

# 2022 ANNUAL REPORT



Cold Spring Harbor Laboratory

DNA LEARNING CENTER



The DNA Learning Center is an operating unit of Cold Spring Harbor Laboratory, extending its traditional research and postgraduate education mission to the college, pre-college, and public levels. Founded in 1988, the DNALC is the world's first science center devoted entirely to genetics education.

The mission of the DNA Learning Center is to prepare students and families to thrive in the gene age. We envision a day when all elementary students are exposed to principles of genetics and disease risk; when all high school students have the opportunity to do hands-on experiments with DNA; and when all families have access to genetic information they need to make informed health care choices.

Front cover: View of a portion of the *DNA Learning Center NYC* at City Tech museum exhibition "What DNA Says About Our Past and Future": Ötzi the Iceman mummy replica in the foreground with a Philistine burial recreation and mural beyond.



## Executive Director's Report

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DNA sequencing costs have decreased 50,000-fold in the last decade and free bioinformatics software is widely available online. These advances have blurred the lines between research and education. DNA, RNA, and protein sequence data are important among the “big data” that are now revolutionizing bioscience research and industry, and bioinformatics is the science of mining information from biological data. “Harnessing data for 21<sup>st</sup> century science and engineering” was first on NSF’s 2016 list of big ideas for future research. The *Future of Jobs Report* by the World Economic Forum lists careers in data science and data management as the first and third most in-demand careers. In the life sciences, data scientist is in the top five job postings in InnovATEBIO’s 2021 *Life Science Workforce Trends* report.

Over the last two decades, the DNALC has pioneered biochemical and bioinformatics infrastructure to lower the barriers to biological data analysis. This began in 1998 with the first “personal genetics” experiment that allows students to sequence and analyze their own mitochondrial (mt) DNA sequence—well in advance of *23andMe*, the *Genographic Project*, and *Ancestry DNA*. With NSF Advanced Technological Education (ATE) support in 2000, we developed *BioServers* as a simple bioinformatics tool to compare mt sequences between classmates and with reference data from world populations and ancient hominins. This platform has proven remarkably durable, engaging over 662,379 users in 2.08 million sessions averaging 15+ minutes. The *BioServers* database currently contains over 168,972 student mtDNA sequences.

This was followed by the launch in 2010 and ongoing development of *DNA Subway*, an intuitive GUI that makes sophisticated bioinformatics analysis accessible to students without coding experience. Operating under the umbrella of the NSF CyVerse cyberinfrastructure, *DNA Subway* coordinated contributions from more than 25 scientists, computer programmers, and bioinformaticians at more than a dozen research institutions. Using the metaphor of a subway map, students can “ride” on any of five different lines to access and analyze DNA sequences. *DNA Subway* has garnered a dedicated following, with 265,832 total users logging 658,150 sessions averaging 17 minutes from 2010–22. Over 234,000 DNA sequences (mainly DNA barcodes) have been uploaded by our partner GENEWIZ, and Blue Line visits account for about 72% of traffic. Undergraduate students compose 68% of 53,336 registered users. Blue Line users have published 2,234 barcode records on GenBank with 1,543 unique student and faculty authors. In a recent survey, we found that 48% of two-year biotech programs that teach bioinformatics currently use or intend to use *DNA Subway* in the future. Efforts are underway to reach the similar percentage of two-year biotech programs that are unaware of *DNA Subway*.

The year saw us cementing new collaborations to bring relevant modern biology to high school and college students. One effort introduces “personal” DNA sequencing to education, another explores synthetic biology, and the third provides resources to analyze human migration and DNA ancestry.

Oxford Nanopore’s inexpensive MinION sequencer is emblematic of the next-generation sequencing technologies that have driven down the cost of DNA sequencing. Smaller than the average cell phone, the MinION connects to a personal computer via a USB port and can generate a whole genome’s worth of data for about a \$1,000! Nanopore sequencing is the starting point to involve students in the entire data life cycle—generating, quality controlling, databasing, curating/annotating, analyzing, sharing, publishing, and reusing. Over the last several years, DNALC Assistant Director Jason Williams has explored the use of the Oxford Nanopore MinION in education. In 2022, the DNALC was awarded a two-year, \$179K exploratory grant to developing nanopore DNA sequencing for course-based undergraduate research experiences (CUREs) at minority serving institutions (MSIs). In this project we will work with faculty from New York City College of Technology, Spelman College, and University of Puerto Rico-Río Piedras to: 1) develop a Nanopore biochemistry and bioinformatics workflow; 2) Develop demonstration projects and pilot the Nanopore workflow with students; and 3) Evaluate the project and characterize barriers to faculty adoption of Nanopore technology. Achieving these objectives will lay the groundwork for nationwide dissemination.

In the fall we received a subaward to do educational outreach for a synthetic biology project with Vincent Noireaux and Steve Bowden of the University of Minnesota. Our outreach will be based on a cell-free transcription-translation (TXTL) system developed in the Noireaux lab. We will use the TXTL system to develop models of CRISPR gene editing and cell-free assembly of bacteriophages. Our first target for development will be a synthetic biology approach to



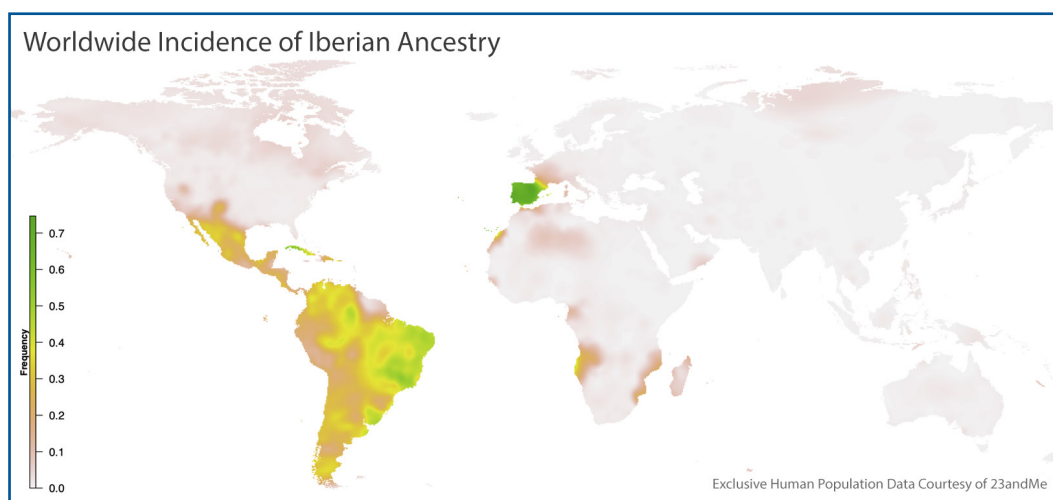
Top left: Preparing and testing a flow cell in the nanopore sequencing device.

Above: Jason Williams (at left) oversees participants setting up a nanopore sequencing experiment during the *Sequence a Genome* summer camp.

Lower left: A graph displays the quantity of reads that have passed or failed quality control.

produce green fluorescent protein. We will employ a cell-free production “chassis”—with “parts” including promoters, transcription factors, and ribosomes.

23andMe founder and CEO Anne Wojcicki contributed \$3 million to the *DNALC NYC* endowment. This was doubly fortuitous, because personal DNA data is at the heart of the NYC exhibit under development, “What DNA Says About our Past and Future.” After several months of discussions with 23andMe scientists, in February we signed a license agreement to have exclusive use of 23andMe ancestry data in our exhibit, accompanying visitor guides, and student curriculum materials. The data allow us to map the distribution of 40 world population components. For example, the image below shows everyone who has taken a 23andMe test and who have an Iberian ancestry component—clearly showing the Spanish and Portuguese colonization of Africa and the New World. We also have maps of maternal and paternal lineages, which illustrate ancient migrations out of Africa to Europe, Asia, Australia, and the Americas. These will be displayed on a 9’ by 16’ digital “video wall” purchased through a grant from the Office of the Brooklyn Borough President, Eric Adams, who became NYC mayor in 2022.



As we turned to 23andMe for help with the *DNA Present* part of the exhibit, we also turned to David Reich, at Harvard University, for help with *DNA Past*. The availability of ancient human genomes—mainly from burials—has grown exponentially over the last decade. The bulk of this DNA sequencing has been performed by the Reich lab and made available through the Allen Ancient DNA Resource (AADR). Currently there are 9,990 ancient genomes available from all continents. Like the 23andMe population components, admixture analysis is used to gauge the population components of ancient genomes. With guidance from Dr. Iosif Lazaridis of the Reich lab, we are developing tools to allow students to visualize admixture analysis from Eurasian burials dated between 12,000 and 1,000 B.C. By comparing the admixture analysis of burials from different places in Europe from different time points, students can track the migration of agriculturalists from the Middle East and the Yamnaya (horse riders) from the Central Asian Steppes as they spread these innovations across Europe.

### Coming Back from COVID-19

Operationally, 2022 witnessed a nearly complete rebound from the COVID-19 pandemic. Income and expenses came into balance, and DNALC operations returned to positive cash flow after two negative years. Income increased 30% over 2019, benefitting from new facilities at Regeneron and City Tech. The structure of these licenses—with no lease or

major facilities costs—means there is little impact on cash flow as we build visitation after the pandemic. Supplies are scaled to visitation, and 2022 income was in proportion to total DNALC staff—which has remained at 25 full-time-equivalents (FTEs) since 2018. We will only add staff members to the Regeneron and City Tech operations as visitation expands.

Summer camp visitation was a key to the year's successful results. With 1,287 campers and \$697,023 in income, the 2022 camp season was the best in DNALC history—besting the record number of 2018 campers by 20% and income by 10%. The DNALC's established business on Long Island recovered to pre-COVID-19 levels. Regeneron income exceeded 2018 income at DNALC *West* (formerly at Northwell Health in Lake Success) in its last full year of operation. Regeneron operated at about 50% capacity during its first summer of operation; the same performance by DNALC *West* during its first year. On this pace, we expect that Regeneron will reach full occupancy in 2024-25. Scaled for its larger size, Brooklyn's performance was about a third that of Regeneron, suggesting that it is not likely to reach full occupancy until 2026-27.

We awarded 118 summer workshop scholarships to underrepresented minority and disadvantaged students. We rekindled a collaboration with Gateway to Higher Education, an intensive college science prep program that operates in 11 New York City public high schools: A. Philip Randolph, Benjamin Cardozo, Brooklyn Tech, Clara Barton, Excelsior Prep, Francis Lewis, George Washington Carver, High School for Enterprise, Business & Technology, Jamaica Gateway to the Sciences, Port Richmond, and Queens Gateway to Health Sciences. We began to collaborate with Gateway in 1989, as part of a grant from the Josiah Macy, Jr. Foundation.

### High School DNA Barcoding Research Programs

The DNALC continued efforts to enable high school students to conduct authentic biodiversity research using DNA barcoding. *Barcode Long Island (BLI)* involves students in "campaigns" to compare biodiversity across Long Island. The *Urban Barcode Project (UBP)*, funded by the Thompson Family Foundation, and *Urban Barcode Research Program (UBRP)*, funded by matching grants from the Pinkerton Foundation and Simons Science Sandbox, involve students in independent research of biodiversity in NYC. Science teachers are mentors for *BLI* and *UBP* students, while scientists from NYC institutions mentor *UBRP* students.

Following the completion of National Institute of General Medical Sciences (NIGMS) Science Education Partnership Award (SEPA) funding, *BLI* adopted a sustainable model of support for Cohort 8 where schools covered the cost of materials and sequencing for their teams, participated in the DNALC's Associate Partner and Partner Memberships, or were awarded scholarships based on financial need. Forty-four teams including 146 total students completed projects. Ten teams were supported through open lab sessions at the Dolan DNALC and 31 teams borrowed equipment. One hundred and ninety-two sequences were published in GenBank with student authors, including four new barcode records and 86 with variable DNA sequence. Twenty teachers attended a five-day summer (6) or one-day fall (14) training workshop, including 17 who had never previously attended a *BLI* workshop. Over 40% of newly trained teachers submitted student project proposals for Cohort 9 as of December.

