



Cold Spring Harbor Laboratory
DNA LEARNING CENTER

2023 ANNUAL REPORT

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: Students in the Women in Science & Engineering *Fun with DNA* summer camp work collaboratively to collect bacterial cells from a plate.

Executive Director's Report

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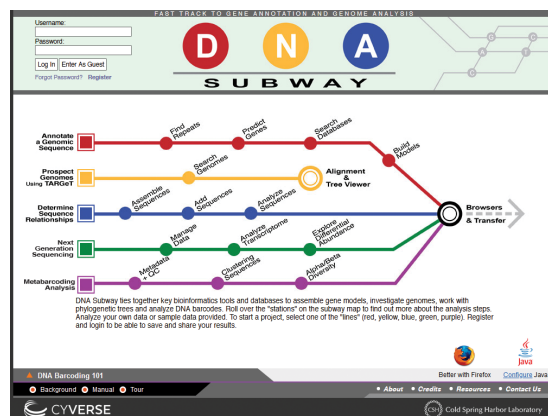
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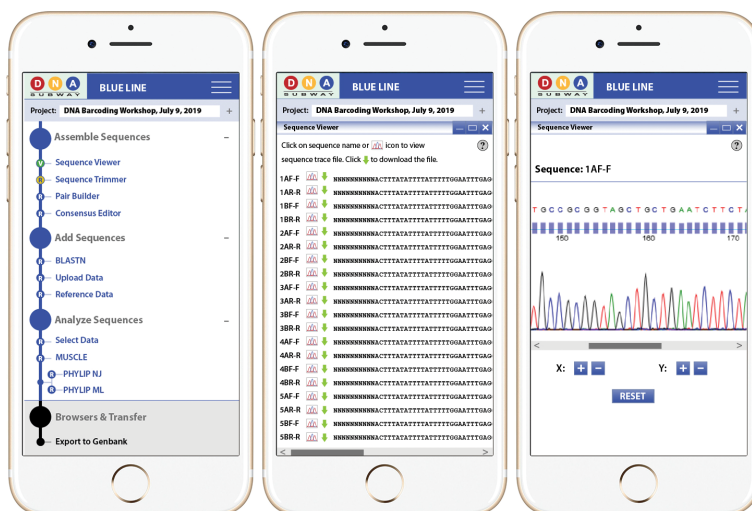
Data science is one of the ten fastest growing careers in the US, and bioinformatics is an essential part of many bioscience careers today. Bioinformatics technicians earn a 30% salary premium over other biological technicians. Over the last 25 years, the DNALC has created pathways to these biological jobs of the future. This began in 1998 with the first “personal genetics” experiment that allows students to sequence and analyze their own mitochondrial (mt) DNA—well in advance of *23andMe*, the *Genographic Project*, and *Ancestry DNA*. With support from the National Science Foundation (NSF) Advanced Technological Education (ATE) Program, in 2000 we developed *BioServers* as a simple bioinformatics tool to compare human mtDNA sequences between classmates and with reference data from world populations and ancient human ancestors. This platform has proven remarkably durable, engaging 662,379 users in 2.08 million sessions averaging 15+ minutes. The *BioServers* database currently contains over 169,000 student mtDNA sequences.

This was followed by the launch in 2010 of *DNA Subway*, an intuitive online interface that makes sophisticated bioinformatics analysis accessible to students without computation experience. Operating under the umbrella of the NSF CyVerse cyberinfrastructure, the project coordinated contributions from more than 25 scientists, computer programmers, and bioinformaticians at more than a dozen research institutions. Using the metaphor of a subway, students can “ride” any of five different lines to access and analyze DNA sequences. *DNA Subway* has garnered a dedicated following, with 296,037 total users logging 739,852 sessions averaging 17 minutes from 2010–23.

Over 260,000 DNA sequences have been uploaded by our partner Azenta (formerly GENEWIZ), and the popular Blue Line, primarily used for DNA barcoding, accounts for about 72% of traffic. Undergraduate students compose 68% of 62,140 registered users. Blue Line users have published 2,391 barcode records on GenBank with 1,594 unique student and faculty authors. Supporting the contention that *DNA Subway* is a research-grade tool, it has become one of the two most widely used infrastructures to support course-based undergraduate research experiences (CUREs), and 41% of non-student users are researchers.



Screenshot of the current *DNA Subway* website.



Mock-up design of DNA Subway 2.0 scaled for a mobile phone.

In July, we received a \$650,000 NSF ATE grant to update the aging *DNA Subway* infrastructure to make it a more flexible, accessible, and capable resource to prepare students for the modern bioscience workforce. The project is taking place within the context of the DNALC's role as Genomics Hub of the InnovATEBIO National Biotechnology Education Center. *DNA Subway 2.0* will rely on NSF's *Jetstream2* cloud computing infrastructure and systems expertise from the Texas Advanced Computing Center and NSF's Science Gateways Community Institute. By adopting a "mobile-first" approach, we believe that this will be the first set of high-level bioinformatics tools to run smoothly on a smartphone. At the same time, design improvements will prioritize accessibility for users with disabilities, including those with low vision and those who use assistive devices to explore web content. The reimaged mobile and desktop *DNA Subway 2.0* versions will give students complete flexibility to collect data and complete assignments in school, at home, or on the road from their preferred device. In this way, *DNA Subway* will serve the needs of low-income, rural, and limited sight students—who rely on mobile devices.

DNA Sequence Analysis Anytime, Anywhere, by Anyone

Since its founding in 1988, the DNALC has popularized experiments in molecular genetics for use in high school and college teaching. DNALC experiments and commercial kits based on DNALC technology are used by millions of students per year. These include the most widely-used methods for putting DNA into bacteria, examining personal genetics, and producing DNA barcodes.

In summer 2023, we signed a memorandum of understanding (MOU) with Oxford Nanopore to help popularize the "next big thing" in biology education—the ability to analyze individual DNA molecules in real time. In addition to massively parallel DNA sequencers used in the CSHL Genome Center, Oxford also produces the MinION, a "personal" DNA sequencer about half the size of a mobile phone that plugs into a computer USB port. At about \$2,000 for the machine and about \$10 for a gene or small genome sequence, the MinION makes gene analysis affordable for almost anyone. Under the MOU, the DNALC will help develop improved chemistry, workflows, directions, and packaging/pricing attractive to high school and college faculty.



DNA Subway 2.0 will include a new line for nanopore sequence analysis. The combination of MinION sequencer and mobile *DNA Subway 2.0* will be the first integrated system to support DNA sequencing and analysis anytime, anywhere, by anyone. We envision a day when a MinION sequencer and *DNA Subway*-powered analysis joins the PCR machine as indispensable equipment in every bioscience teaching lab.

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 the Pinkerton Foundation, involve students in research of biodiversity in NYC. Science teachers are mentors for *BLI* and *UBP* students, while scientists from NYC institutions mentor *UBRP* students.

After the completion of funding from the NIH National Institute of General Medical Sciences (NIGMS) Science Education Partnership Award (SEPA), *BLI* continued the transition to a sustainable support model in which schools cover the cost of materials and sequencing for their teams, participated in DNALC memberships, or received scholarships based on financial need. One hundred and seventy-three students across 60 teams completed projects, with 15 teams utilizing Open Lab sessions at the Dolan DNALC and Brookhaven National Lab, and 39 teams borrowing equipment. A significant portion of student-authored sequences (82) were published in GenBank, including four new barcode records and 22 sequences with variable DNA. Additionally, 11 teachers attended a five-day summer (6) or one-day fall (5) training workshop, with more than half submitting student project proposals by December.

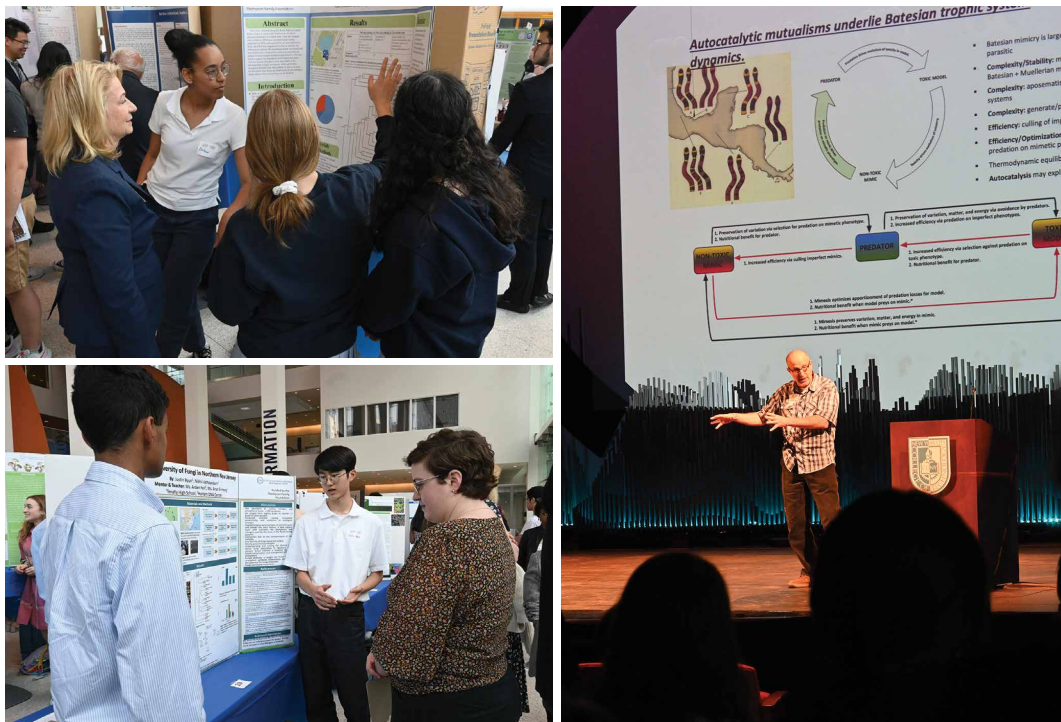
The annual *Barcode Long Island* Student Symposium, held June 6, 2023 on the Cold Spring Harbor Laboratory campus, featured keynote speaker Dr. James Lendemer, Curator of Botany, Research & Collections at The New York State Museum. Dr. Lendemer presented his work on deciphering the dimensions of lichen diversity from cities to wilderness.



Left: Dr. James Lendemer described lichen diversity during a beautifully illustrated keynote talk.

Below: Sam Adler, a student from Long Beach High School, presents barcoding research results to Jennifer Newitt, a mentor from Friends Academy.





Urban barcoding student teams present project results to symposium attendees. CSHL Board of Trustees Chair Marilyn Simons (top, at left) learns about ant barcoding, and one of the outstanding poster teams (bottom) who researched fungi in New Jersey speak with Kelsie Anson, *DNALC NYC* educator (bottom, at right).

In the photo at right, Dr. David Kizirian gives an engaging presentation on the importance of biological processes like autocatalysis.

The annual *Urban Barcode Project* and *Urban Barcode Research Program Symposium* featured keynote speaker Dr. David Kizirian of the American Museum of Natural History, who presented on the evolution of biological systems. Three teams were recognized with outstanding poster awards: in the *UBP*, a team from Tenafly High School for “Biodiversity of Fungi in Northern New Jersey”, and in the *UBRP*, a team mentored at the New York Botanical Gardens for “Effect of Specimen Age on DNA Barcoding Success” and a team mentored at Pace University for “Antibiotic Prospecting from Plant Microbial Endophytes.”

One hundred and twenty-four students on 45 teams completed projects in the *UBP* and 39 students on 15 teams completed projects in the *UBRP*. These students made ample use of *DNALC* resources: 16 teams attended open lab sessions at the *Harlem DNA Lab* or *DNALC NYC*, and 23 teams borrowed equipment. Thirty-eight *UBP* teams and all 15 *UBRP* teams presented posters to peers and science professionals at the annual research symposium on May 31st at the New York City College of Technology. Eight *UBRP* teams also presented posters to peers and science professionals at the annual Science Research Mentoring Program (SRMP) Colloquium on June 9th.

UBRP students emerged from the program with stronger interest and confidence in pursuing a path in science. Fifty-five percent of students from Cohort 10 were more interested in studying biology following their *UBRP* projects. Seventy-five percent felt more capable of going further in science than they did prior to participation in *UBRP*. Importantly, most (82%) felt the approach to problem-solving they learned in *UBRP* would help them succeed in future science courses and their future career.

