

ANNUAL REPORT

2010

**Cover images** created by Todd Rocheford for use in a video coproduced by NYC high school students and DNALC staff. "New York Stories: Martin Chalfie & Green Fluorescent Protein (GFP)" is featured on the *Lab Center* website: <http://labcenter.dnalc.org/harlem>.

# DNA LEARNING CENTER EXECUTIVE DIRECTOR'S REPORT

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*Preparing students and families to thrive in the gene age*

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Just as a unique pattern of bars in a universal product code (UPC) identifies each item for sale in a store, a DNA barcode is a DNA sequence that uniquely identifies each living species. This simple premise was galvanized into action during meetings held in 2003 at Cold Spring Harbor Laboratory's (CSHL) Banbury Center and funded by the Alfred P. Sloan Foundation. At these meetings, scientists agreed to use short, standard DNA sequences to classify all living species and launched the *International Barcode of Life Project* (iBOL).

Operating under the iBOL banner, collaborators from more than 150 countries are involved in "campaigns" to census diversity in different plant, fungal, and animal groups, including ants, bees, butterflies, fish, birds, mammals, fungi, and flowering plants, and within ecosystems, including the seas, poles, rainforests, and coral reefs. The 10-year Census of Marine Life announced in October the first comprehensive list of more than 190,000 marine species, involving 2,700 scientists and identifying 6,000 potentially new species.

DNA barcoding is also important in detecting food fraud and products taken from conserved species. In advance of formal DNA barcoding, in 1996, Rob DeSalle of the American Museum of Natural History (AMNH) used related methods to find that five of 23 samples of caviar purchased in New York City (NYC) were mislabeled and included three samples from threatened sturgeon species. The Congressional Research Service recognizes that more than a dozen commercial fish are often mislabeled, passing off cheaper fish for expensive varieties. In 2008, Trinity High School students worked with Mark Stoeckle of The Rockefeller University and George Amato of AMNH to show the pervasiveness of fish fraud in NYC. They found that 25% of 60 seafood items purchased in grocery stores and restaurants were mislabeled as more expensive species. One mislabeled fish was an endangered species, the Acadian redfish.

### ***Urban Barcode Project***

DNA barcoding came full circle to New York, when in December we received a \$300,000 grant from the Sloan Foundation for the *Urban Barcode Project*, a science competition spanning the five boroughs of NYC. Student research teams will use DNA barcoding to explore biodiversity in the city environment, including:

- Sampling biodiversity in a park, garden, office, or school.



- Checking for invasive plant or animal species.
- Monitoring animal movements or migrations.
- Identifying exotic or endangered food products in markets.
- Detecting food or product fraud.

The competition is open to NYC high school students enrolled in grades 9–12. Teams of two to four students will work with a teacher sponsor to submit a project proposal for a June or October 2011 deadline. Proposals will be judged for originality, creativity, relevance, plausibility, and scientific merit. The top 100 teams will be invited to compete in the *Urban Barcode Project*. Teams must complete their projects by the spring of 2012 and will present their work at a project symposium. The best overall project will win the Grand Prize of \$10,000, and an additional \$10,000 in runner-up prizes will be awarded.

Sponsoring teachers must participate in a 6-hour training session, which will dovetail with our existing training program sponsored by the Howard Hughes Medical Institute (HHMI). Each successful team will have free access to everything needed for their DNA barcode experiments, including equipment, protocols, and reagents. Five equipment footlockers will be available for use by individual schools or for groups of nearby schools to share. During the term of the project, we expect to process ~10,000 DNA sequences. Teams may work on their projects at summer workshops and Open Lab days at designated locations.

Teams will be assigned a mentor from a NYC university, museum, or other scientific institution to answer technical questions and provide advice. Many mentors will be drawn from five NYC institutions that are collaborating on the project: AMNH, New York Academy of Sciences, New York Botanical Garden, Prospect Park Zoo, and The Rockefeller University. The project's scientific advisor Mark Stoeckle is a member of The Rockefeller Program for the Human Environment. In addition to demonstrating the educational promise of DNA barcoding, Dr. Stoeckle was one of the organizers of the 2003 Banbury meeting that launched the field of DNA barcoding and serves on iBOL's Scientific Steering Committee.

A dedicated Internet microsite ([www.urbanbarcodeproject.org](http://www.urbanbarcodeproject.org)) supports all phases of the project. This "online lab notebook" includes a video introduction to the barcode experiment, downloadable PDF lab protocols, teacher preparation, bioinformatics tools, and multimedia resources. Video interviews with scientists, animations, and video podcasts (vodcasts) describe the science and applications of DNA barcoding, and an active news feed and a link to Dr. Stoeckle's *Barcode Blog* provide up-to-date perspectives on DNA barcoding. Student DNA sequences are automatically uploaded to the "Blue Line" of *DNA Subway*, an online tool for DNA barcode and phylogenetic analysis developed as part of the National Science Foundation (NSF)-funded *iPlant Collaborative*. A Google Maps utility will track biodiversity discovered by student experiments, and students will highlight their projects through the social networking website, *Facebook*.

## Student DNA Sequencing

A decade ago, the DNALC developed a similar program—with simplified biochemistry and bioinformatics work flow—to allow students to analyze a portion of their own mitochondrial (mt) chromosome. Using a kit distributed by Carolina Biological Supply Company, students isolate DNA from cheek cells and then use polymerase chain reaction (PCR) to amplify the mitochondrial control region. The student samples are sent by overnight mail to the DNALC, where student interns prepare them for sequencing. The processed samples are then sent to the CSHL Sequencing Facility in Woodbury, and finished DNA sequences are then uploaded to the *Sequence Server* database at our *BioServers* website. There, students visualize their sequences and use software to align them with mitochondrial sequences from modern humans and extinct hominids to explore human genetic diversity and evolution.