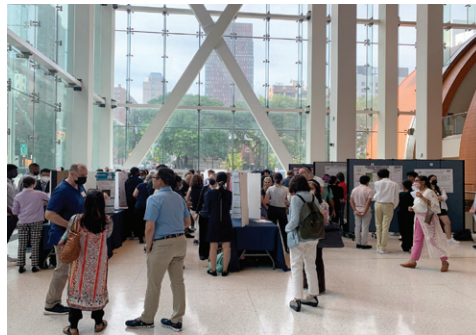
The annual *Barcode Long Island Student Symposium* was held in-person on June 7, 2022 on the Cold Spring Harbor Laboratory campus following two years of remote, combined *BLI*, *UBP*, and *UBRP* symposia. Keynote speaker Dr. Christopher J. Gobler presented on using molecular tools to decode harmful algal blooms.

Over 100 students working on 37 teams completed projects in the *UBP* and 38 students working on 19 teams completed projects in the *UBRP*. *UBP* and *UBRP* students made ample use of DNALC resources: 21 teams attended Open Lab sessions at the *Harlem DNA*



*Lab* or *DNALC NYC*, and 19 teams borrowed equipment. Twenty-eight *UBP* teams and 17 *UBRP* teams presented posters to peers and science professionals at the annual research symposium. Two *UBRP* teams also presented posters to peers and science professionals at the annual Science Research Mentoring Program (SRMP) Colloquium on June 7<sup>th</sup>. This year, 11 students in *UBRP* completed project exit surveys. Participants were asked about their experiences in the programs, how much they had learned, and how they felt about science. *UBRP* students emerged from the program with stronger interest and confidence in pursuing a path in science. In Cohort 9, 62.5% of students from were more interested in studying biology following their *UBRP* projects, and the same number were more interested in studying science in general. Eighty seven and a half percent felt more capable of going further in science than they did prior to participation in *UBRP*. Importantly, most of the students (87.5%) felt that *UBRP* gave them a better understanding of the role of technology in modern biology research and 63.6% felt that the approach to problem-solving they learned in *UBRP* would help them succeed in future science courses. Overall, our results suggest that DNA barcoding demystifies the process of science research and encourages students to continue on STEM pathways.

The annual *Urban Barcode Project* and *Urban Barcode Research Program* symposium was held in-person on June 3, 2022 on the campus of the New York City College of Technology. The keynote speaker, Dr. Theodore Muth of Brooklyn College, presented on the biodiversity



Top row: Dr. Gobler during his talk in Grace Auditorium and *BLI* participants at the Symposium poster session in Nichols Biondi Hall.

Bottom row: NYC DNA barcoding program participants perform the wet lab portion of their projects at an Open Lab held at *DNALC NYC*. The *UBP/UBRP* Symposium was held at The Theatre at City Tech, one block east of *DNALC NYC*, where student posters were set up in the lobby and Dr. Muth presented in the auditorium.

of microbial communities in New York City. Two teams were recognized with outstanding poster awards: in the *UBP*, a team from Brooklyn Tech for “Performing Barcoding and Soil Analyses to Investigate Ecosystem Resilience in Different Flood Zones of Brooklyn, NY”, and in the *UBRP*, a team mentored at the New York Botanical Gardens for “Analysis of Moss Biodiversity in Manhattan Parks”.

### Citizen Science DNA Barcoding

*Citizen DNA Barcode Network* entered its third year of NIGMS SEPA funding. The project organizes local and national DNA barcoding campaigns for citizen scientists at science centers and through nature/conservation organizations. Participants collect and barcode “campaign” organisms including vectors of human disease, invasive species, and economically important species whose ranges may be shifting due to climate change and habitat destruction.

The New York Hall of Science (NYSCI) staff completed work as project co-PI, but implemented DNA barcoding programming permanently through their new *Cecily Selby Inquiry & Investigation Program*. The pilot cohort included five high school and five undergraduate “Explainers” who were trained in DNA barcoding as well as microscopy, microbiology, and entomology. Explainers developed new visitor demonstration, mobile cart, and interactive floor experiences on DNA barcoding. explainer photographs of identified invertebrate samples will decorate NYSCI’s new lab space.

Year 3 officially began our national expansion by onboarding our first program hub, the California Academy of Sciences (CAS). A five-day workshop at CAS trained eight core team “Careers in Science” high school interns alongside two academy Youth Programs staff and a local community college collaborator in the DNA barcoding process and *CDBN* program



Jeff Petracca (maroon shirt) and Sharon Pepenella (pink-flowered shirt) led sample collection and documentation at the Jones Beach Energy and Nature Center in June.



implementation. However, delays in subaward funding and extreme weather shifted the majority of CAS program implementation to Year 4. New York collaborators at The Nature Conservancy at Mashomack Preserve, Sweetbriar Nature Center, Long Island Aquarium, Long Island Science Center, Jones Beach Energy and Nature Center, and new collaborator the Landcraft Garden Foundation, along with the Missoula Butterfly House and Insectarium (MT), also hosted public *CDBN* events. Activities included brief “tabletop” sessions introducing the use of DNA to identify species; partial- or full-day, hands-on labs; virtual bioinformatics activities, DNA barcoding training during internships; specimen collection events; and a two-week DNA barcoding summer camp. Two *BLI* mentors helped implement *CDBN* events.

The program supported 546 participants with a range of ages and skill levels. In total, 199 DNA barcodes were published to GenBank with citizen scientists as authors, including 30 previously unpublished barcode sequences and 89 new variants. Samples included an agriculturally significant leaf beetle (*Brachypnoea lecontei*) collected in Louisiana at the fringe of this species' known range, suggesting a northeastward expansion; a high level (>12%) of variability in the barcode region for multiple collected *Sternidius punctatus* samples, suggesting a possible cryptic species; and multiple specimens of a potentially undefined *Nylanderia* species collected from various locations across the Northeastern US.

### DNA Barcoding in Undergraduate Classes

Under our \$2 million IUSE grant from the National Science Foundation, we continued to popularize DNA barcoding and metabarcoding as solutions for course-based undergraduate research experience. Along with our collaborators at James Madison University (JMU), CUNY City Tech, Bowie State University (BSU), and Austin Community College (ACC), we introduced large numbers of freshmen and sophomore college students to research. JMU administers one of the largest CUREs in the US, providing DNA barcoding experience to 1,500 students in 71 sections of freshman biology for majors and non-majors. Metabarcoding projects were done by 520 students in 24 sections of sophomore biology. At BSU, 84 freshman students participated in DNA barcoding CUREs, and 40 juniors did metabarcoding. We also supported faculty trained during the first three years of the grant, providing free reagents and DNA sequencing, and extended support through email, phone calls, and video chats as they grant as they implemented CUREs. We supported 23 faculty providing DNA barcoding to 2,076 students and 33 faculty providing metabarcoding for 338 students.

In the spring of 2022, respondents to the survey from a large implementation of DNA barcoding at Howard University (n=200) allowed us to compare results of a participant CURE to JMU's large-scale CURE (n=808). Students from Howard University were half as likely to have had any research experience prior to their course. They reported statistically greater effects than their JMU counterparts on their interest in and belief in their ability to go further in science while having similar increases in their self-reported knowledge of barcoding, metabarcoding, and scientific methods. This suggests that replicating the barcoding CURE by a program participant was as effective as JMU's implementation. In addition, the Howard University CURE may have greater impact, possibly because Howard serves a predominantly URM population (94%) while JMU has a predominantly white student population (13% URM).



Visitors at the Long Island Aquarium in December learn about DNA sequencing with a LEGO® Sequencer. Visitors built a LEGO DNA sequence by stacking red (T), green (A), blue (C), and yellow (G) blocks that were then read by the LEGO Sequencer connected to a laptop that searches for a match to identify the organism.

## National Center for Biotechnology Education

The DNALC continued its work as a lead institution in the InnovATEBIO national biotechnology education center funded through NSF ATE, which supports training for America's workforce. We continued to advance the concept of Hubs as a decentralized infrastructure that shares leadership among a unique team of biotechnology educators. Hubs support both the processes and emerging technologies that help prepare an agile bioscience workforce. Eight hubs are "go-to" places for specific expertise to create and support biotech programs in high schools and community colleges: alumni network, careers and entrepreneurship, high school pathways, industry and workforce development, supply chain, student research, genomics, and immunotherapy.

Joe Oleniczak speaks to ACC students in preparation of starting a sequencing run.



Our own Genomics Hub aims to popularize genomics technology as a means to introduce modern biological concepts and workforce skills. We continued to collaborate with Joe Oleniczak (above), to implement a DNA sequencing service at Austin Community College based on the systems we have developed to support human mtDNA sequencing and DNA barcoding. We continued to work with Aron Kamajaya, of Los Angeles Pierce College to develop simple, reproducible methods to isolation *Taq* polymerase. Here the objective is to illustrate modern methods for producing biologicals from cloned genes, as well as a template for student-run "companies" to produce *Taq* for use in other biology classes. This offers a complete model of a modern biological supply chain—from assembly of components, to production, quality control, and distribution. The *SimpleTaq* plasmid constructed by the DNALC constitutively expresses *Taq* polymerase, and we also devised a method to harvest *Taq* from bacterial lawns grown on culture plates. This did away with the need for any large-scale liquid culturing or shaking incubation. We have found that *Taq* polymerase produced by our *SimpleTaq* plasmid and isolated using our simple, 40-minute method has activity comparable to commercial *Taq* polymerase. We have also found that *SimpleTaq* lysates stored at 4°C remain stable and highly active for at least 16 months!

The COVID-19 pandemic broke our 35-year streak of conducting in-person summer teacher training workshops that began in 1985! So, we were happy to return to this tradition with an workshop on "Lab Methods in Personal Genomics and DNA Barcoding" at Los Angeles Pierce College. Hosted by our collaborator Aron Kamajiya, this three-day workshop provided an introduction to the DNALC's popular experiments in polymerase chain reaction (PCR) and DNA sequencing. Two experiments in personal genetics—*Alu* Insertion Polymorphism and mtDNA Sequence Variations—illustrate human diversity and population genetics, while DNA barcoding positively identifies plants and animals—down to species level. All experiments entail the entire data life cycle—including data generation, databasing, and analysis using the DNALC's bioinformatics tool, *DNA Subway*. These open-ended experiments are perfect for extended investigations or course-based undergraduate research experiences. Participants successfully isolated *Taq* polymerase and used it to amplify their own DNA polymorphisms, illustrating a practical use for the freely obtained reagent.

## NSF CyVerse

2022 marked a transformative year for CyVerse as the platform transitioned to a subscription model for different service tiers. This sustainability approach is designed to charge researchers who make extensive use of CyVerse a fee that covers some of the cost of use. A free tier allows new or occasional users to continue using the platform without charge. Although the *DNA Subway* platform is no longer directly supported by the CyVerse grant, CyVerse continues to provide underlying infrastructure. As we enter the final year of the current CyVerse grant, we are revamping plans for a *DNA Subway* upgrade and refresh that will ensure continued and expanded access for educators. *DNA Subway* usage increased by 9% in 2022, with 1,292,306 page views (compared to 1,181,403 in 2021). The platform had 55,284 registered users, a 14% increase from 2021. Project creation increased dramatically with resumed training on metabarcoding with the Purple Line; users created 54,489 student projects, a 35% increase from 2021. We also supported our ongoing *Foundational Open Science Skills* course with a fall 2022 cohort of 48 students and hosted an in-person CyVerse workshop at SUNY Old Westbury College for 23 students. An additional 400 community members were reached at conferences, including the American Society of Plant Biology, Society for Developmental Biology Southwest Regional Meeting, and the NIH National Human Genome Research Institute's summer short course.

## Diversity, Equity, and Inclusion

The **Science, Technology, and Research Scholars (STARS)** program aims to cultivate and diversify the next generation of STEMM (science, technology, engineering, mathematics, and medicine) leaders. *STARS* is designed for high school students from the Long Island and NY metro area who are entering grades 10 and above and are members of groups that have been historically underrepresented in the sciences. In its fourth year, we enrolled 21 students from 13 school districts. Funds available through a gift from CSHL trustee Laurie Landeau were used to provide bussing for eight students who would not otherwise be able to attend. During a trip to Stony Brook this year, students participated in a "simulation" experience where one task included taking a case history of a model patient (an actor trained with a script of symptoms and medical history). The students also examined patient simulators—robotic patients with simulated heartbeats, pulses, and other features. We are now developing opportunities for students to have shadowing experiences with physicians. As alumni progress through the program, we see them integrating into other science research opportunities at CSHL. Several students have continued on to participate in the *Partners for the Future* program and other CSHL internships, including Harrison Banks (*STARS* '20) and Madison Krug (*STARS* '21). We also had several students participate in a college panel during our family orientation and alumni meetup, including Nigel Williams (*STARS* '19) studying at Cornell and Jenifer Martinez (*STARS* '19) attending Quinnipiac University. Carlos Javier (*STARS* '21) and his classmate, Sadé Griffith of Wyandanch Memorial High School, also presented their work on lichens at the DNALC's *Barcode Long Island* symposium. As *STARS* reaches its 100<sup>th</sup> student next year, we continue to actively build our network of alumni, engaging students year-round through virtual and in-person mentoring and meetups.



