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contributions to:*

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Greetings from the Chair

By Dr. Omowumni Sadik, Distinguished Professor and Chair

WELCOME to the inaugural edition of the CES newsletter! We have just concluded a very unique and challenging semester. Like most academic departments across the country, our lives took a drastic turn as we were confronted with the issues of rapid response to the Coronavirus pandemic. Halfway through the semester, we were faced with how to move our courses online, develop virtual laboratories, provide authentic common exams without compromising the integrity, and get the work done.

Despite the pandemic, CES is growing! The biochemistry major continues to grow and thrive – in spite of its continued reputation as one of the more difficult majors in STEM. The number of biochemistry majors increased by 150% in the last 7 years to 53 students. The department offers the first B.S. Forensic Science degree in New Jersey. CES is a major producer of STEM degrees in the region with 148 undergraduate, 38 M.S., and 38 Ph.D. students. To accommodate the rising number of majors, we recently recruited two new faculty members: Drs. Michael Eberhart and Amir Varkouhi will join CES in the fall of 2020. You can read more about them in this newsletter, including our most recent faculty members: Dr. Pier Alexandre Champagne and Dr. Farnaz Shakib.

In this edition of the newsletter, I encourage you to check out our new NMR facility, new NSF, and NIH grants by Drs. Hao Chen, Edgardo Farinas, Yong-Ick Kim, and Somenath Mitra, the visit by the President of the American Chemical Society, Dr. Louis Echegoyen, and much more.



Professor Sadik, CES Chair

Finally, I would like to thank the Chemistry, Biochemistry, and Environmental Sciences student representatives for their efforts on the End-of-Year Virtual celebration held on May 19 with nearly 80 participants. I would also like to acknowledge the NJIT ACS Chapter and Chemistry Honor Society's dedicated service to fellow students as well as to the NJIT community by holding outreach programs. I encourage current students to monitor the club's activities on Facebook and Instagram.

Enjoy the newsletter, and have a great summer!



Above: New NMR facility in Tiernan Hall including a Bruker AVIII - 500 MHz NMR.

CES Opens New NMR Laboratory

NJIT scientists get access to a bevy of brand new, in-house NMR experiments to further their research goals.

In July of 2019, the Chemistry and Environmental Science Department (CES) at NJIT finalized the installation of the new NMR Laboratory at Tiernan Hall. Under the direction of NMR spectroscopist Dr. Carlos Pacheco, CES is excited to offer researchers in Newark, NJ a new campus NMR laboratory to further their research goals and educate the next generation of chemists.

NJIT's NMR Laboratory comprises two spectrometers: one Bruker AV-300-MHz, equipped with an RT Quad probehead, capable of gathering data from ^1H , ^{19}F , ^{31}P , and ^{13}C nuclides. This instrument is the workhorse for routine experiments, but it can execute more complex ones, such as 2D experiments, if one needs further structure elucidation of the compound of interest.

The other instrument at the NMR Lab is the Bruker AVIII-500-MHz, equipped with an RT triple-resonance TXI probehead (observing ^1H , ^{13}C , and ^{15}N). The hardware offers operation with gradients (0 to 50 G/cm), automatic shimming of the sample, faster acquisition of multi-dimensional data (e.g., heteronuclear ^1H - ^{13}C and ^1H - ^{15}N and through-bond correlations, NMR diffusion), selective excitation experiments, and high-quality solvent suppression among other experiments.

The NMR Lab also acquired licenses for off-line data processing (MNova, from Mestrelab Research SL, <https://mestrelab.com/>), which aims at easing the interpretation of NMR spectra. The software allows researchers and students to process NMR data anywhere and using any platform (Windows, Mac, Linux).

The NMR Lab also acquired the Facility Online Manager (FOM) software from FOM Networks, Inc. (<https://www.fomnetworks.com/>). The software is a web-based reservation of the NMR spectrometers (via the university-wide <https://fom4nmr.njit.edu/fom/>), which allows the students not only to log onto any of the instruments but also to schedule time on them guaranteeing their accessibility when they come to the NMR Laboratory, many from other buildings on campus.

