

ANNUAL REPORT 2014



Cold Spring Harbor Laboratory
DNA LEARNING CENTER

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

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

On the cover:

Amanda McBrien and students in a *World of Enzymes* camp on Parent Participation Day.

DNA LEARNING CENTER EXECUTIVE DIRECTOR'S REPORT

Preparing students and families to thrive in the gene age

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A fall meeting of computer scientists and undergraduate biology educators at CSHL's Banbury Center came to a surprising conclusion: there is plenty of compute time available on high performance computers for undergraduate research projects, but most teaching faculty do not know how to access or use it. Representatives of the National Science Foundation's (NSF) supercomputer system, XSEDE (Extreme Science and Engineering Discovery Environment), and two major cyberinfrastructure projects—NSF's *iPlant Collaborative (iPlant)* and the Department of Energy's KnowledgeBase (KBase)—agreed that they would make increased efforts to reach faculty at primarily undergraduate institutions.

High performance computing (HPC) generally refers to supercomputers composed of hundreds of thousands of individual processors (identical to a high-end desktop processor) linked in a parallel system that optimizes communication speed between the individual processors. HPC involves splitting a job into tasks that are performed by different processors (parallelization) and also assigns repeated, or looped, tasks (vectorization). Extremely intensive calculations may engage a large proportion of the available processors; however, smaller jobs are assigned to one or a few nodes, or clusters, of processors. Thus HPC begins with clusters of parallel processors—often including some “cloud” services—that can perform in minutes or hours complex calculations that would take a desktop computer days or weeks to finish, if at all.

Biology is awash with data from genome sequencing. The cost of DNA sequencing—and, by extension, of producing a sequenced genome—has decreased 10,000 fold since 2007. Beijing Genomics Institute, a genome sequencing “factory” in Shenzhen and Hong Kong, China, can sequence several hundred eukaryotic genomes per day—including a human genome for as little as \$3,000. Mike Schatz, a genome informaticist at CSHL, said that within a decade the “data tsunami” of DNA sequence will grow to an exabyte (1 billion gigabytes) annually—equivalent to the information carried by 200 million DVDs. Indeed, 95% of 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 in the near future

At least DNA data makes use of a standard file format called FastQ. Unfortunately, there are few standards for many other types of biological data—from phenotyping, field studies, remote sensing, range mapping, modeling, and visualization. According to Bryan Heidorn of the University of Arizona, 80% of biological data is being created by smaller projects—without computational infrastructure, data standards, or data federation. These data are often “trapped” in lab notebooks or in Word, Excel, or PDF files that cannot readily be accessed. For these reasons only about 8% of non-genomic ecological data is shared. This creates a

massive amount of biological “dark data.” Like the dark matter of the universe, “we know it is there or used to be there, but we can’t see it.”

Unlike the physical sciences, which have a long tradition of large-scale, computationally-intensive projects, biology has only recently entered the HPC world. Henry Neeman of the University of Oklahoma said, “The undergraduate biology education community is in the same position today as the physical science education community was some years ago—aware of the value and potential of HPC, but still figuring out what resources and capabilities are available, and how to use them.”

Neeman explained that there are “owners and orphans” in the HPC world. The “owners” are high-level research programs with annual allocations of hundreds of millions of core hours. Owner jobs, which may command thousands of compute nodes at once, get priority scheduling. The “orphans” are small-scale users who use nodes that are not scheduled by owners. Orphans can access XSEDE through a gateway—such as *Galaxy*, a popular bioinformatics web-based graphical interface, or *iPlant*—or can formally request an education allocation. A “start-up” education allocation of 150,000 core hours is enough to process at least 200 RNA-Seq experiments capable of yielding publishable results. So, although HPC resources are oversubscribed by owners, there is ample orphan bandwidth for undergraduate biology faculty. However, biological projects only account for 10% of educational allocations on XSEDE.

Amid calls to make undergraduate biology education more engaging, datasets from genomics, phenomics, range mapping, modeling, and visualization can provide authentic research opportunities for large numbers of undergraduate courses. Although the nation’s supercomputers have enough capacity to support a major expansion in undergraduate biology research, faculty need to be made aware of computational resources and trained to use them to analyze big data.

Answering the Call for RNA Sequence Analysis

RNA sequence (RNA-Seq) analysis is viewed as an “entry level” analysis of a whole eukaryotic genome, providing a snapshot of genes expressed by an organism that can be used to annotate new genes and gene variants or to document differential gene expression. Tools for RNA-Seq analysis are the most frequently requested genome applications at the *iPlant Collaborative* and *Galaxy*. The biochemical expertise for extracting RNA needed for RNA-Seq analysis is available at virtually any undergraduate institution and sequencing costs under \$3,000.

However, the computational challenge of analyzing even a modest RNA-Seq experiment is daunting. The simplest RNA-Seq experiment—two experimental conditions and two biological replicates—generates 30–50 million sequence “reads,” each 150 base pairs. Aligning these reads to a sequenced genome, assembling the reads into gene models, and calculating differences in gene expression would take 27 days for a laptop computer with a single processor. Thus we have made a major commitment to develop a simple way for biology faculty and students to access the HPC resources to analyze RNA-Seq datasets.

As part of the *iPlant Collaborative*, a ten-year NSF project to develop computer infrastructure to support biological research, the DNALC developed *DNA Subway* with several “lines” to simplify the analysis of genes and genomes. In 2014 we completed the Green Line of *DNA Subway* as an educational workflow for RNA-Seq analysis that taps into the XSEDE national high performance computing infrastructure. Based on the popular Tuxedo Protocol, the Green Line stages faculty and student jobs on the Stampede supercomputer at the Texas Advanced Computing Center, where an average RNA-Seq experiment takes about 40 hours



Above: Mike Schatz speaks with the RNA-Seq Working Group.



Left: Eric Antoniou gives a tour of the CSHL Genome Center to RNA-Seq faculty.

on 16 processors (cores), or 640 core hours. This represents 0.015 % of available computational power on this supercomputer!

This *iPlant* infrastructure coordinates with our \$537,000 NSF grant, *Infrastructure and Training to Bring NGS*

Analysis into Undergraduate Education, under which we are helping undergraduate faculty to develop novel RNA-Seq datasets for use in course-based and independent student research. In June 2014, faculty members from predominantly undergraduate teaching institutions (PUI) in 10 states convened at CSHL for a Working Group Retreat. With support from Illumina and sequencing services performed by the CSHL Genome Center, faculty obtained 50 RNA-Seq transcriptomes covering ~4.2 billion paired-end DNA sequencing reads. Projects were diverse, included eight different species, and examined gene expression changes in: 1) *Apis mellifera* flight muscle during life-stage transitions; 2) leaf development and senescence in *Arabidopsis thaliana*; 3) retina development in *Gallus gallus*; 4) caprine testes during juvenile development to puberty; 5) maize in response to cold stress; 6) retinas of mice with retinitis pigmentosa; 7) differentiation of rat neural precursors during maternal immune activation; 8) seed abscission in *Sorghum bicolor*; 9) floral inflorescence genes in banana/plantains; and 10) *Brassica rapa* gibberellic acid (*gad*) mutants upon gibberellic acid exposure. The beta version of the Green Line was rigorously tested during the retreat; 837 jobs were submitted to TACC, consuming 695 hours total CPU time.

Also during the Retreat, Working Group members planned classroom implementation and contributed content to a new website *RNA-Seq for the Next Generation* (www.rnaseq-forthenextgeneration.org) which was launched in December. The site already features a Profile section, where each Working Group member has a dedicated page that includes a video introduction and abstract, experimental details and data access information, and course descriptions and resources. The RNA-Seq data and profile page content can serve as a foundation and reference for other undergraduate faculty as they incorporate RNA-Seq analysis in their teaching. Post-retreat, we have conducted monthly videoconferences (utilizing Adobe Connect meeting rooms) to update Working Group faculty on data analysis progress, changes to the website, and to share evolving instructional strategies. A multi-faceted evaluation program will assess effects on student learning, interests, and attitudes across different classroom and student research settings. By year's end, Working Group members had already used their RNA-Seq datasets with over 1,000 students in a variety of classes—including introductory biology, anatomy and physiology, genetics, cell and molecular biology, genomics, agricultural breeding, and independent research.

iPlant Collaborative

The *iPlant Collaborative* cyberinfrastructure includes high-performance computing, data storage, software, and human resources. *iPlant's* mission is to empower researchers and educators to use cyberinfrastructure to solve grand challenges in biology—large questions that integrate large-scale data from genomes, phenotypes, and environments to predict how organisms and ecosystems function. *iPlant's* second five-year plan was ratified by the National Science Board in fall 2014, bring total funding to \$100 million. As lead for the Education, Outreach, and Training (EOT) component, the DNALC is involved with a number of activities that are transitioning *iPlant* from infrastructure development to widespread use and sustainability into the future.

In addition to the release of the Green Line for RNA-Seq analysis, we continued to improve the usefulness of *DNA Subway*. Blue Line, used primarily for DNA barcoding, received an upgraded alignment viewer that shows the quality scores of polymorphisms, and phylogenetic tree building was improved with an easy toggle to designate outgroups. We made significant progress in integrating WebApollo, a faster and easier to use version of the Apollo gene annotation tools. There were 20,832 site users, and 3,782 new registrations in 2014, a 37% and 44% increase respectively. This increase in traffic gave us a grand total of 28,934 projects for 2014, a 58% increase over 2013!