STARS students at work in the lab.



The DNALC was awarded a Coordinating Center award from the NIH National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). **Short-Term Research Experiences to Unlock Potential (STEP-UP)** supports high school students from groups historically excluded from science, offering paid, eight-week summer internships at research labs near their homes. Students work with scientist mentors on a research project to be presented at an end-of-summer symposium. During the school year, *STEP-UP* also provides mentorship to prepare students for college and future research.

As a Coordinating Center for the high school component of *STEP-UP*, the DNALC assists with placing students into research experiences, focusing on the US Northeast region. In the first year, we placed 11 students in colleges from Michigan to New York. *STEP-UP* is highly complementary with the DNALC's *STARS* program and we anticipate that future *STARS* students will participate in *STEP-UP* as a follow-up research experience. *STEP-UP* is led by Assistant Directors for Diversity and Research Readiness, Jason Williams and Michelle Juarez. The DNALC's participation has made activities such as nanopore sequencing and introductory genetics content visible to a national audience of students participating in *STEP-UP*, as we assist students in preparing for their summer research experiences and meet regularly with them for mentoring.

The Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) organized the National Diversity in STEM (NDiSTEM) Conference in San Juan, Puerto Rico. The largest multidisciplinary and multicultural STEM diversity event in the country, the conference serves to equip, empower, and energize participants for academic and professional paths in STEM. Jason and Michelle joined the CSHL School of Biological Sciences staff to participate in the conference as exhibitors. This was the first time DNALC staff attended the conference and highlighted our role as the *STEP-UP* program Northeast coordinating center. We focused outreach on networking about *STEP-UP* to potential mentors. Michelle has been attending the SACNAS conference since 2002 when she was an exhibitor for CSHL and presented her graduate research. Michelle also served as judge in the graduate student oral presentations and participated as a mentor in a one-on-one mentoring workshop. Jason presented on a scientific careers panel for working with data and plant sciences.

As the DNALC continues to strengthen its commitment to diversity and inclusion, we also have an obligation to share lessons learned and advocate for broad change. We did so in the article "Achieving STEM Diversity: Fix the Classrooms,"<sup>1</sup> which appeared in *Science* magazine in June. We argued against conceptualizing diversity and inclusion as efforts that need to "fix" students or that assume some students are inherently less capable than others. Instead, we called for examining the structures of educational systems that do not meet the needs of students or appreciate that supporting a diverse population of students means anticipating different interests and needs. The lead recommendation of the article was the need to advance hands-on learning—something the DNALC has been doing for more than 35 years. We also stressed the importance of creating a welcoming environment where every student feels included. Our *STARS* program, for example, is designed to create an environment where students from underrepresented backgrounds are surrounded by their peers and exposed to role model scientists and professionals. As we continue to increase our commitment, we will also support and advocate for the inclusion of all students in the learning experience.

1. Handelsman J., Elgin S., Estrada M., Hays S., Johnson T., Miller S., Mingo V., Shaffer C., Williams J. (2022). Achieving STEM diversity: Fix the classrooms. *Science*, 376, 1057-1059. DOI: 10.1126/science.abn9515

## Licensed Centers

This was our first full year of in-person programming at the *Regeneron DNALC*. We worked hard to contact teachers we met before the pandemic, and initiate new relationships with others. In total, 889 students visited for field trips, including 31 high schoolers from Yonkers Partners in Education who met with social media influencer Dr. Raven the Science Maven to learn more about her journey in STEM and perform a genetic engineering lab. An additional 171 students from Sleepy Hollow Middle School visited for the annual *Regeneron Day for Doing Good* event. They moved through a series of lab activities presented by DNALC-trained Regeneron staff, who volunteered to help increase STEM exposure for the local community. Our first camp season in Sleepy Hollow was a success. We were thrilled to host 198 campers— 33% of whom were children of Regeneron employees—meeting our goal of 50% occupancy for the pilot season.



Dr. Raven shared about her visit to the *Regeneron DNALC* on Instagram.

With the release of new campus-wide COVID-19 safety protocols in April, the **Notre Dame DNA Learning Center** (ND DNALC) continued towards a return to pre-COVID-19 instruction programming. In summer, 43 participants attended the first in-person residential programs and workshops since 2019! An additional 250 students participated in laboratory field trips, more than half of whom were from schools visiting for the first time. In fall, seven high school students—including some former summer campers—worked on independent research projects from DNA barcoding bacteria, to cancer and COVID-19 investigations. One student project titled “What Is the Role of PRPF39 in Cisplatin Treated Cancer Cells?” advanced to the Regeneron International Science and Engineering Fair. Notre Dame staff also participated in two campus-wide science events: “Moment of Science” and the “College of Science Tailgate.”

We continued to develop plans for a **DNA Learning Center in Passaic County**, New Jersey. The new DNALC will be located in the Biotech Innovation Center on the campus of the Passaic County Technical Institute (PCTI), a vocational-technical high school. A bridge will connect the Biotech Center to an adjacent campus of Passaic County Community College (PCCC), which cements the center's goal to provide AS degrees to 150 students per year in the dual-enrollment biotech program. The \$25 million construction project is funded by New Jersey's Securing Our Children's Future Bond Act. The 6,500-square-foot DNALC will contain two teaching labs, a bioinformatics lab, and a research/supply chain lab (in part to produce *Taq* polymerase). The DNALC will serve biotech students, as well as students enrolled in PCTI's Biomedical STEM Academy and AP Biology. Importantly, the new DNALC will provide lab field trips, summer camps, and DNA barcoding projects for middle and high schools throughout Passaic County, which have among the lowest science achievement scores in the US. The project is led by Ted Szczawinski, PCTI Assistant Superintendent for Instruction, and Steven Rose, President of PCCC. We have a strong advocate in Geoff Gordon, PCCC Director of Special Projects, who, as superintendent, steered Port Washington into the Wall Street Journal's top 10 high schools in the US. During his 10-year tenure, Port Washington was a standout in the Intel Science Talent Search and a strong participant in DNALC programs.

## International Partnerships

### China

Travel restrictions continued to hamper our collaboration with **Beijing No. 166 School** in China. With our program on hold since the start of the pandemic, we worked with school faculty to figure out how to finish out the contract and provide hands-on instruction for their students. The solution was modified *On-Demand* camps with comprehensive pre-recorded video instruction so students could perform labs in their classrooms using real lab equipment, and follow a more traditional lab schedule for three courses: *Genome Science*, *DNA Barcoding*, and *Introduction to Genetics*, a hybrid of *Fun with DNA* and *World of Enzymes*. In addition to filming about 15 hours of video instruction per course, we developed custom course and support materials, and ordered reagents and consumables from a vendor in China. We also provided regular access to DNALC staff for Q & A, troubleshooting, and engagement with an instructor as needed. Overcoming obstacles like social distancing restrictions and family reticence to send children back to school following a lockdown, teachers filled one session each of *DNA Barcoding* and *Introduction to Genetics*, with 36 total enrolled. They plan to implement *Genome Science* over winter break in January 2023.

In 2022, **Cold Spring Harbor Asia (CSHA) DNALC** in Suzhou faced challenges due to COVID-19 closures, with schools reopening permanently in mid-May. Nonetheless, the center recorded 25,724 total visits—including 292 camp and 118 weekend program attendees—a 22% increase over the previous year. After-school science clubs thrived and student projects were showcased in a city-wide popular science event, garnering 120,000 views during live broadcasts. Illumina (China) Science Equipment Co., Ltd. sponsored the 2022 *Life Science Enters Campus—Deciphering the DNA Code* course, reaching 1,000 students across nine schools in four provinces. The 10-part *Life Journey Lectures* series engaged 4,148 people, and three-part series on biodiversity during *Popular Science Week* reached 159 classes, with nearly 10,000 live viewers.

The 6<sup>th</sup> Annual *Suzhou Young Life Scientist Cultivation Program* attracted 1,855 students from 129 schools, a significant increase from the previous year. This program has strengthened CSHA DNALC's position as a leader in science education and fostered valuable school relationships. The DNA barcoding research course remained popular among high school students, aiding college applications with CSHL branding. The *Phyto-Identity Collaboration (PIC)* developed in 2021, engaged 24 students who completed 21 research posters and published over 100 sequences. The *Innovative Biology Education Program (IBEP)* continued to receive support from the SIP Education Bureau, enrolling 2,300 students, a 5% increase from the previous year. Since its inception in 2018, IBEP has engaged almost 32,000 high school students in two biotechnology labs. Research has shown that students taking this course can score about 15% higher on the biology portion of the Jiangsu Province Gaokao, the do-or-die entrance exam to Chinese Universities.

Dr. John Olsen, the former Education Director, left in March 2022 for a position at the University of California, San Diego. Dr. Zhiyuan Liu took over as lead educator.

### DNA Learning Center Nigeria

The pandemic was just one of the challenges faced by DNALC Nigeria. Despite this, the center has continued to offer courses and meet its objectives using the current funding. Over 500 participants have benefited from the Center's programs, including 240 post-graduate trainees and faculty members who enrolled in courses on *DNA Barcoding* and *Genome Science*. Furthermore, 200 pre-college students received training through the grant funding from the *Back to School Initiative (BATOSCIN)*. Facility upgrades now ensure 24-hour power and increased water storage capacity, among other essential repairs. Even though attendance



numbers remain modest, these achievements are commendable, especially given the region's challenges with rising insecurity, extended strikes, and economic difficulties. Michael Okoro, a former DNALC intern and now a DNALC Nigeria Scholar, continues to lead the Center's operations, with supplemental funding from DNALC.

### Lab Instruction and Outreach

With rising COVID-19 vaccination rates and the lift of the New York State school mask mandate, we started to see increased field trip reservations. This was especially noticeable on Long Island where high school classes began to flood back, making up for lost time in the lab. We initiated advertising campaigns in the fall to remind teachers who were still coming out of the pandemic haze that we were open for business. Our efforts paid-off, and a total of 16,335 students attended lab field trips at Dolan DNALC, *Regeneron DNALC*, and *DNALC NYC* at City Tech. In-school programs reached an additional 7,208 students, and footlocker kits were used by 1,499 students, 117 of whom were conducting independent research through *UBP*, *UBRP*, or *BLI*.

Tuition assistance for field trips to Dolan and *Regeneron DNALC* was provided for 234 students from Uniondale School District, A. Philip Randolph High School, Excelsior Prep High School, Benjamin N. Cardozo High School, and Jamaica Gateway to the Sciences. An additional 269 students from the Brentwood School District received subsidized in-school instruction for their honors Living Environment program. Five hundred and twenty 6<sup>th</sup>- and 7<sup>th</sup>-grade students from Central Islip School District participated in lab programs funded by the National Grid Foundation, including a student who was nominated by her science teacher for two camp scholarships. At *Harlem DNA Lab* and *DNALC NYC*, field trip scholarships were awarded to 870 students (24%) who attended Title I schools. A portion of these scholarships were subsidized by a grant from the William Townsend Porter Foundation.

In summer we offered a full schedule of in-person camps at all three locations, requiring that students provide proof of vaccination, or a negative COVID-19 test to attend. With 1,575 total campers, we had the highest summer enrollment in DNALC history—evidence that parents and their children were ready to get back to science camp! We had 772 campers on Long Island and an impressive 198 for our pilot camp season in Sleepy Hollow. In Brooklyn we hosted 459 campers, including 231 who attended subsidized *UBRP* prep courses, and 17 who were supported by the City Tech *Bridging the Gap Science and Technology Entry Program (STEP)* for pre-college students. Need-based scholarships were awarded to 55 campers in NYC. Sixty-seven percent of scholarship recipients were Black, Hispanic, or Native American, fulfilling our goal to focus on accessibility for underrepresented minorities in STEM.