The donation of sequencing reagents by Applied Biosystems of Foster City, California, has made it possible to provide this *Sequencing Service* free of charge for students. Since 1998, a total of 49,217 student DNA samples have been sequenced, and 1.3 million students and teachers have used the supporting *BioServers* website. We continued the *Sequence Service* in 2010, processing 7128 student DNA samples received from 93 high schools and 57 colleges and universities.

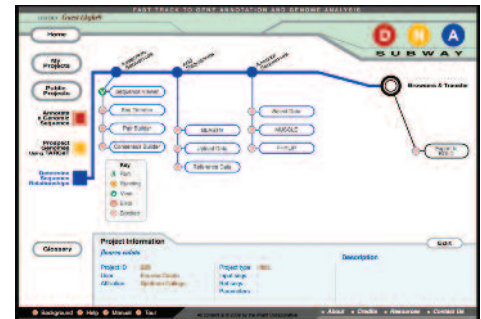
The cost of commercial sequencing, however, has decreased so dramatically over the last year that in December, we ceased sequencing on site and shifted all sequencing to *Genewiz*, a global contract research organization with expertise in sequencing. We negotiated a much-reduced price of \$3.00 per sample, which is less than our cost of sequencing with free reagents and student labor! This arrangement anticipates the increased volume of sequencing demanded by our *Urban Barcode Project*, as well as growing interest in using DNA sequencing in education. Student sequences are uploaded to our server within 48 hours of receipt by *Genewiz*, a dramatic improvement over the 2-week turnaround we were previously able to provide.

## *iPlant Collaborative*

The *iPlant Collaborative* is a consortium headed by the University of Arizona and CSHL to develop a computer (cyber) infrastructure to support plant research. *iPlant* aims to develop tools and interfaces that will provide scientists with easy access to large-scale plant data sets and high-powered informatics tools. Working Groups composed of *iPlant* staff and plant community members are currently building “discovery environments” to help plant scientists solve two “grand challenges”: (1) to produce an *iPlant* Tree of Life (iPToL) encompassing ~500,000 plant species and (2) to explore the genotype-to-phenotype continuum in plants (iPG2P).

Education, outreach, and training (EOT) is integral to *iPlant*'s mission of helping plant scientists make the best use of computer infrastructure to solve biological problems. During the first 2 years of the project, EOT worked in parallel with the Grand Challenge teams to create an educational Discovery Environment that allows students and teachers to work with the same data and use the same tools at the same time as high-level plant researchers. This culminated in the release in March of *DNA Subway*, a student-centered platform for gene annotation and comparison.

*DNA Subway* utilizes the metaphor of a subway map as an appealing interface to sophisticated informatics tools. “Riding” on either of the initial lines, students can predict and annotate genes in up to 150 kb of DNA (Red Line) or identify homologous, or related, sequences in whole genomes (Yellow Line). By year's end, a third “Blue Line” to analyze DNA barcodes and other short DNA sequences was mostly complete. This line offers the types of



*DNA Subway's* Blue Line

sequence analysis that precedes the massive tree construction envisioned by the iPToL Grand Challenge, simplifying sequence alignment and the construction of phylogenetic trees. The Blue Line will support the *Urban Barcode Project* in NYC and a nationwide *iPlant* program to encourage students to identify plants using the bar-code region of the *rbcl* gene found in chloroplasts. Thus, *DNA Subway* provides opportunities for students to discover basic principles of genome biology while embarking on independent research. By December 2010, the site had 742 registered users and had received 14,535 unique visits.

Acting on recommendations of an NSF site visit in 2010, EOT began to expand its role and became a Working Group analogous to those within the iPToL and iPG2P Grand Challenges. The EOT Working Group (EOTWG) includes core *iPlant* staff, collaborators, and community members from each of the Grand Challenge areas. The EOT Working Group also aims to increase the number of scientists who use and contribute to *iPlant* Discovery Environments and tools. Toward this goal, we are extending our successful workshop program to high-level researchers and are encouraging participants to bring their own data to analyze at workshops. This collaborative effort will help us develop case studies of interesting research questions that can be addressed with *iPlant* Discovery Environments.

As part of this expanded role, EOT multimedia staff at the DNALC took on the task of redesigning the *iPlant* website to increase its appeal and utility ([www.iplantcollaborative.org](http://www.iplantcollaborative.org)). This included the development of podcasts that introduce *iPlant* and the significance of the two Grand Challenges. The podcasts are available at the *iPlant* and DNALC websites, and on *YouTube*. In the coming year, we will develop intuitive interfaces to data sets and simplified work flows that make *iPlant* cyberinfrastructure available to a wide range of users. One project will repackage the iPG2P work flow for high-throughput sequencing as a “Green Line” on *DNA Subway*, allowing analysis of RNA data, including transcriptome and RNA-Seq data. We will also develop an *Orphan Data* interface that will match underworked data sets with students and faculty who would like to contribute to original research.



### **Harlem DNA Lab**

Genetics and biotechnology occupy major parts of required science courses and exams taken by virtually all NYC students in the eighth through tenth grades. However, teachers have received little training and few resources to deliver hands-on labs that could make these topics come alive for students. Thus, the objective of our Howard Hughes Medical Institute (HHMI) program is to use our expertise to prepare NYC teachers to teach a set of six labs that target key genetics and biotechnology concepts: *DNA Structure and Isolation*, *Variability and Inheritance*, *Bacterial Transformation*, *Protein Isolation*, *DNA Analysis and Forensics*, and *Analysis of Human DNA Variations by PCR*.

The lab program is supported by an Internet microsite, *Lab Center*, which is a virtual classroom into which a DNALC staff member enters to make a video introduction for each lab. By clicking on various objects on the whiteboard and desk, students can access (1) interactive and PDF versions of the experiment, (2) follow-up activities, (3) scientist interviews, (4) animations, and (5) selected links. In 2010, we began development of the final element of *Lab Center*, a series of vodcasts to highlight how each of the target labs relates to research done at New York area institutions. Each *New York Story* will be largely produced by a team of NYC students. The initial vodcast, on green fluorescent protein (GFP) and bacterial transformation, was developed by a six-student team from Brooklyn International School and organized by HHMI Teacher Fellow and Assistant Principal



Left: Title sequence from *New York Stories: Martin Chalfie & Green Fluorescent Protein (GFP)*.  
 Right: Brooklyn International School students filming for the video.

