



ANNUAL REPORT 2012



CSH 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:

Students participating in the *DNA Barcoding: The Biocube* summer camp collect specimens in Cold Spring Harbor.

DNA LEARNING CENTER

EXECUTIVE DIRECTOR'S REPORT

Preparing students and families to thrive in the gene age

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Many science educators search for ways to scale student research from local, individual projects to distributed, class-based experiments that involve many students working simultaneously on aspects of the same problem. DNA barcoding fulfills the promise of modern, Internet-enabled biology—allowing students to work with the same data, with the same tools, at the same time as high-level researchers. Just as the unique pattern of bars in a universal product code (UPC) identifies each consumer product, a short “DNA barcode” (about 600 nucleotides in length) is a unique pattern of DNA sequence that can potentially identify any living thing. DNA barcoding projects can stimulate independent student thinking across different levels of biological organization, linking molecular genetics to ecology and evolution—with the potential to contribute new scientific knowledge about biodiversity, conservation biology, and human effects on the environment. DNA barcoding also integrates different methods of scientific investigation—from *in vivo* observations to *in vitro* biochemistry to in silico bioinformatics.

DNA barcoding provides a practical way to bring open-ended experimentation into biology classes. Projects can operate at various scales, from working with other students to investigate a local ecosystem, museum collection, or conservation issue, to joining an International Barcode of Life “campaign” to explore an entire taxonomic group or global biome. Projects may also take on a forensic slant, when students attempt to identify product fraud (such as mislabeled food items) or to identify the sources of commercial products (such as plants or animals used in traditional medicines). The core lab and phylogenetic analysis can be mastered in a relatively short time, allowing students to reach a satisfying research endpoint within a single academic term. Using DNA barcoding as the common method across a range of projects decreases the need for intensive, expert preparation and mentoring, thus providing a practical means to engage large numbers of students in meaningful research.

To help realize this promise, over the past two years we have devoted ourselves to developing an integrated biochemical and bioinformatics (B&B) workflow for DNA barcode analysis. The biochemistry uses non-caustic reagents to isolate DNA from plant, animal, or fungi. The barcode region is amplified by polymerase chain reaction (PCR) and visualized by agarose gel

electrophoresis. The barcode amplicons are mailed to GENEWIZ, Inc., a company that provides inexpensive sequencing—\$3.00 per forward and reverse read. Within 48 hours, the finished barcode sequences are automatically uploaded to *DNA Subway*, the DNALC’s intuitive bioinformatics workflow for education developed under the National Science Foundation (NSF) *iPlant Collaborative* (described below).

The Blue Line of *DNA Subway* includes all tools needed to visualize and edit barcode sequences, search GenBank (www.ncbi.nlm.nih.gov/genbank/) for matches, align sequences, and construct phylogenetic trees. The Blue Line includes web applications that heretofore could only be used as stand-alone applications, including an electropherogram viewer/editor and a “zoomable” sequence aligner/barcode viewer. An export feature simplifies barcode sequence submissions to GenBank, automatically providing sequence files, associated metadata, and sequence annotations in the required National Center for Biotechnology Information (NCBI) format.

The barcode experiment, including extensive teacher prep and planning for both lab and bioinformatics components, is available in three formats: the online lab notebook at www.dnabarcoding101.org, the lab-text *Genome Science: A Practical and Conceptual Introduction to Molecular Genetic Analysis in Eukaryotes* (Cold Spring Harbor Laboratory Press), and as a stand-alone kit marketed by our collaborator, Carolina Biological Supply Company (CBSC).



Urban Barcode Project

With a grant from the Alfred P. Sloan Foundation, we tested the B&B workflow in the context of the *Urban Barcode Project (UBP)*, a high school science competition spanning the five boroughs of New York City (NYC). A dedicated Internet site (www.urbanbarcodeproject.org) supported all aspects of the project—including vodcasts on barcoding and student projects, protocols, guidelines for proposal preparation, and database management tools for tracking student projects and metadata. Participating during the 2011–12 academic year were over 100 teams comprising more than 300 students (37% Asian, 32% White, and 31% Latino or African-American) from 31 public and nine private high schools. Students worked on their projects in the schools—often using freely available DNALC footlockers—or at 70 Open Lab sessions at *Harlem DNA Lab*, and Genspace, a non-profit citizen science center in Brooklyn. DNALC staff also made more than 40 school visits to assist with experiments and phylogenetic analyses. Teams collected and processed over 1,000 samples for DNA sequencing, with over 2,500 single sequences provided by GENEWIZ.

Seventy-five teams—comprising 218 students from 30 high schools—completed their projects in time to present their results at two poster sessions held at the American Museum of Natural History (AMNH) on May 31 and June 1. The projects spanned five categories: 1) wildlife in parks and public spaces; 2) commercial products and trade in endangered species; 3) food mislabeling; 4) public health and disease vectors; and 5) exotic and invasive species. A jury of 34 experts in biodiversity, conservation biology, DNA barcoding, and education selected the top 10 teams, who presented oral presentations at the AMNH on June 6. The

Grand Prize team from Hostos-Lincoln Academy of Sciences in the Bronx won \$10,000 for their finding that many herbal Ginkgo products contained little to no *Ginkgo biloba* DNA. Other finalists shared \$10,000 in prizes for projects including the first DNA barcoding census of fungi in Central Park, mapping clades of Atlantic silversides and killifish in New York coastal waters, identifying species of bed bugs in Brooklyn through bacterial DNA, comparing morphological identification versus DNA barcoding of ants in the South Bronx, and improving the identification of insects seized by U.S. Customs and Border Protection at Newark International Airport.



Importantly, *UBP* students produced 65 novel DNA sequences that did not match existing GenBank data. These barcodes included new sequence differences (polymorphisms), as well as new records of species for which no barcode had been previously reported. Using the simplified export feature of *DNA Subway*, these sequences were submitted to GenBank with student and teacher authors. The published sequences represented animals, plants, and fungi collected in a range of student projects: 36 from wild organisms collected in parks or natural areas; 13 from products purchased in markets and shops around the city; seven from exotic or invasive species; six from invertebrate disease vectors; and three from investigations of food mislabeling.

Surveys of participating teachers suggested that the *UBP* will potentially improve science instruction for many students beyond those who actually did barcoding projects. A majority said they plan to implement barcoding concepts, independent research, and bioinformatics exercises into a range of general biology, *AP Biology*, and biology electives. Surveys and structured interviews overwhelmingly showed that students appreciated the ownership of their projects and the sense of “doing real science.” For most, it was their first experience with open-ended research. Compared to previous experiences with science fairs or competitions, the vast majority of students thought the *UBP* had provided “much more” experience in learning science, doing independent inquiry, understanding the scientific process, developing critical thinking skills, and increasing interest in science careers. Thus, in the context of the nation’s largest school system, we have demonstrated that DNA barcoding projects can be scaled to introduce large numbers of students to authentic research.



Top right: A student works on her *UBP* project during an Open Lab at *Harlem DNA Lab*. Above: Following the *UBP* Symposium award ceremony at AMNH, the ten finalist teams display their prizes with *UBP* staff and judges.



David Liittschwager (above, in hat) works with barcoding students collecting specimens at CSHL and photographing specimens (right) at the DNALC.



Barcode Long Island

During the summer, we explored a different format for student DNA barcoding—a sustained “campaign” to explore the biodiversity of Cold Spring Harbor. The diversity of biological niches found at the interface of land and water was the impetus for founding the Biological Laboratory at Cold Spring Harbor in 1890 as a field station for the study of evolution in the natural world. For several decades, naturalists came for summer courses to study organisms of the intertidal zone, salt marshes, sandspit, and open waters of the harbor and Long Island Sound. Their sustained and detailed work formed the basis for the modern field of ecology. When Cold Spring Harbor Laboratory’s (CSHL) research shifted toward genetics, several generations of local school students carried on the ecological tradition during summer *Nature Study Courses* conducted from the 1940s through to the mid 2000s.

The *Barcoding Biodiversity* student workshops marked a return to CSHL’s roots. Naturalist photographer David Liittschwager joined us for the first workshop. David’s stunning photographs of life in one-cubic-foot samples from habitats in Costa Rica, French Polynesia, South Africa, Tennessee, and New York appeared in the February 2010 issue of *National Geographic*. David instructed students in how to tease out all of the visible plants and animals (1 mm or larger) in a “biocube” and trained DNALC staff how to take publication-quality photographs.

Ninety-seven students, including 20 students from Beijing No. 166 High School, participated in six workshops. The students collected and processed more than 300 samples, obtaining 165 high-quality DNA barcodes. Most DNA barcodes came from aquatic invertebrates such as bryozoans, hydrozoans, gastropods, amphipods, isopods, and crustaceans. We published 30 novel sequences to GenBank with students as primary authors. Among the organisms for which there were published barcode



An unidentified nudibranch specimen.

sequences was a still unidentified “mini” nudibranch (a 3-mm snail without a shell) and an inch-long mud crab (*Eurypanopeus depressus*). Students identified three sequence polymorphisms in the mud crab, indicating a great deal of genetic diversity and suggesting that the southern members of this group may be a different species.

New Experiments in Epigenetics

We continued a collaboration with CSHL professor Rob Martienssen and North Carolina State researcher Bill Thompson on their NSF-funded project “Epigenome Dynamics During DNA Replication.” Epigenetics describes heritable phenomena that affect gene expression without changing the DNA sequence. Methylation—the addition of methyl groups (CH_3) to DNA—is one type of epigenetic effect. In the simplest case, methyl groups attached to a promoter region block binding of transcription factors needed to express a gene. The pattern of DNA methylation is stably inherited through at least several generations.