In partnership with CSHL Women in Science and Engineering (WiSE), we hosted the sixth annual *WiSE Fun with DNA* summer camp. Twenty-four female science enthusiasts had the opportunity to meet engaging role models with careers in science. After completing the core *Fun with DNA* curriculum each day, campers participated in WiSE activities on advanced topics like cancer



Campers work together during a bacterial transformation lab.

research, neuroscience, and gene expression. In addition to Parent Participation on the final day of camp, parents and campers enjoyed a guided tour of the CSHL campus.

Membership programs thrived with a total of 19 Sustaining Members, including new member Hendrick Hudson School District at Regeneron. The Dolan Associate Partner program grew with the addition of Friends Academy. We helped design and implement a plan for the development of the school's research program, with a focus on using DNA barcoding as a springboard into continued research. Associate Partner Glen Cove City School District, also invested instructional time in development of their research program, and implementing course related labs with their middle school life science, Living Environment, and AP Biology classes.

Dolan Partner Members, Long Beach City School District and Massapequa School District, started year two of membership with a number of new initiatives in place. In Massapequa, every research student will be exposed to our barcoding wet lab and bioinformatics infrastructure as 8<sup>th</sup> graders, and then complete a barcoding research project in grade 9. There are also structured exposure opportunities for all of the Living Environment and middle school life science classes. Long Beach instituted lab exposures for all of the 8<sup>th</sup> grade Life Science and Living Environment classes, and offered summer camps at Long Beach Middle School for their science interested 6<sup>th</sup>–8<sup>th</sup> graders. In July, 38 students attended *Fun with DNA* and *Forensic Detectives*. Feedback was positive: "Camp was very interactive which kept my daughter engaged and interested. She's a visual, hands-on learner and this program really suited her learning style. She was always excited to share what she learned. That never happens...."

As part of other ongoing local partnerships, the year-long *Molecular and Genomic Biology* elective at Cold Spring Harbor High School continued in spring. The 12 enrolled students spent the last two periods of every other school day at the DNALC, immersed in hands on experiments in DNA barcoding, human and plant genomics, and bioinformatics. Due to low enrollment, a new student cohort was not enlisted in fall. An additional 11 students from St. Dominic High School in Oyster Bay participated in a half-year *Molecular and Genomic Research* elective taught at the DNALC. As part of their course requirements, all students in both elective classes participated in *Barcode Long Island*.

The NYC Partner Member program continued to provide custom instructional sequences and advanced electives for six independent schools.

- Portfolio School grade five students conducted molecular and historical inquiries into the origin of lactase persistence.
- Research teams from Fontbonne Hall Academy used DNA barcoding to produce novel GenBank entries for flowering plants and snails. AP Biology students studied viruses, vaccines, and protein structure, and created 3D-printed models of the SARS-CoV-2 spike protein.
- Lycée Français de New York implemented genetics programs in their AP Biology courses. High school students in a *Genome Science* summer camp pioneered a protocol to manufacture their own *Taq* DNA polymerase, which they used for PCR throughout the camp.
- At Marymount School of New York, genetics programs were incorporated as key parts of the biology curriculum at multiple grade levels, including Advanced Molecular Biology. Grade eight physical science students studied energy transformations and the nature of light using fluorescent proteins.
- St. David's School integrated basic genetics with existing curricula in grade five. Grade eight used DNA barcoding to survey the ants of Central Park.
- The Chapin School coordinated genetics programs at several grade levels, including the advanced Molecular Genetics elective. Grade-six students analyzed chromosomes in human cells while studying Henrietta Lacks and bioethics. They were among the first students to explore the new *What DNA Says About Our Past and Future* exhibit at DNALC NYC.

This year we took steps to deliver on our commitment to level the science playing field for underrepresented minority (URM) and disadvantaged students. With support from the Lounsbery Foundation, we initiated our flagship *Research Ready Program* in New York City by selecting the first two public high schools to join elite independent schools as Partner Members of the DNALC.

- Manhattan Center for Science and Mathematics in Harlem is a URM alternative to NYC's specialized science high schools. It has an impressive selection of advanced and college-level courses, which can readily incorporate the DNALC's opportunities for student projects and research. The student body is 68% URM.
- Satellite Academy in midtown Manhattan is a transfer alternative high school that admits older students who have fallen behind in credits, dropped out, or need a fresh start. Satellite students will appreciate the workforce orientation that we can provide through InnovATEBIO, as the school is designed to help students get back on track towards graduation. The student body is 95% URM.

We began working with the leadership of these schools to develop an enhanced scope and sequence for modern biology that will include up-to-date lab experiences in Regents Living Environment, new biology electives, and extended student research opportunities. Long-term engagements will support cohorts of students along the pathway from high school to college to careers.

In September, the *Our Human Inheritance* exhibition in Cold Spring Harbor was finally reopened to the public and we hosted 39 visitors after a two-year pandemic closure. An additional 2,722 students received guided tours of the exhibit on field trips. In parallel, the new *What DNA Says About Our Past and Future* exhibition under construction at DNALC NYC had 77 visitors, 65 of whom were on field trips.

The *Saturday DNA!* program drew 258 participants across three locations, including the first ever *Saturday DNA!* sessions at the *Regeneration DNALC*. Eighteen different sessions included topics such as cellular respiration in yeast, how to be DNA detectives, the indestructible tardigrade, Mendelian genetics, "painting" with bacteria, and the scientific method. Participants had fun with Halloween-themed sessions and extracted DNA from pumpkins, built candy DNA models, and delved into the enduring mystery of Anastasia Romanov. On Veteran's Day we also hosted a *Saturday DNA!* spin off called *Day in the Lab*. With the help of the CSHL Association Directors, we enrolled 152 children and their parents for fun hands-on activities designed to expose a young (ages 5–10) audience to a variety of STEAM (Science, Technology, Engineering, Art, and Math) including fingerprint analysis and painting with fingerprints, heredity, observing biochemical reactions, and DNA extraction from strawberries.

Participants at the *Day in the Lab* got hands-on (and a little grossed out) with the day's STEAM activities.





In spring, 11 high school students in the City Tech *Bridging the Gap STEP* program attended 12 hours of Saturday workshops at DNALC NYC to provide a comprehensive introduction to DNA—from DNA isolations to forensic DNA fingerprinting and DNA restriction analysis. Math for America teachers attended two mini courses in Brooklyn where they explored applications of genetic engineering. Participants genetically engineered bacteria to produce Green Fluorescent Protein (GFP), and used PCR to test snack foods for genetic modifications. Teachers who attended these mini-courses are now eligible to borrow DNALC footlockers to implement these labs at school, and many decided to bring students on a field trip after seeing our new space.

DNALC NYC staff participated in Brooklyn community events to meet the neighbors and do hands-on science! Families attending the Brooklyn Bridge Parents Indoor Block Party and the Brooklyn “Atlantic Antic Festival” extracted DNA and made DNA necklaces. We also participated in the SUBMERGE Marine Science Festival field trip day at Hudson River Park. Students visiting rotated through activity tables and learned about eDNA or did “pipette painting” with our team.

The virtual *Meet a Scientist* series continued to connect high school and public audiences with local researchers to learn more about their career paths, and current projects. CSHL Assistant Professor Dr. Jeremy Borniger shared his work on how bran circuits influences cancer processes in the body; CSHL Fellow Dr. Corina Amor introduced her research on senescent cells and their involvement in aging and age-related diseases like cancer and fibrosis, focusing on the importance of identifying new therapeutic approaches; CSHL Assistant Professor Dr. Jessica Tollkuhn discussed how estrogen and testosterone generate sex differences in the brain and behavior; CSHL Assistant Professor Dr. Ullas Pedmale presented his work on how plants sense their environments; and CUNY City Tech Associate Professor Dr. Jeremy Seto introduced how he dissects genomes, microbiomes and transcriptomes of common disease vectors in the city to find ways to reshape urban ecosystems. All lectures are archived on the DNALC website.

With the return of field trips in Cold Spring Harbor, we re-initiated our graduate training collaboration with the CSHL School of Biological Sciences. This year's program included both the first-year cohort, and the second-year students who couldn't participate in 2021 due to COVID-19 field trip restrictions. First-year graduate students worked with DNALC instructors to develop skills needed to communicate science to a variety of audiences. They completed 12 half-day sessions where they progressed from observation to co-instruction, and then independent teaching of lab classes, while second year students did the same over a modified six sessions.

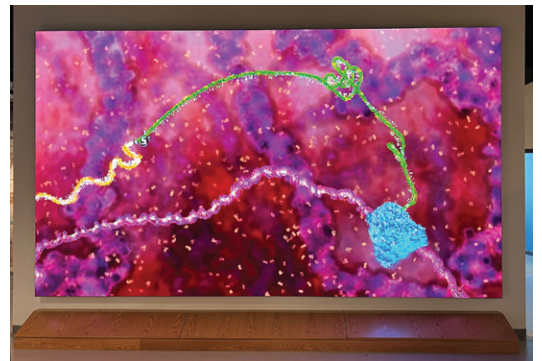
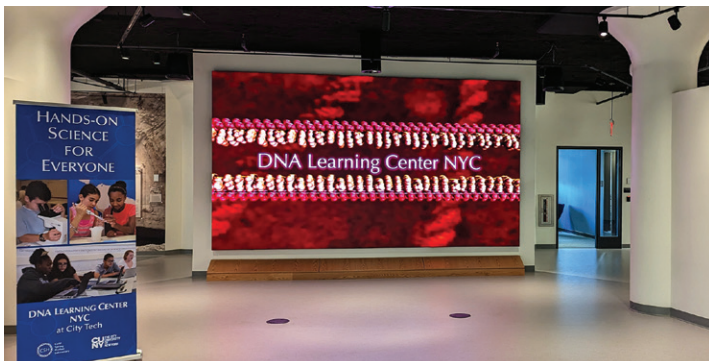
### **BioMedia Visitation and Projects**

In 2022, 4.69 million visitors accessed our multimedia resources, a decrease from the previous year largely attributed to fall off of YouTube visits after two videos went viral in 2021. Our YouTube channel had 1,817,089 views with 106,480 hours of watch time and added 5,889 subscribers. Google Analytics counted 2.4 million visits to DNALC websites, 91.72% of the prior year. *3D Brain* and *Gene Screen* smartphone/tablet apps were downloaded 485,201 times, including 4,800 *3D Brain HQ* in app purchases earning \$3,319. We benefitted from an ongoing nonprofit Google Ads grant that funds ads for our websites and programs in the Google search engine; ads generated 146,299 impressions and 12,401 clicks; the equivalent of \$19,992 in advertisement spending.

Development of the *What DNA Says About Our Past and Future* exhibition at DNALC NYC continued through the year. For the *DNA Past* section this included: installation of the Ötzi mummy replica glass case after months of supply chain delays, as well as a life model of Ötzi wearing replica clothing; mount of final display labels in July, including a timeline of notable

events from the end of the Copper Age into the early Iron Age; and addition of a touch screen and interactive on the introductory wall (see images below). In consultation with CSHL trustee Jeanne Moutoussamy-Ashe, the *All the World in New York City* photography contest wrapped up and 17 photos were selected for inclusion; the gallery space will be completed in early 2023. A Samsung "The Wall" video screen was installed in May and staff received training on its use. We are able to control the display and schedule media content from anywhere using cloud-based tools. A new sign was hung in the lobby and several donors' names were added to relevant spaces acknowledging gifts.

The *BioMedia* team continues to provide support for our programs through print and web design, photography, and videography. In the spring three sets (total 33.5 hours) of modified *On-Demand* camp videos were produced—*Introduction to Genetics*, *DNA Barcoding*, and *Genome Science*—for collaborators at Beijing 166, although the videos can be used by any educator with the necessary equipment. In collaboration with educators, a new "Producing *Taq* DNA Polymerase" 69-page protocol was laid out in our *Genome Science* textbook style.