Dr. Pacheco grants access to both NMR instruments after the user undergoes the NMR Training which covers the basic operational aspects of both instruments. The NMR Lab operates on an open-access model, where the students come to the laboratory with their samples already prepared in the NMR tubes.

If you would like to use the NMR facility for your research, please contact Dr. Pacheco at carlos.n.pacheco@njit.edu or call (973)596-6534 to schedule an NMR Training session. Students interested in learning more about NMR theory and practice are encouraged to take Chem 702 Special Topics: Spectrometric Identification of Organic Compounds, offered Monday nights in Fall 2020.

RECENT RESEARCH ARTICLES BY THE LI GROUP

Synchronic Biotransformation of 1,4-Dioxane and 1,1-Dichloroethylene by a Gram-Negative Propanotroph *Azoarcus* sp. DD4

Published in ACS's Environmental Science and Technology Letters in 2018, Volume 5, Issue 8, pp. 526–532.

DOI: 10.1021/acs.estlett.8b00312



A Novel Propane Monooxygenase Initiating Degradation of 1,4-Dioxane by *Mycobacterium dioxanotrophicus* PH-06

Published in ACS's Environmental Science and Technology Letters in 2018, Volume 5, Issue 2, pp. 86–91

DOI: 10.1021/acs.estlett.7b00504

NJIT Researchers Discover Bacteria to Clean Up Challenging Pollutants

CES researchers gain national recognition for advances in bioremediation.

The industrialization of chemical compounds has made modern life possible as these compounds can be produced in large enough quantities that can be distributed globally. However, with large-scale chemical production comes large environmental impact when large chemical storage sites and chemical plants accidentally release toxic chemicals into the environment. The research at the Laboratory of Environmental Microbiology and Biotechnology led by Dr. Mengyan “Ian” Li at NJIT is oriented to advance our knowledge of applied microbiology and molecular biotechnology and develop innovative techniques to tackle grand challenges caused by the contamination with various environmental pollutants.

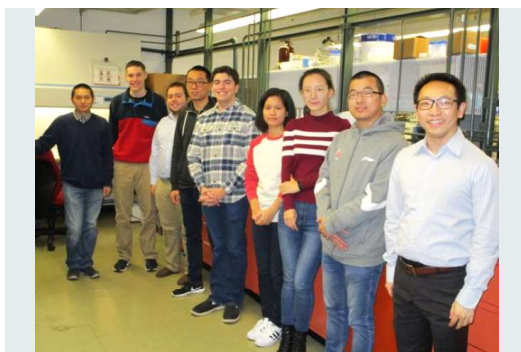
Armed with external grants from National Science Foundation, United States Department of Agriculture, Environmental Protection Agency, United States Geological Survey, New Jersey Department of Health, Hudson River Foundation, and industrial collaborators (e.g. Langan and EOS), the group has researched stimulating technology innovations in the field of environmental remediation, wastewater treatment, green energy, and agricultural sustainability. Notably, their discovery of a new propane monooxygenase with the capability of initiating the oxidation of 1,4-dioxane has been featured as the cover of Environmental Science and Technology Letters, selected as the American Chemical Society (ACS) Editors’ Choice, highlighted by various scientific media, including wateronline.com, phys.org, and cemag.us, and received the CAPEES Founding President Best Paper Award.

Another paper the group recently published in Environmental Science and Technology Letters on a new bug, *Azoarcus* sp. DD4, also attracted significant attention given its superior fitness to treat commingled contamination of 1,4-dioxane and 1,1-DCE. This work was also featured by Chemical & Engineering News, the news magazine for ACS, and other venues, that served as clear indications

for its scientific novelty and broad public impact recognized by the top-notch scientists and engineers in the field. A patent entitled “Bioremediation of 1,4-dioxane and chlorinated aliphatic hydrocarbons by propanotrophic bacteria” was granted in March 2020.