Although epigenetics is an increasingly important area of genome research, it is not widely taught in classes. Thus, during the year we completed development of two labs that demonstrate epigenetic effects in model plants: maize and *Arabidopsis thaliana*. The experiments will be released as kits in 2013 from CBSC.

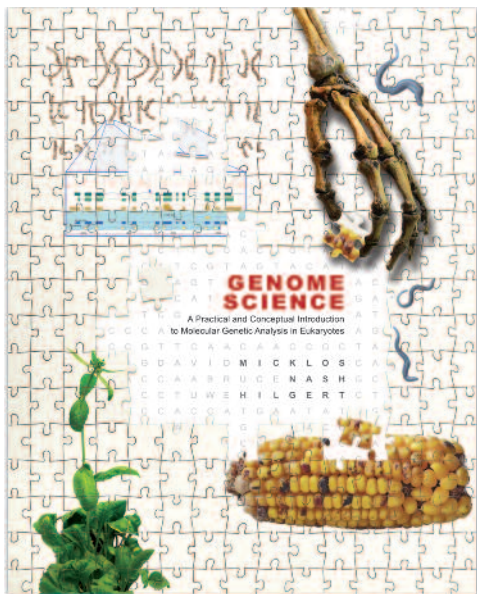
A simple observational experiment looks at epigenetic inheritance of the *R* gene, which controls the expression of a dark red pigment in maize kernels. The *R* allele is dominant over the *r* allele, which produces no pigment (yellow kernels). At first glance, kernels from a cross between two heterozygous plants (*Rr*) conform to the expected 3:1 phenotypic ratio of red pigmented to unpigmented kernels. However, close inspection reveals that one third of pigmented kernels are actually yellow-speckled. Methylation at the *R* promoter (*R**) disrupts pigment production in some cells in the developing kernels and the kernels show a yellow-speckled pattern. Extending molecular analysis to the maize *R* locus is difficult, because the imprinted region has not yet been precisely mapped. The methylated *R** is inherited from the male pollen, making this an example of imprinting.

An advanced experiment examines the molecular basis of epigenetics in plants by relating flowering time to DNA methylation. In *Arabidopsis*, methylation of the *FWA-1* promoter region in DNA silences the gene in wild-type adults while loss of methylation causes late flowering in *FWA-1* mutants. To study this phenomenon, students isolate DNA from wild-type and *FWA-1* mutant plants. Digestion with the restriction enzyme McrBc, which recognizes methylated regions, cleaves the methylated wild-type promoter but leaves the unmethylated *FWA-1* promoter intact. PCR amplifies a product from the intact *FWA-1* DNA, but none from the wild-type DNA.



Genome Science Published

At year's end we received the first copies of *Genome Science: A Practical and Conceptual Introduction to Molecular Genetic Analysis in Eukaryotes*. The work is the culmination of 15 years of development by co-authors Dave Micklos, Bruce Nash, and Uwe Hilgert—with artwork by Susan Lauter and former DNALC designer Stephen Blue, and help from many staff,



students, teachers, and granting organizations. *Genome Science* follows the DNALC's original lab text *DNA Science: A First Course in Recombinant DNA Technology*. Now in its 2nd edition, *DNA Science* has sold over 90,000 copies and is credited with helping catalyze the movement to bring hands-on experiments with DNA into high school and beginning college classrooms. Two experiments are now found in the *AP Biology* curriculum, giving them a nationwide audience. Associated kits from CBSC reach well over 100,000 students per year.

Like its predecessor, *Genome Science* aims to help beginners use modern tools to explore the unseen world of genes. However, the new book aims to take students to a higher level of biological and technological integration—to study the function of eukaryotic genes and genomes. Nineteen laboratories focus on four revolutionary technologies—PCR, DNA sequencing, RNA interference (RNAi), and bioinformatics—across three eukaryotic systems—humans, plants, and the

roundworm *C. elegans*. The work includes our newest labs on DNA barcoding and the *FWA-1* epigenetic switch in *Arabidopsis*. All labs stress the modern synthesis of molecular biology and computation, integrating *in vitro* experimentation with *in silico* bioinformatics. In addition to well-tested biochemical methods, *Genome Science* introduces *DNA Subway* to make easy work of gene and genome analysis.

The four major technologies are organized into chapters with extensive text introductions that place related labs into a common historical and conceptual framework. This modular approach provides easy options to integrate sets of labs into existing courses, provide the basis for new courses, or serve as the foundation for student research projects. *Genome Science* borrows many user-friendly features from its predecessor—including flow charts, marginal notes, reagent recipes, and extensive instructor information. To ease implementation, most labs are available as CBSC kits.

iPlant Collaborative

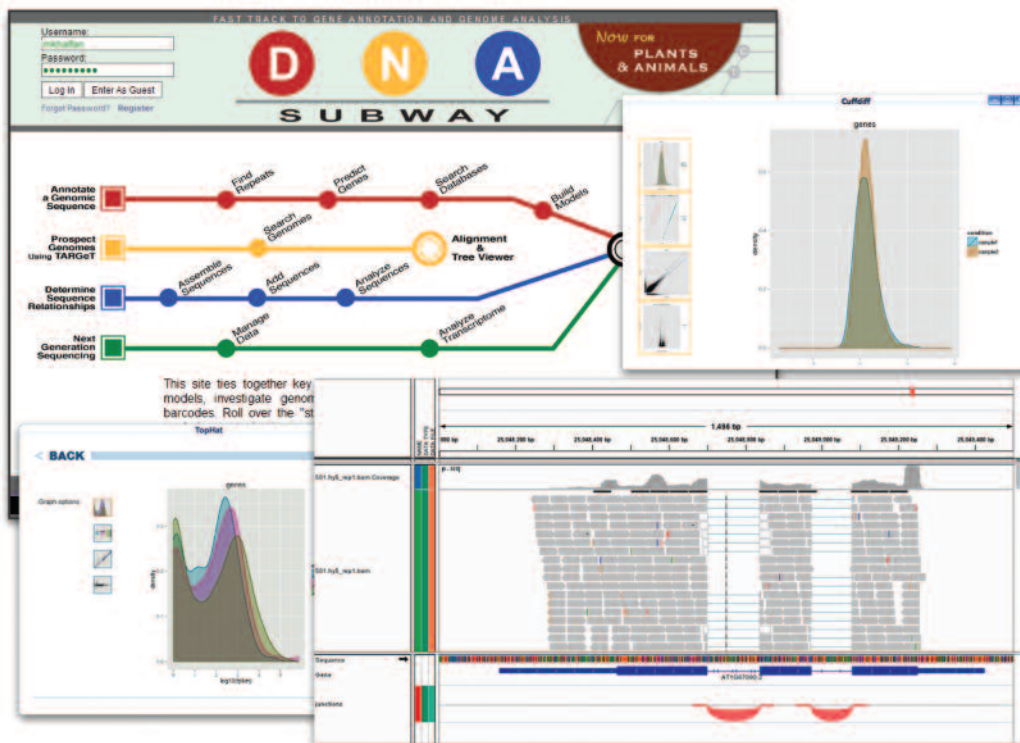
In contemplating the cosmos in 1927, the great mathematical geneticist J.B.S. Haldane famously said, “My own suspicion is that the universe is not queerer than we suppose, but queerer than we can suppose.” Had he been alive today, Haldane would almost certainly have the same suspicion about the genomes of higher organisms. In this sense, genome scientists are the new cosmologists of biology, uncovering the strange and beautiful structure of the genetic material that runs through all life. Like cosmology, genome science is based on the collaborative analysis of massive datasets that exceed the capacity of desktop computing and sometimes even outstrip the available resources of an entire institution.

The *iPlant Collaborative* is an NSF-funded project to develop a national computer infrastructure (CI) to support biologists working within the new paradigm of large-scale genomic, phenomic, ecological, and phylogenetic data. The primary components of the *iPlant* CI include the *Data Store*, *Atmosphere* cloud computing, and the *Discovery Environment* analysis platform. The DNALC takes the lead in Education, Outreach, and Training (EOT) among consortium partners at University of Arizona, University of Texas, and CSHL. The EOT group has developed a sophisticated computational and Internet design group that occupies a unique niche in science education. EOT leverages scientific knowledge, teaching pedagogy,

and bioinformatics expertise to translate the *iPlant* CI into workflows that are accessible across the continuum of research and education—from “entry-level” and education-oriented users to sophisticated bioinformaticians and computational scientists.

We continued to evolve *iPlant*'s educational discovery environment, *DNA Subway*. In keeping with the increased use of the *iPlant* infrastructure across the diversity of life, the Red Line (for gene annotation) and Blue Line (for barcode and phylogenetic analysis) were upgraded with appropriate algorithms to analyze mammals, birds, fish, insects, and fungi. The Blue Line became the analysis workhorse for the *Urban Barcode* and *Barcode Long Island* projects described above, helping to double registered accounts to 4,254 and increasing visitation 40% (to 33,376) over the previous year. We devoted substantial resources to develop the Green Line, which aims to make next-generation sequence (NGS) analysis of eukaryotic genomes accessible to a broad audience of first-time users. The Green Line integrates the Tuxedo Protocol, a workflow incorporating open source components for all steps of RNA sequence (RNA-Seq) data analysis—from the processing of raw data from major sequencing platforms through to publication-quality results. The Green Line will be integrated with the Red Line, where assembled transcripts can provide evidence for community (or class) annotation of sequenced genomes. The Green Line articulates directly with high-performance clusters at the Texas Advanced Computing Center, providing what we believe to be the first, easy biological on-ramp to the national supercomputing highway.