## Staff and Interns

In March, we welcomed Michelle Juarez as the Assistant Director of Diversity and Research Readiness at *DNALC NYC*. She has a Ph.D. in Genetics from SUNY Stony Brook, and defended her thesis on the genetics of developmental patterning and microRNA regulation in corn at Cold Spring Harbor Laboratory. Throughout her postdoctoral journey, Michelle has served as a mentor to precollege, undergraduate, and graduate level students, and has been part of the teaching faculty at a number of universities, including locally at City College of New York, City University of New York School of Medicine, and John Jay College of Criminal Justice. Most recently she was a Science Education Fellow at Howard Hughes Medical Institute. Michelle's experiences in research and education, her commitment to science accessibility and mentorship, and her connections to CUNY are the perfect fit for her *DNALC* role of working to level the STEM playing field for students in NYC.

Elizabeth Asaro came aboard in September as the Receptionist at the Dolan DNA Learning Center. Liz recently re-entered the workforce after choosing to stay home and raise her three children. Liz grew up on Long Island, and received a B.A. in Public Communication from Ithaca College. She has previously worked as a teaching assistant for Harborfields School District, a real estate agent, a bank teller, and a pharmaceutical sales specialist, executive, and representative. With her customer relations, networking, analytical and creative thinking and public speaking experience, Liz is well prepared for working on the *DNALC* front-line directly with parents, students, and teachers.

Chaunna Henry joined the Brooklyn team in November as the Administrative Manager at *DNALC NYC*. Born and raised on Long Island, she is a graduate of Uniondale High School, and received a Bachelor of Science in Journalism from St. John's University. Chaunna has held a number of eclectic positions within the legal, e-commerce, art production, and education fields. She has also traveled to over 20 countries, including living in South Korea for a few years! Chaunna's extensive background in a variety of roles, and her adaptability, creativity, and problem-solving skills will be helpful as she oversees administrative support for the programs in Brooklyn.

In December, we welcomed new middle school educator Tiffani Rushford to the Dolan *DNALC*. A graduate of Smithtown School District, Tiffani went on to complete a B.A. in Environmental Studies with an Ecology Concentration from SUNY Purchase. In 2018, Tiffani volunteered at Costa Rica Animal Rescue Center, a wildlife rehab facility. The experience sparked her passion for ecosystem preservation, so locally she volunteered at Coastal Steward Long Island and Westmoreland Nature Sanctuary, and became an Environmental Educator at Sweetbriar Nature Center. She has also been a General Ecology Learning Assistant, Great Ecology Environmental Monitor, Jones Beach Energy and Nature Center Environmental Educator, and HDR Wildlife



*DNALC* staff from all locations gathered at the Banbury Center for a "retreat" in September. Areas of discussion included budgets, future directions, areas of responsibility, and ways to ensure a consistent level of service to our audience.





From left: Michelle Juarez, Elizabeth Asaro, Chaunna Henry, and Tiffani Rushford.

Technician for the NYC Department of Environmental Protection. Tiffani enjoys providing fun science experiences for students that inspire them to pursue their own scientific interests.

We bid farewell to five staff members in 2022: administrators Valerie Meszaros and Andréa Mahee; educators Megan Capobianco and Catherine (Xiaoqun) Zhang; and lab technician Justin Burke.

Huntington native Valerie Meszaros started as an Administrative Assistant in April 2007, and was promoted to the role of Administrative Manager in 2017. With experience at two major Manhattan law firms and a background in advertising, communication, and publishing, she successfully led the DNALC admin team for five years. Her role included field trip and camp administration support, proofreading grants, articles, and reports, and marketing local programs. Val retired in April to pursue her passions for writing, art, and music, and spend quality time with her son Matthew.

Andréa Mahee became Administrative Manager at *DNALC NYC* in spring 2021. Her experience with event and workshop coordination and her outgoing personality served her well as she helped bring Brooklyn up to full speed at a difficult time. She worked through the very first summer as we settled in a new place, hired and trained new staff, and navigated the new landscape of CUNY infrastructure.

With her strong teaching experience, background in environmental conservation, and love of science Megan Capobianco was an valued member of the DNALC instructional team. Her degree in Childhood and Special Education supplied her with the pedagogical tools to skillfully engage with a wide variety of students. In addition to teaching, she also oversaw the management of the middle school program, which included working closely with school teachers and administrators to book field trips and in-school instruction. Megan left the DNALC to work for the TNPO2 Foundation. She assists with outreach and research efforts that focus on a rare genetic disease involving variations in the TNPO2 gene which can lead to developmental delays, seizures, and other severe abnormalities.

Justin Burke became our lab technician in 2019. His college education combined business, biochemistry, and cell biology, which served him well as a lab and intern manager. His job was to support all of our lab-based programs, and oversee lab preparation and quality control for everything we teach—a monumental task! During the pandemic he organized, prepared, and filled an essential role and managed packing and shipping of kits for virtual labs all over the country. In spring he left the DNALC to pursue other interests.

Catherine Xiaoqun Zhang began her CSHL journey in 2000 as a technician in the Tonks Lab, assisting with cancer research. She transitioned to the DNALC in 2013 to help culture our relationship with Beijing School 166, and oversaw that fruitful collaboration for 10 years. She was also a high school educator, and handled lab purchasing, including for the Breakthrough Junior Challenge program.

Since the DNALC opened, we have relied on high school and college interns to support our day-to-day operations. An internship offers students the unique opportunity to gain real laboratory or design experience in an educational environment. This year an amazing group of interns helped out, and we said farewell as others left for college:

*High School Interns*

Ashley Alexander, Yonkers High School	Brianna MacDonald, Commack High School
Lauren Belkin, Syosset High School	Robert McBrien, Miller Place High School
Hayden Calabretta, Cold Spring Harbor High School	Muhammad Naqvi, Francis Lewis High School
Daniel Galvin Gusmano, Portledge High School	Jakob Rechtweg, Friends Academy
Charlotte Gordon, Cold Spring Harbor High School	Ian Smith, Cold Spring Harbor High School
Alexander Gottlieb, St. John the Baptist High School	Croi Spillane, St. Dominic High School
Lauren Graziosi, Syosset High School	Evana Toumazatos, Sanford H. Calhoun High School
Nathan Leobandung, John Jay Senior High School	

*High School Interns Departing for College*

Raquel Belkin, SUNY Stony Brook University	Sandhya LoGalbo, Hofstra University
Kimberly Cardinale, Oxford College of Emory University	Maggie Wang, SUNY Stony Brook University
Nicholas Liotta, Borough of Manhattan Community College	

*College Interns*

Timothy Broadbent, Colby College	Brielle Monez, Sacred Heart University
Taehwan Cha, New York University	Jamie Price, Lehman College
Cristofer Hernandez, Hunter College	John O'Hara, University of Richmond
Anagha Khandelwal, SUNY Stony Brook	Mina Sarmas, Brown University
Ashley LaSalle, New York City College of Technology	Alexandra Sawicki, SUNY Buffalo
Jillian Maturo, Boston College	Morgan Serbagi, Hunter College
Sebastian Maurice, The City College of New York	Michael Stabile, Cornell University
Neal Mehta, Boston College	Nicholas Stabile, University of Notre Dame

**David Micklos**

DNA Learning Center Executive Director

## Workshops, Meetings, Collaborations, and Site Visits

January 5– February 16	<i>Urban Barcode Research Program Conservation Genetics Workshop, DNALC NYC</i>
January 15	<i>Saturday DNA! “Yeast Feast,” DNALC</i>
January 18	Site Visit & Tour by Dr. Avner Hershlag, Stony Brook University Department of Medicine, with Bruce Stillman, Alea Mills, and Leemor Joshua-Tor, DNALC
January 20	“Meet a Scientist: Dr. Jeremy C. Borniger,” Virtual Webinar, DNALC
January 22	<i>Urban Barcode Project Open Lab, Harlem DNA Lab</i>
February 5	<i>Urban Barcode Research Program Open Lab, DNALC NYC</i>
February 12	<i>Saturday DNA! “DNA Detectives,” DNALC</i>
February 17	“Meet a Scientist: Dr. Corina Amor,” Webinar, DNALC
February 18	<i>Barcode Long Island Open Lab, DNALC</i>
February 22–25	<i>Urban Barcode Research Program Conservation Genetics Workshop, Harlem DNA Lab</i>
March 5	Brooklyn Bridge Parents Block Party and Summer Camp Fair, City Point, Brooklyn, New York
March 7–April 13	<i>Urban Barcode Research Program DNA Barcoding and Bioinformatics Workshop, DNALC NYC</i>
March 14	<i>Urban Barcode Project Open Lab, Harlem DNA Lab</i>
March 17	“Meet a Scientist: Dr. Jessica Tollkuhn,” Webinar, DNALC
March 19	<i>Saturday DNA! “Tardigrades: The Indestructible Water Bears,” DNALC</i> <i>Urban Barcode Research Program Open Lab, Harlem DNA Lab</i>
March 21	<i>Urban Barcode Project Open Lab, Harlem DNA Lab</i>
March 23	“Plotting and Programming in Python Software Carpentry,” Student Training Workshop, National Society of Black Engineers National Conference, Anaheim Convention Center, Anaheim, California
March 26	<i>Citizen DNA Barcoding Network Bug DNA Barcoding Event, Long Island Science Center, Riverhead, New York</i> <i>Urban Barcode Project Open Lab, DNALC NYC</i>
March 29	Math for America Teacher Training Workshop, “Biotechnology with a Flair: From Genes to Jellyfish Part 1,” DNALC NYC
March 31	Open House, DNALC NYC
April 2	<i>Saturday DNA! “Cracking the Code,” DNALC NYC</i>
April 4	<i>Urban Barcode Project Open Lab, DNALC NYC</i>
April 7	Open House, <i>Regeneron DNALC</i>
April 9	<i>Saturday DNA! “Agar Art,” DNALC</i> “Doggie DNA: Session 1,” Quogue Library, New York
April 11	“Open Science and Learning in the Genome Age,” National Academies of Sciences, Distinctive Voices Seminar Series, Irvine, California
April 14	District 7 Science Expo, Bronx, New York
April 16	“Doggie DNA: Session 2,” Quogue Library, New York
Apr 18–22	<i>Urban Barcode Research Program DNA Barcoding and Bioinformatics Workshop, Harlem DNA Lab</i>
April 21	“Meet a Scientist: Dr. Ullas Pedmale,” Webinar, DNALC
April 26	Math for America Teacher Training Workshop, “Biotechnology with a Flair: From Genes to Jellyfish Part 2,” DNALC NYC
April 27	<i>Urban Barcode Research Program Workshop, Irondale Theatre, Brooklyn, New York</i>
April 30	<i>Barcode Long Island Open Lab, DNALC</i>
May 3	Math for America Teacher Training Workshop, “Biotechnology with a Flair: From Genes to Jellyfish Part 3,” DNALC NYC
May 7	<i>Saturday DNA! “Mendelian Critters: Inheritance of Traits,” DNALC NYC</i>



22 Workshops, Meetings, Collaborations, and Site Visits

- May 11 Site Visit by Kelly Gaudreau and Carissa Jordan, CSHL Association Directors with Karen Orzel, DNALC  
Site Visit by Dr. Avner Hershlag, Stony Brook University Department of Medicine and Mrs. Shelley Hershlag, DNALC
- May 14 *Saturday DNA!* "A Method to the Madness," DNALC  
*Barcode Long Island* Open Lab, DNALC
- May 15-28 "Making Career-spanning Learning in the Life Sciences Inclusive and Effective for All," CSHL Banbury Center, Lloyd Harbor, New York
- May 19 "Meet a Scientist: Dr. Jeremy Seto," Virtual Webinar, DNALC
- May 21 *Saturday DNA!* "Selection Detection," DNALC
- May 31–June 3 NIH SciEd Conference 2022, Washington, D.C.
- June 1–3 2022 IUSE National Summit, Washington, D.C.
- June 3 *Urban Barcode Project/Urban Barcode Research Program* Symposium, The Theater at City Tech, Brooklyn, New York  
Central Pine Barrens Joint Planning and Policy Commission Cooperators Meeting, "DNA Barcoding," Riverhead, New York
- June 4 *Saturday DNA!* "A Royal Ruse," DNALC
- June 7 *Barcode Long Island* Student Symposium, CSHL
- June 13–17 *Genome Science* Workshop, Lycée Français de New York, New York  
*Green Genes* Workshop, Lycée Français de New York, New York
- June 18 *Citizen DNA Barcoding Network* Collection Event, Jones Beach Energy & Nature Center, Wantagh, New York
- June 20-24 InnovATEBIO National Biotechnology Education Center: Methods in Personal Genetics and DNA Barcoding, DNA Sequencing, PCR, and *Taq* Supply Chain Production Teacher Workshop, DNALC NYC
- June 21–24 *Forensic Detectives* Workshop, St. David's School, New York, New York
- June 27–July 1 *DNA Science* Workshop, DNALC  
*World of Enzymes* Workshop, DNALC  
*Fun with DNA* Workshop, DNALC  
*Green Genes* Workshop, DNALC  
*DNA Science* Workshop, DNALC NYC  
*Fun with DNA* Workshop, DNALC NYC  
*Forensic Detectives* Workshop, DNALC NYC  
*Fun with DNA* Workshop, *Regeneration* DNALC
- June 29 Site Visit by Marilyn Simons, CSHL Board of Trustees, DNALC NYC  
Site Visit by Kristin Olson Smith, CSHL Association Directors, and Sara Naison-Tarajano, DNALC NYC
- July 5–8 *Green Genes* Workshop, DNALC  
*Fun with DNA* Workshop, DNALC  
*Forensic Detectives* Workshop, DNALC  
*World of Enzymes* Workshop, DNALC  
*Fun with DNA* Workshop, DNALC NYC  
*World of Enzymes* Workshop, DNALC NYC  
*Forensic Detectives* Workshop, *Regeneration* DNALC
- July 7 *Citizen DNA Barcoding Network* Landcraft Collection Event, Landcraft Garden Foundation, Mattituck, New York  
"Computational Basics for Plant Biology," CSHL Frontiers in Plant Science Course, Cold Spring Harbor, New York

