



Cold Spring Harbor Laboratory
DNA LEARNING CENTER

DOLAN DNA LEARNING CENTER

ANNUAL REPORT
2016

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.

Executive Director's Report

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The DNALC occupies the middle ground on a continuum of science enterprise that spans from pure research to pure education. We adapt methods and concepts from research so they can be done in educational settings. In this way, we empower students and teachers to experience cutting-edge research. In the last several years, most of our major grant projects explore this middle ground, trying to scale research methods to reach large numbers of students—especially in the context of undergraduate courses. The DNALC's task is to prepare undergraduate faculty so that they and their students can analyze the new datasets as they are released—at the same time and using the same tools as high-level researchers.



For example, our work with CyVerse (Cyber Universe) is bringing students and teachers into the world of biological “big data.” This \$100 million National Science Foundation project supports an extensive computer infrastructure for scientific research and education. Leveraging the CyVerse infrastructure, our program in RNA sequence analysis (RNA-Seq) allows undergraduate faculty to generate a data set on all of the genes active in an organism of their choice. Using bioinformatics tools at our *DNA Subway* website, faculty work with students to analyze their data on the Extreme Science and Engineering Discovery Environment (XSEDE) national supercomputer system. This is likely the simplest graphical user interface to access the XSEDE system, which is typically reached via command line programming.

Over the last decade six consensus publications, including reports by the American Association for the Advancement of Science, the National Science Foundation, and the National Academy of Sciences have recommended similar reforms to undergraduate Science, Technology, Engineering, and Math (STEM) education:

- Focus on the first two years of college education, which are critical to recruiting and retaining STEM majors.
- Foster conceptual understanding, higher-level thinking, and practice of STEM rather than memorization of terms, facts, and techniques.
- Adopt inquiry- and student-centered approaches that begin with students' own questions.
- Increase opportunities for interdisciplinary and collaborative work.

A study by the President's Council of Advisors on Science and Technology (PCAST) recommended "replacing standard laboratory courses with discovery-based research courses." Similarly, the 2015–16 New York State Budget for the first time, mandated "experiential or applied learning activities"—including "faculty-supervised undergraduate projects"—as a graduation requirement at all City University of New York (CUNY) and State University of New York (SUNY) schools. The PCAST study calculated that increasing retention of STEM graduates by 10% would generate 750,000 additional STEM degrees over a decade. Past studies have shown that participation in independent research improves student persistence and academic performance. A new analysis of the Freshman Research Initiative (FRI) at the University of Texas at Austin showed that student participation in course-based undergraduate research experiences (CUREs) can exceed the PCAST challenge. Students who completed two semesters of course-based research had a 23% higher probability of graduating with STEM degrees than carefully matched controls. CURE participants also had a 17% higher six-year graduation rate. These results have prompted many universities to adopt CUREs to provide authentic research opportunities to large numbers of freshman or sophomore students through courses for credit.



Developing genomics-focused CUREs is now feasible. In the last decade, a 50,000-fold decrease in DNA sequencing costs in combination with freely available bioinformatics software has made the analysis of whole genomes accessible to anyone with internet access.

Biological big data is creating myriad employment opportunities for students who are prepared to think in new and integrative ways. A 2003 report of an NSF blue-ribbon panel headed by Daniel Atkins popularized the term *cyberinfrastructure* to describe systems of data storage, software, high performance computing (HPC), and people that can solve scientific problems of the size and scope presented by big data. The Atkins report described cyberinfrastructure as the means to develop a "knowledge economy." First on NSF's 2016 list of six future big research ideas is "harnessing data for 21st century science and engineering." Third on the list is "understanding the rules of life" that determine phenotype (traits) from

genotype (genome information). According to *Science Careers*, “Big pharma, biotech, and software companies are clamoring to hire professionals with experience in bioinformatics and the identification, compilation, analysis, and visualization of huge amounts of biological and health care information.”

Biology students and faculty realize that the world of big genome data is upon them. Nine out of ten graduate students, postdoctoral fellows, and research faculty we have surveyed at workshops and professional meetings say that they are currently analyzing large datasets or expect to soon. Bioinformatics and data science skills present significant barriers to faculty exploration of genomics in the classroom. Respondents to a 2016 CyVerse needs analysis of principal investigators (PIs) funded through the NSF's Biological Sciences Directorate said they have enough data storage and high performance computing, but lack training to effectively use these resources to analyze big data. Through our role as outreach lead for CyVerse, we are helping faculty to grapple with big data science.

DNA Barcoding

In the last decade, the DNALC has developed several integrated biochemical and bioinformatics workflows that scale up discovery-based experiments for use in advanced high school and introductory college courses. These provide educators with the tools to easily and affordably provide authentic research experiences to their students. We think DNA barcoding in particular offers a complete solution for student research. (“DNA barcodes” are short DNA sequences that can be used to objectively identify almost any plant, animal, or fungal species.) DNA barcoding can be mastered in a relatively short time, applied to many different questions, and allows students to reach a satisfying research endpoint within a single academic course. Students can undertake individual projects to explore product mislabeling, or contribute to distributed efforts to explore a local ecosystem, museum collection, or conservation issue. These projects can stimulate independent thinking across different levels of biological organization—linking molecular genetics to ecology and evolution. DNA barcoding can readily scale for CUREs. Notably, 500 freshman students completed DNA barcode projects during the fall semester at James Madison University (JMU), one of the largest CURE implementations in the U.S.

The DNALC runs three active programs that demonstrate different models for using DNA barcoding in student research. *Barcode Long Island (BLI)*, funded by the National Institutes of Health (NIH), involves students in collaborative “campaigns” to compare biodiversity across Long Island. In the *Urban Barcode Project (UBP)* funded by the Thompson Family Foundation, and *Urban Barcode Research Program (UBRP)* funded by the Pinkerton Foundation, students work on independent projects to explore biodiversity in New York City. *BLI* and *UBP* students are mentored by classroom science teachers, while *UBRP* students are mentored by scientists from different New York City (NYC) research institutions.

UBP and *UBRP* involved 214 students from 46 schools. Twenty-nine percent of participants were underrepresented minorities (URM) in science—African American, Latino, or Native American. To complete their research projects in the spring, 73 students attended Open Lab sessions at *Harlem DNA Lab* and Genspace in Brooklyn, while 113 students used 16 equipment footlockers borrowed from the DNALC. Student teams developed 2,200 barcode sequences, including 12 new GenBank entries, for studies of food fraud, biodiversity, conservation genetics, and forensics. Student teams competed at the annual symposium, held at the Borough of Manhattan Community College, with winning projects on invertebrate biodiversity on Staten Island and the spread of an invasive plant, *Corydalis incisa*, along the Bronx River. Winning team members from the Hostos-Lincoln Academy, Rosa Bermejo and Josiah Estacio, presented their research at CSHL's Double Helix dinner at the American Museum of Natural History. The NYC Department of Education continued its support for a two-week barcoding course at its



Above:

Students, mentors, and visitors explore project posters at the *UBP* and *UBRP* Symposium held at the Borough of Manhattan Community College.

Right:

Mark Stoeckle speaks to *BLI* Symposium attendees in Grace Auditorium on the CSHL campus.



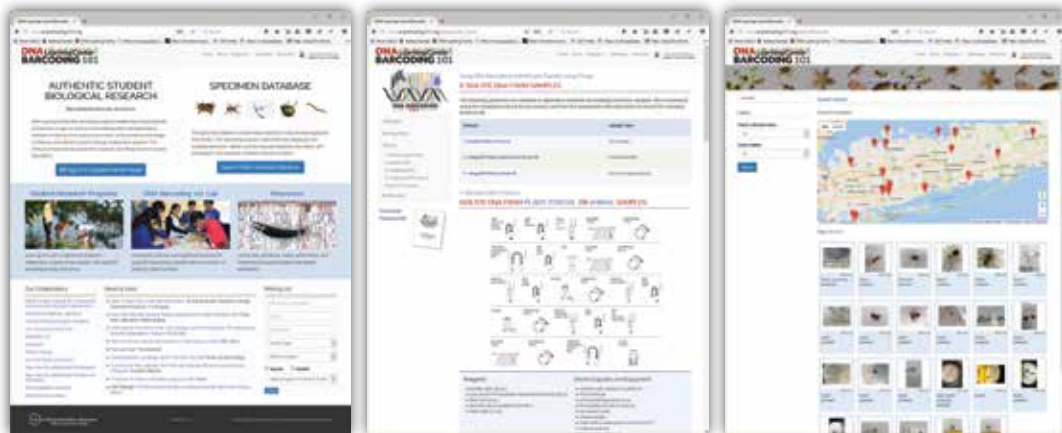
Environmental Study Center at Bergen Beach, Brooklyn. Four teacher-led teams of students contributed 66 DNA barcodes to ongoing study of biodiversity in Marine Park. Work measuring biodiversity during salt marsh restoration by a team from Forest Hills High School—Akansha Thakur, Ilona Petrychyn, Indu Puthenkalam, and mentor Camila Lock—was featured in the March 2016 *Barcode Bulletin* of the International Barcode of Life.