Dr. Li and his group are interested in collaboration to demonstrate this novel bioremediation technology in the field. In addition, they have developed applications utilizing nanotechnology to disinfect supplies contaminated with pathogens and the use of biomass-derived charcoal to remove trace toxins. They examine the microbial processes in natural and engineered systems and integrate conventional organism-dependent approaches with state-of-the-art high-throughput molecular technologies, such as cloning, microarray, omics, and single-cell analysis. They also design innovative and inexpensive genetic forensic tools for rapid quantification of the essential microbial populations or functions in the environment. Extended research topics of Li’s research include mitigation of biofouling in membrane treatment facilities, control of microbial induced corrosion, and identification of microbial enzymes for biofuel production.

Further information about our ongoing research can be found at <https://centers.njit.edu/emb/>.



The Li Group



Interested in a degree offered by CES?

CES undergraduate programs include:

- › B.S. Biochemistry
- › B.S. Chemistry
- › B.S. Environmental Science
- › B.S. Forensic Science - Forensic Biology, Forensic Chemistry, and Digital Forensics concentrations

More information can be found at: <https://catalog.njit.edu/undergraduate/science-liberal-arts/chemistry-environmental-science/>

CSI:NJIT is on the case!

Professor David Fisher trains NJIT students to help bring criminals to justice.



Prof. David Fisher leads the NJIT Forensic Program

How many times have we all watched a crime drama and a person in a Tyvek suit comes up to the detective and provides the detective with an impossible piece of evidence? A piece of evidence that is invisible to the naked eye, odorless, colorless, yet somehow the forensic team managed to find it in time to catch the bad guy before any more damage could be wrought. Have you ever wondered how evidence is gathered at a crime scene and brought to court? Or, have you ever pondered how the forensic scientist started his career?

Well, the answers to those questions can be found at NJIT in the Chemistry and Environmental Sciences Department through the Forensic Science Program. The only Bachelor of Science degree in Forensic Science offered in the State of New Jersey, the program is led by Professor David R. Fisher who has over 17 years of experience in the forensic field, is certified by the American Board of Criminalistics and is a Fellow of the American Academy of Forensic Sciences.

Students in the program can choose from multiple forensic science concentrations including Digital Forensics, Forensic Biology, and Forensic Chemistry. Students take lecture and lab courses in subjects such as Forensic Biology (FRSC 479), Crime Scene Investigation (FRSC 307), Forensic Microscopy (FRSC 480), Forensic Chemistry (FRSC 475), and Introduction to Forensic Nursing (FRSC 498) to learn modern theory and best practices in the pursuit of justice through science.

The program puts great value in hands on practice for its students in order to gain real life experience in collecting and interpreting evidence. In fact, curious drivers in the Summit Street parking structure may find forensic science students busy locating and

collecting evidence from a beat up white Chevy sedan which serves as a mock vehicular crime scene. States Dr. Fisher, "Besides the state-of-the-art equipment in our forensic science teaching lab, what makes NJIT's Forensic Program such a great return on investment is the knowledge, skills, and experience that the faculty bring to the classroom. Many of our faculty have real-world experience in actual casework because they have been, or are, currently forensic practitioners in crime laboratories in the NY/NJ area."

More information about the Forensic Science degree program can be found at www.njit.edu/forensicscience or by contacting Prof. Fisher at dfisher@njit.edu. After all, with CSI:NJIT on the case, criminals don't stand a chance.



Students collecting evidence at a mock crime scene right here on NJIT's campus.