Citizen Science DNA Barcoding

The *Citizen DNA Barcode Network (CDBN)* entered its fourth year of NIGMS SEPA funding. The project mobilizes citizen scientists around the United States, working under the guidance of trained staff at science and nature centers, to collect and barcode insects including ants, beetles, and mosquitos. Citizen science-derived barcodes can then be used to better inform range maps, identify new species, and contribute new barcode records to sequence databases.

California Academy of Sciences (CAS) fulfilled their role as a Year 3 *CDBN* Hub, which including working with a cohort of *Careers in Science* high school interns to learn, execute, and communicate DNA barcoding programming among themselves and with the general public at CAS. The DNALC also supported citizen science DNA barcoding programming at a number of local institutions, including the New York Hall of Science, Jones Beach Energy and Nature Center, Sweetbriar Nature Center, South Fork Natural History Museum, and the Long Island Aquarium.

CDBN supported the Natural History Museum of Utah (NHMU) as a Year 4 Hub, successfully engaging 972 citizen scientists through a variety of DNA barcoding activities, including tabletop events, one- or two-day wet labs, and internships. One highlight was the inclusion of DNA barcoding at NHMU's BugFest 2023, where they set up stations focusing on each part of the wet lab and invited NHMU's Mycology lab to discuss how they used DNA barcoding in their research. This tabletop-style event engaged 340 members of the public. Beyond NHMU, a new *CDBN* collaboration was initiated with Discover Life in America (DLIA) and the National Park Service in Great Smokey Mountains National Park (GSMP). DLIA regularly conducted DNA barcoding programming with park staff, volunteers, and naturalists; notably, a firefly beetle collected during a DLIA *CDBN* event, *Photuris quadrifulgens*, made local news as it was the first time that the species was recorded in GSMNP.

During the fourth program year *CDBN* supported 1,355 participants who spanned age ranges and skill levels. In total, 1,212 specimens with photos and metadata were entered into our Barcode Sample Database, and 1,161 of those specimens were processed to generate DNA barcodes. Two hundred and fifty DNA barcodes were published to GenBank with citizen scientists as authors, including 16 previously unpublished barcode sequences and 51 new variants. *CDBN* continues to engage citizen scientists into its fifth program year, bringing the Missouri Botanical Garden on as a new barcoding Hub.



Educators at *CDBN* training at the Dolan DNA Learning Center.

Suzhou Barcoding Project

During the summer, DNALC educator Jeffry Petracca travelled to the DNALC's licensed center in Suzhou, China, *Cold Spring Harbor Asia DNA Learning Center*, to instruct a two-week *DNA Barcoding* summer course. The course engaged local secondary school students and undergraduate *DNALC Asia* interns on the use of DNA barcoding in research projects. The group was asked to design a project over the course of the two-week session, and they produced and presented a scientific poster to the class. In addition, a GenBank BioProject

was established for the *DNALC Asia* team to help track and monitor GenBank sequence submissions. Ninety-four DNA barcodes were published to GenBank with Chinese students as authors, including 13 previously unpublished barcode sequences and 22 new variants.

Lounsbery eDNA

The Richard Lounsbery Foundation funded creation of a website illustrating and explaining key topics of environmental DNA (eDNA) research. Due to the departure of Bruce Nash, the grant transitioned to the *BioMedia* Group and is now being spearheaded by Jason Williams and Carol Henger, whose expertise in metabarcoding is well-suited for this project. The website will be geared toward students, teachers, and researchers entering the field of eDNA research who need help learning the basics of best practices and protocols. In late 2023, we conducted a small survey of scientists actively involved in eDNA research to ask them which topics they believe would benefit from an explanatory educational aid. With the responses gathered, we are in the process of developing new and contributed content to create an "eDNA Primer."

Carolina Biological

The DNALC collaborated to update more than 20 DNALC laboratory kits distributed by Carolina Biological Supply Company, including redesign of manuals, incorporation of Next Generation Science Standards, and testing of different DNA polymerases to reduce costs for PCR laboratories. In addition, the DNALC finalized the testing and development of teaching materials for a new kit to be released in 2024, "*Taq* Polymerase Production and Validation."

National Center for Biotechnology Education

The DNALC continued its work as Genomics Hub of the InnovATEBIO National Biotechnology Education Center. This project is funded through the National Science Foundation's Advanced Technological Education (ATE) Program, which supports training for America's workforce. The MOU with Oxford Nanopore and receipt of funding for *DNA Subway 2.0* supported our new hub goal of advancing nanopore sequencing in workforce development. We returned to an active summer of teacher training, reaching 58 faculty at workshops conducted in three states. We collaborated with co-PI Jim Hewlett to introduce metabarcoding and nanopore sequencing at the Great Bay Undergraduate Skills Workshop, May 13–15. Workshops at Maricopa Community College (Phoenix, June 5–7) and Santiago Canyon College (Los Angeles, June 7–9) introduced *Methods in Personal Genomics and DNA Barcoding*, including PCR, DNA sequencing, and *Taq* polymerase production. These workshops were organized with Pushpa Ramakrishna, formerly at NSF, and co-PI Terry Quenzer.

NSF CyVerse and DNA Subway

As we reach the final year of the CyVerse award—the DNALC's largest single NSF grant—there is reason to look back at major accomplishments and ongoing impact. The kick-off meeting for what was then known as the iPlant Collaborative was held at CSHL in 2008. For 15 years, the DNALC has played the primary role in the project's education and outreach activities, ultimately reaching more than 3,700 educators and faculty at over 100 multi-day workshops and training events, in addition to thousands more reached in person and online. While it is impossible to quantify all the outcomes from such an immense and collaborative project, several of the most important programs in the current DNALC portfolio resulted from our connection to CyVerse. DNA barcoding, for example, began as an exercise for the iPlant *Genomics in Education* Workshops. Just prior to that, in 2010, *DNA Subway* was the first major software platform for the project and served as an "educational discovery environment" for gene annotation projects and transposon detection.

When iPlant started, there were fewer than ten fully sequenced plant genomes available, and the cost of genome sequencing was around \$10,000 per megabase. Today, there are hundreds of released plant genomes, and generating a megabase of sequence costs less than ten cents! Next- and third-generation sequencing platforms have enabled these cost reductions, including long-read sequencing made possible by Oxford Nanopore. iPlant steeped the DNALC in the world of plant genomics, and expertise and connections to researchers in this space also drew us to Oxford Nanopore early on. *DNA Subway 2.0's* update will enable the use of Oxford Nanopore reads both for Blue Line DNA barcoding projects and include a new dedicated *DNA Subway* line for sequence assembly (e.g., plasmids, phages, plastids). As the DNALC's formal collaboration with CyVerse draws to a close, the new and expanding DNA barcoding, *DNA Subway*, and Oxford Nanopore sequencing programs are important legacies from our work with iPlant and CyVerse. This collaboration, and the many educators and colleagues with whom we have worked, are sources of immense pride and gratitude for what we have accomplished together.

Phage Biomanufacturing

In 2022, the DNALC was awarded a Future Manufacturing Research Grant (FMRG) titled "Enabling Cell-Free Engineering and Biomanufacturing of Bacteriophages as a Universal Platform for Tailorable Bioactive Materials." The project is a collaboration with synthetic biologist Vincent Noireaux and microbiologist Steve Bowden at the University of Minnesota. In year one, there was a necessary change in co-PI from CSHL's DNALC from Bruce Nash to David Micklos. In July of 2023, DNALC staff were trained by PI Vincent Noireaux at a Synthetic Biology Course held at CSHL. The intensive four-day course included training on experimental design, reagent preparation, and execution of experiments using the cell-free transcription-translation (TXTL) system originally developed in the Noireaux lab. The training showcased the flexibility, modularity, and ease of doing molecular biology manipulations in a cell-free system. The experiments focused on three main areas: gene expression from plasmids, modulation of gene expression using CRISPR/Cas9, and the cell-free assembly of phages. In the fall, DNALC staff began regular planning meetings with Noireaux and Bowden to prepare for educator workshops scheduled for the following year.

NSF IUSE Nanopore

In the second year of our NSF Improving Undergraduate STEM Education (IUSE) pilot grant, *Developing Foundations for Nanopore DNA Sequencing Course-based Undergraduate Research Experiences at Minority-Serving Institutions*, we have built a small but growing network of educators across the country interested in bringing Oxford Nanopore sequencing into the classroom. More than 60 educators have registered on our QUBES-hosted website, and more than half of the registrants have participated in one or more of our 23 semi-monthly faculty mentoring network online sessions. These 1.5–2-hour sessions are interactive discussions where faculty members work together to solve challenges related to teaching. This summer, we hosted our first week-long faculty workshop for nanopore sequencing in Brooklyn at DNALC NYC. Sixteen educators from New York to California gathered to work on all aspects of

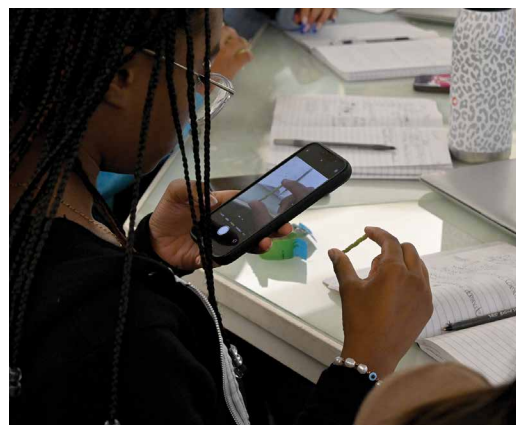


Anna Feitzinger and Jason Williams (kneeling) with attendees at the first nanopore sequencing faculty workshop at DNALC NYC.

nanopore sequencing from sample preparation to data analysis. Mentoring sessions continue as we reach the last quarter of the project, and we are working on consolidating the teaching materials and experience the group has developed into a collection of resources. The resources will be used in our planned summer workshops at *DNALC NYC* in collaboration with Jeremy Seto from City Tech, as well as with our collaborators in Atlanta at Spelman College, and in collaboration with the University of Puerto Rico, Río Piedras team, hosted at the new Arecibo C3 Center (described on page 10).

Diversity, Equity, and Inclusion

This year, the **Science, Technology, and Research Scholars (STARS)** program passed its 100th student milestone as we welcomed 23 students from 21 school districts, including 6 private or homeschooled students. We continue to build our network of alumni, engaging students year-round through virtual and in-person mentoring and meetups. STARS physician shadowing grew from one student in the prior year to five student participants this year. Funds gifted by CSHL Trustee Laurie Landeau were used to provide bussing for nine students who would not otherwise be able to attend.



Above: STARS campers enjoy a lunchtime discussion with researcher David Jackson (standing) who spoke about his study of genes that regulate plant growth. A STARS student (right) documents a tiny ear of Teosinte, a wild ancestor of maize that Jackson shared.

Right: The STARS 2023 cohort, including workshop organizers/instructors Brittany Johnson (back left) and Jason Williams (back right).



Alumni also integrated into other science research opportunities at CSHL; several students have participated in the *Partners for the Future* program and other CSHL internships. Carlos Diaz ('19) continued study as a volunteer in the Lloyd Trotman lab and was also selected for the prestigious MIT Research Science Institute. We also had several alumni participate in a college panel during our family orientation and alumni meetup, including Madison Krug (STARS '21), a Partners for the Future alumna attending Harvard; Ellis Eisenberg (STARS '20), a Regeneron ISEF 4th Place Award Winner in Physics and Astronomy currently at Yale; and Jenifer Martinez (STARS '19) attending Quinnipiac University.

We have linked STARS with partner DEI-focused STEM programs, including a new collaboration with Gina Granger of Hofstra School of Medicine. Ms. Granger is head of their Pipeline Programs, and through shared interests and work with the NYC Gateway Schools, we have already instituted student exchanges where STARS students participate in Hofstra-led programs and several of their students participate in DNALC programs. As we continue to forge stronger connections with Brookhaven National Laboratory and Northwell Health, we aim to expand diverse introductory STEM programs across the region.

This year, we completed a full cycle as a Coordinating Center for the NIH's **Short-Term Research Experiences to Unlock Potential (STEP-UP)** program. STEP-UP supports high school students from groups historically excluded from science by offering a paid eight-week summer internship at a research lab near their homes. Students work with scientist mentors on a research project to be presented at an end-of-summer symposium. In our second year, we placed 20 students in colleges from Michigan to New York. STEP-UP is highly complementary to our STARS program, and we had our first STARS student, Gabriella Williams ('22), successfully apply for the program. With the worst of the pandemic behind us, this was the first year we could participate in the in-person symposium held at NIH in Bethesda, MD. In addition to organizing travel and lodging for our own students, we managed 20 chaperones who supervised the group of more than 75 total students—from New York to Palau—who traveled for the event. Previously managed by Michelle Juarez, Brittany Johnson has come on board to assist with all aspects of STEP-UP student mentoring and support. As with STARS, we provide regular virtual check-ins with students during the school year to assist high school seniors who continue after the summer with college prep and applications, as well as other research skill-building activities. We are also working to promote the program by building regional relationships with educators who serve historically excluded students.