- July 11–15 *DNA Science Workshop, DNALC*  
*Forensic Detectives Workshop, DNALC*  
*Fun with DNA Workshop, DNALC*  
*Genome Science Workshop, DNALC*  
*BioCoding Workshop, DNALC*  
*DNA Science Workshop, DNALC NYC*  
*Genome Science Workshop, DNALC NYC*  
*DNA Science Workshop, Regeneron DNALC*
- July 11 “Reproducible Workflows with CyVerse,” Public Lecture, Plant Biology 2022, Oregon Convention Center, Portland, Oregon
- July 12–15 InnovATEBIO National Biotechnology Education Center: Methods in Personal Genetics and DNA Barcoding, DNA Sequencing, PCR, and *Taq* Supply Chain Production Teacher Workshop, Pierce College, Los Angeles, California
- July 13 “Riding the Bicycle, Putting all Researchers on a Path to Excellence,” Public Lecture, Intelligent Systems for Molecular Biology 2022, International Society for Computational Biology, Madison, Wisconsin
- July 18–20 Pop-Up Training for Biology Educators: Bring Your Own Experiment Nanopore Sequencing Teacher Workshop, *DNALC NYC*
- July 18–22 *DNA Science Workshop, DNALC*  
*Fun with DNA Workshop, DNALC*  
*Forensic Detectives Workshop, DNALC*  
*World of Enzymes Workshop, DNALC*  
*Forensic Detectives Workshop, DNALC NYC*  
*DNA Barcoding Workshop, Regeneron DNALC*  
*Urban Barcode Research Program Conservation Genetics Workshop, Harlem DNA Lab*
- July 20–22 InnovATEBIO National Biotechnology Education Center: Teaching Biotechnology Skills through DNA Metabarcoding Biodiversity Research Teacher Workshop, *DNALC NYC*
- July 25–29 *DNA Science Workshop, DNALC*  
*Green Genes Workshop, DNALC*  
*World of Enzymes Workshop, DNALC*  
*DNA Barcoding Workshop, DNALC*  
*World of Enzymes Workshop, DNALC NYC*  
*Green Genes Workshop, DNALC NYC*  
*Urban Barcode Research Program Conservation Genetics Workshop, DNALC NYC*  
*World of Enzymes Workshop, Regeneron DNALC*  
*Fun with DNA Workshop, Long Beach Middle School, Long Beach, New York*  
*Urban Barcode Research Program DNA Barcoding and Bioinformatics Workshop, Harlem DNA Lab*
- July 25 High Impact Technology Exchange Conference 2022, “Planning and Experiencing the Biotechnology Future,” Salt Lake City, Utah
- August 1–5 *Green Genes Workshop, DNALC*  
*Genome Science Workshop, DNALC*  
*Fun with DNA Workshop, DNALC*  
*Citizen DNA Barcode Network Barcoding Workshop, DNALC*  
*BioCoding Workshop, DNALC NYC*  
*Urban Barcode Research Program DNA Barcoding and Bioinformatics Workshop, DNALC NYC*  
*DNA Science Workshop, Regeneron DNALC*  
*Forensic Detectives Workshop, Long Beach High School, Long Beach, New York*  
*Urban Barcode Research Program Conservation Genetics Workshop, Harlem DNA Lab*

- August 3 “Opening the Door to Good Science Education,” Johns Hopkins University Welsh Virtual Symposium  
 “DNA Barcoding - A Simple and Robust Research Experience for Molecular Biology, Bioinformatics, and Biodiversity,” National Human Genome Research Institute Virtual Short Course in Genomics, NIH
- August 8–12 *DNA Science Workshop, DNALC*  
*STARS DNA Barcoding Workshop, DNALC*  
*Forensic Detectives Workshop, DNALC*  
*World of Enzymes Workshop, DNALC*  
*DNA Science Workshop, DNALC NYC*  
*DNA Barcoding Workshop, DNALC NYC*  
*Urban Barcode Research Program Conservation Genetics Workshop, DNALC NYC*  
*Genome Science Workshop, Regeneron DNALC*  
*Urban Barcode Research Program DNA Barcoding and Bioinformatics Workshop, Harlem DNA Lab*
- August 8–10 InnovATEBIO National Biotechnology Education Center: Teaching Biotechnology Skills through DNA Metabarcoding Biodiversity Research Teacher Workshop, Forsyth Technical Community College, Winston-Salem, NC
- August 15 NYC Science Research Mentoring Consortium Summer Symposium and College Now Poster Presentations, *DNALC NYC*
- August 15–19 *DNA Science Workshop, DNALC*  
*Green Genes Workshop, DNALC*  
*Fun with DNA Workshop, DNALC*  
*DNA Barcoding Workshop, DNALC*  
*STARS BioCoding Workshop, DNALC*  
*Fun with DNA Workshop, DNALC NYC*  
*Urban Barcode Research Program DNA Barcoding and Bioinformatics Workshop, DNALC NYC*  
*Fun with DNA Workshop, Regeneron DNALC*
- August 22–26 *Forensic Detectives Workshop, DNALC*  
*Sequence a Genome Workshop, DNALC*  
*Wise Fun with DNA Workshop, DNALC*  
*World of Enzymes Workshop, DNALC*  
*DNA Science Workshop, DNALC NYC*  
*Fun with DNA Workshop, DNALC NYC*  
*Urban Barcode Program Teacher Training, DNALC NYC*  
*World of Enzymes Workshop, DNALC NYC*  
*Green Genes Workshop, Regeneron DNALC*
- August 29–  
 September 2 *Fun with DNA Workshop, DNALC*  
*Forensic Detectives Workshop, DNALC NYC*  
*World of Enzymes Workshop, DNALC NYC*  
*Forensic Detectives Workshop, Regeneron DNALC*
- September 16 “Open Science, the Next Generation,” NASA Horizons in Biosciences & Informatics Virtual Seminary Series
- September 20–24 *Citizen DNA Barcode Network Training Workshop, California Academy of Sciences, San Francisco*
- September 26 Site Visit by Dr. Raven the Science Maven, *Regeneron DNALC*
- September 29 City of Science – Dr. Phillip Sharp in conversation with Dr. Siddhartha Mukherjee, hosted by CUNY Graduate Center and CSHL Archives
- September 30 “A Day in the Life” River Program, Massapequa Preserve, Massapequa, New York



- October 2 "Atlantic Antic Festival," Brooklyn, New York
- October 10–11 National Institute of Health Meeting, Seattle, Washington
- October 12 Math for America Teacher Training, "Genetically Modified Organisms," DNALC NYC
- October 14 SUBMERGE Marine Science Festival, Hudson River Park, New York, New York
- October 15 *Saturday DNA!* "Agar Art," DNALC NYC
- October 18–20 NSF CyVerse Meeting, Knoxville, Tennessee
- October 19 Math for America Teacher Training, "Genetically Modified Organisms," DNALC NYC
- October 21 *Regeneration Day for Doing Good*, Regeneron Pharmaceuticals, Sleepy Hollow, New York  
Site Visit by Michelle Kidwell-Gilbert, National Arts Club, DNALC NYC
- October 22 *Saturday DNA!* "Dust Away Crime: Fingerprints," DNALC  
*Saturday DNA!* "Cancer Cells Under the Scope," DNALC NYC  
*Saturday DNA!* "Jack-o'-Lantern Genetics," *Regeneration DNALC*
- October 26 Math for America Teacher Training, "Genetically Modified Organisms," DNALC NYC
- October 26–28 NSF National ATE Principal Investigators' Conference, Washington, D.C.
- October 27–29 Society for the Advancement of Chicanos/Hispanics & Native Americans in Science 2022  
National Diversity in STEM Conference, San Juan, Puerto Rico
- October 29 *Saturday DNA!* "Halloween at the DNALC NYC," DNALC NYC
- November 3 "Effective, Inclusive, and Scalable Training in the Life Sciences, Clinical Education, and Beyond,"  
Australian Biocommons Virtual Webinar
- November 4 "Career-spanning Learning in the Life Sciences," Southwest Society for Developmental Biology  
Regional Meeting, Austin, Texas
- November 5 *Urban Barcode Project* Teacher Training, DNALC NYC  
Ötzi the Iceman Museum Tour, DNALC NYC
- November 8 *Barcode Long Island* Teacher Training Workshop, *DNA Barcoding*, DNALC  
DNALC Teacher Training Workshop, "Detect Genetically Modified Foods with In-lab Purified *Taq*  
DNA Polymerase," DNALC  
*Regeneration DNALC* Teacher Training Workshop, "DNA Barcoding," *Regeneration DNALC*
- November 11 "A Day in the Lab," DNALC
- November 12 *Saturday DNA!* "The Hominin Family Tree," DNALC  
*Saturday DNA!* "Compare Yourself to a Plant!" DNALC NYC
- November 14 "Python Basics," CSHL Advanced Sequencing Technologies & Bioinformatics Analysis Course,  
Cold Spring Harbor, New York
- November 19 *Saturday DNA!* "Mystery of Anastasia," DNALC NYC
- November 28–  
December 2 "Running to Stand Still – Traversing Skill Gaps in Computational Biology," Public Lecture,  
Australian Bioinformatics And Computational Biology Society 2022 National Conference,  
Melbourne, Australia
- December 2 Shelter Island High School Science Fair, Shelter Island, New York
- December 3–7 American Society for Cell Biology 2022 Annual Meeting, Washington D.C.
- December 10 *Saturday DNA!* "A Royal Ruse," *Regeneration DNALC*
- December 13 Site Visit by Bruce Ratner, CSHL Board of Trustees and Linda Johnson, DNALC NYC
- December 17 *Saturday DNA!* "Butterfly Secrets," DNALC
- December 21 Site Visit by Dr. Jim Watson and Liz Watson, DNALC
- December 27–28 *Citizen DNA Barcoding Network* LEGO® Sequencer Activity, Long Island Aquarium, Riverhead,  
New York