Kathleen Rucker and science teacher David Conneely. In parallel with a DNALC videographer, students used flip cameras to record in their school and at locations at Columbia University, where they interviewed Nobel laureate Martin Chalfie.

During the year, we also implemented an important new element of in-school support for NYC teachers. A grant from the Lounsbery Foundation supported the purchase of equipment to outfit 15 biotechnology footlockers that contain all the equipment and expendable supplies needed to teach each target lab. The kits are available to any teacher who has undergone HHMI training. At \$50 per class of 32 students, each footlocker is less than half the cost of a commercial kit. In their inaugural year, the kits extended lab experiences to 1,455 students, about half the number accommodated in field trips to *Harlem DNA Lab*. To accelerate footlocker use, we waived the restocking fee for most schools and provided free footlocker shipping. To further support teachers as they implement the labs, we recruited a part-time instructor at year's end to accompany footlockers to schools and help set up the equipment or to co-teach the lab activities.

We also tore a page out of the DNALC's own play book when we created a *Charter Membership Program* for *Harlem DNA Lab*. The DNALC was started in 1985 with multi-year memberships from local Long Island school districts. Adopting this model in the spring, we welcomed Trinity School and The Chapin School as Charter Members of our Manhattan operation. Each school receives an exclusive set of benefits to develop a sequenced program of accelerated science opportunities for students. The program launched in June with in-school *Fun with DNA*, *DNA Science*, and *Human Genomics* workshops taught by DNALC instructors. The collaboration continued through the academic year with focused faculty development, field trips to the DNALC, and assistance with student research.

Although *Harlem DNA Lab* prospered in the face of the recession, we became increasingly concerned with the continued devolvement of the NYC Department of Education (DOE). In the spring, DOE quietly disbanded its entire science supervisory department, with whom we and other organizations collaborated to enrich science programs. It has also reassigned key science discretionary funds to English and math, for which student test scores are closely tracked for federal aid. The administration has pushed responsibility for science advancement onto loosely allied networks of schools, expecting them to self-organize without access to funds. This explains why it is difficult for teachers to find even the modest funds needed to take a field trip to *Harlem DNA Lab* or to restock reagents for a footlocker kit they borrow from us.

Our host school, the John S. Roberts Educational Complex, is emblematic of the instability faced by many schools in NYC. It has been adversely affected by administrative shuffling, with two schools phased out and two schools phased in during our tenancy. Simple tasks, such as securing resources and teacher cooperation, have become more difficult. Student discipline and security have become major concerns as enrollment increases in each of the tenant schools. These situations impact the field trip experience for our visitors.

## Reaching Underrepresented Minorities

It is a sad fact that Hispanic and African Americans perform poorly in science and are underrepresented in scientific fields when compared with Caucasians. Hispanic and African Americans perform ~20% lower in science than Caucasians on the International Assessment of Education Progress, a respected benchmark for student achievement. This disparity holds true in grades 4, 8, and 12. According to the National Science Board, these groups are underrepresented in post-secondary science education and science careers compared to their proportion of the overall U.S. population (24%). Underrepresented minorities received 17% of bachelor's degrees, 13% of master's degrees, and 7% of doctorates in science and engineering fields in 2007. They accounted for only 10% of college-educated persons employed in science and engineering occupations and received salaries that averaged 25% less than Caucasian workers.

The National Science Education Standards and other studies emphasize that students need to be engaged in the process of science, asking questions, forming hypotheses, designing experiments, collecting data, analyzing results, and forming conclusions. Underrepresented minorities—who are concentrated in low-achieving schools and who may receive less science “boosting” at home—have less access to hands-on experiences that help them learn about science in the same way as scientists.

The DNALC takes the challenge of increasing minority representation in science seriously. The *Urban Barcode Project* and our *Harlem DNA Lab* were established for the express purpose of providing minority and disadvantaged students—and their teachers—the same opportunities for laboratory-based learning as students in wealthy suburban school districts. Statistics for 2010 show that our Manhattan operation is reaching this target audience. Hispanic and African Americans made up 69% of students visiting *Harlem DNA Lab* and 41% of teachers trained under our HHMI program. The strong Harlem numbers, combined with a policy of conducting many teacher-training workshops at institutions serving minorities, maintained underrepresented minorities at 25% of 696 teachers trained at 1–10 day workshops.

Doing the best job in science education for underrepresented minorities also requires that an institution practice what it preaches—and provide role models for students to emulate. Thus, over the last several years, the DNALC has hired four exemplary African American and Latino educators, who now compose 33% of the instructional staff. Jermel Watkins, Ph.D., began his science career as a DNALC intern and did his graduate training at Stony Brook University. Jason Williams moved into education after research stints in two CSHL laboratories. Ileana Rios, Ph.D., attended elementary school several blocks away from *Harlem DNA Lab* and did her graduate training at City University of New York. Our newest staff member Kerri-Ann Matthews brings experience as an informal science educator with the New York Hall of Science and other science exhibitions.

## Internet Strategies and Visitation

The September issue of *Wired* magazine ran the full-page headline, “The Web is Dead.” The lead article made the point that the World Wide Web—navigated by browsers such as Explorer, Firefox, Safari, and Chrome—now accounts for less than 25% of total Internet traffic. The vast majority of Internet bandwidth is consumed by other types of communication—notably, email, virtual private networks (VPNs), voice-over Internet, music and video sharing, and active gaming. The article also referred, metaphorically, to the struggle between the chaotic, “everything-all-the-time (from-everyone)” world of websites—dominated by search engines like Google—and the “what-you-need-when-you-need-it (from someone you trust)” world of cell phone applications (apps) and social media—dominated by sharing software such as Facebook and Apple iTunes. The DNALC now finds itself in this struggle to adapt to the changing Internet landscape.