We continued to deliver two-day training workshops at sites nationwide, reaching 124 researchers at five *Tools & Services* workshops and 60 faculty at three *Genomics in Education* workshops. One-hour monthly "Getting Started with *iPlant*" webinars reached 168 attendees, and Livestream feeds from in-person workshops reached an additional 96 participants. Realizing that we can only reach a fraction of *iPlant's* 20,000 registered users with in-person training, we initiated a *Train-the-Trainers* program to extend our reach. Working with 29 faculty at workshops at University of California, Davis and the USDA's Big Data Initiative, we devised a model curriculum that will be expanded in 2015. Our goal will be to develop networks of *iPlant Helpers* that can act as local campus "experts" to help others get started with *iPlant*.

The EOT team presented papers and posters to a number of different audiences. *DNA Subway: Making Genome Analysis Egalitarian*, presented at the XSEDE14, showcased the Green Line's use of the Stampede supercomputer—currently the world's seventh most powerful

computer. *Cyberinfrastructure for Life Sciences: iAnimal Resource for Genomics and Other Data Driven Biology* and *DNA Subway: An Educational Bioinformatics Platform for Gene and Genome Analysis* were presented at the World Congress of Genetics Applied to Livestock Production. Participation in the European Conference on Computational Biology and organization of CSHL meetings on *Biological Data Science* and *High-Performance Computing in Undergraduate Education* (described earlier) advanced the DNALC's leadership in linking biology and computation.

We also developed online materials for asynchronous learning. The new Online Learning Center (www.iplantcollaborative.org/learning-center) features more than 50 tutorials and 100 YouTube videos. These help users get started with applications and analysis tools available in the *iPlant* Discovery Environment and *iPlant* cloud computing service, Atmosphere. The new *iPlant Academy* is a place for biology faculty to exchange lesson plans, present case studies of how they use *iPlant* tools in their teaching, and showcase student projects.

Evaluation continues to guide and inform EOT efforts and document our success in reaching our intermediate audience of biological researchers who do not have specialized expertise in computation. Our pre-workshop surveys in 2014 indicated 49% of attendees classify themselves at the beginner's level of bioinformatics skills, while surveys across a wide variety of meetings and conferences now indicate a whopping 95% of researchers currently work with or anticipate working with large datasets involving genome sequencing and RNA-Seq. This great interest in analysis of these specialized datasets punctuates the need for increased access to training and help.

New Developments Around the World

Following three years of collaboration, in May we established Beijing 166 High School as a licensed DNA Learning Center. The project is funded by the Dongcheng School District, which serves 100,000 students in the ancient core of Beijing, adjacent to the Forbidden City and Tiananmen Square. The licensing agreement is part of Principal Wang Lei's master plan in strengthening the leadership of Beijing 166 as the city's only designated high school of biology.

Under the contract, we increased the number of summer training weeks from three to ten—and added student and teacher training workshops in Beijing—with the objective of providing 260 student weeks of training. Seventy-two middle and high school students attended four 2- or 3-week courses at the DNALC in the summer. Middle school students completed modules on *Fun with DNA*, *World of Enzymes*, and *Forensic Detectives*. High school students completed modules on *DNA Science*, plus *DNA Barcoding Research* or *Human Genomics*. Eighteen students designed and conducted independent research projects exploring the biodiversity of Cold Spring Harbor's ecosystem using DNA barcoding, including fieldwork, lab work, computer analyses, and a presentation of research findings. Some summer camp students met Dr. James Watson during a special media event in August, which was covered by journalists from more than ten media agencies.

In October, we taught two four-day student courses on *Human Genomics* at Beijing 166 School. Sixty-three students used PCR to look at DNA variations in their own DNA, highlighting concepts in population genetics, genotype-phenotype analysis, and human evolution. The courses culminated with a field trip to the Peking Man World Heritage site outside of Beijing. We also conducted two-day teacher training workshops to 340 biology teachers from the Beijing area.



Clockwise from upper left: Dave Micklos leads students in a PCR lab, Catherine Zhang leads Beijing students on a trip to see the Peking Man site, and Beijing 166 High School course graduation.

We rigorously evaluated the students who participated in courses conducted at the DNALC and at Beijing 166 School—and we compared their genetic content knowledge and literacy with New York students taking the same courses. The results of these studies support our contention that the DNALC courses provide Chinese students with an exposure to biology practice and concept development that is largely missing from even the best Chinese schools. The results of this study suggest that Beijing high school students are less “scientifically mature” than their Long Island counterparts—with less general biological knowledge and less exposure to the scientific process, critical thinking, and “soft” skills of scientific collaboration and communication. The results also suggest that science enrichment programs—such as the DNALC courses—can bolster Chinese students’ familiarity with science process and enquiry, and prepare them for science study at American universities.

In November, we initiated serious negotiations with Suzhou Industrial Park (SIP) to establish a licensed DNALC in its BioBay biotechnology park. SIP mayor Barry Yang offered his strong support to develop eight teaching labs and support spaces, exhibit, and cafeteria in three existing buildings in a grassy park in the center of BioBay. The agreement will build upon the existing relationship with SIP, with which the Laboratory currently operates CSH Asia Conferences. Like the CSHL conferences, the DNALC at SIP would be directly operated by CSHL. However, due to the ongoing liberalization in China and strong support from the SIP mayor and Communist Party secretary, the DNALC at SIP will be set up as a non-governmental organization (NGO). In addition to being tax exempt, the NGO designation should make monetary transfers between SIP and CSHL much easier. The NGO will share core management and accounting services with CSH Asia Conferences. We expect to sign a formal agreement in spring 2015, with the objective of bringing the facility into operation in late 2015.

We also worked with a high-level consortium on plans for two licensed centers in Mexico due to open in late 2015 and 2016. One center will be a major attraction of the “Codes of Life Health Park,” an EPCOT-like exposition in Chapultepec Park, Mexico City’s “Central Park” and the largest urban green space in the western hemisphere. The Mexico City Project is headed by Armando Barriguetta, a world expert on nutrition, Jose Cordova, Minister of Health under former President Felipe Calderone, and Hugo Scherer, the campaign manager for current President Enrique Pena Nieto. The other licensed DNALC will be located in the new “Agri-food Research Center” (CIDAM) in Morelia, the capital of Michoacán State. Michoacán is the most important agricultural region in Mexico—the world’s largest producer of avocados—and the Ministry of Agriculture has invested \$10 million to develop CIDAM as a biotechnology research center to buttress the local agricultural sector. The DNALC project has strong support from Antonio Jara, the new governor of Michoacán, a physicist who was formerly president of the University of Michoacán.

DNA Center NYC

The success of the *Harlem DNA Lab* and DNALC-inspired centers around the world provided the impetus to establish a dedicated center in New York City. This will allow us to further extend the DNALC “brand” to NYC, using a successful formula of academic year field trips, in-school instruction and teacher training and follow-up support, perfected over 25 years. The development of *DNA Center NYC* is a \$25 million goal of CSHL’s current \$250 million 125th Anniversary Campaign. The catalyst for the venture came in April 2012 with a \$6 million lead gift from CSHL trustee Laurie Landeau. This was followed in 2013 by a \$10 million gift from the Thompson Family Foundation and a \$3 million grant from the Alfred P. Sloan Foundation. An additional \$750,000 of support has come from the Hearst Foundation, the Booth Ferris Foundation, and the Achelis Foundation. The strategy is to use \$3 million for renovation, with drawdown from a \$22 million endowment funding about half of annual operating costs and providing scholarships for at least half of the student participants.

During the year we worked intensively with Cushman and Wakefield Realtors to identify a 7,000-10,000 square foot facility with good street visibility and easy access to public transport. VVA and Gilman Consulting reviewed the complicated New York City Department of Buildings codes. We visited and reviewed approximately 20 properties, ultimately developing preliminary plans or offers on six. Safety zoning, cost, or landlord issues scuttled all of the best prospects. So, we were heartened when we re-opened negotiations with City University of New York (CUNY). Chief Operating Officer Allan Dobrin, Vice Chancellor for Research Gillian Small, and New York City College of Technology President Russell Hotzler, for space on their City Tech Campus in Brooklyn.

The *DNA Center NYC* leadership team was significantly strengthened in April with the hiring of Annie Greengard as Manager of Science Education Partnerships. Annie reports to the CSHL Vice President of Development, Charlie Prizzi, and is charged to work closely with the DNALC to help establish, sustain, and operate a Manhattan location. Annie is working to establish a donor base in NYC by identifying, cultivating, and soliciting individuals, foundations, and corporations. A major effort is to build the *DNALC NYC* Council, whose objective is to help integrate the center into the life of NYC. The Council will be challenged to raise funds to support the center on an annual basis to complement the Center’s endowment. Members are introducing the initiative to opinion leaders in business, government, education, and science who can help advance CSHL’s mission to bring New Yorkers into the gene age. Annie is also spearheading efforts to grow our network of *Partner Member* (previously *Charter Member*) schools, whose prepayment for activities eases annual budgeting.