2023 was the first full calendar year for the Richard Lounsbery Foundation-supported **Research Ready** program in New York City. As part of our commitment to level the science playing field for underrepresented minority and disadvantaged students, two public high schools have been receiving customizable, in-school instruction and opportunities equivalent to our *Partner Member* program.

- Manhattan Center for Science and Mathematics (MCSM) in Harlem has used their program membership to offer forensics lab activities in-school and attend free field trips at the *Harlem DNA Lab*. Many MCSM students also participated in the *UBRP* and *UBP*.
- Satellite Academy in midtown Manhattan is a transfer high school that admits students who need a fresh start. They participated in hands-on in-school science instruction on a variety of topics including bacterial transformation, human mitochondrial DNA sequencing, and forensic DNA analysis. Access to lab equipment at Satellite Academy is very limited, so the students really enjoyed the opportunity to feel like real scientists and use lab equipment.

We continue to develop the *Research Ready* program to adapt to the needs of public schools in New York City and to expand the number of schools we are able to serve.

DNALC Around the World

Arecibo, Puerto Rico

In September, the National Science Foundation awarded a \$5.5 million grant to a DNALC-led collaboration to redevelop Puerto Rico's Arecibo Observatory into a new center for science outreach and research. The Arecibo Center for Culturally Relevant and Inclusive Science Education, Computational Skills, and Community Engagement, has the mission is to integrate Ciencia (Science) across the breadth of STEM disciplines, empower learners with Computación (Computing), and foster Comunidad (Community) through culturally relevant and inclusive values—hence the acronym AC3. Previously managed by NSF's Astronomical Sciences Division, the current award is under the purview of NSF's Directorate for STEM Education. This shift in support opens new avenues for the site's mission, with a primary focus on education.



Before its collapse on December 3, 2020, the Arecibo Observatory boasted the world's largest radio telescope with a 305-meter dish. Although the remaining buildings and spaces within the 118-acre site were operational, the collapse of the telescope due to structural damage cast doubt on the site's future. Fortunately, NSF's commitment to repurpose the site gained support from the 2022 CHIPS and Science Act, which included a provision "encouraging the NSF to consult with other federal agencies to enhance and broaden the Arecibo Observatory's role in Puerto Rico through education, outreach, diversity programs, and future research and technology capabilities."

AC3 builds upon DNALC's growing commitment to diversity, equity, and inclusion. As the first DNA Learning Center directly supported by a federal agency, AC3 also extends our approach



The Arecibo C3 Kickoff Meeting was held in October. While onsite, we toured all facilities and gathered photos and measurements to begin planning for classrooms and exhibition spaces. The Visitor Center (bottom, left) includes exhibition space and an auditorium. The rear of the center overlooks the damaged telescope dish that remains after the collapse.

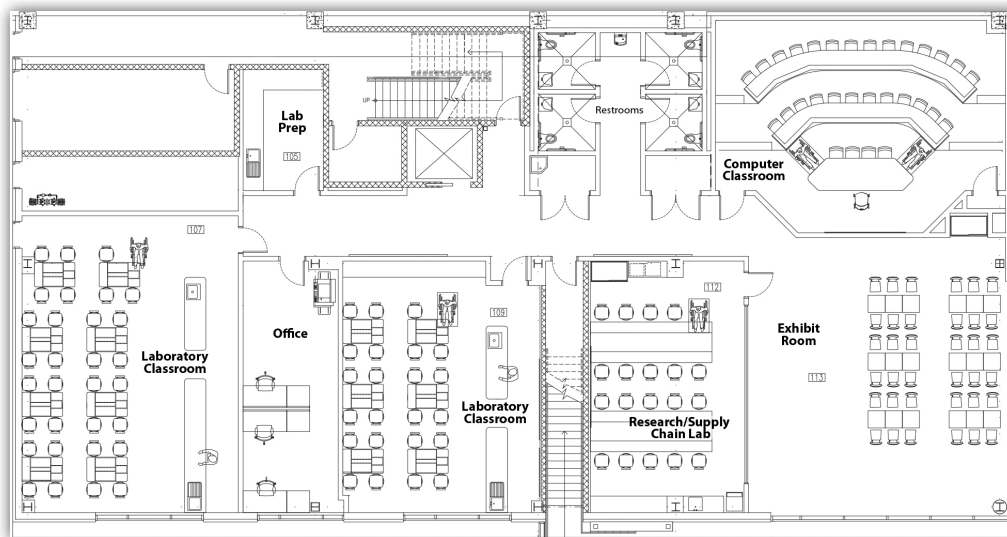


to licensed DNALC centers. The proposal was spearheaded by DNALC Assistant Director for Diversity, Jason Williams, who grew up in New York with his grandfather from Puerto Rico. The proposal leverages existing partnerships, including those developed by Williams for nanopore sequencing with collaborators at the University of Puerto Rico in Río Piedras. It also brings in new collaborators from the Universidad del Sagrado Corazón and the University of Maryland, Baltimore County. In addition to deploying DNALC field trips and summer camps in new biology labs planned for the space, the project will leverage the observatory's on-site lodging and meeting spaces, fostering integration with the CSHL Meetings and Courses Department. Over the program's five-year duration, efforts from the DNALC and collaborating institutions will emphasize inclusion, accessibility, and cultural relevance. The program aims to enrich undergraduate research, as well as student and educator programs in astronomy, data science, and biotechnology.

Passaic County, New Jersey

On May 24th, the Board of Education of the Passaic County Technical Institute (PCTI) approved a license agreement for a DNA Learning Center (DNALC) in Passaic County, New Jersey. At \$210,000 per year, this license is second in size only to the *Cold Spring Harbor Asia DNALC* in Suzhou. The Passaic center will include two teaching labs, a bioinformatics lab, a research/supply chain lab, a prep lab, and staff offices. Although the 6,500-square-foot facility was originally planned to open in winter 2023–24, delays in construction have pushed opening to later in 2024. Like other locations in the New York metropolitan area, the Passaic center will be staffed and directly run as part of the core DNALC enterprise—so we can ensure that students throughout the metro area have the same great experience at any of our centers.

The entire Passaic project is in synch with the DNALC's role as Genomic Hub of InnovATE BIO, the National Biotechnology Education Center—whose goal is to promote workforce development at two-year colleges. The Biotechnology Innovation Center, in which the Passaic DNALC is located, literally bridges the campuses of a



Architectural rendering and floor plan for the future DNA Learning Center in New Jersey.

5,000-student vocational-technical high school and a community college. High school students enrolled in the PCTI biotech program will receive dual enrollment credits at Passaic County Community College and graduate with a 60-credit AS degree in biotechnology. Construction of the Innovation Center, including the DNALC, was funded by \$25 million in state and local bonds, and each student's AS degree is entirely funded by state and federal grants. About 150 students have been recruited for the inaugural biotech class, immediately making it one of the largest dual-enrollment programs in the county. Similar cohorts will be added over the next three years to create a full complement of freshman through senior students.

The Passaic DNALC will support students in the dual-degree program with specialized lab and research experiences, including a supply chain lab in which students will run a "company" that produces biotech reagents for use in high schools throughout Passaic County. This will include producing *Taq* polymerase, the key reagent of the widely-used polymerase chain reaction (PCR). This project is based on a specialized plasmid, which constitutively produces *Taq* polymerase, and simplified extraction methods developed by the DNALC. Our facility will also serve approximately 1,000 students enrolled at a science magnet school on the PCTI campus. Middle- and high-school students from throughout Passaic County, including a large proportion of underrepresented minority and disadvantaged students, will have access to the DNALC's full menu of academic year lab field trips and summer camps.

The Passaic County venture will further bolster the proposition that we can potentially expand the "run by the DNALC" model to sites across the country. We hope to test this soon, as we are currently discussing developing at DNALC with the Morehouse School of Medicine and Atlanta Public Schools.

Sleepy Hollow, New York

Regeneron DNALC continued to see an increase in field trips and summer camp attendees. A total of 1,816 students visited for field trips and 339 campers attended 18 camps during the summer. We partnered with Regeneron for their annual *Day for Doing Good* event, where DNALC-trained Regeneron employees volunteered to lead a series of student lab activities to help increase STEM exposure in the local community. Regeneron volunteers taught a total of 236 students from Sleepy Hollow Middle School and Intellectus Preparatory Charter School. We continue to nurture relationships with schools that visit *Regeneron DNALC* for field trips and we perform outreach to form new relationships by hosting teacher training and *Saturday DNA!* sessions (122 students) as well as attending STEM fair events. *Regeneron DNALC* is on pace to reach full occupancy in 2024–2025.

Notre Dame, Indiana

The Notre Dame DNA Learning Center (ND DNALC) continues to rebound from COVID-19 shutdown challenges. While visitation has not yet returned pre-2020 totals, the growth trajectory remains strong with 425 student lab exposures—60% of whom were from low income schools—a 45% increase over 2022. Summer programs brought campers from all over the United States, and one international student from Barbados. The high school research program continued to thrive, drawing participants from the pool of 2022 summer campers, and one student advanced to the Regeneron International Science and Engineering Fair for the second consecutive year. Additionally, the ND DNALC continued to participate in broad College of Science and Notre Dame activities throughout the year.

The Advisory Board was reformed and diversified to include community, regional, and other members who will bring valuable perspectives to ensure continued growth and success. In November 2023, the primary donors of the ND DNALC, Dr. John and Heidi Passarelli, were celebrated for their cumulative support and dedication of the endowed Directorship, Dr. John and Heidi Passarelli Family Director of the DNA Learning Center.

Suzhou, China

DNALC Asia welcomed 12,383 visitors in 2023, including 10,014 course participants, 1,229 visitors and 1,140 outreach participants. The center hosted projects at both district and municipal levels, with activities spanning across 12 cities and 6 provinces, and actively collaborates with various institutions, including government bodies, media outlets, and renowned scientific research institutions in China and worldwide.

In July, first-time application of third-generation sequencing (Oxford Nanopore technology) was introduced to Chinese high school students by *DNALC Executive Director Dave Micklos and Educator, Jeffery Petracca*, in *Genome Science* and *DNA Barcoding Research* summer workshops. Suzhou students' experiment results were published by a professional scientific research database (NCBI) for the first time.

The center organized several successful public outreach events in 2023. The *Colorful Wetlands* attracted 51 schools and 1,555 student submissions, with their work displayed at the center.

Dave Micklos (top left, lower right) and Jeff Petracca (top right in center, bottom right at left) introduced nanopore sequencing to *Genome Science* and *DNA Barcoding* students in July. The article title translates to "First class for Chinese high school students! 37 high school students from across the country tried the third generation DNA sequencing technology."

Source:
<https://app.suzhou-news.cn/news/300576610>



首次面向中国高中生授课！全国37名高中生尝鲜第三代DNA测序技术

借助第三代DNA测序技术——纳米孔单分子测序技术，现场就能完成样本提取并测序。本周，来自全国各地的37名高中生来到位于苏州工业园区的冷泉港亚洲DNA学习中心，在美国冷泉港实验室老师的带领下，抢鲜体验了这项新的测序技术。这也是此项技术首次向中国高中生授课。

DNA序列是基因组学最基本最重要的数据，也是生命科学领域大数据时代的核心组成部分。测序技术的每一次变革，都会对基因组研究、疾病研究、药物研发、育种等领域产生巨大的推动作用。纳米孔单分子测序技术，被称为第三代测序技术。与前两代相比，它们最大的特点就是单分子测序，无需模板扩增，使用场景更灵活，仪器更便携，使用成本也更低、耗时短。



本周课程中，美国冷泉港实验室DNA学习中心执行总监大卫·米克洛斯博士和美国公民DNA条形码网络项目负责人杰弗里·佩特拉卡两位教师带领高中生们提取了环境中的细菌样本，比如课桌上、鞋底下的物质都成了大家的实验对象。米克洛斯带来的新测试工具非常小巧，从外观看，好像一支圆珠笔。提取好的样本放在测试仪器里面，对应电脑里的软件，便能读取出来结果。“第三代测序技术需要提前建立好一个DNA文库，就好比有一堆细菌的身份证号码散落在环境中，我们将这些身份证号码进行收集、鉴别，得知细菌的种类。”佩特拉卡解释道。

“把纳米孔单分子测序技术带给高中生接触，是DNA科学教学领域的创新。我们希望给中国的优秀学生们更多实验机会，帮助他们增加学术竞争力。”米克洛斯说。

北京市第一六六中学高一年级的陈源闻是2022-2023北京市英才计划入选者，他正在参与生物信息方面的课题研究，因此报名了此次来苏州的学习项目。“新技术很神奇，DNA学习中心周边的科研氛围也很浓郁，我的收获很大。”他说。世界名中学联盟上海学校高一年级的钱苏洋表示，纳米孔单分子测序这项尖端技术虽然前沿，但是很好理解，涉及很多基础细胞知识，对校内所学的知识有所巩固，且对提升实验思维很有帮助。

They collaborated with Illumina to deliver the Life Science Enters Campus project provided *DNA Science* classes, online and offline to over 3,448 elementary and middle school students in six provinces. Additionally, the 7th Annual Suzhou Young Life Scientist Cultivation Program expanded its reach by involving teachers, fostering scientific literacy in both students and educators. The program's success is reflected in the increased participation (173 schools and 1,632 students) and the development of project manuals to guide future iterations.