We worked very hard to get the word out about *iPlant*, holding 24 two-day training workshops in 2012, in addition to dozens of seminars and talks at professional meetings and universities. From Arkansas to Alaska, 340 researchers and 201 educators attended *Tools and Services* and *Genomics in Education* Workshops respectively, introducing them to advanced



The *DNA Subway* Green line includes visualizations of RNA-sequence reads and graphs detailing differences in gene expression.

computational resources for science and teaching. This year we provided additional travel awards for 40 minority faculty and faculty who reach large numbers of African American or Hispanic students, minorities that are underrepresented in science study and careers—awardees reported an average of 47% underrepresented students in their classes.

In 2012 we assumed responsibility for internal *iPlant* project evaluation and began to coordinate with East Main Educational Consulting, LLC, to complement their existing program of external evaluation. Eighty percent of respondents to a *Genomics in Education* Workshop follow-up survey (n=241) had used the workshop materials, reaching over 1,600 students. The materials were used in a range of courses—including general biology (34%), genetics/genomics (30%), molecular biology (19%), and bioinformatics (13%). Materials were used for background information (59%), class resources (37%) and laboratory protocols (23%). One in five (21%) had developed a new topic, wet lab, or bioinformatics lab. Participants also shared materials with colleagues (20%) and provided training in bioinformatics (15%). Of 60 respondents to a follow-up survey of the *Tools and Services* Workshop, 57% had used at least one *iPlant* tool, with 57% using *Data Store* and 31% using *Atmosphere* or the *Discovery Environment*. Respondents used the tools to analyze their own data (54%), a colleague's data (30%), or to share data (27%). Encouragingly, 68% of respondents introduced *iPlant* tools and services to colleagues, and 41% provided training.

We distributed a “community” survey at the American Society of Plant Biologists meeting. Of 51 respondents, 88% said they currently used large data sets or expected to in the next one to five years. This suggests that a large majority of plant researchers are potential users of the *iPlant* CI. Structured interviews with 15 attendees revealed major challenges in extracting, storing, and sharing data; keeping abreast of current tools; collating tools into one workflow; and learning how to perform analyses.

Nationwide Faculty Training

The DNALC continued its tradition of providing cutting-edge biochemical and bioinformatics training for educators at sites nationwide. In 2012, 743 educators and scientists participated in workshops conducted at 30 sites across the United States. Overall, underrepresented minorities in science composed 19% of educators trained at 37 workshops of 1–10 days. An additional 466 educators and scientists attended seminars, short workshops, and presentations at professional meetings—including American Society of Plant Biologists, Botanical Society of America, CSHL President's Council, International Barcode of Life, National Association of Biology Teachers, National Science Teachers Association, International Plant & Animal Genome Conference, and the Purdue Statistics Symposium. (For a complete list of training activities and host sites, see “2012 Workshops, Meetings, and Collaborations.”)

With funding from the NSF, over the last two years we have collaborated with community college faculty and the National Advanced Technological Education (ATE) Center for Biotechnology (Bio-Link) to develop and disseminate *Genomic Approaches in BioSciences*. This workshop introduces the four key technologies included in *Genome Science*—PCR, DNA sequencing, RNAi, and bioinformatics—which provide a scientific foundation for biotechnology careers in the genome age. The first seven workshops were held in 2011 and 2012, reaching 155 faculty (of 272 applicants). Forty-three percent of participants taught at two-year colleges, 31% at four-year colleges or universities, and 26% at high school. One fourth of participants were minorities that are underrepresented in science. Summer workshops were conducted at Austin Community College (Austin, Texas), Bluegrass Community and Technical College (Lexington, Kentucky) and Southern Maine Community College (South Portland, Maine). Follow-up activities were conducted at 2011 workshop sites: Gwinnett

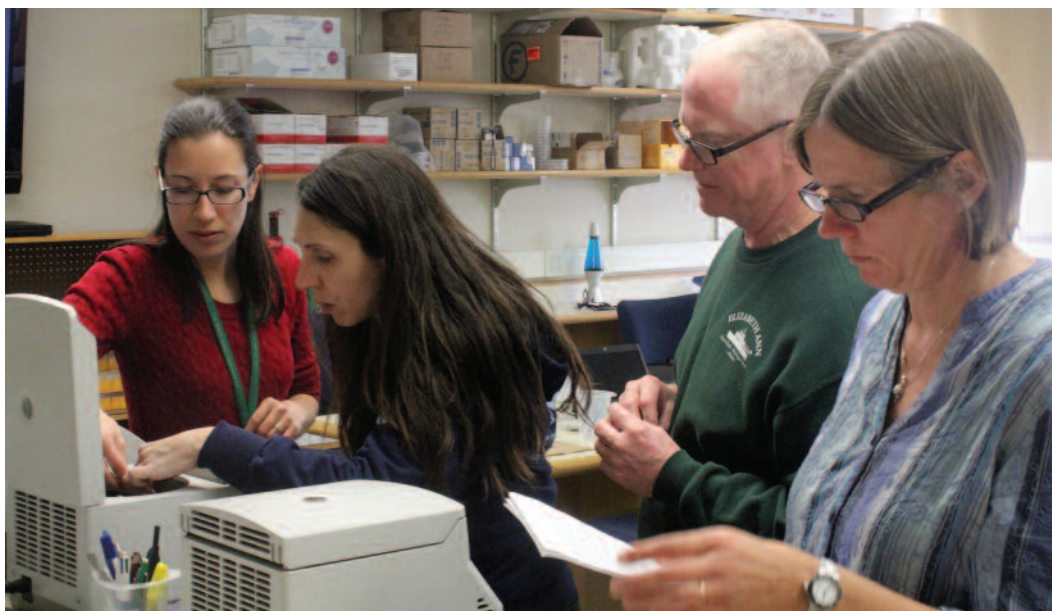
Technical College (Lawrenceville, Georgia), Madison Area Technical College (Madison, Wisconsin), Shoreline Community College (Shoreline, Washington), and Universidad del Turabo (Gurabo, Puerto Rico).

We are carefully tracking the impact of the *Genomic Approaches in BioSciences Workshops*. Pre-workshop (n=145) and post-workshop (n=142) surveys showed notable increases in faculty knowledge and confidence. Before the workshop only 12% of participants knew “a lot” about the key genomic concepts, compared with 41% afterwards. There was a marked increase in participants who felt confident in teaching the genomics labs (17% to 41%) and bioinformatics (8% to 34%). Follow-up surveys (n=70) found strong classroom implementation of the four genomic technologies—DNA barcoding (41%), PCR (55%), RNAi (22%), and bioinformatics (42%)—as well as career modules (75%). These faculty reported 9,029 student exposures to labs, 4,796 to bioinformatics, and 2,605 to biotech careers—with an average of 46% underrepresented minority students.

New York City Faculty Training

In 2012, we concluded the Howard Hughes Medical Institute (HHMI) teacher-training program, which we administered in collaboration with the NYC Department of Education (DOE). This program was designed to develop a strong base of 8th–12th grade science teachers who can competently introduce six experiments in genetics and biotechnology at identified points in state-required science courses. Over the four-year term of the grant, 835 NYC teachers completed an average of 15 hours of training each, accounting for 1,642 lab exposures and 9,852 workshop hours. In 2012, 101 teachers took one or more workshop sessions, and 45 completed a 24-hour sequence of certificate training. Eighty-five percent of workshop participants taught 8th–10th grades, our target audience, including 38% African American or Hispanic teachers. Pre- and post-workshop surveys showed significant knowledge gains, and 13 faculty also participated in advanced leadership training.

To ease classroom implementation, in 2010 funding from the Richard Lounsbery Foundation allowed us to develop 15 biotechnology Footlocker Kits for use by teachers trained in the



Melissa Lee (far left), *Harlem DNA Lab Manager*, works with NYC teachers.

HHMI program. Each Footlocker contains equipment and expendable supplies sufficient for 3–4 classes; a modest restocking fee of \$50 per class of 32 students is less than half the cost of a commercial reagent kit. Over a two-year period, Footlockers were used to do experiments with 5,708 students, 68% of whom were underrepresented minorities. Footlocker rental fees were waived for 75% of schools with high proportions of disadvantaged students, based on Title I status.

An experimental study compared outcomes for students in classes that implemented the HHMI labs versus classes that did not. We focused on restriction analysis, because a paper-based lab simulation is a mandatory component of the NYS Regents biology curriculum, *Living Environment*. To control for teacher proficiency, we recruited study participants from the pool of HHMI-trained teachers, who taught the mandated *Living Environment* curriculum. To control for student variance we choose 9th or 10th grade general studies classes. Student learning was assessed using a standardized quiz, which incorporated Regents exam questions on DNA structure and function, restriction enzymes, gel electrophoresis, and applications of restriction analysis.

Teachers who had completed an HHMI workshop on restriction analysis were in the experimental arm of the study and implemented the wet lab using a Footlocker. Teachers who had completed a different HHMI workshop were in the control arm and used the mandated paper-based activity. Twelve teachers and 294 students (115 experimental, 179 control) participated in the study. Results showed that doing the hands-on DNALC biotechnology lab improved student learning by almost a full letter grade over the pen-and-paper equivalent (68% vs. 60% quiz scores, $p < 0.001$). The wet lab also impacted students' interest in science more than the paper-based lab, with 46% vs. 35% of students saying they were now more interested in science.

Student Lab Programs

On October 29th, Hurricane Sandy made an appearance along the northeastern seaboard, leaving parts of New York and New Jersey completely immobilized. The DNALC and most school systems were without power for at least a week. School closings and adjustments in school calendars to make up for lost days resulted in 25 cancelled lab field trips. In spite of this unanticipated setback, 19,327 students attended lab field trips at our three facilities—Dolan DNALC, DNALC *West*, and *Harlem DNA Lab*. An additional 7,221 students received in-school instruction from DNALC staff members.