Genomic Approaches in BioSciences Workshops

During the year, we wound down on NSF's Advanced Technological Education project to train college faculty members to implement experiments that integrate four major technologies of the genome era: PCR, DNA sequencing, RNAi, and bioinformatics. DNALC staff taught a workshop on the CSHL campus in August, bringing the workshop total to 13 and exceeding our goal of providing direct training to 288 faculty. Underrepresented minorities composed 21.7% of participants, and 67.2% were females. We maintained a mix of educators from three educational levels: about ¼ high school, ½ community college, and ¼ four-year college or university.



Genomic Approaches in Biotechnology locations of participant home institutions.

We concentrated primarily on supporting second-round workshops that were taught by faculty trained by us in the initial term of the grant. Six summer workshops were taught by collaborators at Universidad del Turabo (Gurabo, Puerto Rico), Bluegrass Community and Technical College (Lexington, Kentucky), Madison Area Technical College (Madison, Wisconsin), and Kennedy-King College (Chicago, Illinois). A preliminary analysis of surveys of teachers trained in first- and second-round workshops offers support for the “train-the-trainer” model. Post-workshop knowledge gains and confidence in teaching lab methods and bioinformatics were strikingly similar for participants instructed by DNALC staff at primary workshops and those instructed by faculty trainers at supplementary workshops. Slight differences for certain categories are most likely due to differences in emphasis at the supplementary workshops, which were customized according to local instructional needs. Most importantly, the follow-up survey conducted 9-12 months later showed that similar or higher proportions of supplementary workshop participants reported having incorporated workshop labs, bioinformatics, and biotech careers into their teaching.

As part of a collaboration with Stony Brook University, doctoral student Caren Gough is measuring the impact of the *Genomic Approaches in Biosciences Workshops* on faculty confidence over time. The workshops are unique in that they by design include a mix of educators from high school, community colleges, and four-year universities. In a preliminary analysis, Ms. Gough found that

there were significant gains (with medium to large effect sizes) in both knowledge and confidence pre-to post-workshop. Statistical comparisons revealed similar gains across the three teacher groups. High school, community college, and university faculty had similar outcomes, indicating that the benefits were comparable for all participants. High school teachers felt as confident as teachers from other levels—even for difficult bioinformatics computer labs. Importantly, 75% of respondents to a reflection survey agreed that having teachers from multiple education levels working together was a positive aspect of the workshop. Focus groups corroborated that participants benefitted from sharing their learning experiences with teachers from the other levels.

DNA Barcoding

DNA barcoding programs at the DNALC have now expanded into three separate programs. The newest is *Barcode Long Island: Exploring Biodiversity in a Unique Urban Landscape (BLI)*, which is funded by a \$1.2 million National Institutes for Health (NIH) Science Education Partnership Award. In collaboration with Stony Brook University (SBU), Brookhaven National Laboratory (BNL), and the American Museum of Natural History (AMNH), *BLI* will provide students with real and relevant research experience while they contribute to our knowledge of Long Island biodiversity.

After advertising to our extensive network of school districts and holding several information sessions, we held two *BLI* training workshops for 73 teachers planning to mentor student teams. By the end of the year, 24 teams with 71 students from ten Long Island schools had submitted research proposals. The two schools from Nassau County and eight schools from Suffolk are diverse, with minority enrollment ranging from 5% to 91% (24% average). The students have proposed DNA barcoding projects on animals (6), plants (6) and fungi (1), and will present their findings at a symposium in spring 2015. A website to support all aspects of the project has been developed that allows for project proposal submission, review, revision, and acceptance—features that are necessary to make distributed barcoding feasible.

BLI builds upon our experience with two student research programs in New York City: the *Urban Barcode Project (UBP)* competition and the *Urban Barcode Research Program (UBRP)*. In the *UBP*, students work with teacher mentors on DNA barcoding projects during the school year and compete for a grand prize. In the *UBRP*, students complete summer workshops and then conduct 55+ hours of research directly with scientist mentors.



Top: Antonia Florio demonstrates DNA isolation during a *Barcode Long Island* teacher workshop. Right: *BLI* teacher using a pestle to grind his plant sample for DNA barcoding.



Thirty-eight *UBP* teams—145 students, 53% African American or Latino—presented research posters at the American Museum of Natural History (AMNH) on May 27th. These projects were supported by 14 footlocker kits and 42 weekend or after-school “open labs” at *Harlem DNA Lab* and Genspace. The students’ projects included mapping wildlife found in NYC, detecting food fraud, determining biodiversity of NYC green spaces, identifying traded plant and animal species, and exploring the effects of biodiversity on human health. When asked to compare the experience with other research experiences—mostly eighth grade exit projects or school science fairs—*UBP* students (n=145) felt that DNA barcoding programs provide more “real world” science (82% of students), more chance for hands-on experience (84%) and to learn science (75%), more opportunity to develop critical thinking (71%) and independent inquiry skills (73%), and more understanding of the scientific process (68%). DNA barcoding increases students’ interest in studying science or pursuing careers in science (72%), while still being more fun than other research experiences (69%).

A jury of 21 experts in biodiversity, conservation biology, DNA barcoding, and education selected the top six finalist teams (13 students) who gave oral presentations at AMNH on June 2nd. Mark Stoeckle, Senior Research Associate in the Program for the Human Environment at The Rockefeller University, gave the keynote address: “DNA Barcoding: The Thrill of Discovery.” The *UBP* grand prize winner was Eric Bovee, from The High School for Environmental Studies, under the direction of mentors J.T. Boehm and Marissa Bellino. Their project studied the international and domestic seahorse trade to see if vendors abide by trade regulations. After measuring and extracting DNA from hundreds of seahorses, Eric found that several vulnerable species are sold and most domestically traded seahorses are under the ten centimeter size limit. Both of these findings suggest more work needs to be done to protect vulnerable seahorse populations.

Twenty *UBRP* teams (38 students) presented their projects as posters and oral presentations on April 29th at the AMNH. These students were selected from 130 high-achieving NYC high school students who completed *UBRP* preparatory courses in *Conservation Genetics* and *DNA Barcoding*. The students worked with scientist mentors from institutions all over NYC, including the AMNH, CUNY, Fordham University, and Albert Einstein Medical Center. The *UBRP* projects spanned studies of food fraud, biodiversity, conservation genetics, phylogenetics (evolution), behavior, and the first DNALC microbiome studies. The *UBRP* was the first science fair for 32% of students. Of those who had previously participated in a science fair or competition (68%), the vast majority felt that the *UBRP* experience increased their interest in a career in science (86%).

The NYC teams collected and processed over 1,000 samples for DNA sequencing—an average of 17 samples per team—with over 1,600 single sequences provided by GENEWIZ, Inc. and 600,000 sequence reads produced by next-generation sequencing methods. Importantly, *UBP* and *UBRP* students produced an additional 12 novel DNA sequences that did not match existing data in the international database, GenBank. These are being published to Genbank with the students as authors, which will make the data freely available for use by other researchers.

During the summer, 48 middle school students attended the *Backyard Barcoding* camp, while 39 high school students stepped up to *DNA Barcoding Research*. The advanced students explored the aquatic biodiversity of the intertidal zone of CSHL’s campus, collecting 158 samples that produced 30 novel sequences to be published to GenBank. The students developed project proposals, collected samples from Cold Spring Harbor, extracted and amplified specimen DNA, and analyzed DNA sequences. We also partnered with the NYC Department of Education to offer two DNA barcoding courses at the Environmental Study

Center, where teams from four public high schools assessed the biodiversity of Brooklyn's Marine Park. The NYC students collected 115 samples, with 15 novel sequences to be published to GenBank. Each barcoding workshop closed with oral presentations of student findings. Most of the barcoding sequences came from small aquatic invertebrates, species that are hard to classify using traditional taxonomy, highlighting the power of DNA barcoding.



Student-teacher teams organize sample specimens at the Environmental Study Center in Brooklyn.

High School Research Programs

In 2014 19,298 students attended field trips at our three facilities: Dolan DNALC, DNALC *West* and *Harlem DNA Lab*. We reached an additional 9,046 students through in-school instruction by DNALC staff, and over 1,300 students attended week-long DNALC summer camps. Grants from Bank of America and National Grid Foundation supported programs for over 2,000 underserved students from Long Island public school districts including Brentwood, Uniondale, William Floyd, Central Islip, and Valley Stream. An additional 15 students from IS 59 in Queens participated in an ongoing collaboration with NSLIJ at DNALC *West*, which culminated at the New York Hall of Science's *STEMtastic* day where students showcased their lab skills.

Eighty-five percent of the 2,314 students who visited *Harlem DNA Lab* received scholarships from the William Townsend Porter Foundation, including students from two schools co-located within the John S. Roberts Educational Complex: Coalition School for Social Justice and Harlem Village Academy Leadership School. Supported by the New York City Department of Education (NYC DOE) Office of School Programs and Partnerships, 83 high school and 71 middle school students attended camps at the *Harlem DNA Lab* and the NYC DOE Environmental Study Center during school breaks. The footlocker kit rental program at the *Harlem DNA Lab* continued to provide teachers with equipment and reagents to implement basic genetics, biotechnology, and DNA barcoding labs. Footlocker kits were used by 1,032 students, 117 of whom were conducting independent research under the *UBP* and *UBRP*. Sixty-four percent were under-represented minorities.