The center received news of college admissions from 42 students who participated in one or more programs at *DNALC Asia*. From 2017 to 2022, 30 out of 76 international high school

students who reported their college admissions (out of 131 total students who conducted 47 DNA barcoding research projects) were accepted into top universities abroad, resulting in a 39.5% acceptance rate.

Beijing, China

In the wake of consistent travel restrictions early in the year, we continued to work with faculty of Beijing No. 166 Middle/High School to implement modified *On-Demand* Camps. Using comprehensive pre-recorded video instruction, 19 high school students performed *Genome Science* labs using real equipment in their classroom over winter break. Additional recordings of class data analysis were filmed and shared to help with DNA sequence analysis during the course. Fortunately, travel restrictions were lifted by summer, and meetings with faculty from the school resulted in a plan to resume in person instruction. To start, an educator will visit Beijing for a *Green Genes* workshop in 2024, moving us one step closer to fulfilling our pre-pandemic lab instruction contract.

Beyond Beijing and Suzhou

In April, Peking University Affiliated High School in Beijing contacted us about conducting a summer study abroad program in New York. Due to limited time for planning and US visa applications, the program was postponed until February 2024. Twenty-four students and two biology teachers will participate in a two-week high school workshop at *DNALC NYC*. We have also received inquiries from several Chinese education consultant agencies regarding their summer travel programs. With relaxed travel restrictions and the growing reputation of *DNALC* programs, we look forward to new partnerships in China, with the goal of hosting international students for winter and summer camps at *DNALC NYC* every year.

Enugu, Nigeria

We continued to provide financial and reagent support for *DNALC Nigeria*. Located in Enugu State, a region that has never fully recovered since its failed attempt to secede from Nigeria in 1967 resulted in civil war. The 2023 election in Nigeria brought increased inflation and economic instability, including a tripling of fuel prices, which severely strained the center's already tight budget. Political unrest, insecurity and safety concerns in Southeast Nigeria limited engagement with local communities and the ability of schools to travel to the center. Even so, the center conducted six extended workshops, reaching 345 students, teachers, and industry professionals. In September, Michael Okoro and George Ude supported a workshop in DNA barcoding conducted at the SENA Institute of Technology, in Ghana.

Lab Instruction and Outreach

With visitation building at New York *DNALC* facilities—Dolan *DNALC*, *Harlem DNA Lab*, *DNALC NYC*, and *Regeneron DNALC*—income from local school programs and camps reached a record high of \$1.5 million, 26% over pre-COVID-19 income. Focused email, social media, and Google Ads marketing to new audiences in Westchester and NYC paid off with a 30% increase in field trip visitation over 2022. Combined, a total of 21,230 students attended lab field trips, and 6,698 received in-school instruction. An additional 963 used *DNALC* footlocker kits, 186 of whom were conducting independent research through *UBP*, *UBRP*, or *BLI*. Tuition assistance for field trips to Dolan and *Regeneron DNALC* was provided for 1,704 students from the Amityville, Brentwood, Floral Park, Freeport, Hempstead, Yonkers, Malverne, Nyack, NYC, Ossining, Uniondale, and Westbury school districts. We offered a full schedule of in-person summer camps at three locations. We hosted 662 campers in Cold Spring Harbor, and 339 in Sleepy Hollow for nearly full occupancy in its second summer season! In Brooklyn we hosted 489 campers, including 168 who attended subsidized *UBRP* prep courses.



Students teach their families all they learned during the week at a *Fun with DNA* Parent Day at *Regeneron DNALC*.

Our operating contract with the City University of New York requires that our Brooklyn center provide scholarships to 50% of New York City public school students who participate in lab field trips. We exceeded this statutory challenge in 2023, providing academic year scholarships to 56% of students at our NYC centers. Scholarships also were provided to 29% of summer campers in NYC. In all, 4,124 NYC students received scholarships valued at \$161,760. Across all DNALC locations, 5,909 students received scholarships totaling \$254,600. Endowment provided \$171,328 of this amount. Grants from the William Townsend Porter Foundation, National Grid, STEM Matters NYC, and the City Tech STEP Program provided \$83,272.

In partnership with CSHL Women in Science and Engineering (WiSE), we hosted the seventh annual *WiSE Fun with DNA* summer camp. Twenty-one young female science enthusiasts, including one who received a full scholarship from WiSE, 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 research, neuroscience, and gene expression. In addition to the Parent Participation showcase on the final day of camp, parents and campers enjoyed guided tours of the CSHL campus.

Sustaining Membership enrollment in our School Membership Program increased to 21 schools, with the addition of Archbishop Stepinac High School at *Regeneron DNALC* and Magen David Yeshiva High School at *DNALC NYC*. *Dolan Associate Partner* Friends Academy continued development of their research program with implementation of DNA barcoding projects for entry-level students, and metabarcoding projects for returning researchers, while Glen Cove City School District focused on consistent lab exposures for every Living Environment and AP Biology class, and continued support for DNA barcoding teams.

Dolan Partner Members Long Beach City School District and Massapequa School District entered year three of membership with plans to continue implementation of DNALC research supports and uniform exposures for specific student cohorts. In the Massapequa research program, every 9th grader completed a DNA barcoding project, while every 8th grader had three structured exposures to learn lab techniques. Additionally, all Living Environment classes completed electrophoresis labs, and all 5th grade classes performed microscopy investigations. Long Beach

continued lab field trips for all of the 8th grade Living Environment and life science classes, and added 5th grade field trips to the mix. A new research teacher was trained, so, with our help, all 9th grade researchers will participate in *BLI*. In the summer, 40 students attended *Fun with DNA* and *World of Enzymes* camps taught at Long Beach Middle School.

As part of our ongoing partnership with St. Dominic High School, 11 students participated in the *Molecular and Genomic Biology Research* course, where they received daily hands-on instruction in *DNA Barcoding*, *DNA Science*, and *Genome Science* curricula from DNALC educators. After a year-long hiatus, the Cold Spring Harbor High School *Molecular and Genomic Biology* course returned. Participants spent two periods every other day this fall immersed in experimentation and independent projects at the DNALC. All students in these courses develop research projects and present posters at the annual *Barcode Long Island Symposium*.

Six independent schools benefitted from custom instructional sequences and advanced electives as *DNALC NYC Partner Members* or *Associate Partners*.

- Dwight School integrated DNALC laboratories within middle school science electives. Grade seven students explored bacterial transformation through inquiry, while grade eight students analyzed DNA evidence in a forensic mystery.
- Portfolio School grade five and six students used experiments and models to learn the fundamentals of chemistry through inquiry. In a culminating research experience, they used DNA barcoding to identify plant and insect species.
- Lycée Français de New York implemented genetics programs in their AP Biology courses. Grade seven students solved a mystery using DNA evidence. Grade ten students explored Genetically Modified Organisms, and grade 11 studied human mitochondrial DNA and what it can tell us about evolution.
- 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 six students explored the roles of gene mutation and natural selection in evolution.
- 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 nine students used PCR and restriction enzyme analysis to determine their genotypes for a bitter taste allele, which they correlated with their phenotypes.

During the year, our Ötzi the Iceman exhibition drew 3,637 visitors, most of whom were students on field trips. Fifty visitors were members of the general public taking self-guided tours. Sixteen *Saturday DNA!* sessions drew 417 participants at the Dolan DNALC and *Regeneron DNALC*. Participants learned about the true story behind the mystery of Anastasia Romanov, crime scene analysis, what Ötzi the Iceman can tell us about ancient human life, and the curious way that milk has shaped human evolution. Some created artwork by "painting" with genetically engineered bacteria, while others learned how to construct custom plasmids, such as those used to manufacture human insulin. An additional 140 students attended *School Break Bio* classes over winter and spring breaks, ranging from full-day sessions on GMOs, forensics, and Ötzi the Iceman, to two-hour, field-trip style lessons on infectious disease and electrophoresis. On Veteran's Day we hosted the second annual CSHL *Day in the Lab* event for local youngsters. With the help of the CSHL Association Directors, we enrolled 106 children and their parents for fun hands-on activities designed to expose a young audience to STEAM (Science, Technology, Engineering, Art and Math), including observing biochemical reactions, using stereomicroscopes, and modeling DNA.



Cristina Fernandez Marco leads a DNA extraction activity during the CSHL *Day in the Lab* event.

Math for America teachers attended a mini course in Brooklyn where they learned about human mitochondrial sequencing. Teachers who attended mini-courses became 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. STANYS (New York State Science Teachers Association) teachers attended a professional development session in Brooklyn where they learned about DNA fingerprinting and how to teach about gel electrophoresis. The DNALC NYC hosted STEM Teachers NYC for a Molecular Modeling workshop when Daniel Fried from *Biochemistry Literacy for Kids* taught teachers and DNALC staff about molecular modeling for the classroom, and teachers learned about the Ötzi the Iceman exhibit and field trips.

DNALC NYC staff participated in Brooklyn community events to meet our neighbors and do hands-on science. Families attending the Brooklyn “Atlantic Antic Festival” and SUBMERGE Marine Science Festival learned about eDNA or did “pipette painting” with our team.

The virtual “Meet a Scientist” series continued to facilitate connections between public audiences and Regeneron Pharmaceuticals researchers. From January through May, four presenters were invited to share their career journeys and research endeavors. Research specialist Zachary Oberholtzer discussed his work on biochemical and biophysical characterization in drug development, and Senior Research Associate Terrence Turner talked to us about the use of DNA sequencing in the modern age. Dr. Turner also highlighted Regeneron’s commitment to DEI initiatives, as well as their efforts in STEM outreach programs. Assistant Investigator Dr. Joel N.H. Stern shared his career path emphasizing his approach to balancing teaching and research responsibilities, and veterinarian and Associate Director of Veterinary Services and Vivarium Operations in VelociGene, Dr. Stephanie E. Woods, provided her perspective on the ethical treatment of animals in research settings, underscoring the importance of safeguarding animal welfare while conducting scientific experiments. These “Meet a Scientist” presentations are archived on our webpage, and have received 1,782 views.

Annual training with graduate students from the CSHL School of Biological Sciences continued with the 2023 cohort of first year students. Over a series of 12 half-day sessions, students worked with DNALC instructors to develop skills to communicate science to a variety of audiences. Beginning with observing field trips, then progressing to co-teaching and independently teaching lab classes, each grad student interacted with middle and high school students, and rounded out the semester with elective teaching or lab development projects.

BioMedia Visitation and Projects

In 2023, 3.5 million visitors accessed our suite of multimedia resources, a decrease from the previous year. Our YouTube channel had 1,236,206 views with 44,306 hours of watch time and added 3,941 subscribers. Google Analytics counted 2 million user sessions on DNALC websites, 85.3% of the prior year. These visitation statistics include a transition beginning in July to an updated version of Google Analytics, the tool we use to track visitation data on our websites. Although the old and new versions are not quite an “apples to apples” comparison, the metric reported, user sessions, is fairly similar in months where we collected data from both versions. Overall, decreased visitation is likely attributed to shifted focus of the BioMedia team away from developing online educational content as well as aging of our existing web resources. *3D Brain* and *Gene Screen* smartphone/tablet apps were downloaded 235,801 times, including 4,615 *3D Brain HQ* in app purchases earning \$3,136.

We benefitted from an ongoing nonprofit Google Ads grant that funds ads for our websites in the Google search engine; ads generated 126,720 impressions and 13,763 clicks equaling a 10.86% click through rate; the equivalent of \$18,840 in advertisement spending.