Summer camp enrollment reached an all-time high in 2012, with 1,069 student participants in 55 weeks of camps conducted at eight locations on Long Island and NYC: Dolan DNALC, DNALC *West*, Stony Brook University (SBU), Brookhaven National Laboratory, Mulligan Elementary School, The Chapin School, and Trinity School. Among the campers were 20 students from Beijing No. 166 High School, the first specialized school of life sciences in the Chinese capital. This was the second cohort of students from Beijing to participate in a three-week immersion program that included classical genetics, human and plant genomics, and independent research using DNA barcoding.

We focused considerable resources on underserved youth. Grants from the Dana Foundation and the William Townsend Porter Foundation provided scholarships totaling \$51,000 for 2,209 students to attend lab field trips at the *Harlem DNA Lab*. Three-quarters of students receiving scholarships were underrepresented minorities from Title I schools. We also provided intensive enrichment to students from two schools housed with the *Harlem DNA Lab* in the John S. Roberts Educational Complex. Students from the Coalition School for Social



Amanda McBrien, DNALC Assistant Director for Education, teaches pipetting techniques to *Green Genes* summer camp students.

Justice participated in three biotechnology laboratories, and 6th–8th graders from MS 45 enjoyed seven introductory genetics laboratories. A \$15,000 grant from the National Grid Foundation supported in-school instruction for 996 5th–7th graders from Central Islip School District. Students used microscopes to view plant and animal cells, extracted DNA from living cells, and observed mutations in fruit flies. Twelve 5th–6th students received scholarships to participate in a *Fun with DNA* summer camp at Central Islip's Mulligan Elementary School.

During the spring, fall, and winter, 249 students (10 years and older) and parents participated in monthly *Saturday DNA!* sessions. DNALC staff members provided hands-on investigations of a variety of topics, including family genealogy, unicellular organisms, dinosaur evolution, the Romanov family mystery, DNA extraction, protein purification, gene regulation, the agricultural revolution, and the role of carbon dioxide in our lives.

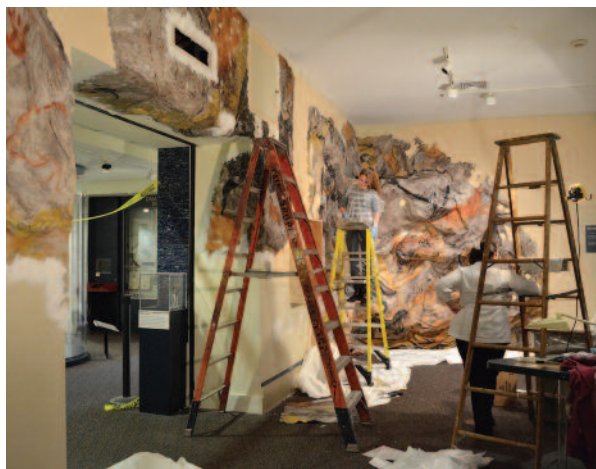
We continued to work intensively with Trinity School and The Chapin School, who belong to our Charter Membership program for independent schools in the New York metro area. The program includes field trips to the DNALC and in-school instruction by DNALC instructors, as well as exclusive, on-site summer camps for students. In September, Convent of the Sacred Heart School in Greenwich, Connecticut became the third Charter Member school. Together, we planned an extensive program of in-school visits for their environmental science, biology, *AP Biology*, and chemistry across 5th through 8th grade classes. With a strong research program already in place, they wasted no time organizing workshops using *C. elegans* as a model to study gene function and launching several student projects with roundworms.

In May, we celebrated the 10th anniversary of DNALC *West*, the first licensed DNALC affiliate. Developed in collaboration with the North Shore-Long Island Jewish (NS-LIJ) Health System, DNALC *West* opened in 2002 in space adjacent the NS-LIJ Clinical Core Laboratory in Lake Success. During its first decade, DNALC *West* provided lab field trips for 28,163 students, and intensive summer camps were attended by 1,919 students. With strong support from CSHL



Bob Stallone, James Watson, and Dave Micklos at the DNALC *West* celebration.

trustee Arthur Spiro, DNALC *West* was originally supported by a core grant from NS-LIJ's Feinstein Institute for Medical Research. When Feinstein funding lapsed in 2011 and there was no ready source of funds during the recession, Bob Stallone, Vice President of NS-LIJ Laboratories, stepped up to continue funding for DNALC *West*. Thus, we were doubly thankful when Bob hosted a cocktail reception to honor the long collaboration—with guest of honor, CSHL chancellor emeritus James Watson and NS-LIJ leaders, including Dr. James Crawford, Senior Vice President for Laboratory Services and Chair of Pathology, and Dr. Christine Ginocchio, Senior Director of Infectious Disease Diagnostics.



By year's end the Dolan DNALC had received a mini-facelift. A larger lunchroom was created within former exhibit space and the former lunchroom was redesigned as our fourth teaching lab. Although our exhibit space shrank, we maintained most of the popular elements of the "The Genes We Share" exhibit. The room on genetic origins and evolution, affectionately called "The Cave," was recreated in the main exhibit area. New Lab #4 is our smallest teaching space; at 525 square feet it demonstrates the most compact floor plan that can accommodate 24 students. It is also our most beautiful lab. A wall of windows, with mullions designed as a visual metaphor for the DNA bands in an electrophoresis gel, looks serenely out onto a patio and landscaped hillside. The Dolan DNALC prep labs, carved out of the crusty basement in 1989 and not updated since, were remodeled and reorganized to better support a range of activities, including inorganic reagent preparation, bacterial and *C. elegans* culture, microscopy, student research, and new experiment development. We also reorganized the storeroom as a center to restock the Footlockers that support in-school instruction by DNALC staff and are used independently by classroom teachers. These Footlockers were used by 8,937 students in 2012.

Graduate Training and Student Research

We continued to support the graduate training of the CSHL Watson School of Biological Sciences (WSBS) students. From January through March the students work under the watchful eye of experienced DNALC instructors to learn effective teaching techniques that prepare them to be better science communicators. During the first phase of training, each student team observed a DNALC instructor performing a restriction analysis experiment with a class of local high school students. Phase two, co-instruction, involved preparing a lesson plan that

integrated their own perspectives, then delivering the practical portion of the lab to high school students. DNALC instructors provided constructive critique to help the WSBS students prepare for the third phase of training: team teaching the entire experiment to a high school class. After additional reflection, this learning cycle was repeated with a DNA extraction lab for middle school students, which required increased pacing. Upon completion of both high school and middle school teaching rotations, each WSBS student team delivered three additional lessons to demonstrate mastery of instructional and classroom management skills.

We continued our collaboration with the New York Academy of Sciences, training young scientists to help improve science literacy among high needs students throughout NYC. DNALC instructors worked with 67 graduate students and post-doctoral researchers participating in the Academy's after school mentoring program. Each mentor received six hours of training in effective strategies to provide hands-on laboratories to middle school students.

Our partnership with Cold Spring Harbor High School (CSHHS) to offer a college-level laboratory course entitled *Molecular and Genomic Biology* continued. Co-instructed by DNALC staff members and CSHHS faculty member Jaak Raudsepp, the year-long course occupies the last two periods of the day and alternates instruction between CSHHS and the Dolan DNALC. The 2011–12 cohort, our seventh class, focused on hands-on experimentation and independent projects across a range of biological systems. Highlights of the year included units presented by WSBS graduate students Colleen Carlston, Katie Liberatore, and Eugene Plavskin. Colleen assisted in setting up a genetic screen in *C. elegans* that identified three new genes that affect RNAi function. Katie taught a unit, "Cell Signaling: Communication, Development and Disease." Eugene guided experiments on environmental factors that affect fitness and natural selection in bacteria. Joan Kiely, of SBU's Biotechnology Teaching Center, followed up with a unit on modeling proteins involved in cell signaling. Student teams selected proteins, developed computer files describing their structure, then used a 3D printer to output small-scale models. The students presented their work during a poster session of the CSHL "Cell Cycle" meeting on May 18.



CSHHS students discuss their project poster on the MAD2 protein with a CSHL "Cell Cycle" meeting participant.

Building on the success of the CSHHS partnership, we offered a similar course for students from St. Dominic High School in Oyster Bay. The course capitalized on St. Dominic's new science building, made possible through a major gift from a parishioner. In collaboration with science teacher Teresa Kuehhas, DNALC staff introduced students to experimental methods for future independent projects: species diversity using DNA barcoding, gene function using RNAi in *C. elegans*, and human variation using PCR.

The annual *Great Moments in DNA Science* seminar series attracted 185 top Long Island high school students for presentations on current biological research at CSHL. Michael Feigin explained how cells generate and maintain shape—and how defects in these processes can lead to human disease. Jonathan Ipsaro discussed new scientific methods to study the micro-scale orchestration of DNA and proteins that sustain life. Shane McCarthy discussed advances in genome technology that provide insights into the neurobiology and treatment of schizophrenia.

BioMedia Projects and Visitation

In spring 2012 we launched the *Weed to Wonder* e-book and enhanced website, developed as outreach for a NSF research project with CSHL's Marja Timmermans and Mike Scanlon at Cornell University. *Weed to Wonder* shows the continuity of research on corn—from Native American agriculturalists to agricultural breeders, corn geneticists, plant physiologists, and molecular biologists—that culminated in the Maize Genome Sequencing Project. The interactive e-book is available as a website, tablet app, or printable PDF. Six chapters tell the story of the development of modern maize—including domestication and hybrid vigor, genome sequencing and transposon complexity, and genetic modification and biofortification. The e-book revolves around video footage from Mexico, interviews with prominent scientists, and animations of different approaches to sequencing the maize genome. The history of maize research is brought to life through reconstructions of George Shull and Barbara McClintock's work at CSHL, rare photographs, and links to original publications and artifacts. The e-book also includes a time-lapse video of growing maize plants—from germination, through growth spurts, to pollination, senescence, and harvest.