The *Partner Membership* program continues to flourish in NYC. Founding member Chapin School is now in the second year of an advanced elective *Molecular Genetics*, which included a pilot project using metabarcoding to investigate the diversity of bacteria in their school. The third-prize *UBP* team from Convent of the Sacred Heart School presented *Nice to Meat You: Using DNA Barcoding to Detect Mislabeling in the Meat Industry*. St. David's School finished its

first year in the program with 5th grade poster presentations, including a few DNA barcoding projects. Marymount School began their first year with in-school labs for upper and middle school girls, as well as DNALC participation in the Upper School after-school program.

We continued to collaborate with Cold Spring Harbor High School (CSHHS) to deliver *Molecular and Genomic Biology*. Students devote two class periods per day to this college-level laboratory course co-instructed by DNALC staff and CSHHS faculty Jaak Raadsepp. The 2013–14 cohort focused on hands-on experimentation and independent projects across a range of biological systems—including units on eugenics, DNA barcoding, RNAi, human and plant genomics, microbiomes, and protein structure. The 2014–15 cohort, our tenth class, began the year with classic *DNA Science* labs in recombinant DNA technology and a survey of plant diversity at the Nature Conservancy.

The second year of partnership with St. Dominic High School in Oyster Bay progressed with the independent research component of a five-month course *Molecular and Genomic Biology Research*. Several students chose to develop projects using DNA barcoding to study local biodiversity. A new group of high school juniors began year three in September. The fall curriculum included labs in bacterial genetics, genomics, bioinformatics, and RNAi.

Our newest collaboration with the Nassau BOCES Doshi STEM School entered its second year of programming with two cohorts of students in grades nine and ten. Students in *Living Environment* and research electives began the school year with DNA barcoding projects that included surveys of biological diversity in pristine and polluted environments, combined with an investigation of abiotic factors that might affect biodiversity in each location. This culminated in the presentation of posters at a small poster session.

Monthly *Saturday DNA!* sessions drew 215 participants, with parents and grandparents joining children for classes on forensics, human evolution, the central dogma, and experimental design. An additional 4,183 visitors viewed films in the Multitorium, including Cablevision's multimedia presentation *Long Island Discovery*, and/or viewed the exhibition *The Genes We Share*. The annual *Great Moments in DNA Science* seminar series drew 50 Long Island high school students to three presentations by researchers. Dr. Michael Feigin, CSHL, discussed how genomic data is used to find gene targets in breast cancer; Dr. Daniel Bogenhagen, SBU, explained how the mitochondria became an essential part of eukaryotic cells; and Dr. Danielle Engle, CSHL, talked about efforts to improve survival in patients with pancreatic cancer by developing early detection strategies and identifying better biomarkers for this type of cancer.

Graduate Training

Our collaboration with the CSHL Watson School of Biological Sciences (WSBS) continues to provide graduate students with the opportunity to learn skills necessary for communicating with non-biologists. During a three-month training program, graduate students of the WSBS work together with seasoned DNALC instructors to develop effective teaching techniques. When they have completed the training, the graduate students will be prepared to quickly assess any audience and structure quality lessons accordingly.

In the first phase, the WSBS students observe a DNALC instructor teaching a laboratory, and then must organize lesson plans integrating their own experiences. In the second phase of training, the graduate students co-teach a lesson with DNALC instructors. DNALC staff then provide feedback, discussing strengths and appropriate preparation for an independent lesson. The final phase requires the graduate students to teach a lesson under DNALC

instructor observation. When both middle and high school rotations have been completed, the WSBS students select three additional lessons to demonstrate mastery of instruction and class management skills.

Our successful collaboration with the New York Academy of Sciences (NYAS) continues to improve the science literacy among high needs students throughout New York City. DNALC instructors provided training to graduate students and post-doctoral researchers who serve as mentors in the Academy's afterschool mentoring program. Each received six hours of training in effective strategies to provide hands on laboratories to middle school students.

BioMedia Visitation and Projects

We had a record number of visitors to our suite of multimedia resources in 2014. *Google Analytics* counted 5,202,881 visits to 22 DNALC websites. Our *YouTube* videos received 873,881 views, and the *3D Brain*, *Weed to Wonder*, and *Gene Screen* apps were downloaded 668,396 times. Total website, *YouTube*, and smartphone/tablet apps visitation reached 6.75 million, a 7.7% increase over 2013.

Developed under a grant from the Dana Foundation, the *3D Brain* app continues to be successful, with 2.72 million downloads to date on Apple, Windows, and Android devices worldwide. In late 2013 we released an update for the Apple version of the *3D Brain* that included an "in-app" purchase of *3D Brain HQ*, which includes higher resolution images and a redesigned user interface for \$0.99. In 2014, there were 25,343 downloads of the *HQ* version, netting \$17,600 after Apple took its share. Proceeds from in-app purchases support the educational programs of the DNALC.

Although reduced in size by almost half, the *BioMedia* Group continued to support the DNALC's educational programs with website development and maintenance; videography and post production for webinars, special events, and offsite workshops; program promotion through email campaigns; flyer, poster, and backdrop design for professional meetings; museum development; photo documentation of events and barcoding specimens; social media management; and creation of architectural concept plans for potential DNALC venues in NYC and China. The Laurie J. Landeau Multimedia Studio hosted several events, including: monthly bioinformatics webinars for *iPlant* and the CSHL *Gramene* project; mtDNA sequencing field trip follow-up webinars; remote hands-on laboratory instruction; and seminars to remote student and faculty audiences. We also routinized our traveling Livestream studio setup at several events, including: meetings at CSHL, Stony Brook University, University of Nebraska, and the USDA; and for *UBP* and *UBRP* symposia.

As part of the EOT Group of *iPlant Collaborative*, we developed and implemented a new design for the *iPlant* website that launched in May. The new site incorporates several improvements over the previous *iPlant* site: increased focus on and easier access to *iPlant's* tools; simplified structure eliminating embedded and redundant content; integration of the *iPlant Learning Center*; and modified color palette and updated imagery.

In the summer, we worked with high school student Olympia Davison to create short videos that give a



Chun-hua Yang (left) films Olympia Davison explaining how to perform a DNA extraction.

student's perspective on hands-on laboratories and research careers. Olympia interviewed CSHL neuroscientist Dr. Anne Churchland, and demonstrated "How to Load a Gel" and a "DNA Extraction" from strawberries. The videos were uploaded to *YouTube* where they have had more than 1,200 views.

In September, we installed *BOLD* (named for the acronym for the Barcode of Life Data Systems), an art exhibition on DNA barcoding displayed in the front and side halls of the DNALC. Seattle-based artist, Joseph Rossano, partnered with biologists to engage the public around the science of DNA barcoding and how it is being used to catalog the world's vast and threatened biodiversity. The work is inspired by specimens barcoded by Dr. Daniel Janzen from the Area de Conservación Guanacaste (ACG) in Costa Rica and by researchers for the University of California, Berkeley Moorea Biocode Project being carried out at the Richard B. Gump South Pacific Research Station in Moorea. All of the pieces deliberately represent the specimens as fuzzy, obscured, or out of scale, making it difficult to identify the organism. However, on closer inspection the viewer discovers that each piece includes the DNA barcode sequence and a link to the BOLD database, where the species identity is revealed. This underscores the reality that identifying species with certainty requires more than taxonomic methods. Our educators are developing interpretive activities for visiting students, many of whom will take part in a barcoding laboratory during their visit.



Left: Artist Joseph Rossano discusses his artwork with students during the installation of his show in the DNALC halls. Right: BOLD exhibition artwork inspired by life in coral reefs in French Polynesia.

As the evolution of our museum continues, plans are in place to include a one-of-a-kind reproduction of the 5,300-year-old natural mummy discovered in the melting ice of the Ötztal Alps in 1991. Gary Staab, artist and life modeler, will create the "Ötzi" replica (named for the region where the mummy was found) using CAT scans of the mummy and 3D printing technology. Working with the South Tyrol museum of Archeology in Bolzano, Italy (where the iceman's body is kept), the project is planned to start in early 2015 and installation is projected for late spring. The iceman's unique story will give us a platform to create a central theme on forensic biology and human origins. The publication of Ötzi's genome provides a unique opportunity to reflect on the meaning of *becoming* and *being* human. Written in each person's DNA is a record of our shared ancestry, the information that makes us both similar and unique, and information that could foreshadow each person's future health. This exhibit aims to encourage people to consider where we came from, who we are, and where we are going.

Staff and Interns

In 2014 we said goodbye to several staff members. Although it happens rarely, two design positions were phased out due to a lack of funding. Eun Sook Jeong, Multimedia Designer, is originally from South Korea and began as an intern in 2001. With a personality and design style tagged as “Zen” by our director, she has left a beautiful legacy as lead designer on several DNALC websites, as well as making significant contributions to all of our sites. She also applied her interior design training in our unique upstairs kitchen/lounge area. Chris Weidler, Junior Designer, began as a college intern in the *BioMedia* Group in 2007. Initially assigned the tedious jobs that freed up the senior designers, he quickly proved that he could take on more intensive tasks. He soaked up knowledge in the Visual Communications major at Farmingdale State College and became a skilled Flash animator, print designer, video editor, and web designer who finalized a redesign of the *iPlant Collaborative* website just before departing.

Jermel Watkins, Ph.D., Staff Molecular Biologist & Educator, began his time with the DNALC as a high school intern from 1994 to 2000. After earning his Ph.D. in molecular and cellular pharmacology at Stony Brook University, he returned to us as a high school instructor in 2007. He pioneered new workshops, managed interns, mentored research projects, and managed prep for workshops taught at all levels. Jermel accepted a position as an Assistant Professor, and a Cancer and Neuroscience Research Scientist in the Department of Biological Sciences at Hampton University.