## Sites of Major Faculty Workshops

Program Key: *Middle School* High School College

State	Institution	Year(s)
VIRTUAL	Host: <b>Atlanta University Center Consortium, Atlanta, Georgia</b>	<b>2021</b>
	Host: <b>Bowie State University, Bowie, Maryland</b>	2020
	Host: <b>DNA Learning Center, New York</b>	2020
	Host: <i>Harlem DNA Lab and Regeneron DNALC, Sleepy Hollow, New York</i>	2020
	Co-host: <b>James Madison University, Harrisonburg, Virginia</b>	<b>2020, 2021 (3)</b>
	Host: <b>North Carolina State University, Raleigh, North Carolina</b>	<b>2021</b>
	Co-hosts: <b>University of Arizona, Tucson, Arizona &amp; DNA Learning Center, NY</b>	<b>2020</b>
	Host: <b>Quantitative Undergraduate Biology Education and Synthesis (QUBES) Project</b>	<b>2020</b>
ALABAMA	University of Alabama, Tuscaloosa	1987–90
ALASKA	<b>Hudson Alpha Institute, Huntsville</b>	<b>2014</b>
	<b>University of Alaska, Anchorage</b>	<b>2012</b>
ARIZONA	<b>University of Alaska, Fairbanks</b>	<b>1996</b>
	Arizona State University, Tempe	2009
	Tuba City High School	1988
ARKANSAS	<b>University of Arizona, Tucson</b>	<b>2011, 2019–20</b>
	<b>United States Department of Agriculture, Maricopa</b>	<b>2012</b>
	Henderson State University, Arkadelphia	1992
	<b>University of Arkansas, Fayetteville</b>	<b>2017, 2019</b>
	<b>University of Arkansas, Little Rock</b>	<b>2012</b>
CALIFORNIA	<b>University of Arkansas for Medical Sciences, Little Rock</b>	<b>2019</b>
	<b>California State University, Dominguez Hills</b>	<b>2009</b>
	<b>California State University, Fullerton</b>	<b>2000</b>
	<b>California State University, Long Beach</b>	<b>2015</b>
	<b>California Institute of Technology, Pasadena</b>	<b>2007</b>
	<b>Chan-Zuckerberg BioHub, San Francisco</b>	<b>2018</b>
	Canada College, Redwood City	1997
	City College of San Francisco	2006
	<b>City College of San Francisco</b>	<b>2011, 2013</b>
	Contra Costa County Office of Education, Pleasant Hill	2002, 2009
	<b>Foothill College, Los Altos Hills</b>	<b>1997</b>
	Harbor-UCLA Research & Education Institute, Torrance	2003
	<b>Los Angeles Biomedical Research Institute (LA Biomed), Torrance</b>	<b>2006</b>
	Laney College, Oakland	1999
	Lutheran University, Thousand Oaks	1999
	Oxnard Community College, Oxnard	2009
	<b>Pasadena City College</b>	<b>2010</b>
	<b>Pierce College, Los Angeles</b>	<b>1998, 2022</b>
	Salk Institute for Biological Studies, La Jolla	2001, 2008
	<b>San Francisco State University</b>	<b>1991</b>
<b>San Diego State University</b>	<b>2012</b>	
<b>San Jose State University</b>	<b>2005</b>	
Santa Clara University	2010	
<b>Scripps Institute, San Diego</b>	<b>2019</b>	
<b>Southwestern College, Chula Vista</b>	<b>2014–15</b>	
<b>Stanford University, Palo Alto</b>	<b>2012</b>	
<b>University of California, Berkeley</b>	<b>2010, 2012</b>	
University of California, Davis	1986	

	<b>University of California, Davis</b>	<b>2012, 2014–15</b>
	<b>University of California, Long Beach</b>	<b>2015</b>
	<b>University of California, Northridge</b>	<b>1993</b>
	University of California, Riverside	2011
	<b>University of California, Riverside</b>	<b>2012</b>
	<b>University of California, San Francisco</b>	<b>2015</b>
COLORADO	Aspen Science Center	2006
	Colorado College, Colorado Springs	1994, 2007
	<b>Colorado State University, Fort Collins</b>	<b>2013, 2018</b>
	<b>Community College of Denver</b>	<b>2014</b>
	<b>United States Air Force Academy, Colorado Springs</b>	<b>1995</b>
	University of Colorado, Denver	1998, 2009–10
CONNECTICUT	Choate Rosemary Hall, Wallingford	1987
	<b>Jackson Laboratory, Farmington</b>	<b>2016</b>
DELAWARE	<b>University of Delaware, Newark</b>	<b>2016</b>
DISTRICT OF COLUMBIA	<b>Howard University, Washington</b>	<b>1992, 1996, 2009–10</b>
FLORIDA	Armwood Senior High School, Tampa	1991
	Florida Agricultural & Mechanical University, Tallahassee	2007–08
	<b>Florida Agricultural &amp; Mechanical University, Tallahassee</b>	<b>2011</b>
	<b>Florida SouthWestern State University, Fort Myers</b>	<b>2015</b>
	North Miami Beach Senior High School	1991
	<b>Seminole State College, Sanford</b>	<b>2013–14</b>
	University of Florida, Gainesville	1989
	University of Miami School of Medicine	2000
	University of Western Florida, Pensacola	1991
GEORGIA	Fernbank Science Center, Atlanta	1989, 2007
	<b>Gwinnett Technical College, Lawrenceville</b>	<b>2011–12</b>
	<b>Morehouse College</b>	<b>1991, 1996</b>
	Morehouse College	1997
	<b>Spelman College, Atlanta</b>	<b>2010</b>
	<b>University of Georgia, Athens</b>	<b>2015</b>
HAWAII	Kamehameha Secondary School, Honolulu	1990
	<b>University of Hawaii at Manoa</b>	<b>2012</b>
IDAHO	University of Idaho, Moscow	1994
ILLINOIS	Argonne National Laboratory	1986–87
	iBIO Institute/Harold Washington College, Chicago	2010
	Illinois Institute of Technology, Chicago	2009
	<b>Kings College, Chicago</b>	<b>2014</b>
	<b>University of Chicago</b>	<b>1992, 1997, 2010</b>
	<b>University of Southern Illinois, Carbondale</b>	<b>2016</b>
INDIANA	Butler University, Indianapolis	1987
	<b>Purdue University, West Lafayette</b>	<b>2012</b>
IOWA	Drake University, Des Moines	1987
KANSAS	University of Kansas, Lawrence	1995
KENTUCKY	<b>Bluegrass Community &amp; Technical College, Lexington</b>	<b>2012–14</b>
	Murray State University	1988
	University of Kentucky, Lexington	1992
	Western Kentucky University, Bowling Green	1992
LOUISIANA	Bossier Parish Community College	2009
	Jefferson Parish Public Schools, Harvey	1990
	John McDonogh High School, New Orleans	1993
	<b>Southern University at New Orleans</b>	<b>2012</b>



	<b>University of New Orleans</b>	<b>2018</b>
MAINE	Bates College, Lewiston	1995
	<b>Southern Maine Community College</b>	<b>2012–13</b>
	Foundation for Blood Research, Scarborough	2002
MARYLAND	Annapolis Senior High School	1989
	<b>Bowie State University</b>	<b>2011, 2015</b>
	Frederick Cancer Research Center	1995
	McDonogh School, Baltimore	1988
	Montgomery County Public Schools	1990–92
	National Center for Biotechnology Information, Bethesda	2002
	<i>St. John's College, Annapolis</i>	1991
	<b>University of Maryland, School of Medicine, Baltimore</b>	<b>1999</b>
MASSACHUSETTS	<b>Arnold Arboretum of Harvard University, Roslindale</b>	<b>2011</b>
	Beverly High School	1986
	Biogen Idec, Cambridge	2002, 2010
	<b>Boston University</b>	<b>1994, 1996</b>
	CityLab, Boston University School of Medicine	1997
	Dover-Sherborn High School, Dover	1989
	Randolph High School	1988
	The Winsor School, Boston	1987
	Whitehead Institute for Biomedical Research, Cambridge	2002
MICHIGAN	Athens High School, Troy	1989
	<b>Schoolcraft College, Livonia</b>	<b>2012</b>
MINNESOTA	<b>American Society of Plant Biologists, Minneapolis</b>	<b>2015</b>
	Minneapolis Community and Technical College, Madison	2009
	<b>Minneapolis Community and Technical College, Madison</b>	<b>2013</b>
	University of Minnesota, St. Paul	2005
	<b>University of Minnesota, St. Paul</b>	<b>2010</b>
MISSISSIPPI	Mississippi School for Math & Science, Columbus	1990–91
	<b>Rust College, Holly Springs</b>	<b>2006–08, 2010</b>
MISSOURI	<b>St. Louis Science Center</b>	<b>2008–10</b>
	Stowers Institute for Medical Research, Kansas City	2002, 2008
	<b>University of Missouri, Columbia</b>	<b>2012</b>
	Washington University, St. Louis	1989
	<b>Washington University, St. Louis</b>	<b>1997, 2011, 2019</b>
MONTANA	<b>Montana State University, Bozeman</b>	<b>2012</b>
NEBRASKA	<b>University of Nebraska-Lincoln, Lincoln</b>	<b>2014</b>
NEVADA	University of Nevada, Reno	1992, 2014
NEW HAMPSHIRE	Great Bay Community College, Portsmouth	2009
	<b>New Hampshire Community Technical College, Portsmouth</b>	<b>1999</b>
	St. Paul's School, Concord	1986–87
NEW JERSEY	Coriell Institute for Medical Research, Camden	2003
	Raritan Valley Community College, Somerville	2009
NEW MEXICO	Biolink Southwest Regional Meeting, Albuquerque	2008
	<b>Los Alamos National Lab</b>	<b>2017</b>
	<b>New Mexico State University, Las Cruces</b>	<b>2017</b>
	<b>Santa Fe Community College, Santa Fe</b>	<b>2015</b>
NEW YORK	Albany High School	1987
	American Museum of Natural History, New York	2007, 2015
	Bronx High School of Science	1987
	Brookhaven National Laboratory, Upton	2015–18
	Canisius College, Buffalo	2007

	<b>Canisius College, Buffalo</b>	<b>2011</b>
	City College of New York	2012
	Cold Spring Harbor High School	1985, 1987
	<b>Cold Spring Harbor Laboratory</b>	<b>2014–15, 2018–19, 2022</b>
	<b>Columbia University, New York</b>	<b>1993</b>
	<b>Cornell University, Ithaca</b>	<b>2005</b>
	<i>DeWitt Middle School, Ithaca</i>	1991, 1993
	Dolan DNA Learning Center	1988–95, 2001–04, 2006–09, 2015–19
	<b>Dolan DNA Learning Center</b>	<b>1990, 1992, 1995, 2000–11</b>
	<i>Dolan DNA Learning Center</i>	1990–92
	DNA Learning Center <i>West</i>	2005
	<i>DNA Learning Center NYC</i>	2019, 2021, 2022
	Environmental Science Center, Bergen Beach, Brooklyn	2015–16
	<i>Fostertown School, Newburgh</i>	1991
	<i>Harlem DNA Lab, East Harlem</i>	2008–09, 2011–13, 2016–19
	<i>Harlem DNA Lab, East Harlem</i>	<b>2015–16</b>
	Huntington High School	1986
	Irvington High School	1986
	K-12 Summer Institute, Kerrville	2019
	John Jay College of Criminal Justice	2009
	<i>Junior High School 263, Brooklyn</i>	1991
	<i>Lindenhurst Junior High School</i>	1991
	<b>Math for America</b>	<b>2017–19, 2022</b>
	Michel J. Petrides School, Staten Island	2018
	Mount Sinai School of Medicine, New York	1997
	<b>Nassau Community College, Garden City</b>	<b>2013</b>
	<b>New York Botanical Garden, Bronx</b>	<b>2013</b>
	New York City Department of Education	2007, 2012
	New York City Technical College (City Tech)	2018
	New York Institute of Technology, New York	2006
	<b>New York Institute of Technology, New York</b>	<b>2006</b>
	<i>Orchard Park Junior High School</i>	1991
	<i>Plainview-Old Bethpage Middle School</i>	1991
	<b>Regeneron Pharmaceuticals, Inc</b>	<b>2019</b>
	<b>School of Visual Arts, New York</b>	<b>2017</b>
	State University of New York, Purchase	1989
	State University of New York, Stony Brook	1987–90, 2015–18
	<b>State University of New York, Stony Brook</b>	<b>2014, 2016</b>
	Stuyvesant High School, New York	1998–99
	The Rockefeller University, New York	2003, 2015–16
	<b>The Rockefeller University, New York</b>	<b>2010</b>
	<i>Titusville Middle School, Poughkeepsie</i>	1991, 1993
	Trudeau Institute, Saranac Lake	2001
	Union College, Schenectady	2004
	<b>United States Military Academy, West Point</b>	<b>1996</b>
	Wheatley School, Old Westbury	1985
NORTH CAROLINA	CIIT Center for Health Research, Triangle Park	2003
	<b>Forsyth Technical Community College, Winston-Salem</b>	<b>2022</b>
	<b>North Carolina Agricultural &amp; Technical State University, Greensboro</b>	<b>2006–07, 2009–11</b>
	North Carolina School of Science, Durham	1987
	<b>North Carolina State University, Raleigh</b>	<b>2012, 2018</b>
NORTH DAKOTA	<b>North Dakota State University, Fargo</b>	<b>2012</b>