We also completed the *Lab Center* website (<http://labcenter.dnalc.org/harlem>), which supports the six genetics and biotechnology labs in the HHMI-funded program. The final task was the production of *New York Stories*, a series of mini-documentaries about past or current work of notable scientists based at New York institutions. Students from NYC high schools contributed significantly to writing and production of the last three videos in the set. Teams of 9th and 11th grade students from Trinity School worked on productions about DNA fingerprinting and restriction enzyme analysis, while a team of 11th and 12th graders from Brooklyn International High School worked on a production about Thomas Hunt Morgan's "Fly Room" at Columbia University. Each video features a scientist "explainer": Larry Kobilinsky of John Jay College of Criminal Justice, on the use of DNA fingerprinting in forensics; former CSHL scientist Scott Lowe, now of Memorial Sloan-Kettering Cancer Center, on the use of restriction analysis techniques in cancer research; and CSHL researcher Glenn Turner on the use of Morgan's "fly," *Drosophila melanogaster*, as a model in neuroscience research. The videos are featured on the *Lab Center* website and on YouTube (www.youtube.com/dnlearningcenter). To date the set has received over 5,000 views.

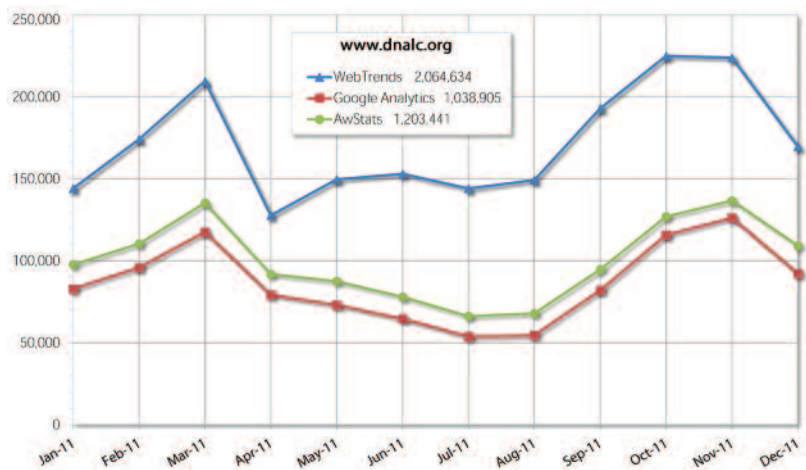
Trinity School students interview their classmates and teacher for *New York Stories*.



Over the year, we continued our effort to disaggregate and redistribute content across different multimedia platforms. The majority of *BioMedia* content is now available in an original content site or app, as well as through our searchable database on www.dnalc.org and our YouTube channel. We also feature and cross-link resources in our social media accounts (Facebook and Twitter), blogs, presentations, and publications. A good example of multitasking is the Punnett square interactive originally developed for our iPhone app, *Gene Screen*. It was reformatted for iPad, and as a website for personal use or on a classroom Smartboard.

Counting visitors to the DNALC family of 21 websites is important, but complicated. *Webtrends* was the dominant analytic software at the inception of many of our websites, and we used it faithfully over the years to track long-term trends in visitation to all of our websites. So it was with some trepidation that in 2012 we transitioned all of our websites to the *Google Analytics* package, which has become the *de facto* standard for measuring web visitation.

To insure that we can analyze trends retrospectively, we compared 2011 visitation data for the DNALC homepage (www.dnalc.org) using *Webtrends*, *Google Analytics*, and a third tool, *AWStats*. The three tools use different rules to analyze the same web logs, resulting in different numbers of visitors, as shown in the graph. This is mainly because *Google Analytics* defines one visit as up to 60 minutes of viewing vs. 20 minutes for *Webtrends*. (For example, if a visitor spends 60 minutes at a site, *Google Analytics* counts one visit while *Webtrends* counts three.) There are also other differences in how the tools count views of images, videos, and Flash animation files.



Although the overall trends are similar—with March and November peaks, and a July trough—the results from *Webtrends* and *Google Analytics* cannot be accurately scaled to compare year-to-year changes in visitation across all of our websites. We used *Google Analytics* to compare 2011 and 2012 data for the DNALC homepage, revealing a 42% increase to 1.48 million visitors. Overall *Google Analytics* counted 4,213,086 visits to our suite of 21 DNALC websites in 2012. Our YouTube videos received 865,899 views, and the 3D Brain, Weed to Wonder, and *Gene Screen* apps were downloaded 568,879 times. Therefore total multimedia visitation—websites, YouTube, and smartphone/tablet apps—was 5.65 million. This will become the new baseline against which we measure future visitation.

Staff and Interns

In 2012, the DNALC bid farewell to two staff members: Tedhar (Tedi) Setton, middle and high school educator, and Dr. Alexandra Manaia, Ph.D., *UBP* outreach team member. Tedi left the DNALC to begin a master's program in human genetics at Tulane University, where she will pursue a degree in medicine. She joined our educational team in 2008, following studies in biological science at Wellesley College and forensic pathology at the Suffolk County Medical

Examiner's Office. Tedi brought spirit and high energy to her teaching, helping us establish a new summer camp in forensic biology for middle school students.

Dr. Alexandra Manaia returned to her native Portugal to coordinate the Ph.D. program at Lisbon Medical School. Alexandra's internship at the DNALC—including a key role in establishing the *UBP*—fulfilled the final phase of her Fulbright Fellowship and master's degree in International Education Development at Columbia University. Alexandra met Dave Micklos in 2003 at a kickoff meeting of the European Learning Laboratory for the Life Sciences, an education and outreach facility at the European Molecular Biological Laboratory in Heidelberg, where she was then a science officer.

In December 2012, we welcomed Brooke Roeper and Katie McAuley to our DNALC teaching staff. Raised in northeastern Ohio, high school educator Brooke Roeper received a bachelor's degree in biology from Kenyon College. After doing research on West Nile virus at Case Western Reserve University, she earned a master's in science at Tulane University's School of Public Health and Tropical Medicine and a master's in ecology at Colorado State University. She went on to work as a middle school science teacher in Wyoming, a ranger at Wind Cave National Park, and, most recently, outreach coordinator at Teddy Roosevelt Sanctuary in Oyster Bay.

Katie McAuley, a native Long Islander and graduate of Harborfields High School, has come full circle to the DNALC in the role of middle school educator. Solving the "Mystery of Anastasia" on a class field trip to the DNALC inspired her to pursue science in college. As an undergraduate at the University of Rhode Island, Katie added education to biology for a double major. Her life experiences included studying abroad at Macquarie University in Sydney, Australia and the University of the South Pacific, Fiji, and helping students build robots in Lego's Bricks 4 Kidz program.



Brooke Roeper(left) and Katie McAuley

Our year-round internship program continued to draw some of Long Island's most talented high school and college students, engaging them in science research and providing practical laboratory experience. We were pleased to accept new high school interns Matthew Angeliadis, Rachel Bosco, Brittany Coscio, Pauline McGlone, and Robert Scott (all from Huntington); Anne Bode (St. Anthony's); Magdalene Economou (Syosset); Nathaniel Hogg (Friends Academy); Jack Manzi (Kings Park); Anant Mehrotra (Oyster Bay); Sophie Podhurst (Walt Whitman); and Daliah Ross (Harborfields). The new hires joined veterans Katie Bellissimo (Walt Whitman) and Anna Saum (home school).

We bid farewell to a number of high school interns as they left for their freshman year at college: Cyril Danielcutty (SBU), Alexa DeAngelis (Georgetown), Jack Greenfield (MIT), Devika Gupta (Lehigh), Frieda Haerter (Rensselaer Institute of Technology), Julie Hemphill (U. Pittsburgh), Paras Patel (Hofstra), and Gianna Torre (Hunter).

Our busy summer season of camps requires additional help. Returning interns Becky Hirsch (Friends Academy) and Paul Donat (SUNY Geneseo) were joined at our Dolan facility by newbies Sabrina Gallego (Half Hollow Hills), William Harlow (Trinity School), Grant Murphy (Friends Academy), and Steven Kunis (Seton Hall Prep). Veteran Juliet Jacobson (Hebrew

Academy of Nassau County) returned to help at our DNALC West location, with newbies Arvind Rajabhathor and Shenika Shah (both Herricks), Kalliopi Chatzis (Bayside), and Angell Xiang (Great Neck).

College interns mentor younger interns and fulfill requests for DNA sequencing and RNAi targeting vectors from faculty nationwide. Returning in 2012 were David Dopfel and Lina-Mari Varghese (both SBU), Arielle Scardino (City College of New York), (, Katherine Villalon (John Jay College of Criminal Justice) and Sulaiman Usman (New York Institute of Technology). Arielle and Sulaiman also played key roles in the UBP in Manhattan.

Some high school interns compete in research competitions, including the Seimens Science Competition, and the New York and Long Island Science and Engineering Fairs. Matt Angeliadis (Huntington) is studying the effects of ultraviolet radiation on the population growth of yeast, while Robert Scott (also of Huntington) is exploring a method to counteract toxins released by a species of garlic mustard.