BLI enrolled 271 students from 29 schools in Nassau (14), Suffolk (13), and Queens (3), including 10% from underrepresented groups. To complete their projects, 141 students attended Open Labs at the DNALC, Brookhaven National Laboratory (BNL), and Stony Brook University (SBU), while 252 students used 34 footlocker kits. Over 1,500 DNA barcodes were produced by biodiversity projects on plants (45%), invertebrates (42%), fungi (8%), and lichens (5%)—including four novel barcode sequences published on GenBank. Mark Stoeckle, Senior Research

Associate in the Program for the Human Environment at The Rockefeller University, gave the keynote talk at the annual *BLI* Symposium at Cold Spring Harbor Laboratory. (Mark launched educational barcoding when he encouraged his daughter and her friend to conduct studies of sushi collected from Manhattan restaurants.) Many *BLI* students also presented their research at regional, state, and national science competitions. Several students presented their work to New York State Commissioner of Education Mary Ellen Elia, Deputy Commissioner of Higher Education John D'Agati, and New York State Board of Regents member Roger Tilles during a visit to the DNALC on June 24th.

Survey data from all three programs demonstrates the impact of barcoding research on high school students. Large majorities of students ($n = 204$) were proud of the research they had done (85.5%), felt the problem-solving experience was useful for future science courses (82.7%) and career paths (72.8%), were more capable of pursuing science (72.8%), and more likely to study science in college than they were at the start of the project (61.3%). Among students with other research experiences ($n=187$), majorities felt that DNA barcoding research provided as much or more opportunity for collaborative work with mentors (64.4%) and other students (68.0%) than their previous research projects. Notably, nearly 30% of students reported having discovered something that was unknown to scientists.

During the summer we trained 31 *BLI* teachers, bringing the total to 181 teachers from 105 schools across Nassau County, Suffolk County, Brooklyn, and Queens who have been trained to mentor student projects. In the fall, proposals were accepted from 102 *BLI* teams (302 students), 43 *UBP* teams (172 students), and 19 *UBRP*, teams (39 students).



Our barcoding websites were merged into one comprehensive site that launched in November.

Beyond Barcoding

With funding from an NIH Big Data to Knowledge supplement to *BLI*, DNA barcoding is being expanded to include metabarcoding—determining barcode sequences for all of the microbes in a mixed sample. Microbial diversity is immense and largely uncharacterized, providing students many opportunities for novel contributions. Moving from DNA barcoding to microbiomes perfectly embodies the conceptual transition from single gene to massively parallel genome analysis, introducing students to data science and high-throughput sequence (HTS) analysis. A single lane of an HTS machine can accommodate hundreds of student microbiome studies, supporting many projects and allowing comparisons between microbiomes from different environmental locations or conditions. After collection and DNA purification, PCR is used to amplify a variable region of the 16S ribosomal RNA gene, then HTS reads are used to identify the variety and abundance of microbial species.

To support this new endeavor, we began to develop a laboratory and bioinformatics workflow to support student microbiome sequencing. This includes an inexpensive system to combine student samples during sequencing, a dedicated computer server, and programming notebooks to control microbiome analysis using a state-of-the-art bioinformatics tool, QIIME. Twelve *BLI* mentors were recruited from schools in Suffolk (6) Nassau (3) and Queens (3) to test the system. During the summer, mentors attended a five-day workshop on the biochemistry and data science of microbiome analysis. Then, the mentors worked with 61 high school students (18% URM) to study the effects of pollution, pathogens, pesticides, salinity, plant density, and boating on microbiomes from diverse samples around Long Island. In parallel efforts, one million sequence reads were produced by microbiome research in the *UBRP*, while students from Cold Spring Harbor High School began a pilot project combining eDNA and microbiome analyses to study fish and microbes at the fish hatchery adjacent to CSHL. We are now using CyVerse resources to adapt QIIME as a new Purple Line of *DNA Subway*, which we hope will popularize microbiome analysis for student research.

RNA Sequence (RNA-Seq) Analysis

In 2016 we concluded our NSF grant, "Infrastructure and Training to Bring NGS Analysis into Undergraduate Education." This project created an extensible infrastructure and training program that empowers faculty to integrate NGS analysis and high performance computing into undergraduate biology instruction. Free access to these tools democratizes big data, allowing faculty at any undergraduate institution to engage their students in cutting-edge biological research. Training materials, experiences, and insights from this project will help faculty bring other research technologies to scale in undergraduate classes.

The first two years of the RNA-Seq program involved in-person training workshops at universities on the east and west coasts. Faculty left workshops with preliminary analyses and then continued to explore the data with students during the ensuing academic year. This year's workshop made extensive use of the *Landeau Multimedia Studio* and the project website (<http://www.rnaseqforthenextgeneration.org>), which provides an easy-to-use interface to an extensive bank of faculty-developed tutorials, videos, lesson plans, and instructional use cases. Materials from the website were organized into a two-week online curriculum that included live demonstrations, guest lectures, "office hours," and virtual faculty meet-ups combined with online tutorials and seminars. Forty participants from 22 different states enrolled in the 2016 workshop. Prior to the workshop we coordinated with 12 participants to generate novel

Mona Spector (right) introduces Ray Enke (2014 RNA-Seq working group alumnus) in the DNALC *Landeau Multimedia Studio* during the virtual workshop.



datasets, totaling 500 trillion nucleotides from seven eukaryotes. The remaining participants used private datasets or sets made available in the Sequence Read Archive (SRA, <http://www.ncbi.nlm.nih.gov/sra>) by previous participants, identified by exploring detailed faculty profiles on the website. Several Year 1 and 2 faculty alumni joined the virtual workshop to share their data and classroom experiences. Nine of ten participants reported they were “satisfied” or “very satisfied” with the virtual workshop—showing the cost-effectiveness of virtual training and of mining existing RNA-Seq datasets to answer novel questions.

Project goals and data were also disseminated through presentations by participating faculty and their students at 12 national or regional scientific conferences in 2016. We started this program with the goal of developing 30 RNA-Seq datasets that looked at novel research problems in eukaryotic genomics. We nearly doubled this output, producing a total of 53 novel datasets that have been integrated into a variety of undergraduate courses. To date, more than 900 students have been taught RNA-Seq by program participants in a variety of courses—including genetics, developmental biology, cell and molecular biology, and horticulture. During the three years of the project, 84 undergraduate faculty generated and analyzed RNA-Seq datasets totaling 600 trillion nucleotides from 36 eukaryotes.

CyVerse

During the year, the NSF-funded iPlant Collaborative was rebranded as CyVerse to reflect its expanded mission to provide high-level computation across all disciplines of biology. As lead for CyVerse Education, Outreach, and Training (EOT), the DNALC is nurturing the next generation of computationally-savvy biologists through workshops, outreach at professional meetings, and support of faculty at primarily undergraduate-serving institutions (PUIs). As a direct indicator of this impact, students registered 70% of 10,000 new CyVerse accounts in 2016—44% undergraduate, 18% graduate, and 14% precollege.

The DNALC's student-friendly bioinformatics interface, *DNA Subway*, saw a 14% increase to 63,460 visitors, and a 25% increase in new projects to 36,045. Among the new registrants were the 500 freshman students at James Madison University (JMU) in Harrisonburg, who used the Blue Line during a semester long course on DNA barcoding. The barcoding course replaced traditional freshman biology, uniting ecology, cell and molecular biology, and bioinformatics through a biodiversity study in the JMU Arboretum. Likely the largest CURE implementation of DNA barcoding in the country, the JMU course involved a team of 17 instructors teaching more than 20 lab sections.

We expanded our effort to integrate the training practices of *Data Carpentry* and *Software Carpentry* (the *Carpentries*), which focus on manipulating and visualizing data. Using the *Carpentries* approach, DNALC staff trained 366 researchers and educators at one- and two-day training events in four countries, including seven *CyVerse Tools and Services* workshops (targeted at researchers) and two *Genomics in Education* workshops (targeted at educators), four *Software* and *Data Carpentry* workshops, as well as other training events. As part of our commitment to diversity, we presented on *CyVerse* and *Data Carpentry* for research and learning at the 2016 annual meeting of the *Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)*.

MaizeCODE

At 1.017 billion tons, the worldwide harvest of maize (corn) tops that of rice (738 million tons) and wheat (711 million tons). Maize has assumed this position as the largest staple crop after centuries of careful genetic breeding to enhance many of its growth and nutritional properties. In 2016, the DNALC teamed with scientists at CSHL and New York University on MaizeCODE, a major research project to develop an “encyclopedia” of DNA elements that control gene action

and influence the qualities that are selected by corn breeders. The project will generate 150 new data sets of RNA and DNA sequence that will shed light on the structure and function of the corn genome.

MaizeCODE builds on more than a century of pioneering maize research at CSHL. This began with George Shull's breeding of the first hybrid corn in the first decade of the 20th century and continued with Barbara McClintock's Nobel-winning discovery of transposable elements ("jumping genes") in the 1950s. Transposable elements compose about 85% of the maize genome and contribute to the plant's adaptability under different growing conditions. Modeled after the successful human ENCODE project, MaizeCODE will be a critical resource to help scientists link maize genotypes to phenotypes that impact economic characteristics of maize. For example, changes in global climate and expanded cultivation in developing countries will require modifications of maize genes that govern traits such as drought- and salt-resistance and nutrient assimilation. The identification of genetic variation that controls these and other traits will provide insights to breeders. The DNALC's task is to prepare undergraduate faculty so that they and their students can analyze the new datasets as they are released. Students will have access to virtual machines in the CyVerse cloud configured to run specific analyses, including measuring differential expression and splicing, identifying promoters and enhancers, and correlating transcription marks with population studies.