NJIT'S ACS STUDENT CHAPTER RECEIVES AWARD FROM THE ACS



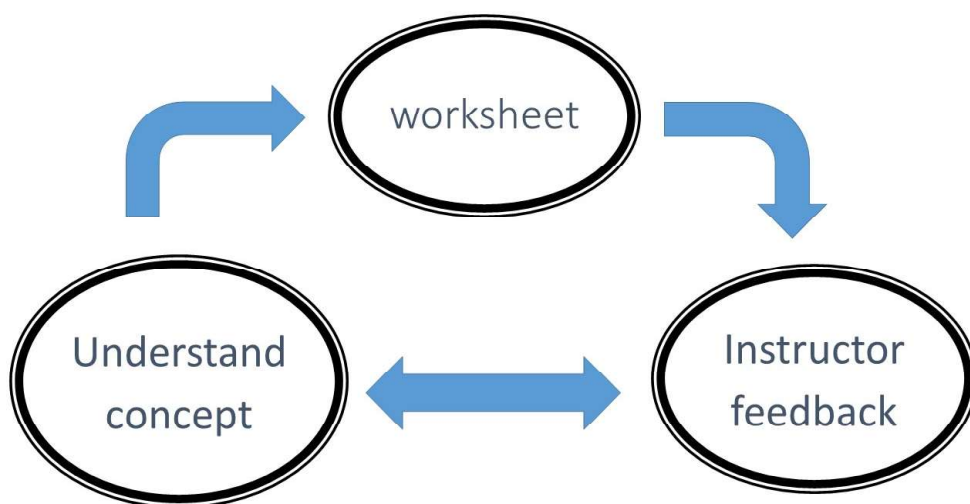
The American Chemical Society (ACS) was created to advance chemical enterprise in the united states.

At NJIT, students, with the aid of Dr. Bhavani Balasubramanian, help bring the ACS's mission to campus through the ACS student chapter. The ACS student chapter reaches out to the campus community through the hosting of events on campus, study groups, and community outreach.

The NJIT's ACS student chapter received a Commendable award for its activities conducted at NJIT for the academic year 2018-2019. The award winning chapters were to be recognized at the ACS National Meeting in Philadelphia, Pennsylvania until the COVID-19 pandemic forced the cancellation of the event.

The award went on to mention Dr. Balasubramanian, the NJIT chapter's advisor, as especially deserving of commendation. The ACS recognized Dr. Balasubramanian, stating "Few faculty members are willing to make the great commitment of time and energy that a successful chapter requires. Dr. Balasubramanian's efforts certainly represent the best in undergraduate science education and mentoring around the country."

The CES faculty and staff would like to congratulate the ACS student chapter members and Dr. Balasubramanian for their successful year.



The iterative approach uses worksheets and instructor feed back to enforce chemical concepts.

Teaching Innovation in CES: An Iterative Approach to Active Learning

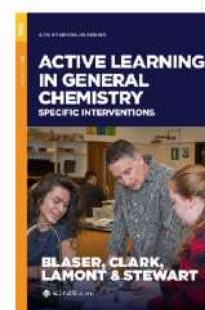
As technology and research alter our everyday home lives overnight, so does it change the classroom experience. More and more research has shown that students learn in different ways which is not always met in a standard lecture setting with the instructor at the front of the class going over projection slides.

Here in CES, when we teach General Chemistry, an important gateway course for students in many majors for Engineering and Pre-Health students at NJIT, we try to increase student engagement and learning to improve passing rates. We accomplish these goals by having the freshman chemistry instructors implement active learning strategies in the classroom.

Active learning refers to the strategy where students become actively engaged in a learning exercise rather than passively watch in standard lecture settings. Hand-written worksheets have been incorporated as a mandatory component of active learning during one of the class periods. The purpose of these worksheets was to challenge the student to work in groups and learn to apply concepts taught during lecture. As students worked through the problems, they received immediate feedback and were encouraged to revisit the concepts and learn

them thoroughly. The worksheets were designed such that a well-prepared student could complete it within the allotted class time, but an unprepared student could not. The unprepared student could then go to instructor office hours and continue to get feedback to better understand the concepts and solve the problems.

Since we have implemented this strategy in the classroom, we have seen increased comprehension of chemical theory and, therefore, an increased success rate for students in the class. More about the iterative learning approach can be read in Dr. Balasubramanian's chapter entitled "An Iterative Approach to Active Learning Improves Student Outcomes in a First Year Chemistry Course" which appears in "Active Learning in General Chemistry: Specific interventions" published by the American Chemical Society, Washington, DC in 2019.



Meet the Newest Faculty at CES

CES is growing and we would like to introduce our newest faculty!