2012 Workshops, Meetings, and Collaborations

January 4	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 7	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 10	Site Visit by Kelley Remole, Columbia University, <i>Harlem DNA Lab</i>
January 11	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 12	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i> <i>Urban Barcode Project</i> presentation at the Vienna Open Lab, Vienna, Austria
January 13	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 14	<i>Saturday DNA!</i> "When Genes are Switched Off," Dolan DNALC
January 14–18	International Plant & Animal Genome XX Conference 2012, "DNA Subway Places Students on the Fast Track to Genome Analysis," Town and Country Convention Center, San Diego, California
January 17	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
January 18	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 19	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 20	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 2," <i>Harlem DNA Lab</i>
January 21	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 2," <i>Harlem DNA Lab</i>
January 25	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 26	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
January 28	STEM Mentor Training, New York Academy of Sciences, New York, New York
January 30	STEM Mentor Training, New York Academy of Sciences, New York, New York
February 2	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
February 4	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
February 7	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
February 8	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York Site visit by Larry Kingsley, Pall Corporation, Port Washington, New York
February 10	HHMI Professional Development Workshop, "DNA Structure and Isolation," <i>Harlem DNA Lab</i>
February 11	HHMI Professional Development Workshop, "DNA Structure and Isolation," <i>Harlem DNA Lab</i> <i>Saturday DNA!</i> "Selection Detection," Dolan DNALC
February 13	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
February 14	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
February 15	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York <i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i> Ecology and Evolutionary Biology Graduate Programs Presentation, "Bushmeat Trade and Diseases," Columbia University, New York, New York
February 16	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York <i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i> <i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
February 20	New York City Department of Education Professional Development Workshop, "DNA Barcoding," American Museum of Natural History, New York, New York
February 21	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i> <i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
February 22	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i> New York City Department of Education Professional Development Workshop, "DNA Barcoding," American Museum of Natural History, New York, New York
February 23	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i> <i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
February 24	City College of New York Teacher Academy Professional Development, "DNA Extraction," <i>Harlem DNA Lab</i> New York City Department of Education Professional Development Workshop, "DNA Barcoding," American Museum of Natural History, New York, New York
February 27–28	HHMI CUREnet Meeting, Howard Hughes Medical Institute, Chevy Chase, Maryland
February 28	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
February 29	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>

	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
March 2	HHMI Professional Development Workshop, "Variability and Inheritance," <i>Harlem DNA Lab</i>
March 3	NSF ATE Professional Development <i>Genomic Approaches in BioSciences</i> Follow-up Workshop, Universidad del Turabo, Gurabo, Puerto Rico
	HHMI <i>New York Stories</i> , "Restriction Analysis," filming Ileana Rios and the Trinity School 11th Grade Laboratory Class, New York, New York
March 5	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
March 7	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
March 8	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
March 10	<i>Saturday DNA!</i> "Genetics of HIV Resistance," Dolan DNALC
March 12–13	NSF <i>iPlant Collaborative</i> Professional Development, <i>Tools and Services</i> Workshop, University of California, Davis, California
March 13	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
March 14	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
March 15	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
	HHMI Professional Development Workshop, "Bacterial Transformation," <i>Harlem DNA Lab</i>
March 17	HHMI Professional Development Workshop, "Bacterial Transformation," <i>Harlem DNA Lab</i>
March 19	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
March 21	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
March 22	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
March 24	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
March 27	<i>Urban Barcode Project</i> Open Lab, Genspace, Brooklyn, New York
March 27–28	NSF <i>iPlant Collaborative</i> Professional Development Genomics in Education Workshop, Purdue University, West Lafayette, Indiana
March 28	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
March 29	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
March 29–April 1	National Science Teachers Association 2012 National Conference on Science Education, "Exploring Genetics with <i>C. elegans</i> ," "Silencing Genomes," "DNA Subway," "DNA Barcoding in Your Classroom," Indianapolis, Indiana
March 31	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
April 2	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
April 4	Presentation for Master's Course in Conservation Medicine, "Parasites and Bushmeat: Molecular Identification of Parasites Found in Wildlife Traded in Markets," Columbia University, New York, New York
April 11	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
	New York City Department of Education Professional Development Workshop, "DNA Barcoding," American Museum of Natural History, New York, New York
April 13	New York City Department of Education Professional Development Workshop, "DNA Barcoding," American Museum of Natural History, New York, New York
April 14	NSF ATE Professional Development <i>Genomic Approaches in BioSciences</i> Follow-up Workshop, Gwinnett Technical College, Lawrenceville, Georgia
April 17–18	2012 Student Research Conference, "Eugenics in 20 th Century America: The Kirksville Connection," Truman State University, Kirksville, Missouri
April 19	<i>Urban Barcode Project</i> Open Lab, <i>Harlem DNA Lab</i>
April 20	HHMI <i>New York Stories</i> , "DNA Fingerprinting," filming Bob Hipkins, Ileana Rios, and the Trinity School 9 th Grade Laboratory Class, New York, New York
	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
	New York City Department of Education STEM Expo/Fair, "DNA Extraction," The Armory Track and Field Center, New York, New York
April 21	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
	<i>Saturday DNA!</i> "The Extraction Attraction," Dolan DNALC
	NSF ATE Professional Development <i>Genomic Approaches in BioSciences</i> Follow-up Workshop, Shoreline Community College, Shoreline, Washington

- April 23 HHMI *New York Stories*, "Fly Lab," interview with Glenn Turner, CSHL
 April 24 *Urban Barcode Project* Open Lab, *Harlem DNA Lab*
 April 25 *Urban Barcode Project* Open Lab, *Harlem DNA Lab*
 BioCube Project Planning Meeting, Smithsonian National Museum of Natural History,
 Washington, D.C.
- April 26 *Great Moments in DNA Science* Honors Seminar, "Can Cell Shape Influence Human Cancer?"
 Dr. Michael Feigin, CSHL, Dolan DNALC
Urban Barcode Project Open Lab, *Harlem DNA Lab*
 HHMI *New York Stories*, "DNA Fingerprinting," interview with Larry Kobilinsky, John Jay
 College of Criminal Justice, New York, New York
- April 26–27 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop,
 Southern University at New Orleans, New Orleans, Louisiana
- April 28 NSF ATE Professional Development *Genomic Approaches in BioSciences* Follow-up
 Workshop, Madison Area Technical College, Madison, Wisconsin
- April 28–29 USA Science and Engineering Festival, Walter E. Washington Convention Center,
 Washington, D.C.
- April 30 Site visit by Richard Snyder and Melanie Jardim, GENEWIZ, Inc., South Plainfield, New Jersey
- May 1 *Great Moments in DNA Science* Honors Seminar, "Seeing the Invisible: Atomic Pictures of
 DNA in Action," Dr. Jonathan Ipsaro, CSHL, Dolan DNALC
- May 2 *Urban Barcode Project* Open Lab, *Harlem DNA Lab*
 May 3 *Urban Barcode Project* Open Lab, *Harlem DNA Lab*
 May 4 HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 1,"
Harlem DNA Lab
- May 8 10 Year Anniversary Celebration, DNALC *West*
 May 9 *Urban Barcode Project* Open Lab, *Harlem DNA Lab*
 May 10 *Urban Barcode Project* Open Lab, *Harlem DNA Lab*
Great Moments in DNA Science Honors Seminar, "Next-Generation Schizophrenia Genetics:
 Finding Needles in the Haystack with Help from Your Family," Dr. Shane McCarthy, CSHL,
 Dolan DNALC
- May 11 Site visit by Vence Bonham and Belen Hurlé, National Human Genome Research Institute,
 Bethesda, Maryland
Urban Barcode Project Open Lab, DNA Learning Center *West*
- May 12 *Saturday DNA!* "Micro RNAs: Tiny RNAs to Turn Off Genes," Dolan DNALC
- May 14 Site visit by Science, Education, and Governmental Delegation, Kuala Lumpur, Malaysia
- May 17–18 NSF *iPlant Collaborative* Professional Development *Tools and Services* Workshop, University
 of Arkansas, Little Rock, Arkansas
 HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 2,"
Harlem DNA Lab
- May 21–22 NSF *iPlant Collaborative* Professional Development *Tools and Services* Workshop, Purdue
 University, Indianapolis, Indiana
- May 21–25 NSF ATE Professional Development *Genomic Approaches in BioSciences* Workshop, Austin
 Community College, Austin, Texas
- May 23 *Urban Barcode Project* Evaluators Workshop, American Museum of Natural History, New
 York, New York
- May 29 Site visit by Association Relative à la Télévision Européenne (ARTE) for "Naturopolis"
 documentary filming, Strasbourg Cedex, France, *Harlem DNA Lab*
- May 31 *Urban Barcode Project* Symposium, Poster Session 1, American Museum of Natural History,
 New York, New York
 NSF *iPlant Collaborative* Professional Development *Tools and Services* Workshop, North
 Carolina State University, Raleigh, North Carolina
- June 1 *Urban Barcode Project* Symposium, Poster Session 2, American Museum of Natural History,
 New York, New York
- June 3 *Urban Barcode Project* presentation, World Science Festival, New York, New York
- June 6 *Urban Barcode Project* Symposium Award Ceremony, American Museum of Natural History,
 New York, New York
 Site visit by Phil Ferralli, Carolina Biological Supply Company, Burlington, North Carolina
 Site visit by Mardi Matheson, Mill Neck, New York