Even though the corn genome sequence was published in 2009, genes and other features have primarily been identified using computer predictions; surprisingly, the vast majority of the corn genome sequence has not been edited, or even carefully looked at, by researchers. The process of editing the genome sequence and adding detailed interpretations—including variations in the control, physical arrangement, and function of genetic information—is termed annotation. So, another key element of the outreach program is to improve the capability of *DNA Subway* for community annotation of the maize genome. The exercise in "genomic crowd-sourcing" will provide a common tool for researchers and students to take a detailed look at families of related genes—and to understand how genes are regulated under similar and different situations. For these reasons, we hope that our work on MaizeCODE will show that good research and education can be exactly the same thing.

Licensing

Since 2003, the DNALC has carried on a licensing program that offers institutions a formal affiliation and transparent access to intellectual property (IP) developed with \$40 million in federal and private grants. The licensing program has founded DNA teaching labs at ten institutions, including those described below.

DNALC Asia

In February 2015, CSHL and the Suzhou Industrial Park (SIP) entered into a 10-year agreement to develop DNALC Asia under the umbrella of the successful CSHL Asia Meetings. By spring of 2016, renovations were completed on three pod-like structures in the biotechnology district of SIP—one pod is equipped with eight teaching labs, while the others house an entrance/exhibit and cafeteria. After months of extensive training for instructional staff at Cold Spring Harbor, the first lab field trip was taught on April 6th, Jim Watson's birthday. Later in the year, DNALC staff traveled to Suzhou to assist with the launch of summer DNA camps and to help organize academic year field trips. Dr. Jessica Talamas spent an intensive six weeks at CSHL, preparing to take over the position of Education Director. With training and research experience at Johns Hopkins, U.C. San Diego, the Salk Institute, and the University of Pennsylvania—as well as experience coordinating human genome sequencing at the Broad Institute – Jessica brings scientific credibility to DNALC Asia. At the annual meeting of the governing Council, CSHL President Bruce Stillman and SIP Chairman Barry Yang ratified the transfer of management of

Right:
Bruce Stillman, Qing Yu, Melissa Du, and Dave Micklos during the December visit to Suzhou. Melissa Du stepped in as SIP DNALC Director and Qing Yu as Council Member following the management transfer.



Below:
Dave and Bruce at SIP CSHL Asia DNALC.



DNALC Asia from CSH Asia Meetings to the SIP Education Society, bringing a strong connection to the Education Bureau and local schools.

Beijing DNALC

Since 2014, the DNA Learning Center has collaborated with Beijing 166 High School, located in the ancient Dongcheng District. Beijing 166 is a designated “Beacon School” in biology, giving us the chance to help it develop as a model for schools throughout Beijing and China. During the year, we focused on preparing for a large-scale program in DNA barcoding, modeled on our *Urban Barcode Project*. DNA barcoding teaching materials were translated into Chinese and Beijing 166 faculty conducted summer workshops for students and teachers participating in the city-wide science collaboration, Ao-Xiang. In spite of snowy weather, 39 Beijing 166 students came to the DNALC in February to participate in courses on *DNA Science* and *DNA Barcoding*. During the summer, 53 middle school students visited for three weeks, completing *Fun with DNA*, *World of Enzymes*, *Green Genes*, and *Forensic Science* camps. DNALC instructor Catherine Zhang, a native of Xi'an, visited Beijing 166 twice in 2016. In April, she conducted a workshop on *Human DNA Fingerprinting* for 85 high school students and three high school science teachers from the Beijing area. The workshop culminated in a field trip to Zhoukoudian, where they came face-to-face with Peking Man, an example of our ancient relative *Homo erectus*. In October, 119 middle school students and ten teachers from Dongcheng School District attended a workshop on *Genome Science*.

University of Notre Dame DNALC

During the academic year, 1,800 students in grades 5–12 participated in hands-on labs, with some traveling as long as two hours to reach the center! During the summer, day and sleep-over camps served 130 students in grades 6–10. Led by Dr. Amy Stark, over 50 undergraduate and graduate volunteers assisted at ND DNALC labs and functions, including a DNA Day essay contest with prizes at the elementary, middle, and high school levels.



Cristina Fernandez-Marco (kneeling, third from left) and Dave Micklos (standing, back row second from right) with workshop participants at Centro de Innovación y Desarrollo Agroalimentario de Michoacán (CIDAM, translated Center of Innovation and Agri-food Development of Michoacán)

DNALC Mexico

We continued our collaboration with DNA Mexico, a consortium of clinical DNA testing companies, and the Mexican Ministry of Agriculture to develop a network of DNALCs around Mexico. Our key collaborators include Armando Barriguete, Hugo Scherrer, Francisco Gurria, Diego Ulibari, Alonso Sanz, and Manuel Rey. We continued to look for an inaugural site in Morelia, the capital of Michoacán State and the most important agricultural region in Mexico. In August, we visited Morelia to conduct workshops on *Human Molecular Genetics* for 72 high school teachers who came from as far as Mexico City—2.5 hours away. With the teachers, we tested a mass spectrometry system used for forensic DNA phenotyping, which uses DNA variation to predict the hair and eye color of crime scene suspects. Two lab instructors, Humberto Contreras-Cornejo and Ricardo Duran, received four weeks of intensive training at the DNALC. We also reconnected with former DNALC staff member Oscar Pineda-Catalan, who helped build the *Urban Barcode Project* in New York City. With plans to return to his native Mexico City, Oscar agreed to help us jump-start a DNA barcoding project in the capital city.

DNALC NYC

Experience from our licensing program—especially running DNALC *West* and *Harlem DNA Lab*—emboldened us to plan a large-scale center in New York City (NYC). In this way we could extend our successful hands-on science education model to serve the city's vibrant and diverse communities—including substantial numbers of underrepresented minority and disadvantaged students. After several years of searching sites around NYC we were offered 17,500 square feet of space at the City University of New York (CUNY) College of Technology (City Tech) campus in downtown Brooklyn. At year's end, we awaited final approval from the CUNY Board of Trustees of our 30-year, no-cost lease of this property. The plan was initially developed with strong support from City Tech President Russ Hotzler and four Vice Chancellors

of the CUNY system: Allan Dobrin (Chief Operating Officer), Gillian Small (Research), and Iris Weinsall and Judy Bergtraum (Facilities Planning, Construction, and Management).

The City Tech site occupies the entire second floor of an academic building on the corner of Adams and Tillary Streets, at the foot of the access ramp to the Brooklyn Bridge. The department of dental hygiene is expected to move out of the space by December 2017, with our renovations beginning in January and ending in late in 2018. A conceptual plan developed by Centerbrook Architects and Planners includes six teaching labs, two bioinformatics labs, prep labs, a lunchroom, and a large exhibit space. Two of the teaching labs will be devoted to course-based research projects by CUNY students during the academic year.

The City Tech location fulfills our key requirements of visibility and ready access to the student populations of New York City. With signage on the façade of the building, the DNALC brand will be immediately visible to all traffic coming off the Brooklyn Bridge. Downtown Brooklyn is one of the most accessible parts of New York City, and there are eight subway lines within several blocks of City Tech. There is ample room for bus drop off on both Tillary and Adams Streets. Brooklyn is the fastest growing of the five boroughs and has the largest population of school-age children (~400,000) and students enrolled in public school (~300,000). Brooklyn also has the greatest number of charter schools (more than 50) and highest charter school enrollment (~18,000).

Bolstered by the lead giving of CSHL trustee and mentor Laurie Landeau, by year's end we had raised \$25 million to develop and partially endow the NYC center. Our business model achieves a balanced budget based only on income from tuition and endowment funds currently pledged to the project. The model provides scholarships for all CUNY students participating in research experiences and achieves our goal of providing scholarships for half of all precollege students participating in academic year lab programs. Additional endowment or grant income will be used for student scholarships and new programs, limiting reliance on external funding.

Helping Out in Nigeria

Since 2013, we have collaborated with Nigerian plant biologist Dr. George Ude to set up a modern biotechnology lab at Godfrey Okoye University (GOU), a small Catholic institution in southeastern Nigeria. The school is located in Enugu, the capital of the Igbo tribe whose attempt to secede from Nigeria resulted in the Biafran Civil War of the 1960s. Enugu Province has never really recovered from the physical destruction of the war, the starvation of an estimated one million civilians, and the diaspora of millions of others. The transportation infrastructure and public administration buildings of Enugu are still in shambles. GOU is an oasis of peace and learning amidst the continuing chaos.



George Ude (left) and Dave Micklos at Godfrey Okoye University.

The biotechnology lab is a resource not only for GOU students but also for professors from throughout Nigeria, whose institutions lack modern lab equipment. Faculty training workshops in DNA barcoding held there in 2014–15 identified many local plants with new sequence variations or that were new accessions to GenBank; four remain today as the only *rbcl* barcode records for that species. An NSF grant to Bowie State University in Maryland,



Michael Okoro looks on as *Fun with DNA* camp students demonstrate DNA extraction techniques.

where Dr. Ude is a full professor, allowed us to implement an exchange program for Nigerian students to do lab projects at Bowie and the DNALC. Michael Okoro was the first exchange student, spending three weeks here in 2014 to complete a project on DNA barcoding of indigenous plants of Nigeria.

We invited Michael back in 2016 as our first “DNALC Scholar,” with the objective of further developing his lab and teaching skills to prepare him for entry into a U.S. graduate program. Michael arrived in spring and by fall we had achieved our objective: Michael was accepted to the graduate program in molecular biotechnology at New York University (NYU)! Our excitement quickly turned to dejection when we realized that Michael had no resources at all to support his graduate education. Nigeria is in the grip of a continuing financial crisis, during which the national currency, the Naira, has lost 50% of its value since 2014. As retired civil servants, Michael’s parents have not received any retirement payments during this time. Although Michael’s university had promised him a scholarship for graduate school, they have had to lay off staff and could not afford to help.