Dr. Farnaz Shakib and her group joined NJIT in the Fall 2019. We are a Theoretical and Computational Chemistry group interested in designing new generation of sustainable energy resources. This puts our research efforts at the intersection of Computer Science, Quantum Chemistry, and Materials Science. On one hand, we develop novel quantum dynamics methods for accurate description of nonadiabatic dynamics of quantum mechanical particles like electron and proton at the heart of energy conversion reactions. On the other hand, we develop classical force fields to enable studying these charge transfer reactions in the context of 2D layered nano-porous material.



Dr. Pier Alexandre Champagne obtained his Ph.D. in organic chemistry from Université Laval in Quebec City (Canada) studying the reactivity of C-F bonds. He then spent two years at UCLA on a FRQNT postdoctoral fellowship to learn applied computational chemistry with Prof. Ken Houk, where his research spanned the field of cycloadditions, organocatalysis, and organic mechanisms. After a second postdoctoral appointment at the University of Ottawa working on transition metal catalysis, he joined NJIT in 2019 as an Assistant Professor in Organic Chemistry. His current research interests are centered on the development of new synthetic organic methods, with a special focus on reactive intermediates. These reactions are developed to be applied for the synthesis of complex molecules of pharmaceutical interest, in an efficient, modular fashion that also reduces waste. Prof. Champagne also uses computational methods to understand the mechanisms of organic reactions, to discover the origins of selectivity in asymmetric catalysis, to predict the reactivity of high-energy intermediates, and to explain the photophysical properties of light-absorbing and -emitting molecules.



Dr. Amir Khashayar Varkouhi will join NJIT in Fall 2020 as an Assistant Professor in Gene and Cell Therapy. Dr Varkouhi has a background in medicine and obtained his Ph.D. in Gene Therapy and Nanomedicine from University of Utrecht, The Netherlands (2007-2011) followed by two postdoc fellowships in Gene & Cell therapy at Erasmus University Medical Center, The Netherlands and University of Toronto, Canada. He worked as a staff scientist in gene therapy at University of Alberta (Canada) and afterwards at Saint Michael's Hospital, University of Toronto where he established a vector core facility (VICTOR) for production of different types of viral vectors and delivery systems. During his career, Dr Varkouhi worked on several gene and cell therapy trials as well as pre-clinical studies focused on development of bio-therapeutics for the treatment of lysosomal storage disorders (LSDs), retinal degenerative disorders, sepsis and acute respiratory distress syndrome (ARDS). His current research is based on the development and application of novel bio-therapeutics including viral and non-viral vectors, genetically modified cells and stem cell-derived exosomes.

Meet the Newest Faculty at CES *continued from page 6*



Dr. Michael S. Eberhart will join the Department of Chemistry and Environmental Science in the fall of 2020. Dr. Eberhart is an inorganic chemist whose research interests include photoexcited state charge transfer reactions, biomimetic strategies for artificial photosynthesis, electrochemistry/electrocatalysis, and photoelectrocatalysis for solar energy conversion. Dr. Eberhart comes to NJIT following postdoctoral appointments at Argonne National Laboratory and the University of North Carolina Chapel Hill. At Argonne, Dr. Eberhart investigated the impacts of confined environments on the photochemistry and photophysics of earth abundant copper(I) photosensitizers. At UNC Chapel Hill, he investigated photochemical water oxidation for solar fuels. Dr. Eberhart earned his Ph.D. from Columbia University where he investigated electron transfer and hydride transfer reactions of organometallic copper hydrides. His research has appeared in high-impact journals including the Journal of the American Chemical Society, ACS Central Science, and Proceedings of the National Academy of Sciences.



From left to right: CSLA Dean Belfield, ACS President. Echegoyen, CES Chair Dr. Sadik.

