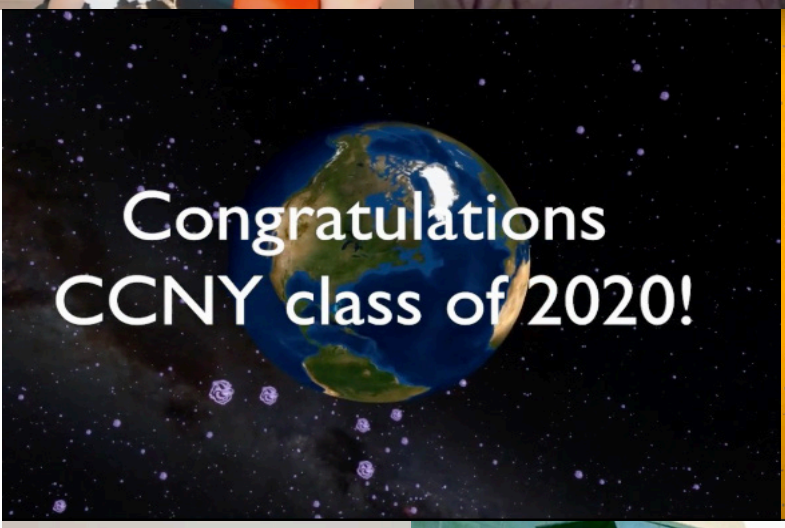
Raymond Hoobler

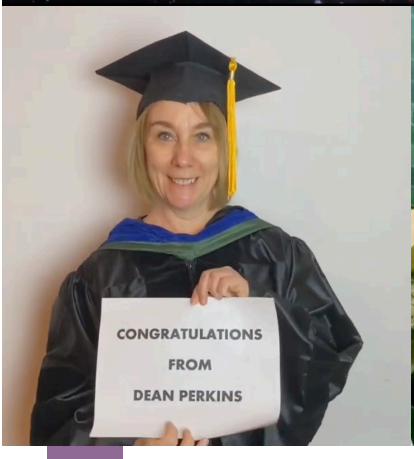
We are deeply saddened by the passing of retired professor Raymond Hoobler (Mathematics), who died on April 29 at age 78. The cause was complications of COVID-19. Hoobler was a longtime professor of mathematics at The City College of New York and The Graduate Center. He was remembered in this obituary for his wildlife preservation efforts and his commitment to math education. His research interests spanned algebraic geometry and the study of sets of zeros of polynomial equations. Hoobler spent his summers in Ostego County, Michigan, at a home on the Pigeon River. A "third-generation advocate for the wild character of the nearby Pigeon River State Forest," he became a board member of the Pigeon River Country Association in 1995 and served as its president from 1998 to 2015. He was the association's secretary at the time of his death. After his retirement, he continued counseling math students. He also established funding through the Ostego Community Foundation for students from Vanderbilt, Michigan, to continue their education beyond high school. He had a Ph.D. from UC Berkeley and a bachelor's degree from Oberlin College. He pursued additional work at Columbia University. He was born on August 14, 1941, in Boston, Massachusetts. He became symptomatic with COVID-19 on April 6, 2020, entered Mount Sinai hospital on April 16, and died on April 29. Hoobler is survived by his wife, Frances Kuehn, who is an artist, two children, and one grandchild.