The DNALC benefited from its early entry into the Internet world. At a time when there were only 10–25 million active websites on the Internet, websites we developed in the late 1990s and





early 2000s rapidly built audiences. Overall visitation increased steadily, peaking at 7.1 million in 2007. However, our visitation declined and then leveled at ~6 million in 2008–2009. In less than five years, the web had grown to more than 100 million active sites; the DNALC and other small-content providers now found it increasingly difficult to build and maintain audiences.

In the face of an exponentially crowded web, search engines, such as Google, became the primary arbiters of website visitation. We therefore embarked on an ambitious program to redesign our older websites to make them more “visible” to search engines, a process called search engine optimization (SEO). DNALC.org, the home site from which all other DNALC websites are reached, was the first to be revamped according to SEO principals. Re-launched in September 2009, it saw a 24% increase in visitation in 2010. *DNA from the Beginning*, our first major website, is now undergoing an even more extensive SEO makeover, and we anticipate a similar bump in visitation when it is relaunched in spring 2011.

In parallel with SEO, we have turned to other channels—applications for handheld devices (“apps”) and social media—to broaden the audience for our multimedia products. Our *3D Brain*—a detailed rendering of the human brain that can be rotated and explored in three dimensions—provides a remarkable example of how rechanneling content can increase viewership. Originally developed as part of the website *Genes to Cognition (G2C) Online*, which debuted in spring 2009, *3D Brain* was later launched as a stand-alone iPhone, iPod, and iPad application. It rose to number seven of 7,100 education apps and number one among 250 iPad apps. In 2010, the web version of *3D Brain* received 54,868 visits, and the app version had 413,874 downloads! Feedback on the *iTunes* site shows, as one would expect, strong use by college students and faculty. However, it is also used by medical professionals: “Excellent! I use this with clients to help them see where some of their PTSD (posttraumatic stress disorder) symptoms are coming from. Has been very helpful for them.”

During the year, we continued an aggressive program to develop a DNALC channel on *YouTube*, the site where most people find and share videos. Visitation surged following the addition of nearly 100 new videos, including a collection of three-dimensional molecular animations created for the *DNA Interactive* website by 2010 McArthur Prize winner Drew Berry. Our collection of 184 videos received 280,503 views in 2010. Blogs, supporting each of our major content sites, generated an additional 283,843 web visits.

As a result of the SEO makeover for the DNALC homepage plus aggressive moves into apps, *YouTube*, and blogs, Internet visitation rose 14% to 7.1 million in 2010, equaling the 2007 peak. App downloads, *YouTube* views, and blog views contributed 933,220 visits, or 13% of total Internet traffic. The amount of data served by DNALC websites surged 35% in 2010, to 6,669 gigabytes

(GB), or 6.5 terabytes (TB). DNALC.org accounted for 43% of all data served.

Visitation was also augmented by a grant from Google AdWords, through which we receive free “sponsored” links on Google searches. The AdWords account contains a set of keywords for each DNALC website. When someone searches for one of the keywords, an ad for the related DNALC site is displayed and logged as an “impression”; a “click-through” is logged when the link is followed. (Each click results in a visit to one of our websites.) AdWords generated 20,185,997 impressions of DNALC ads, resulting in 133,034 website visits. This advertising is valued at \$99,438. *G2C Online* is our most successful AdWords campaign, with two thirds of 62,952 click-throughs resulting from searches for “brain.”

## Teacher Training

Since trekking from New York to California in our mobile *Vector Van* in the summer of 1986, the DNALC has maintained a unique ability to provide sophisticated lab and computer training at essentially any site around the world. 2010 was the zenith of off-site training, with 940 high school and college faculty participating in professional development activities conducted at 27 sites across the United States and Canada. (For a complete list of training activities and host sites, see the tables at the back of this report, “2010 Workshops, Meetings, and Collaborations.”)

With funding from HHMI, and in collaboration with the NYC Department of Education, 290 teachers participated in 52 workshops conducted at *Harlem DNA Lab*. Ease of scheduling and quick completion of P-Credits (graduate equivalent) and Professional Development hours (required to maintain a New York State teaching license) made the summer workshops more popular than those held during the academic year.

In our role as education lead of the *iPlant Collaborative*, we introduced *DNA Subway* to 187 college teachers at ten 2-day workshops hosted at academic institutions around the country. An additional 188 educators learned about *DNA Subway* at short courses and demonstrations at the meetings of the American Society of Plant Biologists, Botanical Society of America, Department of Energy’s Joint Genome Institute, *iPlant Collaborative*, National Association of Biology Teachers, and the USDA Plant and Animal Genome annual meeting.

With funding from NSF’s Course, Curriculum, and Laboratory Improvement (CCLI) program, we continued our effort to bring compelling RNA interference (RNAi) experiments into college classrooms via an experiment- and bioinformatics-rich curriculum. In 2010, 54 faculty attended follow-up workshops designed to increase confidence with our RNAi curriculum and update participants on new developments in the field. The training program is supported by the *Silencing Genomes* website, which includes all experiments and reagent recipes, and a free biological library, which includes all needed bacterial and *C. elegans* strains and over 100 vectors developed by workshop participants to silence worm homologs of human genes. To date, more than 1,500 strain orders have been filled and have been used with a reported 12,500 students. Two stand-alone kits derived from the program have been released by Carolina Biological Supply Company, with a third to be released early in 2011.

With support from the National Institutes of Health (NIH) Science Education Partnership Award (SEPA) and the Hewlett Foundation, we continued to disseminate two large-scale Internet sites at 1–2-day workshops. Under the SEPA program, 71 high school and college faculty attended five workshops to learn how to use the *Inside Cancer* website to enhance teaching of cancer cell biology in health, general biology, and advanced biology classes. In addition, 18 Regional Fellows taught 228 educators at 22 second-round workshops. Five workshops on our Hewlett-sponsored website, *G2C Online*, drew 88 high school and college educators.