We continue to develop the *DNALC NYC* exhibition. In consultation with CSHL trustee Jeanne Moutoussamy-Ashe, the *All the World in New York City* gallery space was completed in April. We also initiated a unique collaboration with City Tech's Communication Design Department (COMD), which is located on the floor below the *DNALC NYC*. COMD freshman students sequenced their own DNA and then integrated this personal perspective into assigned exhibition designs to complement the DNA maps to be displayed on the video wall. In the spring semester, advanced Design Team Students proposed designs for *DNA Future*, which will feature work by CSHL scientists. In the summer session, students created designs for interior and exterior signage; DNALC staff voted on the submissions and plan to install a lobby mural and exterior sign in spring 2024. The hope is that these students will continue to develop exhibit components in advanced classes or as interns.

We also started planning a display on eugenics and immigration to acknowledge 100 years since the Immigration Act of 1924 imposed stringent quotas on people coming to the US. The *BioMedia* team continued to provide additional support for DNALC programs through print and web design, photography, and videography.



All the World in New York City features some faces of the many races, cultures, and ethnicities represented by people living today in New York. Photographs and subject biographies were judged anonymously without submitter's name. Photographers of the selected images received a \$500 award.

Staff and Interns

This year saw a number of significant staff changes, with poignant partings and promising engagements. From our Dolan location, we said goodbye to our Assistant Director of Science, Bruce Nash, Ph.D., and our Manager of Student and Public Research, Sharon Pepenella, Ph.D.

Bruce Nash was recruited in 2005 to spearhead our initiative to popularize *C. elegans* and RNAi in biology instruction. He was instrumental in developing curriculum for high school labs and summer workshops, including an NSF-funded integrated experiment- and bioinformatics-based curriculum on RNAi in *C. elegans*, which later became the *Silencing Genomes Workshop* with a supporting website. In 2007 he was promoted to Assistant Director of Science and in 2012 co-authored the textbook *Genome Science: A Practical and Conceptual Introduction to Molecular Genetic Analysis in Eukaryotes*. Bruce fostered a collaboration in 2013 with the first regional Doshi Science, Technology, Engineering, and Math (STEM) high school, which prepared students for the evolving high-tech science arena. In 2017, he received a supplemental grant from the NIH Big Data to Knowledge Program to adapt microbiome research for high school students. In 2019, he directed the startup for InnovATEBIO (for high schools and community colleges) and iUSE (for 4-year colleges/universities), programs that provide teacher and student support, troubleshooting, and provision of reagents and footlockers. Bruce left the DNALC after 18 years of service.

Sharon Pepenella joined the teaching staff in June 2015 and plunged into teaching and initiating new projects. Her carefully constructed lesson plans are an indispensable resource for training new DNALC teaching staff. She took on the program manager role for the NIH SEPA *BLI* and *CDBN* projects and managed *Partner Member* schools. In April 2021, she advanced to the position Manager of Student and Public Research. After organizing her final *BLI* Symposium in June 2023, she transitioned to Brookhaven National Laboratory as a Senior Research Programs Representative through the Office of Educational Programs, where she will focus on developing and evolving formal and informal science education research projects. While we will miss Sharon's unwavering commitment to science and education, along with her festive holiday hats, we look forward to continued collaboration with her as a BNL representative.

We also said goodbye to Michelle Juarez, Ph.D., Arden Feil, and Chaunna Henry from *DNALC NYC*, and Jack Kellogg from the *Regeneron DNALC*.

Michelle Juarez joined *DNALC NYC* in March 2022 as the Assistant Director of Diversity and Research Readiness. She oversaw collaborations and partnerships to prepare students for research careers, expanded *DNALC*'s outreach to underrepresented STEM students, worked with research-ready schools and CUNY faculty, and recruited scholarship students for the summer. In August 2023, she accepted a position as a Diversity Outreach Coordinator at Stony Brook University.

Arden Feil began her journey with us in June of 2021. She immediately helped with the start-up of the Brooklyn facility during our inaugural summer. Arden managed *UBP* and *UBRP*, including recruiting participants, conducting training workshops, providing scientific support, and organizing the annual symposium. She also worked with *Associate Partner* The Portfolio School and managed purchasing supplies, reagents, and equipment for the *DNALC NYC*. In April she accepted the Science Research Mentoring Consortium Manager position at the American Museum of Natural History (AMNH), where she continues to collaborate with the *UBRP*.

Chaunna Henry joined the Brooklyn team in November 2022 as the Administrative Manager at *DNALC NYC*. She left in April for a position with a remote work option. Her extensive background in a variety of roles and her adaptability, creativity, and problem-solving skills were invaluable during her short time with the DNALC.

In November of 2021, Jack Kellogg joined the DNALC in preparation for reopening the

Regeneron DNALC. He administered classes and laboratory experiments; prepared, tested, cataloged, and ordered supplies and reagents for all programs; and hired and managed high school interns. Due to family relocation, Jack joined the staff at Harvard Medical School in April as a research technician, where he prepares ancient human samples for next-generation sequencing and maintains lab safety and clean room protocols to uphold the integrity of the ancient DNA.

2023 brought new staff and staff changes to all DNALC locations.

Carol Henger started with the *Regeneron DNALC* team in March. Originally from Dallas, Texas, she has a Ph.D. in biological sciences from Fordham University, a M.A. in animal behavior and conservation from Hunter College, and a B.S. in environmental science from Texas Christian University. She has taught genomics at the university level and as a postdoctoral fellow she developed a protocol for detecting big cats in the wild using DNA analysis. Carol has mentored students on wildlife research projects and has authored multiple scientific papers on coyotes and bird behavior.

In May, we welcomed Allison Astudillo, lab manager, and Keith Bannerman, educator, to the Dolan DNA Learning Center team.

Born and raised on Long Island, Allison Astudillo's strong interest in STEM with a focus on health can be seen throughout her academic and professional career. She is currently pursuing a Ph.D. in Health Sciences from Liberty University, where she received a M.A. in medical sciences, and she also has a B.S. in health studies from Monmouth University. Her previous work experience includes serving as a quality control focused microbiologist for AKORN, and a medical scribe for City MD. In addition to filling the crucial role of lab manager and managing the interns, Allison is an Adjunct Assistant Professor for the Biological Sciences Department at New York Institute of Technology.

Keith Bannerman, who started in May, earned a B.S. in biochemistry and a B.A. in philosophy from Stony Brook University Honors College then went on to complete a M.A. in bioethics, medical administration, and compassionate care. While pursuing his graduate degree, Keith served as a genomics researcher at Allied Microbiota where he studied bacterial remediation techniques.

In May, *Regeneron DNALC* found a new educator in Arie Kaz. Originally from Scranton, Pennsylvania, Arie has a M.S. in secondary science education from the University of Scranton, and a B.S. in life science from Penn State University. Arie was a high school teacher in North Carolina where he taught several courses including AP Biology, Honors Research Methods and Techniques, and Honors Biology. Arie brings with him a strong background in NGSS standards and a passion for teaching.

Two staff joined the *DNALC NYC* educator team in October, Christina Newkirk and Ria Jasuja.

Christina Newkirk has a M.A. in environmental conservation education from New York University, and a B.A. in English from the University of Iowa. After graduating, Christina realized she wanted to share her love of science to diverse audiences. She has worked at the New York Academy of Sciences, Christadora, the American Museum of Natural History, and the Intrepid Museum in roles focused on science education and outreach.

Ria Jasuja holds a B.A. in biology, with a concentration in molecular biology/biochemistry from Washington University in St. Louis. As an undergraduate, she was a research technician in the Goldfarb Laboratory for the Department of Cell Biology and Physiology at Washington University School of Medicine. After graduating, Ria stayed on at Wash U as a laboratory technician. Ria co-led a summer program "Astronaut Training Camp - Mars" and volunteered at the Challenger Learning Center in St. Louis.



New staff in 2023 (left to right in order of arrival): Carol Henger, Allison Astudillo, Keith Bannerman, Arie Kaz, Christina Newkirk, Ria Jasuja, and Shreemattie Budhram.

Shreemattie “Sarika” Budhram joined the Brooklyn team in December as the Administrative Manager at *DNALC NYC*. Sarika has a B.S. from the University of Phoenix and an A.A. in business from Western International University and brings experience in business administration and start-up companies. She served as a management consultant and was director of operations of Azimuth Resources for the Australian Consulate in Guyana. She volunteered in Guyana for over 15 years, raising funds for several charitable initiatives.

January saw the first promotional title change for staff; Chun-hua Yang, now Associate Design Director, continues to be a selfless coworker adept at anticipating department needs and working collaboratively. In addition, she has stepped in to facilitate communication with collaborators in China and ensures annual flow of intellectual property, including field trip, summer camp, and website materials.

The departures of Bruce and Sharon provided opportunities for Anna Feitzinger, Cristina Fernandez Marco, and Jeffry Petracca to take on new roles with increased responsibilities. Anna stepped in to be *DNALC*'s Assistant Director, Science, and picked up where Bruce left off on two NSF projects. Cris is now Manager, External Collaborations and lead of the *BLI* program. Jeff, previously a part-time educator, is now full-time Manager, Student and Public Research, and leads the NIH *CDBN* project.

Kelly Eames was elevated to Partnership Manager in August after taking on middle-school field trip reservations for our CSH location and serving as the *DNALC* Relationship Manager with *Membership Program* districts. Kelly helps to shape customized curricula of field trips, in-school instruction, and research mentorship for their students, as well as arranging focused training and follow-up consultation for Partner faculty.

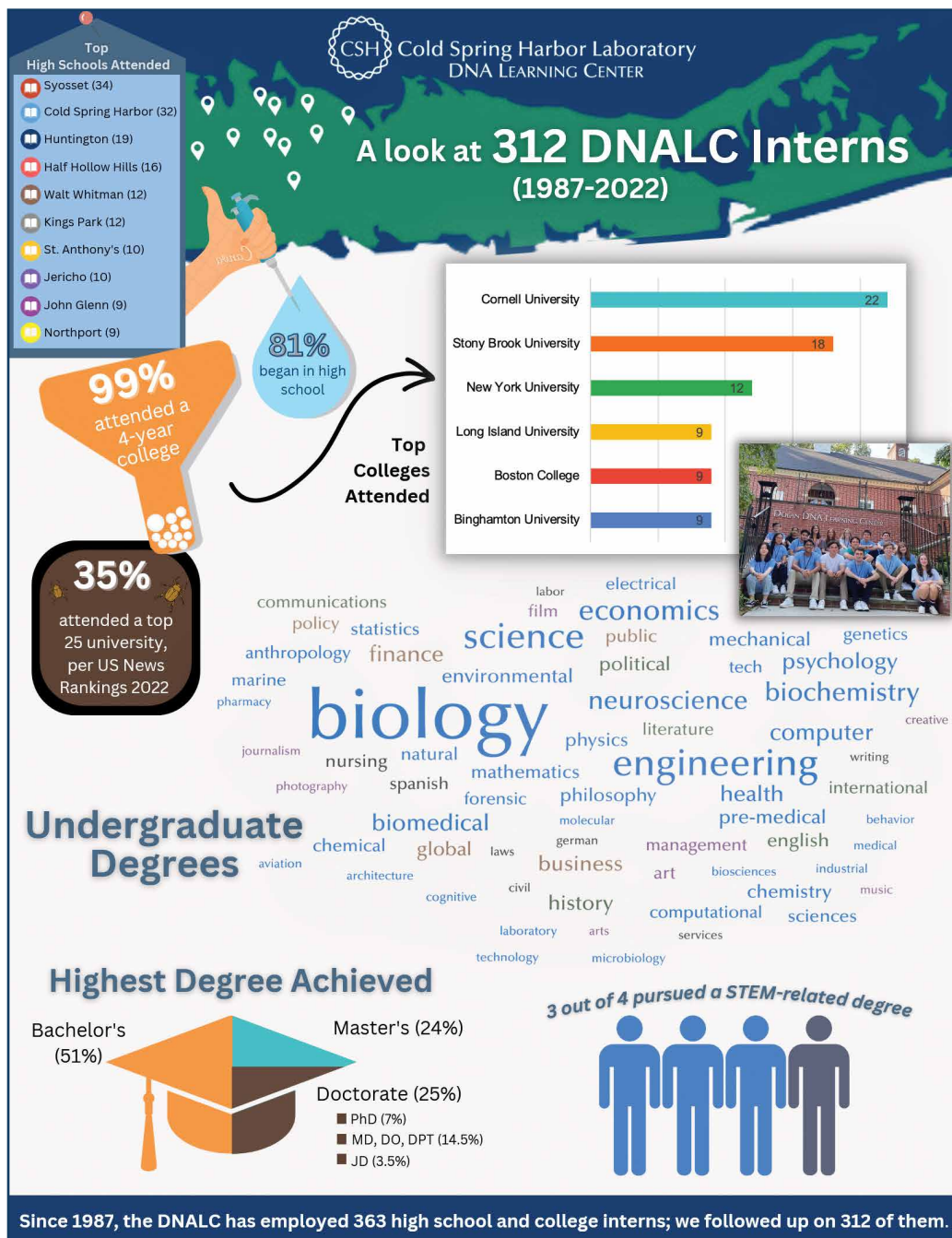
Since the inception of the STARS program, Brittany Johnson has assumed multiple responsibilities that advanced the *DNALC*'s mentoring and inclusion initiatives, including teaching the high-school level STARS curriculum and providing support for monthly student mentoring sessions. She has collaborated with partners to facilitate student participation in medical shadowing programs and student placement in additional research initiatives.