The solution came, at the last moment, through an NSF training supplement to MaizeCODE. Under the supplement, Michael will be mentored by three MaizeCODE co-PIs—Dave Micklos and Doreen Ware at CSHL, and Ken Birnbaum, who fortuitously is also director of the NYU Ph.D. program and cellular biology core. Michael will split his time between CSHL and NYU, weaving maize cell genetics, bioinformatics, and genome analysis into his graduate program. As part of the outreach effort, he will assist undergraduate faculty in using MaizeCODE for student research projects. The supplement will pay Michael’s NYU tuition, room and board at CSHL, and travel between the two sites.

Michael’s traineeship aligns with NSF’s Basic Research to Enable Agricultural Development (BREAD) program, funded in partnership with the Bill and Melinda Gates Foundation. The activities of MaizeCODE support BREAD’s objective to develop genomics resources for breeding

drought-, heat-, and disease-resistant varieties that can grow under the adverse conditions found throughout much of sub-Saharan Africa. Another important goal is to develop varieties that tolerate low-fertility conditions in the fields of smallhold farmers who cannot afford nitrogen fertilizers. (Smallholders, small plots that rely mainly on family labor, constitute approximately 80% of farmers in Nigeria and produce 98% of all food consumed there.) Michael's participation in MaizeCODE will, thus, help translate genetic gains into practical gains in the fields of family farms in Africa.

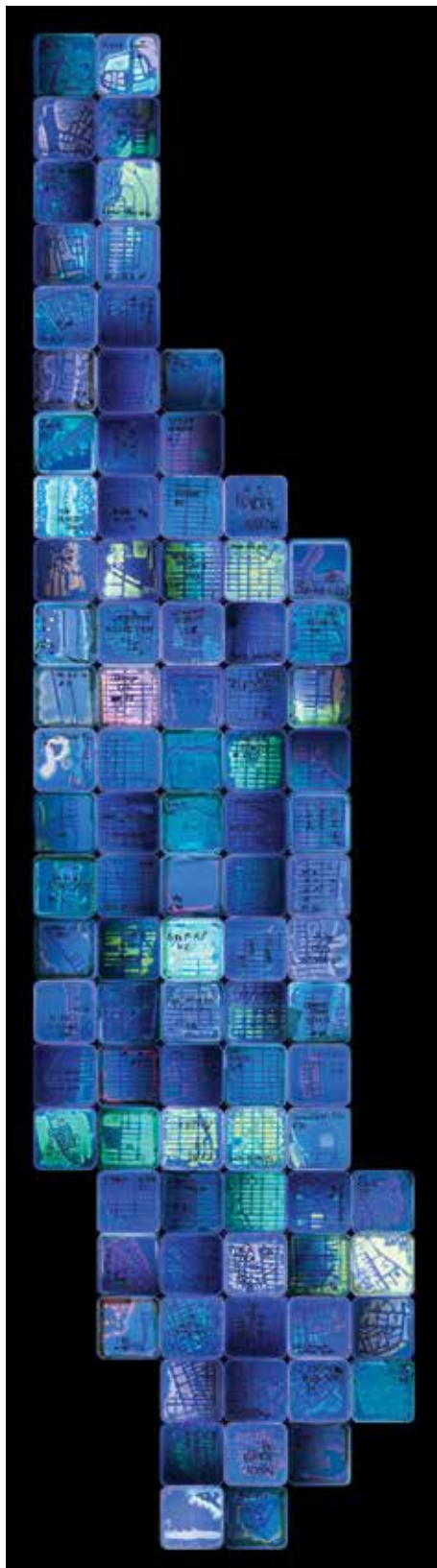
Breakthrough Junior Challenge

In 2015, we teamed with the *Breakthrough Junior Science Challenge*, in which precollege students produce short online videos that “explain a big scientific idea.” The winner receives a \$250,000 scholarship and the inspiring science teacher receives \$50,000. Our task: to administer \$100,000 to design and equip a *Breakthrough Science Lab* for the winning school. The first winner was Ryan Chester from North Royalton High School, outside of Cleveland, Ohio (<https://breakthroughjuniorchallenge.org/winners/2015>). During 2016, we worked with North Royalton teachers and administrators to design a lab with the look and feel of a DNALC lab—including our signature lab desks. In preparation for the new lab, we provided three days of teacher training in recombinant DNA technology and human DNA polymorphisms. In the midst of planning with North Royalton, we received word of a crop of three 2016 winners from around the world (<https://breakthroughjuniorchallenge.org/winners>): Deanna See, Raffles Girls School, Singapore; Antonella Masini, Cambridge College, Lima, Peru; and Hillary Diane Andales, Philippine Science High School, Eastern Visayas, Philippines. The Philippine school is still recovering from a 7.2 magnitude earthquake and Super Typhoon Yolanda that devastated the campus in December 2013 and forced the relocation of students in 2014.

Student Programs

In 2016, 20,784 students participated in labs during field trips to our three facilities: Dolan DNA Learning Center, DNALC *West*, and *Harlem DNA Lab*. An additional 9,232 students completed labs in school led by DNALC staff, and 1,451 students attended week-long summer camps. Footlocker kits were used by 1,229 students, including 404 conducting DNA barcoding research through *UBP*, *UBRP*, or *BLI*. Grants from Bank of America and the National Grid Foundation supported programs for over 2,400 underserved students from Long Island public schools—including Brentwood, Malverne, Uniondale, William Floyd, Central Islip, Roosevelt, and Valley Stream. An additional 24 students received scholarships to attend *Fun with DNA* at the New World Prep Charter School in Staten Island, and 15 students from IS 59 in Queens participated in an ongoing collaboration with Northwell Health at DNALC *West*. Seventy-three percent of the 2,642 students who visited the *Harlem DNA Lab* received scholarships, partially funded by the William Townsend Porter Foundation. The NYC Department of Education (DOE) Office of School Programs and Partnerships subsidized camps at *Harlem DNA Lab* and the DOE's Environmental Study Center in Brooklyn for 45 students.

We continued longstanding partnerships to co-teach courses in *Molecular and Genomic Biology* at Cold Spring Harbor High School (12th year) and St. Dominic High School in Oyster Bay (5th year). These college level experiences include research projects on bacterial genetics, DNA barcoding, bioinformatics, RNAi, CRISPR, human and plant genomics, and microbiomes. Five of 12 graduates of the CSH course intend to pursue undergraduate degrees in either biology or computer science. We also continued our collaboration with the CSHL Watson School of Biological Sciences to provide graduate students a teaching rotation during their first year. The three-month training program includes observations and co-teaching that help the students develop effective teaching techniques as they work toward the final goal of independent teaching.



The NYC Partner Membership Program continued to provide custom programs to six independent schools in the tri-state region. The St. David's School curriculum came full circle this year, when eighth graders, who participated in the school's pilot year as fifth graders, surveyed the biodiversity of Cold Spring Harbor by barcoding plants and invertebrates collected on a field trip. The Chapin School, our longest standing partner of six years, expanded its curriculum to include next-generation sequencing to study microbiomes. Similarly, the DNA barcoding teams from Convent of the Sacred Heart analyzed microbiomes from airplanes and parks. The eighth grade research students at Lycée Français de New York made formal presentations, including videos, of their barcoding research to classmates and parents. Marymount students also conducted DNA barcoding and genome science labs as part of a Molecular Genetics class. Riverdale Country School offered lab sequences for seventh, ninth, and eleventh grade students—including labs on antibiotic resistance, gel electrophoresis, and DNA sequencing.

We joined with other educational groups in expanding STEM to STEAM (Science, Technology, Engineering, Art, and Math). As part of our collaboration with Genspace, 50 citizen scientists produced an "agar art" map of NYC made with glowing bacteria. Participants painted suspensions of bacteria on square Petri dishes prepared with stenciled portions of Manhattan's grid map, including outlines of streets, parks, and waterways. The resulting *NYC Biome MAP* (left) was presented at the New Museum's Ideas City Festival NYC. The artwork came in second in the American Society of Microbiology (ASM) International Agar Art contest and was featured on the cover of ASM's first Agar Art Calendar. The project was covered in 160 news articles—including BBC, CNN, USA Today, and Huffington Post. At the prestigious Aspen Ideas Festival, 120 festival attendees worked to create collaborative microbial artwork depicting Aspen's iconic Maroon Bells mountain peaks. Half of eight *Saturday DNA!* sessions, which drew 171 participants, also had a STEAM focus. Participants tried their hands at agar art, worked on projects with BOLD exhibit artist Joe Rossano, and made watercolor "portraits" of cells and their organelles. Other sessions explored what Ötzi carried in his first aid kit, how doctors are using molecular diagnostics, and how to isolate a "glowing" protein from bacteria.

Finishing touches were added to the Ötzi exhibition and student guides and hands-on lab activities were developed in time to launch public tours that coincided with PBS's debut broadcast of *NOVA Iceman Reborn* on February 17th. The documentary chronicled Gary Staab, a leading artist specializing in natural history and prehistoric life models for museums, as he created a 3D replica of the Ötzi mummy and installed it at the DNALC. During the year, Ötzi drew 5,000 visitors; an additional 400 registered for weekend interpretive tours, which included a new *Pollen Tells a Story* lab. Participants use compound microscopes to identify the types of pollen found in different parts of Ötzi's intestinal tract, deducing



where he had been in the last 36 hours of his life: pollen from flowering plants indicates lower elevations, while pollen from evergreen plants indicates higher elevations.