Continuing our long-term relationship with the Singapore Ministry of Education, two Singaporean biology teachers participated in the HHMI Leadership training in July. Then in the fall, we hosted four primary school teachers (grades 4–6). During their 2-week attachment, they observed

and cotaught student field trips and in-school programs. They were also immersed in the *Fun with DNA* and *World of Enzymes* curricula during small workshop sessions with DNALC instructors. Each teacher developed a plan for sharing their new knowledge when they returned home.

### Program Evaluation

In 2010, we initiated nationwide experimental studies to evaluate how two of our websites contribute to science instruction in the classroom. The *Inside Cancer* website explores the molecular basis of cancer. The evaluation study, funded by an NIH SEPA Phase II grant, involved four teachers who used the website to teach topics such as the cell cycle, mutations, and genetic disease to 199 students in Illinois, Missouri, and Maryland. The *G2C Online* website explores the molecular basis of brain function and dysfunction. In the evaluation, funded by the Dana and Hewlett Foundations, five teachers used *G2C Online* to teach nervous system function and psychiatric disorders to 146 students in Missouri, Minnesota, New York, and North Carolina. (An additional 12 teachers and more than 900 students will participate in both studies in 2011.)

Pre- and post-surveys—used by students across all study sites—measure changes in basic genetics literacy and attitudes toward science. Content tests, developed locally by each teacher, measure specific knowledge gained. To control for differences between teachers and students, we used a repeated measures study design, where a participating faculty member teaches the same topic to two different classes—one class receives classroom instruction only (control) and the other receives classroom instruction PLUS supplementary use of the website (treatment). For a second topic, the classes switch roles as treatment and control. Students were also asked questions to determine whether they prefer to explore information as network-related items or follow a suggested linear “story.”

Considerable effort has focused on evaluating *Silencing Genomes*. With a response rate of 75%, follow-up surveys show that the majority of 262 college faculty who received workshop training completed *Silencing Genomes* labs in their classrooms, reaching 3,926 students and sharing them with 156 other teachers. An in-school study is matching experimental classes that do RNAi laboratories with control classes that learn equivalent topics without labs. Pre- and post-surveys measure changes in student attitudes, genetic literacy, and detailed knowledge of RNAi. To date, six teachers and 76 students have participated, with an additional ten teachers and more than 400 students expected in 2011. Preliminary analyses are encouraging, with experimental students showing significant gains in knowledge of RNAi (12.0%,  $p = .0003$ ).

### Student Programs

In 2010, we continued to be the world's largest provider of hands-on learning in genetics and molecular biology. Twenty thousand students performed experiments at the Dolan DNALC, DNALC West, and the *Harlem DNA Lab*, and 10,856 students received in-school instruction by DNALC staff. High school students composed 31% of lab visitors (9,417). Most of the 21,442 middle school visitors participated in our *Genetics as a Model For Whole Learning* Program. A grant from the William Townsend Porter Foundation provided scholarships for 1,057 Hispanic and African America students to attend labs at *Harlem DNA Lab*. Grants from Bank of America, TD Bank, and National Grid provided lab visits and in-school instruction for



Student attending field trip at *Harlem DNA Lab*.



Participants in a *World of Enzymes* summer camp.

2,349 students from underserved schools in Queens and on Long Island.

Summer camps drew 908 students to the Dolan DNALC, DNALC West, and *Harlem DNA Lab*, and at The Trinity and Chapin Schools, with two new workshops proving popular. DNALC staff member Jen Aiello drew on her recent undergraduate degree in forensic science to develop *Forensic Detectives*. This intermediate-level course for eighth and ninth graders includes labs on fingerprinting, forensic anthropology, toxicology, ballistics, and criminalistics. *Silencing Genomes* is a spin-off of the NSF teacher-training program of the same name, initiated by Bruce Nash. This course introduces the Nobel Prize–winning technology of RNAi in the model organism *C. elegans*.

*Great Moments in DNA Science Honors Seminars*, conducted in the spring, drew 211 top high school students from Long Island for three in-depth presentations of current biological research. Dr. Chih-Shan Jason Chen of Memorial Sloan-Kettering Cancer Center presented his research on the genetics of *Dermatofibrosarcoma protuberans* (DFSP), an aggressive soft tissue tumor that often relapses after treatment. Dr. Damon Love of Weill Cornell College of Medicine discussed his work with a protein called Chibby, which is required for proper lung development in the fetus. Dr. Zuzana Zachar of Stony Brook University discussed recent discoveries in cancer cell metabolism and introduced “thioctans,” a new class of chemotherapeutic agents that target cancer cells while sparing healthy ones.

*Harlem DNA Lab* participated in several science education events around NYC. Children and parents extracted DNA from bananas at our booth at the World Science Festival in Washington Square Park and at the Morningside Area Alliance 2010 STEM Expo in Harlem. With support from the Porter Foundation, high school students from the *Mentoring in Medicine* program attended a week-long *DNA Science* camp. Founded by Dr. Lynne Holden, the program seeks to improve diversity in medicine by providing academic opportunities to underrepresented minority students.

*SaturdayDNA!* drew 203 participants to monthly events held during the fall, winter, and spring. Two-hour sessions were offered at two age levels: one for children ages 10–13 with an accompanying adult, and one for ages 14 and up. Topics presented by the DNALC’s education and scientific staff covered such diverse topics as DNA barcoding and the genetic basis of smell.

### Partnerships and Graduate Training

In the spring, we graduated our fourth class of *Genome Science*, our partnership with Cold Spring Harbor High School (CSHHS). Coconstructed by DNALC staff and CSHHS biology teacher, Martin Glynn, this college-level course brings students to the DNALC for their final two class periods each day. As in previous years, the course emphasized critical thinking and included experiments and

independent projects across a range of biological systems. One unit looked for evidence of genetic modification in common foods and annotated newly sequenced genes in rice. Another unit used students' own DNA to explore the molecular basis of simple traits and to trace human origins. The final unit used RNAi to turn off genes in the roundworm *Caenorhabditis elegans* and to study worm equivalents of genes involved in human diseases.