OHIO	Case Western Reserve University, Cleveland	1990
	Cleveland Clinic	1987
	Langston University, Langston	2008
	North Westerville High School	1990
	<b>The Ohio State University, Wooster</b>	<b>2016</b>
OKLAHOMA	<b>Oklahoma City Community College</b>	<b>2000</b>
	Oklahoma City Community College	2006–07, 2010
	Oklahoma Medical Research Foundation, Oklahoma City	2001
	Oklahoma School of Science and Math, Oklahoma City	1994
	Tulsa Community College, Tulsa	2009
	<b>Tulsa Community College, Tulsa</b>	<b>2012–14</b>
OREGON	Kaiser Permanente-Center for Health Research, Portland	2003
	<b>Linfield College, McMinnville</b>	<b>2014</b>
PENNSYLVANIA	Duquesne University, Pittsburgh	1988
	Germantown Academy	1988
	Kimmel Cancer Center, Philadelphia	2008
RHODE ISLAND	Botanical Society of America, Providence	2010
SOUTH CAROLINA	<b>Clemson University</b>	<b>2004, 2015</b>
	Medical University of South Carolina, Charleston	1988
	<b>University of South Carolina, Columbia</b>	<b>1988</b>
SOUTH DAKOTA	<b>South Dakota State University, Brookings</b>	<b>2015</b>
TENNESSEE	NABT Professional Development Conference, Memphis	2008
TEXAS	Austin Community College – Rio Grande Campus	2000
	<b>Austin Community College – Eastview Campus – Roundrock Campus</b>	<b>2007–09, 2013</b>
	<b>Austin Community College – Roundrock Campus</b>	<b>2012</b>
	<b>Austin Community College - Austin</b>	<b>2018</b>
	<b>Houston Community College Northwest</b>	<b>2009–10</b>
	J.J. Pearce High School, Richardson	1990
	Langham Creek High School, Houston	1991
	<b>University of Lone Star College, Kingwood</b>	<b>2011</b>
	Midland College	2008
	Southwest Foundation for Biomedical Research, San Antonio	2002
	Taft High School, San Antonio	1991
	<b>Texas A&amp;M University, College Station, TX</b>	<b>2013</b>
	<b>Texas A&amp;M University, Prairie View, TX</b>	<b>2013</b>
	Texas A & M, AG Research and Extension Center, Weslaco	2007
	<b>Trinity University, San Antonio</b>	<b>1994</b>
	<b>University of Texas, Austin</b>	<b>1999, 2004, 2010, 2012</b>
		<b>University of Texas, Brownsville</b>
UTAH	<b>Brigham Young University, Provo</b>	<b>2012</b>
	University of Utah, Salt Lake City	1993
	<b>University of Utah, Salt Lake City</b>	<b>1998, 2000</b>
	<b>Utah Valley State College, Orem</b>	<b>2007</b>
VERMONT	University of Vermont, Burlington	1989
	Champlain Valley Union High School	1989
VIRGINIA	Eastern Mennonite University, Harrisonburg	1996
	<b>James Madison University, Harrisonburg</b>	<b>2017</b>
	Jefferson School of Science, Alexandria	1987
	Mathematics and Science Center, Richmond	1990
	Mills Godwin Specialty Center, Richmond	1998
	<b>Virginia Polytechnic Institute and State University, Blacksburg</b>	<b>2005, 2008–09</b>
WASHINGTON	Fred Hutchinson Cancer Research Center, Seattle	1999, 2001, 2008



	Shoreline Community College	2011, 2012
	<b>University of Washington, Seattle</b>	<b>1993, 1998, 2010</b>
WEST VIRGINIA	<b>Bethany College</b>	<b>1989</b>
WISCONSIN	Blood Center of Southeastern Wisconsin, Milwaukee	2003
	<b>Madison Area Technical College/Madison Area College</b>	<b>1999, 2009, 2011–14</b>
	Marquette University, Milwaukee	1986–87
	University of Wisconsin, Madison	1988–89
	<b>University of Wisconsin, Madison</b>	<b>2004, 2012</b>
WYOMING	University of Wyoming, Laramie	1991
PUERTO RICO	<b>Universidad del Turabo, Gurabo, Puerto Rico</b>	<b>2011, 2012, 2014</b>
	University of Puerto Rico, Mayaguez	1992
	<b>University of Puerto Rico, Mayaguez</b>	<b>1992</b>
	<b>University of Puerto Rico, Rio Piedras</b>	<b>1993</b>
	University of Puerto Rico, Rio Piedras	1994
	<b>University of Puerto Rico, San Juan</b>	<b>2019</b>
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AUSTRALIA	Walter and Eliza Hall Institute and University of Melbourne	1996
	<b>EMBL/Australian Bioinformatics Resource, University of Melbourne</b>	<b>2016</b>
	<b>University of Western Australia, Perth</b>	<b>2018</b>
AUSTRIA	<b>Vienna Open Lab, Vienna</b>	<b>2007, 2012</b>
	<b>Technical University of Graz</b>	<b>2019</b>
CANADA	Red River Community College, Winnipeg, Manitoba	1989
	<b>University of Quebec, Montreal</b>	<b>2018</b>
CHINA	Beijing No. 166 High School, Beijing	2013–19
	<b>Ho Yu College, Hong Kong</b>	<b>2009</b>
DENMARK	<b>Faroe Genome Project, Torshavn, Faroe Islands</b>	<b>2013</b>
GERMANY	Urania Science Center, Berlin	2008
IRELAND	<b>European Conference on Computational Biology/Intelligent System for Molecular Biology Conference, Dublin</b>	<b>2015</b>
	<b>University College Dublin</b>	<b>2018</b>
ITALY	International Institute of Genetics and Biophysics, Naples	1996
	Porto Conte Research and Training Laboratories, Alghero	1993
MEXICO	ADN Mexico, Morelia	2016
	ASPB Plant Biology, Mérida	2008
	<b>Langebio/Cinvestav, Irapuato</b>	<b>2016</b>
NIGERIA	Godfrye Okoye University, Enugu, Nigeria	2013, 2018
PANAMA	<b>University of Panama, Panama City</b>	<b>1994</b>
PHILIPPINES	Eastern Visayas Campus, Philippine Science High School, Palo, Leyte	2017
RUSSIA	Shemyakin Institute of Bioorganic Chemistry, Moscow	1991
SINGAPORE	National Institute of Education	2001–05
	Singapore Science Center	2013
SOUTH AFRICA	<b>North-West University, Potchefstroom</b>	<b>2016</b>
	<b>South African Bioinformatics Society, Durban</b>	<b>2016</b>
SWEDEN	Kristineberg Marine Research Station, Fiskebackgkil	1995
	Uppsala University	2004
THE NETHERLANDS	<b>International Chromosome Conference, Amsterdam</b>	<b>2007</b>
	<b>Wageningen University and Research Center, Wageningen</b>	<b>2014</b>
UNITED KINGDOM	<b>Earlham Institute, Norwich</b>	<b>2018</b>
	<b>The Genome Analysis Center, Norwich</b>	<b>2015</b>
	<b>University of York, York</b>	<b>2017</b>
	<b>Wellcome Trust Conference Center, Hinxton</b>	<b>2012–13</b>
	<b>University of Warwick, Coventry</b>	<b>2013</b>

## 2022 Grants

Grantor	Program	2022 Grant Duration	Funding <sup>+</sup>
<i>FEDERAL GRANTS</i>			
National Institutes of Health	<i>Citizen DNA Barcode Network</i>	6/20-3/25	\$249,338
National Institutes of Health	Genomics Step-Up High School	5/22-3/27	\$106,564
National Science Foundation	Implementing DNA Barcoding for Course-Based Undergraduate Research Experiences	10/18-9/23	\$368,649
National Science Foundation (U of Arizona)	CyVerse: Cyberinfrastructure for the Life Sciences	8/18-7/23	\$160,721
National Science Foundation (Washington U.)	RCN-UBE: Establishing a Genomics Education Alliance: Steps Towards Sustainability	9/18-8/22	\$3,791
National Science Foundation (Austin CC)	InnovATEBIO National Biotechnology Education Center	10/19-9/24	\$345,539
National Science Foundation (Pierce College)	Advanced Student-Focused Projects: Internship, Research and Education (ASPIRE)	9/21-8/24	\$11,209
National Science Foundation (U. of Minnesota)	FMRG: BIO: Enabling Cell-Free Engineering	10/22-9/26	\$1,956
National Science Foundation	What Works in Workshops-Evolving Short Format Training to Serve Life Sciences STEM Professionals in the 21 <sup>st</sup> Century	3/21-2/23	\$75,784
National Science Foundation	Nanopore DNA Sequence Course-Based Undergraduate Research	6/22-5/24	\$31,699
<i>NON-FEDERAL GRANTS</i>			
Beijing No. 166 High School	Chinese Collaboration Agreement	7/19-6/23	\$11,150
Breakthrough Prize Foundation	Laboratory Design & Teacher Training for Breakthrough Junior Challenge Prize Winners	12/15-12/22	\$186,243
Health Park	Health Park Agreement	12/15-12/23	\$2,901
Paul Taubman	Support for DNALC NYC Exhibit Development	6/21-6/23	\$319,207
Pinkerton Foundation	<i>Urban Barcode Research Program</i>	1/21-5/23	\$89,238
Richard Lounsbery Foundation	Research Ready Partnerships for NYC Public Schools	6/21-5/23	\$15,066
Richard Lounsbery Foundation	Videos and Animations to Explain Environmental DNA to a Broad Audience	2/22-8/23	\$67,003
The Simons Foundation	<i>Urban Barcode Research Program</i>	12/17-8/23	\$98,778
William Townsend Porter Foundation	<i>Harlem DNA Lab</i> for Underprivileged Students	1/20-1/23	\$10,517
Office of the Brooklyn Borough President	DNALC NYC Video Wall	10/21-10/22	\$261,032
Hudson River Park Trust	Environmental DNA Survey in Hudson River Park's Estuarine Sanctuary	1/20-12/22	\$6,409
NY Harbor Foundation	Billion Oyster Project	6/20-12/21	\$5,887
Laurie Landeau Foundation	Laurie Landeau Seed Program	1/21-2/23	\$12,232

## School Membership Programs

The following schools and school districts participated in these membership programs of the **Dolan DNALC**:

### *Sustaining Memberships*

Bellmore-Merrick Central High School District	\$3,000	Oceanside Union Free School District	\$3,000
Elwood UFSD	\$3,000	Oyster Bay-East Norwich Central School District	\$3,000
Great Neck	\$3,000	Plainview-Old Bethpage Central School District	\$3,000
Herricks Union Free School District	\$3,000	Portledge School	\$3,000
Huntington	\$3,000	Port Washington Union Free School District	\$3,000
Island Trees	\$3,000	Roslyn Union Free School District	\$3,000
Jericho High School	\$3,000	Syosset Central School District	\$3,000
Levittown Union Free School District	\$3,000	Yeshiva University High School for Girls	\$3,000
North Shore Central School District	\$3,000		

### *Associate Memberships*

Glen Cove Central School District	\$16,000	St. Dominic High School	\$16,000
Friends Academy	\$16,000		

### *Partner Memberships*

Glen Cove Central School District	\$16,000	St. Dominic High School	\$16,000
Friends Academy	\$16,000		

The following schools participated in these membership programs of the *DNALC NYC at City Tech*:

### *Sustaining Membership*

Stuyvesant High School	\$3,000
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### *Associate Membership*

Portfolio School	\$16,000
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### *Partner Memberships*

The Chapin School	\$33,000	Marymount School of NY	\$33,000
Lycée Français de NY	\$33,000	St. David's School	\$33,000

The following school participated in this membership program of the *Regeneron DNALC*:

### *Sustaining Membership*

Hendrick Hudson Central School District	\$3,000
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***Regeneron DNA Learning Center***

Regeneron Pharmaceuticals, Inc.  
Sleepy Hollow Campus  
1 Rockwood Road  
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***Harlem DNA Lab***

2351 First Avenue at 120<sup>th</sup> Street  
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