With sadness, *Long Island Discovery* ended its 23-year run at the DNALC, when Cablevision was purchased by Altice, a multinational telecoms group based in the Netherlands. Cablevision developed this 28-minute “electronic field trip” to help students explore the rich history and landscapes of America’s longest offshore island. In 1993, Cablevision provided major funding to renovate our antique auditorium into a state-of-the-art “multitorium” with tiered seating, digital projection, and surround sound to support the multi-screen production. Over 100,000 visitors saw *Long Island Discovery* at the DNALC, including large numbers of fourth graders who study Long Island history as part of their curriculum. The multitorium continues to be used for showings of the short films *Cell Signals* and *Secret of Life*, and presentations by students and scientists. Plans are underway to reclaim the rear projection booth to return a bank of windows and 14-foot ceilings to the lunchroom.

BioMedia Visitation and Projects

A record number of visitors accessed our suite of multimedia resources in 2016. Total website, YouTube, and smartphone/tablet app visitation reached over 8 million, a 6.6% increase over 2015. Google Analytics counted 5,437,407 visits to 24 DNALC websites, just below the prior year’s total. Our YouTube videos received 959,294 views (up 8.9% over 2015), and the *3D Brain*, *Weed to Wonder*, and *Gene Screen* apps were downloaded 1,617,620 times (up 37%!). In-app purchases of *3D Brain HQ* netted \$8,600.

The *BioMedia* Group worked hard to merge the three student barcoding sites—*UBP*, *UBRP*, and *BLI*—with online resources to support student research into *DNA Learning Center Barcoding 101* (<http://www.dnabarcoding101.org>). The updated site includes background on DNA barcoding and detailed instructions for isolating and amplifying DNA samples. Enhanced teaching resources include shared documents, slide sets, animations, videos, references, and links to other online resources. The bioinformatics tool, *DNA Subway*, was upgraded to support fungal (ITS) and microbial (16S rRNA) barcodes. Project management was improved with a cleaner and more intuitive user interface to allow teachers to enroll teams, review proposals, track team progress, register for Open Labs, and request equipment footlockers. All team information and proposals are now linked to sample and sequence information. A new mapping tool searches student barcode sequences by homology, habitat, and taxonomy. A symposium section provides a long-term record of student accomplishments—including project summaries and posters—which can be used to support college applications and mentor funding requests.

The RNA-Seq project website (<http://www.rnaseqforthenextgeneration.org>) provides an easy-to-use interface to an extensive bank of faculty-developed tutorials and videos, lesson plans, and instructional use cases. This format will allow the project to be inexpensively sustained. In addition, detailed faculty profiles provide ready templates to involve additional classes in research on the datasets developed during the project—including project abstract,

research questions, experimental details, dataset description, and teaching resources. The *BioMedia* Group supported the transition of the RNA-Seq project to virtual training by blending these website resources with synchronous (webinars, discussions, and instructor “office hours”) and asynchronous components (seminars and tutorials). Streaming video, produced in the *Landeau Multimedia Studio*, was crucial to the online format. Using the Adobe Connect environment, 19 speakers presented lectures as if in a classroom, with DNALC staff switching between the presenter and a laptop displaying a slide show or live web demonstration. Adobe Connect also provided links and downloadable presentation materials, participant polls, a virtual whiteboard or notepad, screen sharing, and live chat to answer questions in real time. As a video alternative, we simultaneously streamed the webinars to the DNALC Livestream website, where the session was immediately available on demand for later viewing or review.

We have been fortunate to have Joseph Rossano's *BOLD the barcode of life* art exhibit at the DNALC since 2014. In the spring, *BioMedia* staff worked with DNALC educators to develop a *Saturday DNA!* session called “A BOLD Connection.” Participants learned about the science of DNA barcoding and how it gives us a deeper understanding of the natural world, then explored with Joe how art can bridge the gap between scientists and the general public. Participants wrapped up the session by creating their own Joe Rossano-inspired biodiversity art. The BOLD exhibition catalog was published in the fall. Seven essays—by artists, researchers, educators, and photographers—provide insight into the art and the barcoding science that inspired it. Unique to an art catalog, each “object” is described with a species name, Barcode of Life Database identification number, and DNA barcode sequence.



Staff and Interns

During the year, we built up new administrative and instructional capabilities. **Jason Williams** took on a new role as Assistant Director for External Collaboration to help with the management of our growing number of licensed centers. The position is a natural extension of his role as Education, Outreach, and Training Lead for CyVerse, which offers numerous training events around the country and world. Jason jumped in to support the start-up of DNALC Asia, and he will see more duty as we develop multiple centers in Mexico and Nigeria. **Alison Cucco** joined the New York City staff as lead teacher at *Harlem DNA Lab*. Her mentorship role in the NYC barcoding projects make good use of her former faculty position at St. Francis College and her biology master's from Fordham University, where she investigated the effects of urbanization on ecosystems and plant productivity. Hired as a college intern in 2015, **Keil Thomas** was promoted to Middle School Educator after graduating with a bachelor's degree in biomolecular science from the NYU School of Engineering. Keil also manages the footlocker loan program for *Barcode Long Island*.



Alison Cucco



Keil Thomas

We were also saddened to say goodbye to several key staff members. **Dr. Mona Spector** returned to the CSHL main campus to continue her research on leukemia in Mike Wigler's lab. We were lucky when, in 2014, Mona decided to take a sabbatical from research to administer our NSF RNA-Seq project, the most technically advanced biochemistry and bioinformatics work we had ever attempted. Drawing on her extensive research experience with RNA preparation and NGS sequencing, she developed wet lab protocols and oversaw the production of over 170 RNA-Seq transcriptomes for workshop participants. She also worked with the *BioMedia* staff to develop the project website and to improve the functionality of *DNA Subway's* Green Line. **Pan Teng** left to continue her career as a software engineer at Memorial Sloan Kettering Cancer Center. Pan joined the DNALC in 2015, increasing processing speed and expanding the organization of large-scale genomics data in *DNA Subway*, and implementing GPS solutions for the *Barcode Long Island* website. **Paul Donat** joined the Ecology and Evolution Ph.D. program at SUNY Stony Brook in August, focusing on plant genome evolution. Beginning as a college intern in 2012, Paul became our first full-time lab technician in 2015, and was quickly promoted to instructor.

The DNALC relies on high school and college interns to support day-to-day operations. An internship offers students the opportunity to gain laboratory or design experience in an educational environment. In 2016, we worked with an amazing group of interns and said farewell as some left for college:

High School Interns

Duardo Akerle, Half Hollow Hills High School	Rahul Ranjan, Hicksville High School
Alyssa DiArrigo, Bethpage High School	Ben Rhee, Syosset High School
Alec Haber, Syosset High School	Bijia Wang, Syosset High School
Derek Lee, Elwood-John H. Glenn High School	GraceAnne Woods, Glen Cove High School

High School Interns Departing for College

Brady Anna, University of North Carolina Chapel Hill	Stefanie Montalbano, Fairfield University
Juliana Eastment, University of Richmond	Gabrielle Ramirez, University of Pennsylvania
John Messina, Hofstra University	Maria Urbina, Tufts University

College Interns

Benjamin Acosta, Boston College	Marie Jean Francois, CUNY, The City College of NY
Abigail Buckley, Dartmouth College	Michaela Lee, State University of NY, Oneonta
Kathryn Bellissimo, The College of New Jersey	William McBrien, Suffolk Community College
Gabrielle Blazich, Fordham University	Pauline McGlone, Hunter College
Brittany Coscio, College of the Holy Cross	Breanna Tahany, State University of NY, Binghamton
Omotayo Ikuomenisan, Hunter College	

David Micklos
DNA Learning Center Executive Director

2016 Grants

Grantor	Program	Duration of Grant	2016 Funding*
<i>FEDERAL GRANTS</i>			
National Institutes of Health	<i>Barcode Long Island</i>	7/14–3/19	\$327,310
National Science Foundation	<i>Infrastructure and Training to Bring Next-generation Sequence (NGS) Analysis into Undergraduate Education</i>	9/13–8/16	130,480
National Science Foundation, University of Arizona	<i>iPlant Collaborative: Cyberinfrastructure for the Life Sciences</i>	9/13–8/16	690,344
National Science Foundation	<i>Advanced Technology Education (ATE) Genomic Approaches in BioSciences</i>	4/11–3/16	5,901
National Science Foundation	<i>TRPGR; Maize Cell Genomics: Resources for Visualizing Promoter Activity and Protein Dynamics using Fluorescent Protein Lines</i>	10/14–9/17	81,801
National Science Foundation	<i>MaizeCode—An Initial Analysis of Functional Elements in the Maize Genome</i>	6/16–5/19	48,731
<i>NON-FEDERAL GRANTS</i>			
Alfred P. Sloan Foundation	<i>DNA Center NYC Start-up</i>	12/13–11/19	14,079
Bank of America Charitable Foundation	<i>Genetics and Biotechnology Lab</i>	11/15–11/17	15,000
Beijing No. 166 High School	<i>Chinese Collaboration Agreement</i>	5/14–6/17	263,872
Health Park	<i>Health Park Agreement</i>	12/15–12/20	12,125
National Grid Foundation	<i>Scholarships for Minority and Underserved Students in the Central Islip Union-Free School District</i>	9/16–8/17	12,000
Pinkerton Foundation	<i>Urban Barcode Research Program</i>	1/13–5/17	151,461
William Townsend Porter Foundation	<i>Harlem DNA Lab for Underprivileged Students</i>	4/16–3/17	13,500
Teva Pharmaceuticals	<i>DNA Learning Center STEM Access Fund to Support Usage of the DNALC by Under-represented Minorities (URM) and Disadvantaged Students</i>	10/16–10/17	5,000

+ Includes direct and indirect costs.