In 2007, Jennifer Galasso joined us as a Middle School Educator, and helped produce new workshops and labs in barcoding, personalized medicine, and epigenetics. Jenn also managed middle school lab preparation and the intern staff. She is now teaching *Introduction to Research and Living Environment* to ninth grade students at the Doshi STEM Institute of Nassau BOCES down the road in Syosset.

Amy Nisselle, Ph.D, Multimedia and Evaluation Manager, learned about the DNALC at a 2003 congress on human genetics in Melbourne, Australia, where she saw a presentation on our multimedia content. Amy then chose to pursue a Ph.D. in multimedia genetics education. As part of her thesis, she assisted with the evaluation of our *Genes to Cognition* website in 2008. She joined the DNALC in 2010 in her dual evaluation/producer role, and we miss her evaluation abilities and her big picture perspective on multimedia projects. She returned to Australia to be with family and so her son (just beginning to speak) will form an Australian accent. Amy continued to consult with us for several months as we searched for her replacement.

The DNALC welcomed several new staff members in 2014. Emily Harrison joined us from the CSHL campus as a middle school educator. After receiving her Bachelor's degree in Biology and a Master's in Secondary Education from Adelphi University, she became a lab technician in Greg Hannon's lab. She recently returned to Adelphi University for her Master of Science in biology and is completing her Master's thesis research on laser-activated transcription.

Ashleigh Jackobel, a native Long Islander and graduate of Northport High School, began her time at the DNALC when she was hired as a college intern. After graduating from SUNY Farmingdale with a Bachelor of Science in Bioscience and a minor in Chemistry, Ashleigh jumped at the opportunity to join our team as a middle school and high school instructor. She is hoping to pursue a Ph.D. in Virology.

Shreya Shah, a new high school educator, developed an interest in bacteria during an episode of bubonic plague near her village in India, where she volunteered in a public awareness campaign to control the spread of plague. This fascination with microorganisms led her to earn a Master of Science in Microbiology at the University of Kansas. Her recent experience

at Dowling College Microbiology Research Laboratory on soil microbial diversity in Long Island ecosystems makes her an excellent choice to help lead *BLI*.

Dr. Mona Spector became the project coordinator for the DNALC's three-year NSF project bringing RNA-Seq to undergraduate education. Mona also joins us from the CSHL campus, where her impressive contributions to elucidating the genetic causes of cancer include key discoveries in the field of programmed cell death (published in the journal *Nature*) and helping to develop a new 3-D culture system used to examine pancreatic cancer.



Anne Greengard started in the spring as Manager of Science Education Partnerships. Annie is a New York City native who received her B.A. from Dartmouth College. She moved on to Nashville to attend law school at Vanderbilt University, then landed a place at a large law firm in NY. Annie's family roots in science and her passion for education made her well-suited for her role working on development efforts for the *DNA Center NYC*.

We welcomed back Cornel Ghiban after a brief hiatus as a Perl programmer at Estée Lauder. He develops and maintains the expanding suite of DNALC websites and applications and plays a central role in the development of DNA Subway.

Christine Marizzi and Antonia Florio each received well-deserved promotions this year. First a science educator, and now Manager, DNALC *West*, Christine instructs the majority of the 3,000 students who attend field trips there each year, as well as teaches offsite in local schools. Christine also played an integral role in the development of DNA barcoding programs. Since joining our staff in March 2013 as Conservation Genetics Instructor, Antonia has the significant task of managing the *UBP* and *UBRP*, and provides instruction at all three DNALC locations. Now Manager, Research, Antonia also applies for funding, facilitates student evaluation, and plays a guiding role for *BLI*.

Since the DNALC opened, we have relied on high school and college interns to support our day-to-day operations. In addition to laboratory prep work, interns may take on independent or team projects mentored by DNALC staff members, which translate current research into classroom labs. The *BioMedia* Group also welcomes interns for summer or longer-term roles. An internship offers students the unique opportunity to gain real laboratory or design experience in an educational environment. We gathered an amazing group of interns this year, and said farewell as others left for college:

High School Interns

Kayla Bianco, St. Anthony's High School
 Abigail Buckley, Oceanside High School
 Kenneth Collado, George W Hewlett High School
 Liam Gensel, Harborfields High School
 Emily Gruber, Syosset High School
 Joshua Gruber, Half Hollow Hills High School East
 Omotayo Ikuomenisan, Huntington High School
 Aiseosa Irowa, Hempstead High School
 Serena Jones, Portledge High School
 Lenni Joya Amaya, Huntington High School

Andrew Micklos, Ward Melville High School
 Nicholas Nicolia, St. Anthony's High School
 Gabrielle Ramirez, Walt Whitman High School
 Gavrielle Rood, Roslyn High School
 Breanna Tahany, Kellenberg Memorial High School
 Maria Urbina, Oyster Bay High School
 Scott Venturino, Huntington High School
 Diana Vizza, North Shore High School
 Blakelee Woods, Glen Cove High School

High School Interns Departing for College

Gabriella Blazich, Fordham University
Brittany Coscio, College of the Holy Cross
Michaela Lee, SUNY Oneonta

Jack Manzi, Binghamton University
Anant Mehrotra, Rochester Institute of Technology
Jonathan Paris, Johns Hopkins University

College Interns

Kathryn Bellissimo, The College of New Jersey
Anne Bode, University of Notre Dame
Marie Jean Francois, CUNY City College
Nella Hauser, SUNY Stony Brook
Karoline Lake, Columbia University
William McBrien, Suffolk Community College

Pauline McGlone, CUNY Hunter College
Alec Micklos, University of Tampa
Arvind Rajabhathor, New York University
Robert Scott, Sage College of Albany
Shenika Shah, New York Institute of Technology

2014 Workshops, Meetings, Collaborations, and Site Visits

Jan 6–Feb 13	Pinkerton Foundation Bi-weekly <i>Urban Barcode Research Program</i> , “DNA Detectives,” American Museum of Natural History, New York, New York
January 8	Site visit by Tatiana Nikolenko, RUSNANO, Moscow, Russia
January 9–14	NSF ATE Professional Development, <i>Genomic Approaches in BioSciences</i> Supplemental Workshop, Universidad del Turabo, Gurabo, Puerto Rico
January 10	Site visit by Suzhou Industrial Park and bioBAY Delegation, Suzhou, China
January 11–15	NSF <i>iPlant Collaborative</i> pre-PAG Half-Day Workshop, International Plant and Animal Genome Conference XXIII, “A Simple Bioinformatics Workflow for RNA-Seq Analysis and Distributed Genome Annotation,” San Diego, California
January 23	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
January 24	<i>Urban Barcode Project</i> “A Practical Introduction to DNA Barcoding,” University of Delaware, Newark, Delaware
January 25	<i>KidCreate</i> , O’Shea Educational Complex, New York, New York
January 28	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
January 29	NSF <i>iPlant Collaborative</i> Webinar, “Getting Started with <i>iPlant</i> ,” DNALC
January 30	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
Jan 31–Feb 1	NSF <i>iPlant Collaborative</i> Professional Development <i>Tools & Services</i> Workshop, Linfield College, McMinnville, Oregon
Feb 3–Mar 7	<i>DNA Barcoding</i> Research Mentoring Program, “DNA Detectives,” American Museum of Natural History, New York, New York
February 4	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
February 6	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
February 8	<i>Saturday DNA!</i> “Got Milk?,” DNALC
February 8	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
February 10, 11	<i>Human Mitochondrial Sequencing</i> Laboratory Follow-up Webinar, Oceanside High School, DNALC
February 11	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
February 11	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, Genspace, Brooklyn, New York
February 15	STEM Mentor Training Workshop, New York Academy of Sciences, New York, New York
February 17–24	<i>DNA Science</i> Workshop, <i>Harlem DNA Lab</i>
February 18	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, Genspace, Brooklyn, New York
February 19	PCR Workshop, Rockefeller University, New York, New York
February 24	Pinkerton Foundation <i>Urban Barcode Research Program</i> , “Barcode of Life,” American Museum of Natural History After School Program, New York, New York
February 25	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
February 25	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, Genspace, Brooklyn, New York
February 26	Pinkerton Foundation <i>Urban Barcode Research Program</i> , “Barcode of Life,” American Museum of Natural History After-school Program, New York, New York
February 27	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
February 28	NSF <i>iPlant Collaborative</i> Seminar, “The <i>iPlant Collaborative</i> —Community Cyberinfrastructure for Life Science,” Genome Analysis Centre, Norwich, United Kingdom
March 3	Pinkerton Foundation <i>Urban Barcode Research Program</i> , “Barcode of Life,” American Museum of Natural History After School Program, New York, New York
March 3–4	NSF <i>iPlant Collaborative</i> <i>Tools & Services</i> Workshop, Wageningen University and Research Centre, Wageningen, Netherlands
March 4	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
March 5	Pinkerton Foundation <i>Urban Barcode Research Program</i> , “Barcode of Life,” American Museum of Natural History After-school Program, New York, New York
March 5	“DNA Barcoding,” Queensborough Community College, Bayside, New York
March 5	Site visit by The Hearst Foundation, New York, New York
March 5	Site visit by Dr. Jose Cordova and Dr. J. Armando Barriguetta, Mexico City, Mexico
March 6	<i>Great Moments in DNA Science</i> Honors Seminar, “The Search for New Drug Targets in Breast