President Of the ACS Visits NJIT

Professor Luis Echegoyen, President of the American Chemical Society, visited NJIT on February 5, 2020. He delivered a lecture titled “Bucky-ball Maracas: Fullerene Nanocontainers that Stabilize Unusual Atoms and Clusters Inside.” Professor Luis Echegoyen is also the Robert A. Welch Chair Professor of Chemistry at the University of Texas at El Paso. He was honored as the 2020 Organic Syntheses Distinguished Seminar Speaker and held meetings with faculty and students.

Teamwork In Bioanalysis Awarded With R15 Grant

Mass spectrometry (MS) is powerful in protein discovery and identification. Nevertheless, accurate MS quantitation of peptides and proteins has challenges due to the fact that the MS signal fluctuates and the ion signal intensity does not correlate well with the amount of sample. Typically, popular MS quantitation relies on using isotope-labeling methods which have associated drawbacks including the need for expensive and time-consuming synthesis of isotope-labeled peptide, limitation in multiplexing analysis, and non-identical ionization efficiencies/elution times for heavy and light isotope-labeled peptides during an LC/MS run.

In collaboration with Drs. Edgardo Farinas and Yong-Ick Kim at NJIT, Dr. Hao Chen's group propose a conceptually new approach of using electrochemistry-assisted mass spectrometry for absolute quantitation for both peptides and proteins, without using any standards or isotope-labeled peptides. It could also allow direct quantitation of modified peptides such as phosphopeptides and simultaneous quantitation of multiple proteins in a mixture, based on Faraday's Law. This new method is expected to have significance not only in G-protein coupled receptor (GPCR)-related disease studies but also help understand the circadian regulation of the gene expression of cyanobacteria. It could be used to as a general method to quantify peptides including those carrying post-translational modifications (e.g., phosphopeptides) and proteins (e.g., GPCRs and circadian clock proteins). Recently the project was awarded a R15 grant for 3 years. It is expected that this method would lead to a paradigm shift in MS-based quantitative proteomics and lead to prosperous biological applications.

NJIT and CES Celebrate the Class of 2020

While the COVID-19 pandemic has put the brakes on many of life's activities, CES wouldn't let their graduates leave NJIT without celebrating their accomplishments. Faculty and staff joined the families and friends of CES students who were graduating to celebrate their achievements via a live, WebEx-based celebration. Both undergraduate and graduate students were sent off with an encouraging speech by Dean Kevin Belfield knowing they had earned a degree from NJIT which would work for them. Of course graduation allows students and faculty alike to reflect on their time at NJIT and some of our graduates have graciously shared their favorite memories from NJIT and their future plans:



MARY MCGUINNESS, B.S. Chemistry, Outstanding Undergraduate Student Award

My time at NJIT was so transformative. I had access to resources and opportunities to refine my career goals and achieve them. Everyone in the department is so welcoming and always available. I could walk into the office and sit down with my advisor and talk about classes, research, jobs, or anything. At NJIT you have the platform to have a large scope while remaining small enough to make face-to-face and lasting connections.

TIFFANY ROCIO OLIVERA, B.S. Chemistry / B.S. Biology, Applied Mathematics minor

Favorite NJIT memory: My favorite NJIT memory is when I took CHEM 125A and 126A with my freshman orientation friends during freshman year. I learned different reactions, how to perform experiments, and how to successfully work with others. They made participating in 3+ hour experiments every week worth it!

Future plans: Dr. Shakib and I were invited to write a Perspective on "Developing Novel Methods for Modelling Proton and Electron Dynamics" in the Physical Chemistry Chemical Physics Journal published by the Royal Society of Chemistry this summer. After that, I begin my Master's in Chemistry at NJIT in Fall 2020! My long-term career goals are to pursue a Ph.D. and become a researcher.

DANIEL BOYLAN, B.S. Biochemistry

Favorite NJIT memory: My favorite memory while at NJIT has to be when I qualified for the Junior Olympics for fencing. I was traveling the country/world while being a student which was great.

Future plans: I plan on continuing my education and create a Biotechnology business focusing on genetic engineering.

The Virtual 2020 New Jersey Chemistry Olympics Proves a Pandemic Cannot Stop Scientific Exploration



Participants in the 2018 NJCO attempt to determine how much caffeine is in an energy drink.