The following schools and school districts each contributed \$1,000 or more for participation in the *Curriculum Study* program:

Bellmore-Merrick Central High School District	2,000	Massapequa Union Free School District	4,500
East Meadow Union Free School District	3,000	North Shore Central School District	2,000
East Williston Union Free School District	1,500	Oceanside Union Free School District	2,000
Elwood Union Free School District	3,000	Oyster Bay-East Norwich Central School District	3,500
Fordham Preparatory School	2,000	Plainedge Union Free School District	2,000
Garden City Union Free School District	2,000	Plainview-Old Bethpage Central School District	2,000
Half Hollow Schools Central School District	2,000	Portledge School	3,000
Harborfields Central School District	2,000	Port Washington Union Free School District	2,000
Herricks Union Free School District	2,000	Ramaz Upper School	2,000
Huntington Union Free School District	3,500	Roslyn Union Free School District	2,000
Island Trees Union Free School District	2,000	Syosset Central School District	3,000
Locust Valley Central School District	3,500	Yeshiva University High School for Girls	2,000

The following schools and school districts each contributed \$1,000 or more for participation in the *Genetics as a Model for Whole Learning* program:

Adelphi Science and Technology Entry Program	1,400	Lindenhurst Union Free School District	1,000
Baldwin Union Free School District	1,540	Locust Valley Central School District	9,330
Bellmore Union Free School District	2,400	Manhattan High School for Girls	1,440
Berkeley Carroll Middle School	1,300	Merrick Union Free School District	1,400
Cold Spring Harbor Central School District	12,600	Mott Hall II Middle School, NYC	1,400
Commack Union Free School District	1,700	Mount Vernon City School District	1,400
East Meadow Union Free School District	2,719	New Rochelle City School District	1,050
East Williston Union Free School District	1,875	North Bellmore Union Free School District	3,330
Edgemont Union Free School District	3,150	Oceanside Union Free School District	1,625
Elwood Union Free School District	7,075	Oyster Bay-East Norwich Central School District	2,400
Floral Park-Bellerose Union Free School District	7,800	Port Washington Union Free School District	10,370
Garden City Union Free School District	2,880	PS 144, NYC	10,590
Great Neck Union Free School District	8,250	Rockville Centre Union Free School District	6,240
Greenwich Country Day School	2,400	Scarsdale Union Free School District	6,300
Half Hollow Hills Central School District	19,095	Smithtown Central School District	4,400
Herricks Union Free School District	3,815	South Huntington UFSD	5,600
Hicksville Union Free School District	1,400	St. Dominic Elementary School	4,600
Hofstra Science and Technology Entry Program	2,500	St. Patrick's School	1,950
Holy Child Academy	3,411	Syosset Central School District	38,550
Horace Mann School	2,640	Three Village Central School District	4,690
Huntington Union Free School District	2,600	Trinity Regional School	1,045
Jericho Union Free School District	13,850	Yeshiva Darchei Torah	2,963
Lawrence Union Free School District	2,100		1,050

Sites of Major Faculty Workshops

Program Key: *Middle School* High School College

State	Institution	Year(s)
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
	Tuba City High School	1988
	University of Arizona, Tucson	2011
	United States Department of Agriculture, Maricopa	2012
ARKANSAS	Henderson State University, Arkadelphia	1992
	University of Arkansas, Little Rock	2012
CALIFORNIA	California State University, Dominguez Hills	2009
	California State University, Fullerton	2000
	California State University, Long Beach	2015
	California Institute of Technology, Pasadena	2007
	Canada College, Redwood City	1997
	City College of San Francisco	2006
	City College of San Francisco	2011, 2013
	Community College of Denver	2014
	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
	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
	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
	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 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, Atlanta	1991, 1996–97
	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
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, 1997, 2011
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
	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	2015–16
	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
	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, 2015–16
	Dolan DNA Learning Center	1990, 1992, 1995, 2000–11
	<i>Dolan DNA Learning Center</i>	1990–92
	DNA Learning Center West	2005
	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
	Harlem DNA Lab, East Harlem	2015–16
	Huntington High School	1986
	Irvington High School	1986
	John Jay College of Criminal Justice	2009
	<i>Junior High School 263, Brooklyn</i>	1991
	<i>Lindenhurst Junior High School</i>	1991
	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 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
	State University of New York, Purchase	1989
	State University of New York, Stony Brook	1987–90, 2015–16
	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	CIIT Center for Health Research, Triangle Park	2003
CAROLINA	North Carolina Agricultural & Technical State University, Greensboro	2006–07, 2009–11
	North Carolina School of Science, Durham	1987
	North Carolina State University, Raleigh	2012
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
	The Ohio State University, Wooster	2016
OKLAHOMA	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	NABT Professional Development Conference, Memphis	2008
TEXAS	Austin Community College – Rio Grande Campus	2000
	Austin Community College – Eastview Campus	2007–09, 2013
	Austin Community College – Roundrock Campus	2012
	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	2013
	Texas A&M University, Prairie View	2013
	Texas A & M, AG Research and Extension Center, Weslaco	2007
	Trinity University, San Antonio	1994
	University of Texas, Austin	1999, 2004, 2010, 2012
	University of Texas, Brownsville	2010
UTAH	Brigham Young University, Provo	2012
	University of Utah, Salt Lake City	1993
	University of Utah, Salt Lake City	1998, 2000
	Utah Valley State College, Orem	2007
VERMONT	University of Vermont, Burlington	1989
VIRGINIA	Eastern Mennonite University, Harrisonburg	1996
	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	1999, 2001, 2008
	Shoreline Community College	2011, 2012
	University of Washington, Seattle	1993, 1998, 2010
WEST VIRGINIA	Bethany College	1989
WISCONSIN	Blood Center of Southeastern Wisconsin, Milwaukee	2003
	Madison Area Technical College/Madison Area College	1999, 2009, 2011–14
	Marquette University, Milwaukee	1986–87
	University of Wisconsin, Madison	1988–89
	University of Wisconsin, Madison	2004, 2012
WYOMING	University of Wyoming, Laramie	1991
PUERTO RICO	Universidad del Turabo, Gurabo, Puerto Rico	2011, 2012, 2014
	University of Puerto Rico, Mayaguez	1992
	University of Puerto Rico, Mayaguez	1992
	University of Puerto Rico, Rio Piedras	1993
	University of Puerto Rico, Rio Piedras	1994
AUSTRALIA	Walter and Eliza Hall Institute and University of Melbourne	1996
	EMBL/Australian Bioinformatics Resource, University of Melbourne	2016
AUSTRIA	Vienna Open Lab, Vienna	2007, 2012
CANADA	Red River Community College, Winnipeg, Manitoba	1989
CHINA	Beijing No. 166 High School, Beijing	2013–16
	Ho Yu College, Hong Kong	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	2015
ITALY	International Institute of Genetics and Biophysics, Naples	1996
	Porto Conte Research and Training Laboratories, Alghero	1993
MEXICO	ADN Mexico, Morelia	2016
	ASPB Plant Biology, Merida	2008
	Langebio/Cinvestav, Irapuato	2016
NIGERIA	Godfrye Okoye University, Enugu, Nigeria, Africa	2013
PANAMA	University of Panama, Panama City	1994
RUSSIA	Shemyakin Institute of Bioorganic Chemistry, Moscow	1991
SINGAPORE	National Institute of Education	2001–05
	Singapore Science Center	2013
SOUTH AFRICA	North-West University, Potchefstroom	2016
	South African Bioinformatics Society, Durban	2016
SWEDEN	Kristineberg Marine Research Station, Fiskebackskil	1995
	Uppsala University	2000
THE NETHERLANDS	International Chromosome Conference, Amsterdam	2007
	Wageningen University and Research Center, Wageningen	2014
UNITED KINGDOM	The Genome Analysis Center, Norwich	2015
	Wellcome Trust Conference Center, Hinxton	2012–13
	University of Warwick, Coventry	2013

Workshops, Meetings, Collaborations, and Site Visits

January 7–8	NSF Data Science, Learning, and Applications to Biomedical & Health, “A Vision for Collaborative Training Infrastructure for Bioinformatics,” New York Academy of Sciences, New York, New York
January 9	<i>Saturday DNA!</i> “BioArt,” DNALC <i>Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab</i>
January 9–12	International Plant and Animal Genome XXIV Conference 2016, “DNA Subway: Educational Challenger of Biological Big Data; <i>Genomics in Education: DNA and Senses; Cultivating Broader Impacts</i> ,” San Diego, California
January 12	NIH <i>Barcode Long Island Open Lab, DNALC West</i> <i>Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab</i>
January 19–20	NSF CyVerse Data Carpentry Genomics Workshop, Stony Brook University, Stony Brook, New York
January 21	<i>Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab</i>
January 28	NSF <i>Infrastructure and Training to Bring Next-generation Sequence (NGS) Analysis into Undergraduate Education</i> Video Conference, DNALC
February 1	Expanded Professional Development Workshop, <i>DNA Structure and Function, Harlem DNA Lab</i>
February 1–2	NSF CyVerse <i>Genomics in Education</i> Workshop, University of Delaware, Newark, Delaware
February 2	<i>Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab</i>
February 2–5	NSF CyVerse <i>Software Carpentry</i> Workshop, New York Academy of Sciences, New York, New York
February 3	NYCDOE “DNA Extraction and Bacterial Transformation,” STEM Professional Learning, New World Preparatory Charter School, Staten Island, New York Site visit by Angelika Fleckinger, South Tyrol Museum of Archaeology, Bolzano, Italy, Emlyn Kostner, North Carolina Museum of Natural Sciences, Raleigh, North Carolina, and Heinz Reese, Museum Partners Consulting, LLC, Morristown, New Jersey, DNALC