June 7	New York City Department of Education Professional Development Workshop, P.S. 69, Brooklyn, New York
June 8	Site visit by Kim Jasmin, JP Morgan Foundation, New York, New York
June 9	<i>Saturday DNA!</i> "Food for Thought," Dolan DNALC
June 11	Site visit by Indra Nooyi and Mehmood Khan, PepsiCo, Inc., Purchase, New York
June 12	19 th Annual Golf Outing, Piping Rock Club, Locust Valley, New York
June 13	HHMI <i>New York Stories</i> , "Restriction Analysis," interview with Scott Lowe, Memorial Sloan-Kettering Cancer Center, New York, New York
June 16	New York City Department of Education Professional Development Workshop, "DNA Barcoding," American Museum of Natural History, New York, New York
June 18	Site visit by Her Serene Excellency, Dr. Zsana Kawar, Royal Family of Jordan
June 18–22	<i>DNA Science</i> Workshop, The Chapin School, New York, New York <i>Fun with DNA</i> Workshop, The Chapin School, New York, New York <i>World of Enzymes</i> Workshop, The Chapin School, New York, New York <i>World of Enzymes</i> Workshop, Trinity School, New York, New York
June 20–21	NSF <i>iPlant Collaborative</i> Professional Development Genomics in Education Workshop, Tulsa Community College, Tulsa, Oklahoma
June 21	NSF <i>iPlant Collaborative</i> Professional Development <i>Tools and Services</i> Workshop, 8 th International Purdue Statistics Symposium, Purdue University, Indianapolis, Indiana
June 25–29	<i>DNA Science</i> Workshop, Dolan DNALC <i>Fun with DNA</i> Workshop, Dolan DNALC <i>World of Enzymes</i> Workshop, Dolan DNALC <i>Fun with DNA</i> Workshop, DNALC West Forensics Workshop, The Chapin School, New York, New York
June 26–28	NSF <i>iPlant Collaborative</i> Professional Development RNA-Sequencing with the <i>iPlant Collaborative</i> Workshop, and "The <i>iPlant Collaborative</i> : Bringing Together High Performance Computing and Biology," The International Symposium on Genetics in Aquaculture XI, Auburn University, Auburn, Alabama
June 28	New York City Department of Education Professional Development Workshop, "Barcoding," American Museum of Natural History, New York, New York
June 29–30	NSF <i>iPlant Collaborative</i> Professional Development Workshop Genomics in Education, North Dakota State University, Fargo, North Dakota NSF <i>iPlant Collaborative</i> Professional Development <i>Tools and Services</i> Workshop, , North Dakota State University, Fargo, North Dakota
July 2–6	HHMI Professional Development Workshop, "Living Environment," <i>Harlem DNA Lab</i> <i>DNA Barcoding: The Biocube</i> Workshop, Dolan DNALC <i>Forensic Detectives</i> Workshop, Dolan DNALC <i>Green Genes</i> Workshop, Dolan DNALC <i>Plant Genomics</i> Workshop, Dolan DNALC <i>World of Enzymes</i> Workshop, DNALC West
July 2–13	Site visit by David Liittschwager, National Geographic Society, Washington, D.C.
July 8–10	Botanical Society of America Conference, NSF <i>iPlant Collaborative</i> Professional Development Workshop, <i>Tools and Services</i> and <i>DNA Subway</i> , Columbus, Ohio
July 9–12	HHMI Professional Development Workshop, "AP Biology," <i>Harlem DNA Lab</i>
July 9–13	NSF ATE Professional Development <i>Genomic Approaches in BioSciences</i> Workshop, Bluegrass Community and Technical College, Lexington, Kentucky <i>DNA Barcoding: The Biocube</i> Workshop, Dolan DNALC <i>DNA Science</i> Workshop, Dolan DNALC <i>Human Genomics</i> Workshop, Dolan DNALC <i>World of Enzymes</i> Workshop, Dolan DNALC <i>Green Genes</i> Workshop, DNALC West
July 12	Site visit by Ethan Berman, Roxbury Latin School, West Roxbury, Massachusetts
July 16–20	<i>DNA Science</i> Workshop, DNALC <i>Fun with DNA</i> Workshop, DNALC <i>Silencing Genomes</i> Workshop, DNALC <i>Fun with DNA</i> Workshop, Central Islip <i>DNA Science</i> Workshop, DNA Learning Center West

- July 16–27 HHMI New York City Leadership Symposium, *Harlem DNA Lab*
 July 19–20 Woodrow Wilson Teaching Fellows Conference, “DNA Barcoding in the Classroom,”
 Columbus Hilton, Columbus, Ohio
- July 20–24 American Association of Plant Biologists, “E-Books,” “Educational Genome Interfaces,” and
 “Distributed Student Research: Model Outreach Methods for Plant Research Collaborations,”
 Austin, Texas
- July 23–27 *Barcoding Biodiversity* Workshop, Dolan DNALC
Forensic Detectives Workshop, Dolan DNALC
Fun with DNA Workshop, Dolan DNALC
Genomics Workshop, Dolan DNALC
Fun with DNA Workshop, DNALC West
- July 25–26 NSF *iPlant Collaborative* Professional Development *Tools and Services* Workshop, U.S.
 Department of Agriculture Arid-Land Agriculture Research Center, University of Arizona
 Maricopa Agricultural Center, Maricopa, Arizona
- July 27 NSF *iPlant Collaborative* Professional Development RNA Sequencing with *iPlant Collaborative*
 Workshop, University of Arizona, Tucson, Arizona
- July 30–August 2 HHMI Professional Development Workshop, “Living Environment,” *Harlem DNA Lab*
 July 30–August 3 DNA Barcoding Workshop, Dolan DNALC
 DNA Science Workshop, Dolan DNALC
 World of Enzymes Workshop, Dolan DNALC
 DNA Science Workshop, DNALC West
 DNA Science Workshop, Stony Brook University, Stony Brook, New York
- August 6–9 HHMI Professional Development Workshop, “AP Biology,” *Harlem DNA Lab*
 August 6–10 NSF ATE Professional Development *Genomic Approaches in BioSciences* Workshop,
 Southern Maine Community College, South Portland, Maine
Barcoding Biodiversity Workshop, Dolan DNALC
Fun with DNA Workshop, Dolan DNALC
Green Genes Workshop, Dolan DNALC
Human Genomics Workshop, Dolan DNALC
 World of Enzymes Workshop, DNALC West
- August 13–14 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop,
 Montana State University, Bozeman Montana
- August 13–17 DNA Science Workshop, Dolan DNALC
Fun with DNA Workshop, Dolan DNALC
Green Genes Workshop, Dolan DNALC
 World of Enzymes Workshop, Dolan DNALC
Human Genomics Workshop, DNALC West
- August 16–17 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop,
 Brigham Young University, Provo, Utah
- August 20–21 NSF *iPlant Collaborative* Professional Development *Tools and Services* Workshop, University
 of Wisconsin, Madison, Wisconsin
- August 20–24 DNA Science Workshop, Dolan DNALC
Fun with DNA Workshop, Dolan DNALC
Green Genes Workshop, Dolan DNALC
Silencing Genomes Workshop, Dolan DNALC
Barcoding Biodiversity Workshop, DNALC West
- August 22 Site visit by Dr. Pola Rosen, Education Update, New York, New York
 August 22–23 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop,
 University of Wisconsin, Madison, Wisconsin
- August 27–31 *Barcoding Biodiversity* Workshop, Dolan DNALC
Forensic Detectives Workshop, Dolan DNALC
 World of Enzymes Workshop, Dolan DNALC
- August 28 NSF *iPlant Collaborative* Professional Development Using the Generic Synteny Browser
 Workshop, Genetic Model Organism Database Project, The National Evolutionary
 Synthesis Center, Durham, North Carolina
- September 12–14 NSF *iPlant Collaborative* Professional Development *Tools and Services* Workshop, and “The
iPlant Collaborative: Bringing Together High Performance Computing and Biology,” U.S.

- September 13 Department of Agriculture Livestock Cyberinfrastructure, Hinxton, England
NSF "Epigenome Dynamics During DNA Replication" interviews with Caroline Dean, John Innes Centre, Norfolk, United Kingdom and Ali Shilatifard, Stowers Institute for Medical Research, Kansas City, Missouri, CSHL
- September 14 STEM Mentor Training, New York Academy of Sciences, New York, New York
- September 15 STEM Mentor Training, New York Academy of Sciences, New York, New York
- September 17–18 Site visit by Steve Goff, *iPlant Collaborative*, University of Arizona, Tucson, Arizona
- September 20–21 Site visit by Julia Willingale-Theune, Wellcome Trust Sanger Institute, Hinxton, Cambridge, England
- September 27 NSF "Epigenome Dynamics During DNA Replication" interview with Edith Herd, Institut Curie, Paris, France, CSHL
- October 5 Site visit by Katarina Nordqvist, Nobel Museum, Stockholm, Sweden
- October 10 NSF *iPlant Collaborative* Professional Development *DNA Subway* Workshop, University of Washington, Seattle, Washington
- October 13 *Saturday DNA!* "Captivating Carbon Dioxide," Dolan DNALC
CSHL Presidents Council, "Engineering Society: The American Eugenics Movement," CSHL
- October 22–23 Site visit by Winship Herr, Severine Trouilloud and Vincent Parisy, University of Lausanne Eprouvette, Lausanne, Switzerland
- October 26–27 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop, Schoolcraft College, Livonia, Michigan
- October 29 Bay Area Biotechnology Education Consortium (BABEC), "DNA Barcoding and *DNA Subway*: Integrating B&B Workflows," San Mateo, California
- October 30–31 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop, University of Alaska – Anchorage, Anchorage, Alaska
- November 1–3 National Association of Biology Teachers Annual Meeting, "Sense in Molecules," "What DNA Says About Our Human Family," "Silencing Genomes," "DNA Subway in the Classroom," Dallas, Texas
- November 6 Center for Educational Innovation – Public Education Association (CEI-PEA) Professional Development Workshop, "DNA Structure and Isolation," *Harlem DNA Lab*
- November 10 *Saturday DNA!* "Protein Explosion!" Dolan DNALC
- December 1 KidCreate Art, Music, and Science Fair, "DNA Extraction," O'Shea Educational Complex, New York, New York
- December 8 *Saturday DNA!* "Single Cell-ibration!" Dolan DNALC
- December 10–11 NSF *iPlant Collaborative* Professional Development *Tools and Services* Workshop, University of Hawaii at Manoa, Honolulu, Hawaii
- December 13–14 NSF *iPlant Collaborative* Professional Development *Genomics in Education* Workshop, University of Hawaii at Manoa, Honolulu, Hawaii