For the previous 34 years NJIT has been the host of the New Jersey Chemistry Olympics (NJCO), a hands-on competition between teams of high school students from schools across the New Jersey area. In December of the Fall semester, the NJCO Events Committee posts 10 events on their website: <https://www.njchemistryolympics.com/>. Then on a typical event day the following May, nearly 300 high school students plus their coaches and other chaperones come to campus to compete.

The events are judged by of NJIT faculty and staff primarily in the Department of Chemistry and Environmental Science as well as members of the North Jersey section of the American Chemical Society (NJACS). Teams get medals for individual events, but the ultimate prize is ownership of the Platinum Crucible as well as a tour of the Merck Facility in Rahway New Jersey. Merck, Exemplify BioPharma and Ashland LLC as well as the NJCO and NJIT's CSLA all help sponsor the event.

The ongoing pandemic forced cancellation of the on-site 35th annual NJCO but it did not stop the young scientists from pursuing academic glory. 2020 marks the 1st virtual NJCO. Only Chemistry Research, Website Design, and Information Search events were

selected to be part of the 2020 medals competition. These events run synchronously: Students turn in written material ahead of time and then discuss with the judges virtually for the in-person part of the competition. Teams who submitted entries for any of the other events will receive asynchronous feedback from judges.

Seventy-four students from 7 high schools participated in the 1st virtual NJCO. Competition for each of the synchronous events was fierce as each event had 8-10 teams of competitors. Winners were announced during a virtual awards ceremony on June 15. Team B from the Marine Academy for Technology and Environmental Science (MATES) set a very high bar for the Chemistry Research event and took home the gold medal. MATES Team A took bronze in the Information Search Event. After learning the results, coach Brian Jones said, "I'm so proud of these guys!"; a sentiment shared by everyone at the NJCO.

Tenaflly High School also did very well: their A-team took gold in the Information Search event and shared the Chemistry Research silver medal with their B-team. Team chemteam from South Brunswick took silver in the Information Search event. Their teams SB6 and SB7 shared the silver medal for the Website Design event. The gold medal for the Website Design event went to Whippany Park High School and team A from Watchung Hills Regional High School took bronze. Virtual medals were given out during the ceremony, but competitors will get metal versions in the Fall. In addition, every NJCO competitor gets a certificate of participation as well as an NJCO T-shirt.

The NJCO looks forward to holding the 35th annual NJCO in 2021. Our NJCO Director Dr. Miriam Gulotta would love to hear from potential donors and volunteer judges and student workers. Contact her at: mgulotta@njacs.org Stay tuned for more information about this new round of chemistry competition!



Henry J. and Erna D. Leir Research Institute for Business, Technology, and Society

Resilience and sustainability have become more imperative than ever before - especially amid the current pandemic. As a part of the Leir Research Institute's overarching goal, this year's conference brings together experts from business, education, technology, and government to explore disruptive technologies and business solutions to address the prevailing health and societal issues.

The conference will gather internationally recognized university researchers and corporate presenters from: NJIT, Rutgers, FDA, Oregon Health and Science University, Pfizer, J&J, Agril Ledger, Aktana, and HiFiBiO Therapeutics to name a few.

DISRUPTIVE TECHNOLOGIES, REGULATIONS, AND BUSINESS: IMPLICATIONS IN THE BIOTECH INDUSTRY

Friday, August 14, 2020 | 9 a.m. - 1 p.m.

[REGISTER NOW](#)

KEYNOTE SPEAKERS :

DEREK CHOY

*President & Co-founder,
AKTANA*

SAU LEE, Ph.D.

*FDA Director,
Office of Testing & Research,
Office of Pharmaceutical
Quality, CDER at FDA*

LIANG SCHWEIZER, Ph.D.

*Co-founder & CEO,
HiFiBiO Therapeutics*

*A virtual conference for researchers, academics and industry professionals
co-sponsored by*

**The Martin Tuchman School of Management &
The Department of Chemistry & Environmental Science at NJIT**