Following Michelle Juarez's departure, Brittany seamlessly took over NIH *STEP-UP* program responsibilities and was promoted to Manager, Diversity and Research Readiness.

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. We have often wondered how DNALC interns fare after they leave our employment. So, we were pleased when Brittany Johnson worked with interns Mina Sarvas (Brown University) and Neal Mehta (Boston College) to conduct a survey of DNALC interns going back to 1987! The infographic below summarizes the impressive results.



Neil and Mina at work on the intern survey.



This year an amazing group of interns helped out, and we said farewell as others left for college:

High School Interns

Dolan DNA Learning Center

Alexander Gottlieb, St. John the Baptist High School	Jakob Rechtweg, Friends Academy
Alexis Panebianco, Mineola High School	Jordyn Shafran, Pine Crest High School
Andres Orellana, Portledge High School	Lauren Belkin, Syosset High School
Charlotte Gordon, Cold Spring Harbor High School	Lauren Graziosi, Syosset High School
Daniel Galvin Gusmano, Portledge High School	Lily Rodgers, Syosset High School
Francesca Mango, St. Dominic's High School	Ryan Koenigsberger, Cold Spring Harbor High School
Genevieve Decker, St. Dominic's High School	School
Ian Smith, Cold Spring Harbor High School	Ryan Lee, Plainview Old Bethpage JFK High School

Regeneron DNA Learning Center

Ashley Alexander, Yonkers High School	Jackson Meyercord, Bronxville High School
Katelyn Battacharia, Ossining High School	Naflah Mohammed, John Jay Senior High School
Jacob Leobandung, John Jay Senior High School	Maya Shetty, Scarsdale High School
Faye Luneau, Pelham Memorial High School	Brady Wang, Horace Greeley High School

High School Interns Departing for College

Dolan DNA Learning Center

Croi Spillane, Quinnipiac University	Min Hur, University of California Los Angeles
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College Interns

Dolan DNA Learning Center

Charlie Whitman, The Taft School	Maggie Wang, SUNY Stony Brook
Elena Gnilitzkaya, SUNY Stony Brook	Michael Stabile, Cornell University
Holly Schadler, Fairfield University	Nicholas Liotta, Nassau Community College
Ian Quinn, Tulane University	Nicholas Stabile, University of Notre Dame
Jason Long, SUNY Stony Brook	Raquel Belkin, SUNY Stony Brook
Jillian Hooey, University of Chicago	Rosemarie Russo, Siena College
Julia Salatti, Cornell University	Ryan Cui, SUNY Stony Brook
Juliana Dovi, SUNY Stony Brook	Sandhya LoGalbo, Hofstra University
Kimberly Cardinale, Oxford College of Emory University	Timmerree Koepele, University of New Mexico

DNA Learning Center NYC

Ashley LaSalle, New York City College of Technology	Jens Salva, The City College of New York
Cristofer Hernandez, Hunter College	Ella Cervi, Princeton University
Sebastian Maurice, The City College of New York	Rosalie Ye, Stonybrook University
Jamie Price, Lehman College	Sheilaya Gresham, Hunter College
Morgan Serbagi, Hunter College	Milany Bruno, Hunter College
Derbie Desir, New York City College of Technology	Marc Louis, John Jay College of Criminal Justice
Faith Tsentner, Hunter College	Harold Miller, Borough of Manhattan Community College
Tess Fleming, Brooklyn College	College

Regeneron DNA Learning Center

Madelyn Meehan, Penn State	Mikayla Tucci, Sacred Heart University
Kelly Tito, University of Massachusetts, Amherst	Lily Wong, Northeastern University

David Micklos

DNA Learning Center Executive Director

Workshops, Meetings, Collaborations, and Site Visits

- January 13–18 “A Moderated Discussion on the Missing Components in Genomics: Justice, Equity, Diversity, Inclusion;” “Advanced Computational Methods – CyVerse for Machine Learning, Containers and Clouds;” “Understanding Barriers to Bioinformatics Education- Network for Integrating Bioinformatics into Life Sciences Education,” International Plant and Animal Genome Conference (PAG30), San Diego, California
- January 19 “Meet a Scientist: Zachary Oberholtzer,” Virtual Webinar, *Regeneron DNALC*
- January 20 Pop-Up Training for CUNY Biology Educators: Getting Started with Barcoding, Metabarcoding, and Nanopore DNA Sequencing, *DNALC NYC*
- January 21 *Saturday DNA!* “Pathogens, Plasmids, and Petri Dishes–Oh My!” *DNALC Urban Barcode Project Open Lab, Harlem DNA Lab*
- January 23 Pop-Up Training for CUNY Biology Educators: Getting Started with Barcoding, Metabarcoding, and Nanopore DNA Sequencing, *DNALC NYC*
- January 25-26 Site visit & tour by Kwasi Agbleke, Sena Institute of Technology, *DNALC*
- January 26 Site visit & tour by Joe Leniczak and Kissaou Tchendre, Austin Community College, *DNALC NYC*
- January 28–31 Site visit & tour by Mrs. Lorena Martínez Rodríguez, Mrs. Verónica González de Alba, Dr. Armando Barriguete Meléndez, and Dra. Liliana Hernández, Aguascalientes DNA Learning Center Project Delegation, *DNALC NYC, DNALC, & Regeneron DNALC*
- January 30 RockEDU STEM Research Teacher Summit, Rockefeller University, New York, New York
- February 3 The Young Women’s Leadership School’s Summer Enrichment Fair, Harlem, New York
- February 11 *Saturday DNA!* “Pollen Tells a Story,” *DNALC NYC*
Saturday DNA! “A Royal Ruse,” *DNALC*
Saturday DNA! “Agar Art,” *Regeneron DNALC*
- February 14 The Young Women’s Leadership School’s Summer Enrichment Fair, Brooklyn, New York
- February 22 *School Break Bio!* “Science Detectives: Use Forensic Techniques to Solve a Crime!” *DNALC NYC*
School Break Bio! “GMO Analysis: Is My Snack Genetically Modified?” *DNALC NYC*
- February 24 *School Break Bio!* “Infectious Diseases,” *DNALC*
- March 2–4 “Proteins, Biology and Artificial Intelligence,” National Academy of Sciences Kavli Frontiers of Science 33rd U.S. Symposium, Arnold and Mabel Beckman Center, Irvine, California
- March 10–11 Site visit & tour by Dr. Santiago March, Jack Landsmanas, and Dr. Armando Barriguete Meléndez, EDOMEX DNA Learning Center Project, Mexico, *DNALC NYC* and *DNALC*
- March 11 *Urban Barcode Research Program Open Lab, DNALC NYC*
- March 15 *Urban Barcode Research Program Open Lab, DNALC NYC*
- March 16 “Meet a Scientist: Terrence Turner,” Virtual Webinar, *Regeneron DNALC*
- March 18 *Saturday DNA!* “A Day in the Life of the Iceman,” *DNALC*
Saturday DNA! “Dust Away Crime,” *Regeneron DNALC*
- March 25 *Barcode Long Island Open Lab, DNALC*
Urban Barcode Project Open Lab, Harlem DNA Lab
- March 27–30 CyVerse/Bioinformatics Conference, Tucson, Arizona
- March 29–31 NIH Citizen DNA Barcoding Network Collaborator Training, Discover Life in America, Gatlinburg, Tennessee
- April 1 *Urban Barcode Research Program Open Lab, DNALC NYC*
- April 10 *School Break Bio!* “Fresh Fruit DNA Extraction,” *DNALC*
School Break Bio! “Forensic DNA Fingerprint,” *Regeneron DNALC*
- April 11–12 “It’s Impossible to Keep Up – Career-spanning Learning in the Life Sciences,” Seminar, HudsonAlpha Institute for Biotechnology, Huntsville, Alabama
- April 12 *School Break Bio!* “Dust Away Crime,” *DNALC*

	<i>School Break Bio!</i> "Ötzi the Iceman: A Museum Tour & Interactive Laboratory Experience," DNALC NYC
	<i>School Break Bio!</i> "DNA Barcoding: Using DNA to Study Species Biodiversity and Ecology," DNALC NYC
April 13	<i>School Break Bio!</i> "Forensic DNA Fingerprint," DNALC
April 13–18	NIH <i>Citizen DNA Barcoding Network</i> Hub Training, Natural History Museum of Utah, Salt Lake City, Utah
April 17–21	Chan Zuckerberg Initiative Open Science Workshop, Buenos Aires, Argentina
April 19	Math for America Teacher Training Workshop, DNALC NYC
April 20	"Meet a Scientist: Dr. Joel N.H. Stern," Virtual Webinar, DNALC
April 22	<i>Saturday DNA!</i> "The Mystery of Anastasia," DNALC
April 27	Lehman College Biology Club <i>Agar Art</i> , Lehman College, Bronx, New York
	STANYS/SCONYC Teacher Training Workshop, DNALC NYC
April 29	<i>Urban Barcode Research Program</i> Open Lab, DNALC NYC
May 2	"It's Impossible to Keep Up – Career-spanning Learning in the Life Sciences," AgBioData Conference/CyVerse, Chicago, Illinois
May 3	Math for America Teacher Training Workshop, DNALC NYC
May 13–14	InnovATEBIO Undergraduate Skills Workshop, Great Bay Community College, Portsmouth, NH
May 15–17	"Building Communities of Practice," Global Bioinformatics Education Summit, Hinxton, United Kingdom
May 15	"Meet a Scientist: Dr. Stephanie E. Woods, DVM, MS LAM, DACLAM," Virtual Webinar, <i>Regeneron</i> DNALC
May 17	Math for America Teacher Training Workshop, DNALC NYC
May 20	<i>Saturday DNA!</i> "The Magic of Microscopes," DNALC
	<i>Saturday DNA!</i> "Plasmid Manipulation," <i>Regeneron</i> DNALC
May 25	Office of Community Schools Professional Learning Series, Fordham University, Bronx, New York
May 31	<i>Urban Barcode Project/Urban Barcode Research Program</i> Student Symposium at The Theater at City Tech, hosted by DNALC NYC
June 1–2	NIH SciEd Conference, Durham, North Carolina
June 5–7	InnovATEBIO National Biotechnology Education Center: Methods in Personal Genetics & DNA Barcoding, Sequencing, PCR & <i>Taq</i> Production Teacher Workshop, Maricopa Community College, Phoenix, Arizona
June 5–9	<i>Nanopore Sequencing Foundations for Course-based Research</i> ; Teacher Workshop, DNALC NYC
June 6	<i>Barcode Long Island</i> Student Symposium, CSHL
June 7–9	InnovATEBIO National Biotechnology Education Center: Methods in Personal Genetics & DNA Barcoding, Sequencing, PCR & <i>Taq</i> Production Teacher Workshop, Santiago Canyon College, Orange, California
June 10	<i>Saturday DNA!</i> "Got Lactase?" <i>Regeneron</i> DNALC
June 12–16	<i>BioCoding</i> Workshop, Lycée Français de New York, New York
	<i>Green Genes</i> Workshop, Lycée Français de New York, New York
June 20–21	Site visit & tour by Dr. Adrian Tyndall, Dr. Sandra Harris-Hooker, Dr. Rita Finley, Dr. Lisa Herring, Dr. Matt Smith, Dr. Selena Florence, and Dr. Dwionne Freeman, Morehouse School of Medicine and Atlanta Public Schools Delegation, DNALC and DNALC NYC
June 26–30	<i>Fun with DNA</i> Workshop, DNALC
	<i>World of Enzymes</i> Workshop, DNALC
	<i>Green Genes</i> Workshop, DNALC
	<i>DNA Science</i> Workshop, DNALC
	<i>Green Genes</i> Workshop, DNALC NYC
	<i>DNA Science</i> Workshop, DNALC NYC
	<i>Fun with DNA</i> Workshop, <i>Regeneron</i> DNALC
	<i>DNA Science</i> Workshop, <i>Regeneron</i> DNALC