Sites of Major Faculty Workshops 1985–2012

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

ALABAMA	University of Alabama, Tuscaloosa	1987–90
ALASKA	University of Alaska, Anchorage	2012
	University of Alaska, Fairbanks	1996
ARIZONA	Arizona State University, Tempe	2009
	Tuba City High School	1988
	University of Arizona, Tucson	2011
	United States Department of Agriculture, Maricopa	2012
ARKANSAS	Henderson State University, Arkadelphia	1992
	University of Arkansas, Little Rock	2012
CALIFORNIA	California State University, Dominguez Hills	2009
	California State University, Fullerton	2000
	California Institute of Technology, Pasadena	2007
	Canada College, Redwood City	1997
	City College of San Francisco	2006
	City College of San Francisco	2011
	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
	Stanford University, Palo Alto	2012
	University of California, Berkeley	2010, 2012
	University of California, Davis	1986
	University of California, Davis	2012
	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
	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
	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
	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
	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
	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
	St. John's College, Annapolis	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
	University of Minnesota, St. Paul	2005
	University of Minnesota, St. Paul	2010
MISSISSIPPI	Mississippi School for Math & Science, Columbus	1990–91
	Rust College, Holly Springs	2006–08, 2010
MISSOURI	St. Louis Science Center	2008–10
	Stowers Institute for Medical Research, Kansas City	2002, 2008
	University of Missouri, Columbia	2012
	Washington University, St. Louis	1989, 1997, 2011
MONTANA	Montana State University, Bozeman	2012
NEVADA	University of Nevada, Reno	1992
NEW HAMPSHIRE	Great Bay Community College, Portsmouth	2009
	New Hampshire Community Technical College, Portsmouth	1999
	St. Paul's School, Concord	1986–87
NEW JERSEY	Coriell Institute for Medical Research, Camden	2003

	Raritan Valley Community College, Somerville	2009
NEW MEXICO	Biolink Southwest Regional Meeting, Albuquerque	2008
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
	Columbia University, New York	1993
	Cornell University, Ithaca	2005
	DeWitt Middle School, Ithaca	1991, 1993
	Dolan DNA Learning Center	1988–95, 2001–04, 2006–09
	Dolan DNA Learning Center	1990, 1992, 1995, 2000–11
	Dolan DNA Learning Center	1990–92
	DNA Learning Center <i>West</i>	2005
	Fostertown School, Newburgh	1991
	<i>Harlem DNA Lab</i> , East Harlem	2008–09, 2011, 2012
	Huntington High School	1986
	Irvington High School	1986
	John Jay College of Criminal Justice	2009
	Junior High School 263, Brooklyn	1991
	Lindenhurst Junior High School	1991
	Mount Sinai School of Medicine, New York	1997
	New York City Department of Education	2007, 2012
	New York Institute of Technology, New York	2006
	New York Institute of Technology, New York	2006
	Orchard Park Junior High School	1991
	Plainview-Old Bethpage Middle School	1991
	State University of New York, Purchase	1989
	State University of New York, Stony Brook	1987–90
	Stuyvesant High School, New York	1998–99
	The Rockefeller University, New York	2003
	The Rockefeller University, New York	2010
	Titusville Middle School, Poughkeepsie	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
OREGON	Kaiser Permanente-Center for Health Research, Portland	2003
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 – Roundrock Campus	2007–09
	Austin Community College – Roundrock Campus	2012
	Houston Community College Northwest	2009–10
	J.J. Pearce High School, Richardson	1990
	Langham Creek High School, Houston	1991
	University of Lone Star College, Kingwood	2011
	Midland College	2008
	Southwest Foundation for Biomedical Research, San Antonio	2002
	Taft High School, San Antonio	1991
	Texas A & M, AG Research and Extension Center, Weslaco	2007
	Trinity University, San Antonio	1994
	University of Texas, Austin	1999, 2004, 2010, 2012
	University of Texas, Brownsville	2010
UTAH	Brigham Young University, Provo	2012
	University of Utah, Salt Lake City	1993
	University of Utah, Salt Lake City	1998, 2000
	Utah Valley State College, Orem	2007
VERMONT	University of Vermont, Burlington	1989
VIRGINIA	Eastern Mennonite University, Harrisonburg	1996
	Jefferson School of Science, Alexandria	1987
	Mathematics and Science Center, Richmond	1990
	Mills Godwin Specialty Center, Richmond	1998
	Virginia Polytechnic Institute and State University, Blacksburg	2005, 2008–09
WASHINGTON	Fred Hutchinson Cancer Research Center, Seattle	1999, 2001, 2008
	Shoreline Community College	2011, 2012
	University of Washington, Seattle	1993, 1998, 2010
WEST VIRGINIA	Bethany College	1989
WISCONSIN	Blood Center of Southeastern Wisconsin, Milwaukee	2003
	Madison Area Technical College	1999, 2009, 2011, 2012
	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
	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	Ho Yu College, Hong Kong	2009
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

PANAMA	University of Panama, Panama City	1994
RUSSIA	Shemyakin Institute of Bioorganic Chemistry, Moscow	1991
SINGAPORE	National Institute of Education	2001–05
SWEDEN	Kristineberg Marine Research Station, Fiskebackskil	1995
	Uppsala University	2000
THE NETHERLANDS	International Chromosome Conference, Amsterdam	2007
UNITED KINGDOM	Wellcome Trust Conference Center, Hinxton, UK	2012

2012 Grants and Funding

Grantor	Program	Duration of Grant	2012 Funding ⁺
FEDERAL GRANTS			
National Science Foundation, University of Arizona	Educational Outreach for <i>iPlant Collaborative</i> : A Cyberinfrastructure for Plant Sciences	2/08–1/13	860,267
National Science Foundation, North Carolina State University	GEPR: Epigenome Dynamics During DNA Replication	3/11–2/13	73,108
National Science Foundation	Advanced Technology Education (ATE) Program: <i>Genomic Approaches in BioSciences</i>	4/11–3/14	157,894
NON-FEDERAL GRANTS			
Victor Centers for Prevention of Jewish Genetic Diseases, Albert Einstein Healthcare Center / Marcus Jewish Genetic Disease Consortium	<i>Gene Screen</i> iPhone / iPad Application	12/10–12/12	31,900
Alfred P. Sloan Foundation	DNA Barcoding Experiments by New York City High School Students (<i>Urban Barcode Project</i>)	1/11–7/12	74,533
Howard Hughes Medical Institute	Pre-College Science Education Initiative: NYC Teacher Professional Development	9/07–8/12	145,319
Dana Foundation	<i>Harlem DNA Lab</i> Operating Support	3/09–2/12	27,700
William Townsend Porter Foundation	Scholarships for Minority and Underserved Students at <i>Harlem DNA Lab</i>	3/11–3/12	17,000
National Grid Foundation	Scholarships for Minority and Underserved Students in the Central Islip Union-Free School District	1/12–12/12	15,000
Spinal Muscular Atrophy Foundation	<i>Learn About SMA</i> Internet site	4/11–4/13	78,965

+ 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:

Elwood Union Free School District	1,500	Northport-East Northport Union Free School District	3,000
Fordham Preparatory School	3,000	Oceanside Union Free School District	3,000
Great Neck Union Free School District	1,500	Port Washington Union Free School District	3,000
Half Hollow Schools Central School District	3,000	Ramaz Upper School	1,500
Herricks Union Free School District	1,500	Sachem Central School District	3,000
Huntington Union Free School District	1,500	Yeshiva University High School for Girls	3,000
Levittown Union Free School District	3,000		
Locust Valley Central School District	1,500		

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

Adelphi STEP	1,050	Lynbrook Union Free School District	1,000
Bay Shore Union Free School District	2,800	Merrick Union Free School District	3,400
Bellmore Union Free School District	2,800	M.S. 447, Brooklyn	1,800
Bellmore-Merrick Union Free School District	10,000	North Bellmore Union Free School District	2,600
Cold Spring Harbor Central School District	14,400	North Shore Central School District	1,750
Commack Union Free School District	6,900	North Shore Hebrew Academy	1,050
East Meadow Union Free School District	3,730	Oceanside Union Free School District	1,625
East Williston Union Free School District	2,900	Oyster Bay-E. Norwich Central School District	5,625
Elwood Union Free School District	3,425	Plainedge Union Free School District	2,100
Floral Park-Bellerose Union Free School District	7,800	Port Washington Union Free School District	9,600
Friends Academy	2,100	Rockville Centre Union Free School District	6,240
Garden City Union Free School District	4,000	Roslyn Union Free School District	4,200
Great Neck Union Free School District	6,000	Sachem Union Free School District	2,925
Half Hollow Hills Union Free School District	9,150	Saint Dominic Elementary School	4,550
Herricks Union Free School District	2,275	Scarsdale Union Free School District	12,600
Hofstra STEP	1,050	Smithtown Union Free School District	1,680
Holy Child Academy	3,100	Syosset Union Free School District	36,600
IHM Home School Program	1,050	Three Village Central School District	4,200
Huntington Union Free School District	4,600	Trinity Regional School	1,300
Jericho Union Free School District	8,250	Valley Stream 13 Union Free School District	1,050
Locust Valley Central School District	8,859	Yeshiva of Flatbush	2,000

DNA LEARNING CENTER

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