- Cancer," Dr. Michael Feigin, CSHL
- March 8 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- March 10 NSF *iPlant Collaborative* Webinar, "Getting Started with *iPlant*," DNALC
- March 10 Pinkerton Foundation *Urban Barcode Research Program*, "Barcode of Life," American Museum of Natural History After-school Program, New York, New York
- March 11 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- Mar 12–Apr 11 Pinkerton Foundation *Urban Barcode Research Program*, "DNA Barcoding," Queensborough Community College, Bayside, New York
- March 13 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- March 13–16 NSF *iPlant Collaborative Tools & Services* Half Workshop, 56th Maize Genetics Conference, Beijing, China
- March 14 "Women in STEM Careers," Panel Discussion, The Chapin School, New York, New York
- March 15 *Saturday DNA!* "Silencing Genes," DNALC
- March 17 Pinkerton Foundation *Urban Barcode Research Program*, "Barcode of Life," American Museum of Natural History After-school Program, New York, New York
- March 18 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- March 18 *Great Moments in DNA Science* Honors Seminar, "Mitochondrial DNA, Our Second Genome," Dr. Daniel Bogenhagen, Stony Brook University, Stony Brook, New York
- March 19 Pinkerton Foundation *Urban Barcode Research Program*, "Barcode of Life," American Museum of Natural History After-school Program, New York, New York
- March 20 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- March 22 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- March 22 Cold Spring Harbor Schools 3rd & 4th Grade Program, DNALC
- March 24 Pinkerton Foundation *Urban Barcode Research Program*, "Barcode of Life," American Museum of Natural History After-school Program, New York, New York
- March 25–27 NSF *iPlant Collaborative* Train the Trainers/*Tools & Services* Workshop, University of California-Davis, California
- March 26 "DNA Extraction," Presentation, Port Jefferson Science Fair, Edna Louise Spear Elementary School, Port Jefferson, New York
- March 26 Pinkerton Foundation *Urban Barcode Research Program*, "Barcode of Life," American Museum of Natural History After-school Program, New York, New York
- March 26–27 NSF *iPlant Collaborative* Mission Critical Bioinformatics Workshop, University of California-Davis, California
- March 27 *Great Moments in DNA Science* Honors Seminar, "Using Sugars to Detect Pancreatic Cancer," Dr. Dannielle Engle, CSHL
- March 27 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- March 28–29 Interview with Lior Patchley, "Tuxedo RNASeq," University of California, Berkeley, California
- March 29 NSF ATE Professional Development, *Genomic Approaches in BioSciences* Workshop, Seminole State College, Sanford, Florida
- March 29 Site visit by Renaissance Technologies, East Setauket, New York, DNALC
- March 31 Pinkerton Foundation *Urban Barcode Research Program*, "Barcode of Life," American Museum of Natural History After-school Program, New York, New York
- Mar 31–Apr 2 NSF Conference on Course-based Undergraduate Research Experiences (CUREnet), Host and "Infrastructure and Data for Large-Scale Collaborations" Plenary Panel, CSHL
- April 1 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- April 2 Pinkerton Foundation *Urban Barcode Research Program*, "Barcode of Life," American Museum of Natural History After-school Program, New York, New York
- April 3–4 National Science Teachers Association National Conference 2014, "Detecting Epigenetic DNA Methylation in *Arabidopsis Thaliana*," "DNA Subway: Bringing Cutting Edge Bioinformatics into the Classroom," and "DNA Barcoding Independent Research in the Classroom," Boston, Massachusetts
- April 8 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- April 10 *Urban Barcode Project/Urban Barcode Research Program* Open Lab, *Harlem DNA Lab*
- April 11 NSF *iPlant Collaborative* Webinar, "Getting Started with *iPlant*," DNALC
- April 12 NSF ATE Professional Development *Genomic Approaches in BioSciences* Follow-up Workshop, Tulsa Community College, Tulsa, Oklahoma
- April 12 *Saturday DNA!* "Transcription and Translation: What Does DNA Actually Do?" DNALC

April 12	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
April 14–18	Genome Science Workshop, <i>Harlem DNA Lab</i>
April 17–18	NSF Research Collaboration Network: Integrating Bioinformatics into Life Sciences Education, “The <i>iPlant Collaborative</i> : Community Cyberinfrastructure for Life Sciences,” Omaha, Nebraska
April 22	“Glowing Genes,” Remote Instruction Webinar, Berean Christian Jr. Academy, Atlanta, Georgia
April 24	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
April 25	Site visit by Dr. Jose Angel Cordova, Mme. Lia Limon, Dr. J. Armando Barriguette and M. Hugo Scherer, Mexico City, Mexico
April 25	DNA Day Scavenger Hunt, DNALC and Cold Spring Harbor, New York
April 26	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
April 26	<i>Fun with DNA</i> , <i>Forensic Detectives</i> and <i>DNA Barcoding</i> Teacher Training Workshops, DNALC
April 29	Pinkerton Foundation <i>Urban Barcode Research Program</i> Symposium, American Museum of Natural History, New York, New York
May 1	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
May 6	Site visit by Joseph Rossano, Arlington, Washington
May 8	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
May 10	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
May 12–13	NSF <i>iPlant Collaborative</i> Professional Development Software Carpentry Workshop, CSHL
May 14	NSF <i>iPlant Collaborative</i> Webinar, “Getting Started with <i>iPlant</i> ,” DNALC
May 16	Site visit by Dr. J. Armando Barriguette, Mexico City, Mexico
May 17	<i>Saturday DNA!</i> “Human Origins: What DNA Says About Our Ancestry,” DNALC
May 21–22	NSF <i>iPlant Collaborative</i> Professional Development <i>Genomics in Education</i> Workshop, University of Nevada, Reno, Nevada
May 27	<i>Urban Barcode Project</i> Poster Session, American Museum of Natural History, New York, New York
May 27–28	NSF <i>iPlant Collaborative</i> Professional Development <i>Tools & Services</i> Workshop, Stony Brook, New York
May 30	Site visit by The Wall Street Journal, <i>Harlem DNA Lab</i>
June 2	<i>Urban Barcode Project</i> Symposium, American Museum of Natural History, New York, New York
June 2–3	Site visit by Amy Stark, University of Notre Dame, Notre Dame, Indiana
June 2–6	NSF ATE Professional Development <i>Genomic Approaches in BioSciences</i> Supplemental Workshop, Bluegrass Community and Technical College, Lexington, Kentucky
June 3–4	Bio-Link Summer Fellows Forum, <i>Bioinformatics in the Classroom</i> Workshop, University of California-Berkeley, San Francisco, California
June 5	Site visit by Peter Dworkin, Regeneron, Tarrytown, New York
June 5	Ana Almeida, CSHL, Biology Career Webinar for Portuguese students
June 6	NSF <i>iPlant Collaborative</i> New Release Previews Webinar, DNALC
June 7	<i>Saturday DNA!</i> “Exploring Evolution,” DNALC
June 9–13	NSF ATE Professional Development <i>Genomic Approaches in BioSciences</i> Supplemental (English and Spanish) Workshop, Bluegrass Community and Technical College, Lexington, Kentucky
June 9–20	NSF Professional Development <i>Infrastructure and Training Bringing Next-generation Sequence (NGS) Analysis into Undergraduate Education</i> Workshop, CSHL
June 9–23	<i>Forensics</i> Workshop, Convent of the Sacred Heart, Greenwich, Connecticut
June 16–20	<i>World of Enzymes</i> Workshop, St. David’s School, New York, New York
June 19–20	<i>DNA Barcoding</i> Workshop, Cabrini College, Radnor, Pennsylvania
June 23–24	NSF <i>iPlant Collaborative</i> Professional Development <i>Tools & Services</i> Workshop, <i>Understanding GWAS</i> Workshop, Lincoln, Nebraska
June 23–27	NSF ATE Professional Development <i>Genomic Approaches in BioSciences</i> Supplemental Workshop, Universidad del Turabo, Gurabo, Puerto Rico
June 27–28	NSF <i>iPlant Collaborative</i> Professional Development <i>Genomics in Education</i> Workshop, Community College of Denver, Denver, Colorado
June 30–July 4	Pinkerton Foundation <i>Urban Barcode Research Program</i> “DNA Detectives” Workshop, <i>Harlem DNA Lab</i>