- February 3–4 NSF CyVerse *Tools and Services* Workshop, University of Delaware, Newark, Delaware
 February 6 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
 NIH *Barcode Long Island* Open Lab, DNALC
Saturday DNA! "Otzi's First Aid Kit," DNALC
- February 10 NSF CyVerse Webinar Series, "Getting Started with CyVerse," DNALC
 February 11 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
 February 16 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
 February 16–19 Pinkerton *Urban Barcode Research Program Conservation Genetics* Workshop, *Harlem DNA Lab*
 February 21 *Ötzi the Iceman* Tour, DNALC
 February 25 Site visit by Dr. Armando Barriguete and Hugo Scherer, Mexico City, Mexico
 Jan 25–Feb 5 *DNA Barcoding and DNA Science* Workshops with students from Beijing 166 School, Beijing, China, DNALC
- February 27 NIH *Barcode Long Island* Open Lab, Brookhaven National Laboratory, Upton, New York
 NIH *Barcode Long Island* Open Lab, DNALC
Ötzi the Iceman Tour, DNALC
 STEP STEM Expo 2016, *Urban Barcode Research Program* booth, Bronx Community College, Bronx, New York
- March 2 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
 March 3 Professional Development Workshop, Michael J. Petrides School, Staten Island, New York
 March 3–5 NSF Mid-South Computational Biology and Bioinformatics Conference, "Overview of CyVerse," University of Memphis, Memphis, Tennessee
- March 5 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
Ötzi the Iceman Tour, DNALC
- March 7–18 *Human Genome Science* Workshop, Beijing 166 School, Beijing, China
 March 8 *Ötzi the Iceman* Tour, DNALC
 March 9 NSF CyVerse Webinar Series, "Getting Started with CyVerse," DNALC
 March 12 *Saturday DNA! "Protein Aglow,"* DNALC
 March 16 *Ötzi the Iceman* Tour, DNALC
 March 17 NSF CyVerse Livestream Webinar, *Tools and Services* Workshop, The Ohio State University, Wooster, Ohio
Urban Barcode Project/Urban Barcode Research Program Open Lab, *Harlem DNA Lab*
- March 17–18 NSF CyVerse *Tools and Services* Workshop, The Ohio State University, Wooster, Ohio
 March 18 City College of New York Noyce Teacher Academy, *DNA Extraction*, *Harlem DNA Lab*
 March 19 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
 NIH *Barcode Long Island* Open Lab, Brookhaven National Laboratory, Upton, New York
 NIH *Barcode Long Island* Open Lab, DNALC
Ötzi the Iceman Tour, DNALC
- March 22 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
 March 23 NSF "CyVerse Education, Outreach, and Training," iDigBio Webinar Series, DNALC
 March 24 CSHL Public Presentation, "Asking the Wrong Questions About American Science Education," CSHL
- March 29 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
 March 29–30 NSF CyVerse *Genomics in Education* Workshop, Southern Illinois University, Carbondale, Illinois
- March 30 *Ötzi the Iceman* Tour, DNALC
 March 31 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
 Mar 31–Apr 1 NSF CyVerse *Tools and Services* Workshop, Southern Illinois University, Carbondale, Illinois
 April 2 NIH *Barcode Long Island* Open Lab, DNALC
Ötzi the Iceman Tour, DNALC
Urban Barcode Project/Urban Barcode Research Program Open Lab, *Harlem DNA Lab*
- April 6 Pinkerton Teen SciCafe and *Urban Barcode Research Program* Mentor Networking Event, American Museum of Natural History, New York, New York

- April 7 Site visit by Camille Santistevan, CUNY Advanced Science Research Center, New York, New York, *Harlem DNA Lab*
Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab
- April 9 NIH *Barcode Long Island* Open Lab, Stony Brook University, Stony Brook, New York
Ötzi the Iceman Tour, DNALC
- April 11 NSF CyVerse Training Day, European Molecular Biology Laboratory/Australian Bioinformatics Resource, University of Melbourne, Melbourne, Australia
- April 11–12 Cold Spring Harbor First Grade Science Fair, “Seaweed Surprise and Fingerprints,” CSHL
- April 12 NSF CyVerse Training Day, CyVerse and Atmosphere Overview, University of Melbourne, Melbourne, Australia
Site visit by Regeneron Pharmaceuticals Planners, DNALC *West*
Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab
- April 13 *Ötzi the Iceman* Tour, DNALC
- April 16 NIH *Barcode Long Island* Open Lab, Brookhaven National Laboratory, Upton, New York
Ötzi the Iceman Tour, Long Island Real Estate Group, DNALC
Saturday DNA!, “A BOLD Connection,” DNALC
34th Annual Conference of Empire State Association of Two Year College Biologists, *DNA Barcoding* Workshop, Middletown, New York
Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab
- April 20 NSF CyVerse Webinar Series, “Getting Started with CyVerse,” DNALC
- April 21 *Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab*
- April 23 *Ötzi the Iceman* Tour, DNALC
- April 25 *Ötzi the Iceman* Tour, DNALC
- April 25–29 Pinkerton *DNA Barcoding* Workshop, The Rockefeller University, New York, New York
- April 26 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
- April 27 *Ötzi the Iceman* Tour, DNALC
- April 27–29 American Association for the Advancement of Science: “Future of Undergraduate STEM Education: Research and Practice,” Washington, D.C.
- April 30 NIH *Barcode Long Island* Open Lab, Stony Brook University, Stony Brook, New York
Ötzi the Iceman Tour, DNALC
- May 3 *Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab*
- May 5 *Ötzi the Iceman* Tour, DNALC
- May 7 NIH *Barcode Long Island* Open Lab, Stony Brook University, Stony Brook, New York
NIH *Barcode Long Island* Open Lab, DNALC
Urban Barcode Project/Urban Barcode Research Program Open Lab, Harlem DNA Lab
- May 9–12 NIH SEPA SciEd Conference, *Barcode Long Island: Exploring Biodiversity in a Unique Urban Landscape*, Washington, D.C.
- May 11 NIH *Barcode Long Island* Open Lab, Brookhaven National Laboratory, Upton, New York
- May 13 TEDxYouth at the Browning School *Biodiversity Day*, “DNA Barcoding,” Browning School, New York, New York
- May 14 NIH *Barcode Long Island* Open Lab, Brookhaven National Laboratory, Upton, New York
- May 17 New York Department of Education *Stemtastic* Event, New York Hall of Science, Corona, New York
- May 19 Aguascalientes (AGS) Conference on Innovation, “Weed to Wonder: Maize in Mexico,” Aguascalientes, Mexico
- May 21 *Ötzi the Iceman* Tour, DNALC
Manhattan Community School District 5 and Harlem Children’s Zone, Science, Technology, Engineering and Math Expo, Harlem Armory, New York, New York
- May 23 NSF “CyVerse Atmosphere for Educators,” Big Genomic Data Skills for Professors, Jackson Laboratory, Farmington, Connecticut
- May 23–24 Site visit by Cheong Kim Fatt, Singaporean Ministry of Education, Queenstown, Singapore, DNALC and *Harlem DNA Lab*