- June 26–30 “Making Life Science CURES Inclusive and Accessible,” Gordon Research Conference: Undergraduate Biology Education Research, Bates College, Lewiston, Maine
- July 3 DNALC NYC Teacher Training Workshop, “PCR and Human DNA Variation: Part 1: Human Mitochondrial Sequencing,” DNALC NYC
- July 3–7 *World of Enzymes* Workshop, DNALC
Green Genes Workshop, DNALC
Forensic Detectives Workshop, DNALC
Fun with DNA Workshop, DNALC NYC
Forensic Detectives Workshop, DNALC NYC
World of Enzymes Workshop, Regeneron DNALC
- July 5 DNALC NYC Teacher Training Workshop, “DNA Structure, Isolation, and Mutation,” DNALC NYC
- July 6 DNALC NYC Teacher Training Workshop, “DNA Restriction Analysis and Bacterial Transformation,” DNALC NYC
- July 7 DNALC NYC Teacher Training Workshop, “PCR and Human DNA Variation: Part 2: Detecting a Jumping Gene (*Alu*),” DNALC NYC
- July 10–14 *Fun with DNA* Workshop, DNALC
Forensic Detectives Workshop, DNALC
DNA Science Workshop, DNALC
Genome Science Workshop, DNALC
Forensic Detectives Workshop, DNALC NYC
DNA Science Workshop, DNALC NYC
Green Genes Workshop, Regeneron DNALC
DNA Science Workshop, Regeneron DNALC
Urban Barcode Research Program Conservation Genetics Workshop, DNALC NYC
- July 11 NIH Citizen DNA Barcoding Network DNA Collection Event, Sweet Briar Nature Center, Smithtown, New York
- July 17–21 *Fun with DNA* Workshop, DNALC
World of Enzymes Workshop, DNALC
Forensic Detectives Workshop, DNALC
DNA Science Workshop, DNALC
BioCoding Workshop, DNALC
Fun with DNA Workshop, DNALC NYC
World of Enzymes Workshop, DNALC NYC
Green Genes Workshop, DNALC NYC
Fun with DNA Workshop, Regeneron DNALC
DNA Barcoding Workshop, Regeneron DNALC
Urban Barcode Research Program DNA Barcoding Workshop, DNALC NYC
Urban Barcode Research Program Conservation Genetics Workshop, Harlem DNA Lab
DNA Barcoding Workshop, DNALC Asia
- July 23–27 Intelligent Systems for Molecular Biology and the European Conference on Computational Biology, Centre de Congrès de Lyon, Lyon, France
- July 24–28 *World of Enzymes* Workshop, DNALC
Green Genes Workshop, DNALC
DNA Science Workshop, DNALC
DNA Barcoding Workshop, DNALC
Forensic Detectives Workshop, DNALC NYC
DNA Science Workshop, DNALC NYC
DNA Science Workshop, Regeneron DNALC

- World of Enzymes Workshop, Regeneron DNALC*
Urban Barcode Research Program Conservation Genetics Workshop, DNALC NYC
Urban Barcode Research Program DNA Barcoding Workshop, Harlem DNA Lab
DNA Barcoding Workshop, DNALC Asia
Genome Science Workshop, DNALC Asia
- July 31–Aug 4 *Fun with DNA Workshop, DNALC*
Green Genes Workshop, DNALC
Genome Science Workshop, DNALC
NIH Citizen DNA Barcode Network Educator Workshop, DNALC
Fun with DNA Workshop, DNALC NYC
Green Genes Workshop, DNALC NYC
BioCoding Workshop, DNALC NYC
STEM Matters Forensic Detectives Workshop, DNALC NYC
Forensic Detectives Workshop, Regeneron DNALC
Genome Science Workshop, Regeneron DNALC
Urban Barcode Research Program DNA Barcoding Workshop, DNALC NYC
Fun with DNA Workshop, Long Beach High School, Long Beach, New York
- August 3 *Site visit & tour by Dr. Garrett Dunlap, British Consulate General, DNALC NYC*
- August 7–11 *Forensic Detectives Workshop, DNALC*
DNA Science Workshop, DNALC
STARS DNA Barcoding Workshop, DNALC
Forensic Detectives Workshop, DNALC NYC
DNA Science Workshop, DNALC NYC
DNA Barcoding Workshop, DNALC NYC
Urban Barcode Research Program Conservation Genetics Workshop, DNALC NYC
Fun with DNA Workshop, Regeneron DNALC
DNA Science Workshop, Regeneron DNALC
World of Enzymes Workshop, Long Beach High School, Long Beach, New York
- August 14 *NIH Citizen DNA Barcoding Network DNA Collection Event, Jones Beach Energy & Nature Center, Wantagh, New York*
- August 14–18 *Fun with DNA Workshop, DNALC*
World of Enzymes Workshop, DNALC
Green Genes Workshop, DNALC
DNA Science Workshop, DNALC
STARS BioCoding Workshop, DNALC
Fun with DNA Workshop, DNALC NYC
World of Enzymes Workshop, DNALC NYC
Genome Science Workshop, DNALC NYC
Urban Barcode Research Program DNA Barcoding Workshop, DNALC NYC
World of Enzymes Workshop, Regeneron DNALC
- August 21–25 *WiSE Fun with DNA Workshop, DNALC*
World of Enzymes Workshop, DNALC
Forensic Detectives Workshop, DNALC
Sequence a Genome! Workshop, DNALC
Fun with DNA Workshop, DNALC NYC
Green Genes Workshop, DNALC NYC
DNA Science Workshop, DNALC NYC

- Urban Barcode Program Teacher Training, DNALC NYC*
DNA Barcoding Workshop, Regeneron DNALC
Green Genes Workshop, Regeneron DNALC
- August 28–Sept 1 *Fun with DNA Workshop, DNALC*
Green Genes Workshop, DNALC
Forensic Detectives Workshop, DNALC
DNA Science Workshop, DNALC
World of Enzymes Workshop, DNALC NYC
Forensic Detectives Workshop, DNALC NYC
Fun with DNA Workshop, Regeneron DNALC
Forensic Detectives Workshop, Regeneron DNALC
- September 11–12 Hudson Valley Community College Biotech Meeting, Troy, New York
- September 20 Site visit & tour by Professor Yaping Zhang, Mr. Zhenyu Wang and Ms. Ting Tong, Delegation from the Chinese Academy of Science with Bruce Stillman, DNALC
- September 23 NIH *Citizen DNA Barcoding Network DNA Collection and Wet-Lab Event*, South Fork Natural History Museum, Bridgehampton, New York
- September 30 Science Saturday 2023 Festival, Rockefeller University, New York, New York
 SUBMERGE Marine Science Festival, Hudson River Park, New York, New York
 Mercy University STEM Education Conference, Dobbs Ferry, New York
- October 14 *Saturday DNA! "Jack-O'-Lantern DNA!" Regeneron DNALC*
- October 17 Site visit by Carissa Jordan, CSHL Association Board Director and friend Rachel Sitman, with Karen Orzel, DNALC NYC
- October 20 *Regeneron Day for Doing Good*, Regeneron Pharmaceuticals, Sleepy Hollow, New York
- October 21 *Saturday DNA! "Beholding Blood," DNALC*
- October 23–26
- October 24 *Regeneron Day for Doing Good*, Regeneron Pharmaceuticals, Sleepy Hollow, New York
- November 3 Site visit & tour by John Buck, Jessica Raba and Erik Weinstein, Delegation from Long Island Lutheran Middle & High School with Charlie Prizzi, DNALC
- November 7 *Barcode Long Island Teacher Training Workshop, "DNA Barcoding," DNALC*
Regeneron DNALC Teacher Training Workshop, "Human Mitochondrial Sequencing," Regeneron DNALC
- November 10 CSHL Association *A Day in the Lab*, DNALC
- November 11 *Saturday DNA! "Protein Purification," DNALC*
Saturday DNA! "Forensic DNA Fingerprint," Regeneron DNALC
- December 4 "It's Impossible to Keep Up – Career-spanning Learning in the Life Sciences," Genetics and Genomics Academy, North Carolina State University, Raleigh, North Carolina
- December 6 Site visit by Delegation from Meharry Medical College, *Regeneron DNALC*
- December 9 *Saturday DNA! "Got Lactase?" Regeneron DNALC*
- December 16 *Saturday DNA! "Christmas Cactus Cloning," DNALC*

Sites of Major Faculty Workshops

Program Key: *Middle School* High School College

State	Institution	Year(s)
VIRTUAL	Host: Atlanta University Center Consortium, Atlanta, Georgia	2021
	Host: Bowie State University, Bowie, Maryland	2020
	Host: DNA Learning Center, New York	2020
	Host: <i>Harlem DNA Lab and Regeneron DNALC, Sleepy Hollow, New York</i>	2020
	Co-host: James Madison University, Harrisonburg, Virginia	2020, 2021 (3)
	Host: North Carolina State University, Raleigh, North Carolina	2021
	Co-hosts: University of Arizona, Tucson, Arizona & DNA Learning Center, NY	2020
	Host: Quantitative Undergraduate Biology Education and Synthesis (QUBES) Project	2020
ALABAMA	University of Alabama, Tuscaloosa	1987–90
	Hudson Alpha Institute, Huntsville	2014
ALASKA	University of Alaska, Anchorage	2012
	University of Alaska, Fairbanks	1996
ARIZONA	Arizona State University, Tempe	2009
	Maricopa Community College, Phoenix	2023
	Tuba City High School	1988
	University of Arizona, Tucson	2011, 2019–20
ARKANSAS	United States Department of Agriculture, Maricopa	2012
	Henderson State University, Arkadelphia	1992
	University of Arkansas, Fayetteville	2017, 2019
	University of Arkansas, Little Rock	2012
CALIFORNIA	University of Arkansas for Medical Sciences, Little Rock	2019
	<u>California Academy of Sciences, San Francisco</u>	<u>2022</u>
	California State University, Dominguez Hills	2009
	California State University, Fullerton	2000
	California State University, Long Beach	2015
	California Institute of Technology, Pasadena	2007
	Chan-Zuckerberg BioHub, San Francisco	2018
	Canada College, Redwood City	1997
	City College of San Francisco	2006
	City College of San Francisco	2011, 2013
	Contra Costa County Office of Education, Pleasant Hill	2002, 2009
	Foothill College, Los Altos Hills	1997
	Harbor-UCLA Research & Education Institute, Torrance	2003
	Los Angeles Biomedical Research Institute (LA Biomed), Torrance	2006
	Laney College, Oakland	1999
	Lutheran University, Thousand Oaks	1999
	Oxnard Community College, Oxnard	2009
Pasadena City College	2010	
Pierce College, Los Angeles	1998, 2022	
Salk Institute for Biological Studies, La Jolla	2001, 2008	
San Francisco State University	1991	
San Diego State University	2012	
San Jose State University	2005	
Santa Clara University	2010	
Santiago Canyon College, Orange	2023	
Scripps Institute, San Diego	2019	
Southwestern College, Chula Vista	2014–15	
Stanford University, Palo Alto	2012	

	University of California, Berkeley	2010, 2012
	University of California, Davis	1986
	University of California, Davis	2012, 2014–15
	University of California, Long Beach	2015
	University of California, Northridge	1993
	University of California, Riverside	2011
	University of California, Riverside	2012
	University of California, San Francisco	2015
COLORADO	Aspen Science Center	2006
	Colorado College, Colorado Springs	1994, 2007
	Colorado State University, Fort Collins	2013, 2018
	Community College of Denver	2014
	United States Air Force Academy, Colorado Springs	1995
	University of Colorado, Denver	1998, 2009–10
CONNECTICUT	Choate Rosemary Hall, Wallingford	1987
	Jackson Laboratory, Farmington	2016
DELAWARE	University of Delaware, Newark	2016
DISTRICT OF COLUMBIA	Howard University, Washington	1992, 1996, 2009–10
FLORIDA	Armwood Senior High School, Tampa	1991
	Florida Agricultural & Mechanical University, Tallahassee	2007–08
	Florida Agricultural & Mechanical University, Tallahassee	2011
	Florida SouthWestern State University, Fort Myers	2015
	North Miami Beach Senior High School	1991
	Seminole State College, Sanford	2013–14
	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
	Gwinnett Technical College, Lawrenceville	2011–12
	Morehouse College	1991, 1996
	Morehouse College	1997
	Spelman College, Atlanta	2010
	University of Georgia, Athens	2015
HAWAII	Kamehameha Secondary School, Honolulu	1990
	University of Hawaii at Manoa	2012
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
	Kings College, Chicago	2014
	University of Chicago	1992, 1997, 2010
	University of Southern Illinois, Carbondale	2016
INDIANA	Butler University, Indianapolis	1987
	Purdue University, West Lafayette	2012
IOWA	Drake University, Des Moines	1987
KANSAS	University of Kansas, Lawrence	1995
KENTUCKY	Bluegrass Community & Technical College, Lexington	2012–14
	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