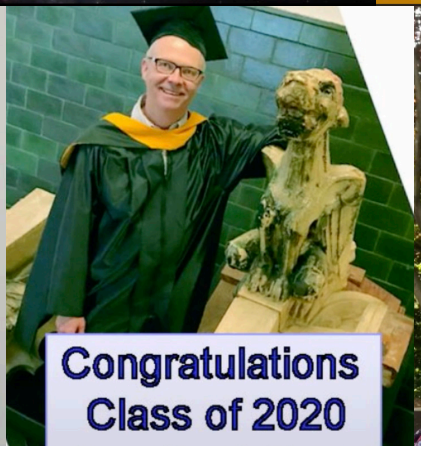
Graduation

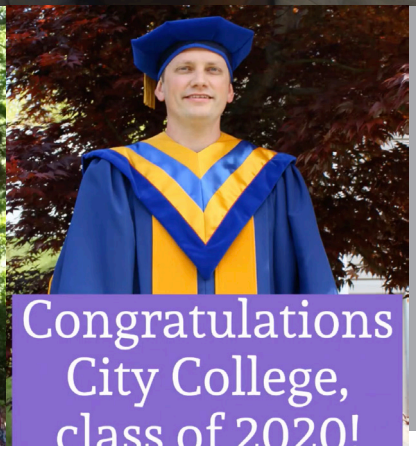
2019 - 2020











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2007 - 2019

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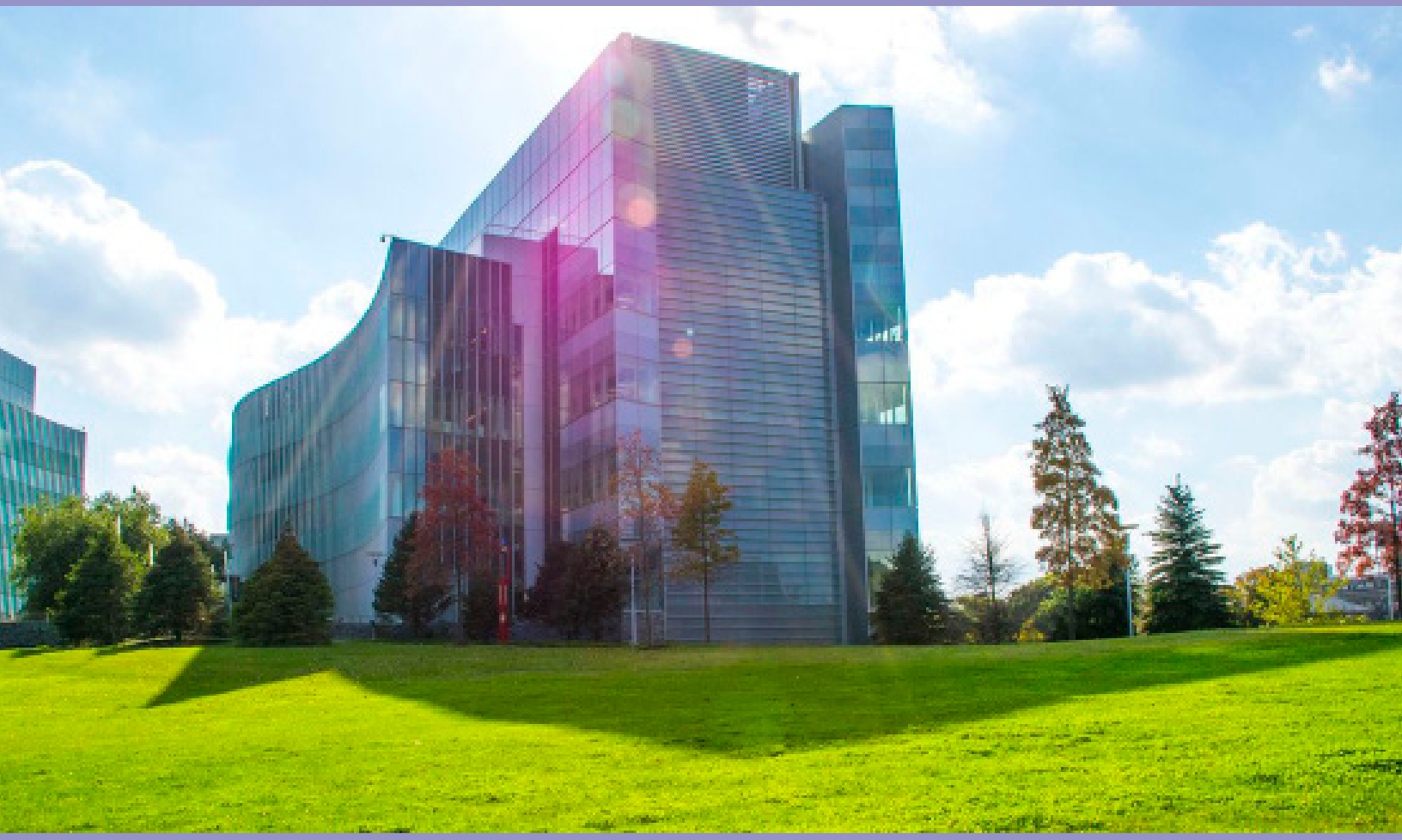

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