- June 30–July 4 *Fun with DNA* Workshops, DNALC (2 sessions)
Green Genes Workshop, DNALC
World of Enzymes Workshop, DNALC
Fun with DNA Workshop, DNA Learning Center West
- July 7–11 Pinkerton Foundation *Urban Barcode Research Program* “Barcode of Life” Workshop, Harlem DNA Lab
- July 7–11 *DNA Science* Workshops, DNALC (2 sessions)
Forensic Detectives Workshop, DNALC
World of Enzymes Workshop, DNALC
World of Enzymes Workshop, DNA Learning Center West
- July 7–11 NSF ATE Professional Development *Genomic Approaches in BioSciences* Supplemental Workshop, Madison Area Technical College, Madison, Wisconsin
- July 9 NSF *iPlant Collaborative* Webinar, “Getting Started with *iPlant*,” DNALC
- July 12–16/17–18 American Association of Plant Biologists 2014, “The *iPlant Collaborative*: Scalable Infrastructure for Life Science” Seminar, *iPlant Collaborative* Software Carpentry Workshop, Portland, Oregon
- July 15 NSF Extreme Science and Engineering Discovery Environment (XSEDE) 2014 Conference, “DNA Subway: Making Genome Analysis Egalitarian,” Atlanta, Georgia
- July 14–18 *DNA Science* Workshop with Beijing, China students, DNALC
Fun with DNA/World of Enzymes Workshop with Beijing, China students, DNALC
Fun with DNA Workshop, DNALC
Genome Science Workshop, DNALC
DNA Science Workshop, DNA Learning Center West
Fun with DNA Workshop, Harlem DNA Lab
- July 14–18 NSF ATE Professional Development, *Genomic Approaches in BioSciences* Supplemental Workshop, Kennedy-King College, Chicago, Illinois
- July 14–25 *DNA Barcoding* Workshop, Anthony J. Genovesi Center, St. Francis College, Brooklyn, New York
- July 17–18 NSF *iPlant Collaborative* Professional Development *Software Carpentry* Workshop, Portland, Oregon
- July 19–21 *DNA Barcoding* Workshop, Environmental Science Center, Brooklyn, New York
- July 21–22 *DNA Barcoding* Workshop, Rockefeller University, New York, New York
- July 21–25 *BioCoding* Workshop, DNALC
DNA Barcoding Workshop with Beijing, China students, DNALC
DNA Science Workshop, DNALC
Green Genes Workshop, DNALC
Green Genes Workshop with Beijing, China students, DNALC
Green Genes Workshop, DNA Learning Center West
- July 23–24 “GOALS for Girls” Workshop, Rockefeller University, New York, New York
- July 26–30 Botanical Society of America, Botany 2014, The *iPlant Collaborative* Tools and Services/*Genomics in Education* Workshop, Boise, Idaho
- July 28–Aug. 1 *DNA Barcoding* Workshop with Beijing, China students, DNALC
DNA Barcoding Research Workshop, DNALC
Forensics Detectives Workshop with Beijing, China students, DNALC
World of Enzymes Workshop, DNALC
Fun with DNA Workshop, DNA Learning Center West
Green Genes Workshop, Harlem DNA Lab
- July 28–Aug 8 *DNA Barcoding* Workshop, Environmental Science Center, Brooklyn, New York
- July 30 *DNA Barcoding* Webinar, Madison High School, San Antonio, Texas, DNALC
- August 4–8 *DNA Barcoding Research* Workshop, DNALC
DNA Science Workshop with Beijing, China students, DNALC
Fun with DNA Workshop, DNALC
Fun with DNA/World of Enzymes Workshop with Beijing, China students, DNALC
DNA Science Workshop, DNA Learning Center West
Forensic Detectives Workshop, Harlem DNA Lab
- August 6 Site visit by Elizabeth Benjamin and Elena Chon, New York City Department of Education, New York, New York, Harlem DNA Lab

- August 11–15 *DNA Science* Workshop, DNALC
Green Genes Workshops, DNALC (2 sessions)
Human Genomics Workshop, DNALC
 Genome Science Workshop, DNA Learning Center West
DNA Science Workshop, *Harlem DNA Lab*
- August 13 NSF *iPlant Collaborative* Webinar, "Getting Started with *iPlant*," DNALC
- August 13–14 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop, Hudson Alpha Institute, Huntsville, Alabama
- August 17–22 10th World Congress of Genetics Applied to Livestock Production, "DNA Subway: An Educational Bioinformatics Platform for Gene and Genome Analysis, *DNA Barcoding* and RNA-Seq," Vancouver, British Columbia, Canada
- August 18–22 NSF ATE Professional Development, *Genomic Approaches in BioSciences* Workshop, CSHL
- August 18–22 *Backyard Barcoding* Workshop, DNALC
Fun with DNA Workshop, DNALC
Silencing Genomes Workshop, DNALC
World of Enzymes Workshop, DNALC
DNA Science Workshop, Delbruck Laboratory, CSHL
Fun with DNA Workshop, DNA Learning Center West
- August 18–22 Pinkerton Foundation *Urban Barcode Research Program* Workshops, "Conservation Genetics," "DNA Barcoding," *Harlem DNA Lab*
- August 25–29 *DNA Science* Workshop, DNALC
Forensic Detectives Workshop, DNALC
Fun with DNA Workshop, DNALC
World of Enzymes Workshop, DNALC
Green Genes Workshop, Hershey Laboratory, CSHL
World of Enzymes Workshop, DNA Learning Center West
- August 25–29 *Urban Barcoding Project* Teacher Training Workshop, *Harlem DNA Lab*
- September 3 National Plant Genome Initiative Postdoctoral Research Fellows Annual Awardee Meeting, "Computational Resources for Young Investigators: How Can *iPlant* Help?" Arlington, Virginia
- September 3 Professional Development Workshop, "Bacterial Transformation," Progress High School, Brooklyn, New York
- September 3–5 Banbury Meeting Presentation: "High Performance Computing (HPC) in Undergraduate Biology Education," "DNA Subway: GUI to HPC for Undergraduates," CSHL
- September 6 *Forensic Detectives* Teacher Training Workshop, New York Academy of Science, New York, New York
- September 7–10 European Conference on Computational Biology, "The *iPlant Collaborative*: Scalable Infrastructure for Life Science," Strasbourg, France
- September 15 NSF *iPlant Collaborative* Webinar, "Getting Started with *iPlant*," DNALC
- September 17–19 Molecular Biology Class, Marymount College, Tarrytown, New York
- September 18–19 USDA/ARS Workshop on Arthropod Genomics, "The *iPlant Collaborative*: Scalable Infrastructure for Life Science," Beltsville, Maryland
- September 21–24 Genomic Informatics 2014 Conference, "DNA Subway: An HPC-Powered, User-friendly Workflow for RNA-Seq Analysis" Presentation, Churchill College, Cambridge, England
- September 22–23 Site visit and exhibition installation by Joseph Rossano
- September 25 Site visit by Datuk Seri Idris Jusoh, Kuala Lumpur, Malaysia
- September 26 Site visit by Dr. J. Armando Barriguetta, Mexico City, Mexico
- October 8 NSF *iPlant Collaborative* Webinar, "Getting Started with *iPlant*," DNALC
- October 13–15 *Human Genome Science* Workshop, Beijing 166 Middle School, Beijing, China
- October 15 *Barcode Long Island* Information Session, Brookhaven National Laboratory, Upton, New York
- October 17 "Using an *Alu* Insertion Polymorphism to Study Human Populations," Beijing 166 Middle School, Beijing China
- October 18 *Saturday DNA!* "Bananas for DNA!" DNALC
- October 18 *Urban Barcode Project* Teacher Training Workshop, *Harlem DNA Lab*
- October 20 Site visit by Wanda Rosado, Unity Center for Urban Technologies, New York, New York, *Harlem DNA Lab*

October 20–22	<i>Human Genome Science</i> Workshop, Beijing 166 Middle School, Beijing, China
October 22	21 st National ATE Principal Investigators Conference, ATE Evaluation Practice: Lessons from the Field Pre-Conference Workshop, Washington D.C.
October 23	<i>Barcode Long Island</i> Information Session, DNA Learning Center West
October 24	“CSHL DNALC Lab Class Design and Implementation,” Beijing 166 Middle School, Beijing China
October 24	21 st National ATE Principal Investigators Conference, <i>Genomic Approaches to BioSciences</i> Presentation, Washington D.C.
October 30	<i>Barcode Long Island</i> Information Session, DNALC
November 1	Metropolitan Association of College and University Biologists Annual Meeting, “Experiments in Gene and Genome Analysis,” Dowling College, Oakdale, NY
November 4	CEI-PEA Teacher Network, “Short Fingerprinting Lab” and “Bacterial Transformation Lab,” East Harlem, New York
November 4	<i>Barcode Long Island</i> Teacher Training Workshop, DNALC
November 5–8	Biological Data Science Meeting, “Unleash Your Inner Data Scientist: Enabling Scalable Data Driven Collaborations with <i>iPlant</i> Cyberinfrastructure,” CSHL
November 8	<i>Saturday DNA!</i> “Food for Thought,” DNALC
November 10	NSF <i>iPlant</i> Collaborative Webinar, “Getting Started with <i>iPlant</i> ,” DNALC
November 13–15	2014 NABT Professional Development Conference, “DNA Barcoding: Independent Student-Driven Inquiry,” “What DNA Says About Our Human Family,” “Analyzing DNA Sequences to Understand Evolutionary Relationships,” Cleveland Convention Center, Cleveland, Ohio
November 16	CureNET Workshop, “Scalable Experiments in Gene and Genome Analysis,” Bowie State University, Baltimore, Maryland
November 19	<i>Barcode Long Island</i> Information Session, Midwood High School, Brooklyn, New York
November 24	<i>Barcode Long Island</i> Information Session, Benjamin N. Cardozo High School, Bayside, New York
December 3	NSF <i>iPlant</i> Collaborative Webinar, “Getting Started with <i>iPlant</i> ,” DNALC
December 4	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
December 4	Site visit by Gary Staab, Staab Studios, Kansas City, Missouri
December 5	Site visit by Dr. J. Armando Barriguette with Mexican Scientific Delegation, Mexico City, Mexico
December 6	<i>Saturday DNA!</i> “Hairy Tales,” DNALC
December 6	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
December 6	<i>Barcode Long Island</i> Teacher Training Workshop, DNALC
December 7–10	<i>iPlant</i> Collaborative Professional Development <i>Train-the-Trainers</i> Workshop, USDA/ARS Big Data: RNA-Seq, CSHL
December 9	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>
December 11	Site visit to Regeneron, Tarrytown, New York
December 12	Site visit by Ni Shuang, Wancheng Bao and Chuansen Zhao, Qilu Company, Shanghai, China
December 13	<i>KidCreate</i> , O’Shea Educational Complex, New York, New York
December 16	<i>Urban Barcode Project/Barcode Long Island</i> Information Session, Math for America, New York, New York
December 18	<i>Urban Barcode Project/Urban Barcode Research Program</i> Open Lab, <i>Harlem DNA Lab</i>