- May 24–26 NSF CyVerse *Genomic Science and Leadership Initiative* Workshop, J. Craig Venter Institute, Rockville, Maryland
- May 25 *Ötzi the Iceman* Tour, DNALC
- May 26–27 NSF CyVerse *Data Carpentry Genomics*, National Institute of Health, Bethesda, Maryland
- May 30–June 2 NSF CyVerse *Tools and Service/Data Carpentry* Workshop, Langebio Cinvestav, Irapuato, Mexico
- May 31 NIH *Barcode Long Island* Open Lab, DNALC
- June 1–2 NSF *Infrastructure and Training to Bring Next-generation Sequence (NGS) Analysis into Undergraduate Education* Webinar, DNALC
- June 3 NSF CyVerse *Genomics Data Carpentry* Workshop, Langebio Cinvestav, Irapuato, Mexico
Urban Barcode Project and Pinkerton *Urban Barcode Research Program* Symposium, Borough of Manhattan Community College, New York, New York
- June 6–17 NSF *Infrastructure and Training to Bring Next-generation Sequence (NGS) Analysis into Undergraduate Education* Virtual Workshop, DNALC
- June 7, 9 *DNA Subway* Workshop and “Citizen Science at the DNALC,” Ecsite Conference 2016, Natural History and Science Museum of the University of Porto, Portugal
- June 10 NIH *Barcode Long Island* Symposium, CSHL
- June 16 *Ötzi the Iceman* Tour, DNALC
- June 20 QUBES – 2016 National Academies Special Topics Summer Institute on Quantitative Biology, University of North Carolina, Raleigh, North Carolina
- June 21 23rd Annual Golf Outing, Piping Rock Club, Locust Valley, New York
- June 22 NSF CyVerse Webinar Series, “Getting Started with CyVerse,” DNALC
- June 22–26 Aspen Ideas Festival, Science/Art Workshop, “Painting with Microbes Brings an Unseen World into View,” Aspen, Colorado
- June 24 Site visit by Mary Ellen Elia, New York State Department of Education and University of the State of New York, John D’Agati, New York State Department of Education, Office of Higher Education, and Roger Tilles, New York State Board of Regents, Albany, New York, DNALC
- June 26–July 15 *DNA Science, Genome Science, and Barcode Long Island* Workshops attended by student from Godfrey Okoye University, Enugu, Nigeria and students from Bowie State University, Bowie, Maryland with George Ude, University System of Maryland Elkins Professor
- June 27–July 1 NIH *Barcode Long Island* Workshop, Brookhaven National Laboratory, Upton, New York
- June 27–July 1 *DNA Science* Workshop, DNALC (2 sessions)
Fun with DNA Workshop, DNALC
Green Genes Workshop, DNALC
Fun with DNA Workshop, DNALC West
- June 28 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
- June 29 National Congress of American Indians 2016 Mid-Year Conference and Marketplace, Tribal Leader Scholar Forum, “Should AI/AN communities consider genomic technologies in agricultural practices?” Spokane Convention Center, Spokane, Washington
- July 5–8 Pinkerton *Urban Barcode Research Program Conservation Genetics* Workshop, *Harlem DNA Lab*
Forensic Detectives Workshop, DNALC
Fun with DNA Workshop, DNALC
Genome Science Workshop, DNALC
World of Enzymes Workshop, DNALC
World of Enzymes Workshop, DNALC West
- July 7 Site visit by Tom Flanagan, Girl Scouts of Suffolk County, Commack, New York
- July 7–12 American Society of Plant Biologists/Plant Biology 2016, “Accelerating Plant Science with CyVerse,” Austin, Texas
- July 11 Site visit by Liz Baird, Christy Flint, Wendy Lovelady, and Imogen Hoyel, North Carolina Museum of Natural Science, Raleigh, North Carolina

- July 11–15 NIH *Barcode Long Island* Workshop, DNALC
DNA Science Workshop, DNALC
Green Genes Workshop, DNALC
World of Enzymes Workshop, DNALC
DNA Science Workshop, *Harlem DNA Lab*
DNA Science Workshop, DNALC West
- July 14 My Long Island TV filming of *World of Enzymes* and *DNA Science* Workshops, DNALC
- July 18 NIH *Barcode Long Island* Microbiome Project Planning Workshop, DNALC
- July 18–22 *DNA Science* Workshop, DNALC
Fun with DNA Workshop, DNALC
Green Genes Workshop, DNALC West
Pinkerton *Urban Barcode Research Program DNA Barcoding* Workshop, *Harlem DNA Lab*
- July 18–Aug 5 International Students Summer 2016, Beijing 166 School, Beijing, China, DNALC
- July 19 Site visit by David Stark, CSHL Association Member, and legal counsel for Teva Pharmaceuticals, Petach Tikva, Israel, DNALC
- July 25–29 Pinkerton *Urban Barcode Research Program Conservation Genetics* Workshop, *Harlem DNA Lab*
BioCoding Workshop, DNALC
DNA Barcoding Research Workshop, DNALC
Green Genes Workshop, DNALC
Fun with DNA Workshop, DNALC West
- July 30 NIH *Barcode Long Island* Microbiome Project Open Lab, DNALC
- August 1–5 NIH *Barcode Long Island* Workshop, Stony Brook University, Stony Brook, New York
Pinkerton *Urban Barcode Research Program DNA Barcoding* Workshop, *Harlem DNA Lab*
DNA Barcoding Research Workshop, DNALC
Fun with DNA Workshop, DNALC
Forensic Detectives Workshop, DNALC West
- August 1–12 New York City Department of Education *DNA Barcoding* Workshop, Environmental Science Center, Brooklyn, New York
- August 2 Site visit by Anthony Clarkson and Peter Turner, Clarkson University, Potsdam, New York
- August 3–6 Network for Integrating Bioinformatics into Life Sciences Education Kick-off Meeting, University of Omaha, Omaha, Nebraska
- August 8–12 Pinkerton *Urban Barcode Research Program Conservation Genetics* Workshop, *Harlem DNA Lab*
Backyard Barcoding Workshop, DNALC
Being Human Workshop, DNALC
Fun with DNA Workshop, DNALC
World of Enzymes Workshop, DNALC West
- August 8–13 ADN Mexico *Molecular Genetics Experiences for Students* Workshop, Morelia, Mexico
- August 9 NSF CyVerse Webinar Series, “Getting Started with CyVerse,” DNALC
- August 15–19 *DNA Science* Workshop, DNALC
Fun with DNA Workshop, DNALC
Genome Science Workshop, DNALC
World of Enzymes Workshop, DNALC
Backyard Barcoding Workshop, DNALC West
Pinkerton *Urban Barcode Research Program DNA Barcoding* Workshop, *Harlem DNA Lab*
- August 21–22 “Leveraging Cyberinfrastructure to Scale Science and People,” South African Bioinformatics Society, Durban, South Africa
- August 22–26 *Forensic Detectives* Workshop, DNALC
Green Genes Workshop, DNALC
World of Enzymes Workshop, DNALC
Fun with DNA Workshop, DNALC West
NIH *Barcode Long Island* Microbiome Project Workshop, DNALC

- August 23 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
 Site visit by Stefan Lutzmeyer, Gregor Mendel Institute, Vienna, Austria, *Harlem DNA Lab*
- August 23–26 *Urban Barcode Project, DNA Barcoding Workshop, Harlem DNA Lab*
- Aug. 29–Sept. 2 DNA Science Workshop, DNALC
Fun with DNA Workshop, DNALC
Green Genes Workshop, DNALC
World of Enzymes Workshop, DNALC West
- September 14 NSF CyVerse Webinar Series, “Getting Started with CyVerse,” DNALC
- September 15 NSF CyVerse SolGenomics Webinar, “CyVerse Virtual Demo,” University of California Davis, Davis, California
- September 22 Pinkerton *Urban Barcode Research Program* featuring Irondale Theater Company, Irondale Theater, Brooklyn, New York
- September 23 South African Bioinformatics Society, South African Genetics Society Joint Conference, “Leveraging Cyberinfrastructure to Scale Science and People,” Durban, South Africa
- September 26–29 NSF CyVerse *Data Carpentry* Workshop, North-West University, Potchefstroom, South Africa
- October 4 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
- October 12 NSF CyVerse *Data Carpentry* Workshop, SACNAS (Advancing Chicanos/Hispanics & Native Americans in Science) National Conference, Long Beach Convention Center, California
 NSF CyVerse Webinar Series, “Getting Started with CyVerse,” DNALC
- October 17–27 *Genome Science and DNA Subway*, Beijing 166 School, Beijing China
- October 15 *Saturday DNA! “Cellular Portraits,”* DNALC
- October 17–19 Breakthrough Prize, *Molecular Techniques for High School*, North Royalton High School, Cleveland, Ohio
- October 19–25 NSF CyVerse *Cereal Genomics* Course, “Introduction to CyVerse,” CSHL
- October 21 Open Space Stewardship Program (OSSP) through Brookhaven National Laboratory, *A Day in the Life*, Peconic River, Riverhead, New York
- October 26–29 Biological Data Science, “Required Parameters: What Does it Take to Bring Bioinformatics into the Classroom at the National Level?” CSHL
- October 28 Site visit by Roberta Trapper, Principal, and Carol Yilmax, Founder, Long Island School for the Gifted, South Huntington, New York
- November 5, 12 *Saturday DNA! “Agar Art,”* DNALC
- November 8 “One Native Scientist’s Path from Red Valley to FLC MARC and Beyond!” Presentation, Fort Lewis College, Durango, Colorado
Ötzi the Iceman Tour, DNALC
 NIH *Barcode Long Island* Microbiome Project Open Lab, DNALC
- November 10–12 AISES National Conference, JCVI/David Jackson project presentation Minneapolis, Minnesota
- November 12 *Ötzi the Iceman* Tour, DNALC
- November 14–15 Science Media Exchange (SCIMEX) Presentation, “*Barcode Long Island* Student-centered Biodiversity Research,” Crest Hollow Country Club, Woodbury, NY
- November 15 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
- November 21 “Gleevec: Smart Bomb in the War on Cancer,” Microsoft, New York, New York
- November 29–30 Indigenous Day Presentation “Balancing Diné and Keres Cultural Heritage in Academic Science,” University of the Fraser Valley, Abbotsford, British Columbia
- November 30 *Ötzi the Iceman* Tour, DNALC
- December 2 Site visit by Dr. Sean Kassen, Dr. Mary Galvin, Allison (Maddux) Slabaugh, Dr. Amy Stark, University of Notre Dame, Notre Dame, Indiana
- December 3 *Saturday DNA! “Molecular Diagnostics,”* (2 sessions) DNALC
- December 6 CSHL *Gramene: A Resource for Comparative Plant Genomics* Webinar, DNALC
- December 10 Pinkerton *Urban Barcode Research Program DNA Barcoding Workshop, Harlem DNA Lab*
- December 17 NIH *Barcode Long Island* Open Lab, DNALC
- December 19 Suzhou High School affiliated with Xi’an Jiaotong University, “What DNA Says About our Human Family,” Suzhou, China



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