In the fall, the fifth year of *Genome Science* began under the tutelage of DNALC staff along with a new CSHHS staff member, Jaak Raudsepp. This was a comfortable change as Jaak is a graduate of our former *Leadership Institute*, the rigorous three-week program for the nation's best biology teachers. Always a proving ground for our latest experiments, the CSHHS students were the first to use DNA barcoding to identify plants collected in the local area. In preparing essays on modern parallels to the eugenics movement of the early 20<sup>th</sup> century, students also visited CSHL Research Archives to examine historical documents remaining from the former Eugenics Record Office.

As part of a reinvigorated collaboration with the Center for Science and Mathematics Education (CESAME) at Stony Brook University, CSHHS students completed a module on protein modeling. Using methods developed by Tim Herman at the Milwaukee School of Engineering, students developed three-dimensional molecular models to illuminate how chemotherapeutic drugs interact with protein receptors on the surface of cancer cells. Using data from primary research papers, students identified important parts of the drugs and receptors. They then used three-dimensional modeling software to highlight key atoms involved in molecular interactions. The modified structure files were sent to CESAME, where detailed atomic resolution models of the proteins were manufactured on state-of-the-art prototyping printers. (These machines are essentially laser printers that layer droplets of polymer resin in three dimensions.) Students will present their models and explanatory posters at the spring 2011 CSHL meeting, "The Biology of Cancer."

During their second semester, graduate students at the CSHL Watson School of Biological Sciences work under the guidance of experienced DNALC instructors. The graduate students work in pairs over 12 half-day sessions, learning from and leaning on one another as they develop effective teaching techniques. During the first phase of training, students observe a DNALC staff member teaching a laboratory class, then organize a lesson plan that integrates their own perspectives. During the second phase, students join with the DNALC staff member to coteach parts of a laboratory class. After critiques of their lesson plans and coteaching experience, the students move on to independently teach an entire lesson. After completing rotations with middle- and high-school-level experiments, students deliver three additional lessons to demonstrate mastery of teaching and class management skills.

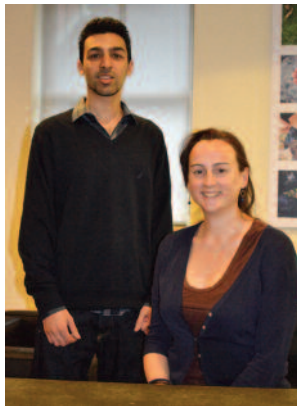
In October, we began a new collaboration with the New York Academy of Sciences (NYAS), one of the oldest scientific institutions in the United States and a leading organizer of scientific meetings. The NYAS developed a new science mentoring program in which graduate students and postdoctoral researchers from NYC research institutions present science activities to students in grades K–12. DNALC instructors trained 22 mentors in effective strategies to deliver hands-on genetics activities in after-school settings.

## Staff and Interns

We were sad when Dr. John Connolly left in February to evaluate clinical trials at the Center for Applied Genomics, Children's Hospital of Philadelphia. After receiving a Ph.D. in neuropsychology at Trinity College, Dublin, John came to the DNALC in 2005 to develop our innovative website, *G2C Online*, for which he interviewed more than 80 scientists. As Multimedia Coordinator, he became indispensable in managing many aspects of our Internet ventures—developing the Landeau Multimedia Studio and launching regular blogs for each of our major content sites. Notably, he moved us into the world of apps with his spectacularly successful *3D Brain*. We will

miss his Irish brogue, which often lightened the office atmosphere.

The multimedia staff returned to full force in November, with the arrival from “down under” of Multimedia and Evaluation Manager, Dr. Amy Nisselle. After attending the DNALC’s presentation at the 19<sup>th</sup> International Congress on Human Genetics in Melbourne in 2003, Amy decided to pursue her Ph.D. in multimedia genetics education. In 2008, she spent three months at the DNALC, evaluating the *G2C Online* website as part of her thesis research. In addition to managing multimedia projects, Amy will also increase our academic profile in the world of science and technology education.



Mohammed Khalfan and  
Amy Nisselle.

Our growing involvement in the *iPlant Collaborative* led to the recruitment in November of Computer Programmer, Mohammed Khalfan. After receiving a B.S. degree from the University of Toronto, he received a Master’s degree in bioinformatics and computational biology at the University of Newcastle upon Tyne, England. His initial projects include building the “Blue Line” (phylogenetics) of *DNA Subway* and redeveloping the *iPlant* website in Drupal, an open source content management system (CMS).

Our multimedia group also benefited from fresh ideas from young people. In the fall, we welcomed Todd Rocheford as Design Assistant and Videographer. Todd has an undergraduate degree in video production from the University of Canberra, Australia. We met Todd through his father, Torbert, a Purdue geneticist who developed vitamin-A-fortified corn. After filming a documentary on his father’s work in Africa, Todd realized that he wanted to develop educational videos, leading to his position at the DNALC. Undergraduate intern Tony Biondo was promoted to Junior Programmer, based largely on the initiative he took in developing an Android version of our *3D Brain* app. Tony is a sophomore majoring in computer science at Stony Brook University. An active supporter of open source software, he won the Student Cluster Competition of the 2009 International Conference on High-Performance Computing at Portland, Oregon. Chris Weidler (Farmingdale State College) continues to support the *BioMedia* Group and was especially productive on the *DNA from the Beginning* upgrade.