Sites of Major Faculty Workshops 1985–2014

Program Key: *Middle School* High School **College**

ALABAMA	University of Alabama, Tuscaloosa	1987–90
ALASKA	University of Alaska, Anchorage	2012
	Hudson Alpha Institute, Hunstville	2014
	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 Institute of Technology, Pasadena	2007
	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
	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
	Stanford University, Palo Alto	2012
	University of California, Berkeley	2010, 2012
	University of California, Davis	1986
	University of California, Davis	2012, 2014
	University of California, Northridge	1993
	University of California, Riverside	2011
	University of California, Riverside	2012
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
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
	North Miami Beach Senior High School	1991

	Seminole State College, Sanford	2013
	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, 2012
	Morehouse College, Atlanta	1991, 1996-97
	Spelman College, Atlanta	2010
HAWAII	Kamehameha Secondary School, Honolulu	1990
	University of Hawaii at Manoa	2012
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
INDIANA	Butler University, Indianapolis	1987
	Purdue University, West Lafayette	2012
IDAHO	University of Idaho, Moscow	1994
IOWA	Drake University, Des Moines	1987
KANSAS	University of Kansas, Lawrence	1995
KENTUCKY	Bluegrass Community & Technical College, Lexington	2012-13
	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
	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	Minneapolis Community and Technical College	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

MISSOURI	Rust College, Holly Springs	2006–08, 2010
	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
NEW JERSEY	St. Paul's School, Concord	1986–87
	Coriell Institute for Medical Research, Camden	2003
NEW MEXICO	Raritan Valley Community College, Somerville	2009
	Biolink Southwest Regional Meeting, Albuquerque	2008
NEW YORK	Albany High School	1987
	American Museum of Natural History, New York	2007
	Bronx High School of Science	1987
	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
	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
	Dolan DNA Learning Center	1990, 1992, 1995, 2000–11
	<i>Dolan DNA Learning Center</i>	1990–92
	DNA Learning Center West	2005
	<i>Fostertown School, Newburgh</i>	1991
	<i>Harlem DNA Lab, East Harlem</i>	2008–09, 2011–13
	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, 2014
	Stuyvesant High School, New York	1998–99
	The Rockefeller University, New York	2003
	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
	North Carolina Agricultural & Technical State University, Greensboro	2006-7, 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
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	2009
	Tulsa Community College	2012-13
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
	Medical University of South Carolina, Charleston	1988
	University of South Carolina, Columbia	1988
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 – Round Rock 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, AG Research and Extension Center, Weslaco	2007
	Texas A & M University, College Station, TX	2013
	Prairie View A & M University, Prairie View, TX	2013
	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	1999, 2009, 2011–13
	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
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AUSTRALIA	Walter and Eliza Hall Institute and University of Melbourne	1996
AUSTRIA	Vienna Open Lab	2007, 2012
CANADA	Red River Community College, Winnipeg, Manitoba	1989
CHINA	Beijing No. 166 High School, Beijing	2013, 2014
	Ho Yu College, Hong Kong	2009
DENMARK	Faroe Genome Project, Torshavn, Faroe Islands	2013
GERMANY	Urania Science Center, Berlin	2008
ITALY	International Institute of Genetics and Biophysics, Naples	1996
	Porto Conte Research and Training Laboratories, Alghero	1993
MEXICO	ASPB Plant Biology, Merida	2008
NIGERIA	Godfrye Okoye University, Enugu, 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
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	Wellcome Trust Conference Center, Hinxton, UK	2012–13
	University of Warwick, Coventry	2013

2014 Grants and Funding

Grantor	Program	Duration of Grant	2014 Funding ⁺
FEDERAL GRANTS			
National Institutes of Health	<i>Barcode Long Island</i>	7/14-3/19	48,628
National Science Foundation	Infrastructure and Training to Bring Next-generation Sequence (NGS) Analysis into Undergraduate Education	9/13-8/16	198,670
National Science Foundation	<i>Gramene</i> , Cereal Comparative Genomics	6/12-9/14	28,460
National Science Foundation, University of Arizona	<i>iPlant Collaborative: Cyberinfrastructure for the Life Sciences</i>	9/13-8/18	873,877
National Science Foundation	Advanced Technology Education (ATE) <i>Genomic Approaches in BioSciences</i>	4/11-3/15	239,397
NON-FEDERAL GRANTS			
Beijing NO. 166 High School	Chinese Collaboration Agreement	5/14-4/15	16,780
Alfred P. Sloan Foundation	<i>DNA Center NYC</i> Start-up	12/13-11/16	138,993
Alfred P. Sloan Foundation	High Performance Computing in Undergraduate Biology Education	5/14-9/14	11,207
National Grid Foundation	Scholarships for Minority and Underserved Students in the Central Islip Union Free School District	10/14-10/15	15,000
Pinkerton Foundation	<i>Urban Barcode Research Program</i>	1/13-5/15	156,535
The Bank of America Charitable Foundation	Genetics and Biotechnology Lab	11/14-11/15	20,000
William Townsend Porter Foundation	<i>Harlem DNA Lab</i> for Underprivileged Students	4/14-3/15	13,500
ENDOWMENT FUNDS			
Chernov Fund, <i>DNA Learning Center</i>			9,594
General Funds, <i>DNA Learning Center</i>			153,266
Hearst Fund, <i>DNA Learning Center</i>			28,861
Landeau Fund, <i>DNA Learning Center</i>			40,048
Landeau Fund, <i>DNA Center NYC</i>			97,354
Thompson Family Fund, <i>DNA Center NYC</i>			166,667

+ Includes direct and indirect costs.

PROGRAM MEMBERSHIP

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	1,500	Levittown Union Free School District	1,500
East Meadow Union Free School District	1,500	Long Beach City School District	1,500
East Williston Union Free School District	2,750	North Shore Central School District	1,500
Elwood Union Free School District	1,500	North Shore Hebrew Academy	1,500
Fordham Preparatory School	1,500	Oceanside Union Free School District	1,500
Garden City Union Free School District	1,500	Oyster Bay-East Norwich Central School District	1,500
Great Neck Union Free School District	1,500	Plainedge Union Free School District	1,500
Green Vale School	1,500	Plainview-Old Bethpage Central School District	1,500
Half Hollow Schools Central School District	1,500	Portledge School	1,500
Harborfields Central School District	1,500	Port Washington Union Free School District	1,500
Herricks Union Free School District	1,500	Ramaz Upper School	1,500
Huntington Union Free School District	1,500	Roslyn Union Free School District	1,500
Island Trees Union Free School District	3,000	Syosset Central School District	1,500
Jericho Union Free School District	3,000		

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

Bais Yaakov Academy for Girls	1,200	Locust Valley Central School District	9,582
Bellmore Union Free School District	2,400	Merrick Union Free School District	3,900
Bellmore-Merrick Union Free School District	4,200	M.S. 447, Brooklyn	1,800
Berkeley Carroll School	1,300	North Bellmore Union Free School District	2,600
Cold Spring Harbor Central School District	12,600	North Shore Central School District	1,050
East Meadow Union Free School District	3,828	Oceanside Union Free School District	1,625
East Williston Union Free School District	2,900	Oyster Bay – East Norwich Central School District	3,175
Elwood Union Free School District	3,725	Portledge School	2,400
Floral Park - Bellerose Union Free School District	7,500	Port Washington Union Free School District	10,300
Franklin lakes Public Schools, NJ	1,300	Redeemer Lutheran School	1,300
Friends Academy	3,300	Rockville Centre Union Free School District	6,240
Friends Seminary of New York	1,100	Roslyn Union Free School District	5,250
Garden City Union Free School District	11,655	Saint Dominic Elementary School	4,200
Great Neck Union Free School District	8,250	Saint Joseph School	2,400
Half Hollow Hills Union Free School District	1,284	Saint Patrick School	5,000
Herricks Union Free School District	2,275	Scarsdale Union Free School District	6,300
Hicksville Public Schools	1,400	Smithtown Union Free School District	1,680
Hofstra STEP	1,500	Syosset Union Free School District	38,800
Holy Child Academy	1,600	Three Village Central School District	2,800
Huntington Union Free School District	8,275	Valley Stream Union Free School District 13	1,050
Jericho Union Free School District	9,450	YBH of Passaic	1,400
Lawrence Union Free School District	2,100	Yeshiva Darchei Torah	2,775
Lindenhurst Union Free School District	1,000		

DNA LEARNING CENTER

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