	Southern University at New Orleans	2012
	University of New Orleans	2018
MAINE	Bates College, Lewiston	1995
	Southern Maine Community College	2012–13
	Foundation for Blood Research, Scarborough	2002
MARYLAND	Annapolis Senior High School	1989
	Bowie State University	2011, 2015
	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
	University of Maryland, School of Medicine, Baltimore	1999
MASSACHUSETTS	Arnold Arboretum of Harvard University, Roslindale	2011
	Beverly High School	1986
	Biogen Idec, Cambridge	2002, 2010
	Boston University	1994, 1996
	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
	Schoolcraft College, Livonia	2012
MINNESOTA	American Society of Plant Biologists, Minneapolis	2015
	Minneapolis Community and Technical College, Madison	2009
	Minneapolis Community and Technical College, Madison	2013
	University of Minnesota, St. Paul	2005
	University of Minnesota, St. Paul	2010
MISSISSIPPI	Mississippi School for Math & Science, Columbus	1990–91
	Rust College, Holly Springs	2006–08, 2010
MISSOURI	St. Louis Science Center	2008–10
	Stowers Institute for Medical Research, Kansas City	2002, 2008
	University of Missouri, Columbia	2012
	Washington University, St. Louis	1989
	Washington University, St. Louis	1997, 2011, 2019
MONTANA	Montana State University, Bozeman	2012
NEBRASKA	University of Nebraska-Lincoln, Lincoln	2014
NEVADA	University of Nevada, Reno	1992, 2014
NEW HAMPSHIRE	Great Bay Community College, Portsmouth	2009
	New Hampshire Community Technical College, Portsmouth	1999
	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
	Los Alamos National Lab	2017
	New Mexico State University, Las Cruces	2017
	Santa Fe Community College, Santa Fe	2015
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
	Canisius College, Buffalo	2011

	City College of New York	2012
	Cold Spring Harbor High School	1985, 1987
	Cold Spring Harbor Laboratory	2014–15, 2018–19, 2022
	Columbia University, New York	1993
	Cornell University, Ithaca	2005
	<i>DeWitt Middle School, Ithaca</i>	1991, 1993
	Dolan DNA Learning Center	1988–95, 2001–04, 2006–09, 2015–19
	Dolan DNA Learning Center	1990, 1992, 1995, 2000–11
	<u>Dolan DNA Learning Center</u>	<u>2021, 2022, 2023</u>
	<i>Dolan DNA Learning Center</i>	1990–92
	DNA Learning Center West	2005
	<i>DNA Learning Center NYC</i>	2019, 2021
	DNA Learning Center NYC	2022–23
	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
	Harlem DNA Lab, East Harlem	2015–16
	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
	Math for America	2017–19, 2022
	Michel J. Petrides School, Staten Island	2018
	Mount Sinai School of Medicine, New York	1997
	Nassau Community College, Garden City	2013
	New York Botanical Garden, Bronx	2013
	New York City Department of Education	2007, 2012
	New York City Technical College (City Tech)	2018
	New York Institute of Technology, New York	2006
	New York Institute of Technology, New York	2006
	<i>Orchard Park Junior High School</i>	1991
	<i>Plainview-Old Bethpage Middle School</i>	1991
	Regeneron Pharmaceuticals, Inc	2019
	School of Visual Arts, New York	2017
	State University of New York, Purchase	1989
	State University of New York, Stony Brook	1987–90, 2015–18
	State University of New York, Stony Brook	2014, 2016
	Stuyvesant High School, New York	1998–99
	The Rockefeller University, New York	2003, 2015–16
	The Rockefeller University, New York	2010
	<i>Titusville Middle School, Poughkeepsie</i>	1991, 1993
	Trudeau Institute, Saranac Lake	2001
	Union College, Schenectady	2004
	United States Military Academy, West Point	1996
	Wheatley School, Old Westbury	1985
NORTH CAROLINA	CIIT Center for Health Research, Triangle Park	2003
	Forsyth Technical Community College, Winston-Salem	2022
	North Carolina Agricultural & Technical State University, Greensboro	2006–07, 2009–11
	North Carolina School of Science, Durham	1987
	North Carolina State University, Raleigh	2012, 2018
NORTH DAKOTA	North Dakota State University, Fargo	2012

OHIO	Case Western Reserve University, Cleveland	1990
	Cleveland Clinic	1987
	Langston University, Langston	2008
	North Westerville High School	1990
OKLAHOMA	The Ohio State University, Wooster	2016
	Oklahoma City Community College	2000
	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
	Tulsa Community College, Tulsa	2012–14
OREGON	Kaiser Permanente-Center for Health Research, Portland	2003
	Linfield College, McMinnville	2014
PENNSYLVANIA	Duquesne University, Pittsburgh	1988
	Germantown Academy	1988
	Kimmel Cancer Center, Philadelphia	2008
RHODE ISLAND	Botanical Society of America, Providence	2010
SOUTH CAROLINA	Clemson University	2004, 2015
	Medical University of South Carolina, Charleston	1988
	University of South Carolina, Columbia	1988
SOUTH DAKOTA	South Dakota State University, Brookings	2015
TENNESSEE	<u>Discover Life in America, Gatlinburg</u>	<u>2023</u>
TEXAS	NABT Professional Development Conference, Memphis	2008
	Austin Community College – Rio Grande Campus	2000
	Austin Community College – Eastview Campus – Roundrock Campus	2007–09, 2013
	Austin Community College – Roundrock Campus	2012
	Austin Community College - Austin	2018
	Houston Community College Northwest	2009–10
	J.J. Pearce High School, Richardson	1990
	Langham Creek High School, Houston	1991
	University of Lone Star College, Kingwood	2011
	Midland College	2008
	Southwest Foundation for Biomedical Research, San Antonio	2002
	Taft High School, San Antonio	1991
	Texas A&M University, College Station, TX	2013
	Texas A&M University, Prairie View, TX	2013
	Texas A & M, AG Research and Extension Center, Weslaco	2007
	Trinity University, San Antonio	1994
	University of Texas, Austin	1999, 2004, 2010, 2012
UTAH	University of Texas, Brownsville	2010
	Brigham Young University, Provo	2012
	<u>Natural History Museum of Utah, Salt Lake City</u>	<u>2023</u>
	University of Utah, Salt Lake City	1993
	University of Utah, Salt Lake City	1998, 2000
VERMONT	Utah Valley State College, Orem	2007
	University of Vermont, Burlington	1989
	Champlain Valley Union High School	1989
VIRGINIA	Eastern Mennonite University, Harrisonburg	1996
	James Madison University, Harrisonburg	2017
	Jefferson School of Science, Alexandria	1987
	Mathematics and Science Center, Richmond	1990
	Mills Godwin Specialty Center, Richmond	1998
	Virginia Polytechnic Institute and State University, Blacksburg	2005, 2008–09

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

2023 Grants

Grantor	Program	2023 Grant Duration	Funding*
<i>FEDERAL GRANTS</i>			
National Institutes of Health	<i>Citizen DNA Barcode Network</i>	6/20-3/25	\$176,540
National Institutes of Health	Genomics Step-Up High School	5/22-3/27	\$180,429
National Science Foundation	<i>Implementing DNA Barcoding for Course-Based Undergraduate Research Experiences</i>	10/18-9/24	\$281,261
National Science Foundation (University of Arizona)	<i>CyVerse: Cyberinfrastructure for the Life Sciences</i>	8/18-7/24	\$82,301
National Science Foundation	<i>Enhancing DNA Subway 2.0 as a Shared Resource for Bioscience Workforce Development</i>	7/23-6/26	\$69,788
National Science Foundation	Collaborative Research: Arecibo C3- Center for Culturally Relevant and Inclusive Science Education, Computational Skills, and Community Engagement	10/23-9/24	\$64,703
National Science Foundation (Austin Community College)	InnovATEBIO National Biotechnology Education Center	10/19-9/24	\$213,554
National Science Foundation (Pierce College)	<i>Advanced Student-Focused Projects: Internship, Research and Education (ASPIRE)</i>	9/21-8/24	\$9,048
National Science Foundation (University of Minnesota)	<i>FMRG: BIO: Enabling Cell-Free Engineering</i>	10/22-9/26	\$28,864
National Science Foundation	<i>What Works in Workshops-Evolving Short Format Training to serve Life Sciences STEM Professionals in the 21st Century</i>	3/21-2/23	\$4,587
National Science Foundation	<i>Nanopore DNA Sequence Course-Based Undergraduate Research</i>	6/22-5/24	\$79,371
<i>NON-FEDERAL GRANTS</i>			
Beijing No. 166 High School	Chinese Collaboration Agreement	7/19-6/23	\$25,593
Breakthrough Prize Foundation	Laboratory Design and Teacher Training for Breakthrough Junior Challenge Prize Winners	12/15-12/25	\$69,421
Health Park	Health Park Agreement	12/15-12/23	\$5,112
Pinkerton Foundation	<i>Urban Barcode Research Program</i>	1/21-5/23	\$100,550
Richard Lounsbery Foundation	Paul Taubman support for DNALC NYC at City Tech Exhibit Development	6/21-6/24	\$125,703
Richard Lounsbery Foundation	Videos and Animations to Explain Environmental DNA to a Broad Audience	2/22-7/24	\$28,869
The Simons Foundation	<i>Urban Barcode Research Program</i>	12/17-8/23	\$26,807
William Townsend Porter Foundation	<i>Harlem DNA Lab for Underprivileged Students</i>	1/20-1/23	\$24,428
DNALC Unrestricted Institutional Grant	DNALC Asia Royalties	9/15-12/23	\$50,000
NY Harbor Foundation	Billion Oyster Project	6/20-12/21	\$296
Laurie Landeau Foundation	Laurie Landeau Seed Program	1/21-1/24	\$931

*Includes direct and indirect costs.

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	\$3,150	Oceanside Union Free School District	\$3,150
Elwood UFSD	\$3,150	Oyster Bay-East Norwich Central School District	\$3,150
Great Neck	\$3,150	Plainview-Old Bethpage Central School District	\$3,150
Herricks Union Free School District	\$3,150	Portledge School	\$3,150
Huntington	\$3,150	Port Washington Union Free School District	\$3,150
Island Trees	\$3,150	Roslyn Union Free School District	\$3,150
Jericho High School	\$3,150	Syosset Central School District	\$3,150
Levittown Union Free School District	\$3,150	Yeshiva University High School for Girls	\$3,150
North Shore Central School District	\$3,150		

Associate Memberships

Glen Cove Central School District	\$17,000	St. Dominic High School	\$17,000
Friends Academy	\$17,000		

Partner Memberships

Cold Spring Harbor Central School District	\$34,000	Massapequa Union Free School District	\$34,000
Long Beach Central School District	\$34,000		

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

Sustaining Membership

Magen David Yeshiva High School	\$3,150	Stuyvesant High School	\$3,150
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Associate Membership

Dwight School	\$17,000		
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Partner Memberships

The Chapin School	\$34,000	Marymount School of NY	\$34,000
Lycée Français de NY	\$34,000	St. David's School	\$34,000

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

Sustaining Membership

Archbishop Stepinac High School	\$3,150		
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DNA LEARNING CENTER

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DNA Learning Center NYC at City Tech

62 Tillary Street
Brooklyn, New York 11201

Regeneron DNA Learning Center

Regeneron Pharmaceuticals, Inc.
Sleepy Hollow Campus
1 Rockwood Road
Sleepy Hollow, New York 10591

Harlem DNA Lab

2351 First Avenue at 120th Street
East Harlem, New York 10035

Coming in 2024:

DNA Learning Center
at Passaic County Biotechnology Innovation Center

45 Reinhardt Road
Wayne, New Jersey 07470

Visit us online at

<https://dnalc.cshl.edu>