Our 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 several new high school interns this year: Devika Gupta (Farmingdale), Jueng Woen Kim (Hauppauge), Yasin Muhammad (Lawrence Woodmere Academy), H. Alan Phipps (Portledge School), David Streitman (Syosset), and Young Joon Suh (John Glenn). The new hires joined a dedicated group of returning interns: Laura Bergsten (Cold Spring Harbor), George Economou (Syosset), Jack Greenfield (Oyster Bay), Lindsay Hochberg (Oyster Bay), Max Vaysman (Commack), and Pamela Wax (Harborfields). We bid farewell to a number of high school interns as they left for their freshman year at college: Anouva Kalra-Lall (Case Western Reserve University), Emily Troge (Brandeis University), Sara Wienclaw (University of Delaware), and Kevin Wu (New York University).

In addition to regular prep duties, college interns help fulfill requests from faculty nationwide for student DNA sequencing and RNAi targeting vectors. Three former high school interns returned to assist with summer workshops: Kaitlin Watrud (Gettysburg College), Arielle Scardino (City College of New York), and Seth Shortz (Emory University). New college interns starting in 2010 were David Dopfel (Stony Brook), Sarah Justvig (Georgetown), Sulaiman Usman (New York Institute of Technology), Lina-Mari Varghese (Stony Brook), and Katherine Villalon (John Jay). Annie Laurie Benzie (Adelphi University) left the DNALC for an internship at Bellevue Hospital.

Many of our high school interns are involved in science research and compete in state and nationwide science competitions. Anouva Kalra-Lall was an Intel semifinalist and a top four finalist for the Neuroscience Research Prize. Young Joon Suh took first place in Chemistry at the New York State Science and Engineering Fair. Laura Bergsten was accepted into the CSHL Partners for the Future Program.

Additionally, DNALC staff served as mentors to local high school students working on independent projects. Elliot Horlick (Cold Spring Harbor) worked on two projects with Dr. Jermel Watkins: sunblock (SPF) protection against UV-induced DNA damage in yeast and the protein complement (proteome) of squamous cell carcinoma. Daniel Krumholz (Oyster Bay) worked with Dr. Bruce Nash to use RNAi to "knock down" genes in *C. elegans* that are homologous to human genes involved in serotonin signaling.

## Expert Advisors and Corporate Support

We are fortunate to have high-level support from two advisory bodies: the DNALC Committee and the Corporate Advisory Board (CAB). The DNALC Committee consists of community leaders and members of the CSHL senior management and Board of Trustees, who oversee strategic development, including capital funding and the evolution of satellite locations in North America and beyond. The CAB provides liaison to the Long Island and NYC business communities; its annual fund campaign and golf tournament contributed \$155,000 in 2010.

### DNALC Committee

Chairperson: **Laurie Landeau, VMD**, Trustee, CSHL

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Maria DeLesseps	Adele Smithers
Lola N. Grace, Sterling Grace Capital Management (Secretary/ Treasurer, CSHL)	Arthur Spiro
Lori Homer	Peter Tilles
Suzanne Kleinknecht	Edward Travaglianti, President, TD Bank Long Island
Suzanne Leeds	Marianne Dolan Weber, Chairman, Dolan Foundations

### Cold Spring Harbor Laboratory Ex-Officio Members

W. Dillaway Ayres, Jr., Chief Operating Officer	Bruce Stillman, President and Chief Executive Officer
David A. Micklos, Executive Director, DNA Learning Center	Karen Orzel, Senior Development Officer

### Corporate Advisory Board

Chairperson: **Edward A. Chernoff**, Motors & Armatures, Inc.

CSHL Trustee Liaison: **Laurie Landeau, VMD**

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James Chinitz, Population Diagnostics	John Passarelli, M.D.
Dan Decker, Eppendorf North America	Patricia Petersen, Daniel Gale Sothebys Real Estate
Robert Dickstein, Ph.D., Pall Corporation	Frank Posillico, Alliance Real Estate Corp
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Arthur D. Herman, Herman Development Corporation	Kurt Timmel, Marsh USA
	Jeffrey K. Tupper, U.S. Trust Company of New York
	Robert Van Nostrand
	Hans Zobel, Ziehm Medical LLC

**2010 Grants**

<i>Grantor</i>	<i>Program</i>	<i>Duration of Grant</i>	<i>2010 Funding*</i>
<b>FEDERAL GRANTS</b>			
National Institutes of Health	Science Education Partnership Award (SEPA): Nationwide Dissemination of <i>Inside Cancer</i> Internet Site	8/08–7/11	\$ 52,701
National Science Foundation	Course, Curriculum, and Laboratory Instruction (CCLI) Program: Nationwide Dissemination of RNAi Curriculum	9/07–8/11	87,245
National Science Foundation, University of Arizona	Educational Outreach for iPlant: A Cyberinfrastructure for Plant Sciences	2/08–1/13	720,501
National Science Foundation, Cornell University	<i>Weed to Wonder</i> Internet Site Development: Educational Outreach for Functional Genomics of the Maize Shoot Apical Meristem	9/08–8/11	74,732
<b>NONFEDERAL GRANTS</b>			
Hewlett Foundation	<i>Genes to Cognition Online</i> Internet Site Dissemination and Evaluation	10/08–4/11	\$ 37,190
Howard Hughes Medical Institute	Pre-College Science Education Initiative: NYC Teacher Professional Development	9/07–8/12	142,476
Dana Foundation	<i>Harlem DNA Lab</i> Operating Support	3/09–2/12	129,334
North Shore-LIJ Health System	DNALC <i>West</i> Operating Support	2010	50,000
Lounsbery Foundation	Biotechnology Footlocker Program at <i>Harlem DNA Lab</i>	11/09–10/10	21,546
William Townsend Porter Foundation	Scholarships for Minority and Underserved Students at <i>Harlem DNA Lab</i>	3/10–3/11	35,035
Bank of America	Scholarships for Minority & Underserved Students on LI	2010	25,000
National Grid Foundation	Scholarships for Minority and Underserved Students in the Brentwood Union Free School District	10/10–10/11	15,000

\* Includes direct and indirect costs

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

Bellmore-Merrick Central High School District	\$3,000	Northport-East Northport Union Free School District	2,000
Bethpage Union Free School District	1,500	Oyster Bay-East Norwich School District	1,500
East Meadow Union Free School District	1,500	Plainview-Old Bethpage Central School District	1,500
Great Neck Union Free School District	1,500	Portledge School	1,500
Harborfields Central School District	1,500	Roslyn Union Free School District	1,500
Herricks Union Free School District	1,500	Syosset Central School District	1,500
Long Beach City School District	1,500	The Green Vale School	1,500
Massapequa Union Free School District	1,500	Yeshiva University High School for Girls	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:

Bay Shore Union Free School District	\$6,000	Locust Valley Central School District	9,989
Bellmore Union Free School District	3,500	Merrick Union Free School District	2,250
Bellmore-Merrick Central HS District	8,000	MS 447-The Math and Science Exploratory School, NYC	3,000
Commack Union Free School District	6,700	North Bellmore Union Free School District	1,600
Copiague Union Free School District	1,200	Northport-East Northport Union Free School District	1,025
Eastern Middle School, Greenwich, CT	3,000	North Shore Central School District	1,500
East Meadow Union Free School District	5,550	Oceanside Union Free School District	1,500
East Williston Union Free School District	2,800	Oyster Bay-East Norwich Central School District	3,050
Elwood Union Free School District	4,500	Palisades Middle School, PA	1,800
Floral Park-Bellerose Union Free School District	6,250	Rockville Centre Union Free School District	2,400
Friends Academy, Locust Valley	2,800	Roslyn Union Free School District	3,599
Garden City Union Free School District	11,500	Scarsdale Union Free School District	10,500
Great Neck Union Free School District	16,550	Smithtown Central School District	1,400
Half Hollow Hills Central School District	7,625	Saint Dominic Elementary School, Oyster Bay	4,050
Herricks Union Free School District	3,150	St. Edward the Confessor School, Syosset	2,025
Holy Child Academy, Westbury	6,500	Syosset Central School District	32,500
Huntington Union Free School District	6,700	Three Village Central School District	1,500
Island Park Union Free School District	1,350	Valley Stream 13 Union Free School District	2,400
Jericho Union Free School District	7,875	Yeshiva Darchei Torah School	1,600
Kings Park Central School District	1,950	Yeshiva of Flatbush	1,800
Lawrence Union Free School District	7,100		



**2009 Workshops, Meetings, and Collaborations**

January 5	Site visit by William Mak, Hong Kong Biotechnology Education Resource Center and Mobile Lab, Hong Kong University, Pokfulam
January 12	Site visit by Denise Philpotts, Trinity School, <i>Harlem DNA Lab</i>
January 14	NSF <i>iPlant Collaborative</i> , Genotype 2 Phenotype Steering Committee Meeting, San Diego, California HHMI Professional Development Workshop, "PCR and Human DNA Variations, Part 2," <i>Harlem DNA Lab</i>
January 16	HHMI Professional Development Workshop, "PCR and Human DNA Variations, Part 2," <i>Harlem DNA Lab</i>
January 22	Site visit by Hans Bosch and Laura Savini, WLIW, New York
January 23	<i>Saturday DNA!</i> "Express Yourself!" DNALC
January 29	Site visit by Marilyn Parks, Life Technologies Foundation, Carlsbad, California, and Randi Spatz, Invitrogen, Carlsbad, California
February 24	HHMI Professional Development Workshop, "DNA Structure and Isolation," <i>Harlem DNA Lab</i>
February 27	<i>Saturday DNA!</i> "Composting 101," DNALC HHMI Professional Development Workshop, "DNA Structure and Isolation," <i>Harlem DNA Lab</i>
March 3	Site visit to Carolina Biological Supply Company, Burlington, North Carolina
March 10	Oyster Bay Rotary Club Meeting Luncheon presenting DNALC programs and events, Oyster Bay, New York
March 12	G2C <i>Online</i> Workshop, Santa Clara University, Santa Clara, California
March 13	NIH <i>Inside Cancer</i> Workshop, Santa Clara University, Santa Clara, California
March 17	HHMI Professional Development Workshop, "Variability and Inheritance," <i>Harlem DNA Lab</i>
March 20	<i>Saturday DNA!</i> "Explore the Realm of Your DNA," DNALC HHMI Professional Development Workshop, "Variability and Inheritance," <i>Harlem DNA Lab</i>
March 20–21	National Science Teachers Association National Conference, "Exploring Gene Function in <i>C. elegans</i> : Mutations and RNA Interference," "Genomic Science," and "Silencing Genomes," Philadelphia, Pennsylvania
March 24–26	Joint Genome Institute User Meeting, Walnut Creek, California
March 26	G2C <i>Online</i> Workshop, Oklahoma City Community College, Oklahoma City
March 27	NIH <i>Inside Cancer</i> Workshop, Oklahoma City Community College, Oklahoma City
April 7	HHMI Professional Development Workshop, "Bacterial Transformation and Protein Isolation," <i>Harlem DNA Lab</i>
April 9	Site visit by graduate students from Molloy College, Rockville Centre, New York
April 10	HHMI Professional Development Workshop, "Bacterial Transformation and Protein Isolation," <i>Harlem DNA Lab</i>
April 11–14	NIH SEPA Principal Investigators Meeting, Birmingham, Alabama
April 13	<i>Great Moments in DNA Science</i> Honors Seminar: "Dead End? Not Anymore! Molecular Targeted Therapy for Skin Cancer," Dr. Chih-Shan Jason Chen, Memorial Sloan-Kettering Cancer Center, New York
April 16	G2C <i>Online</i> Workshop, iBio Institute, Harold Washington College, Chicago, Illinois
April 17	NIH <i>Inside Cancer</i> Workshop, iBio Institute, Harold Washington College, Chicago, Illinois
April 17	<i>Saturday DNA!</i> "The Insomniac's Guide to Wildlife," DNALC
April 20	Site visit by Debby Hirshman, Victor Centers for Jewish Genetic Diseases, Philadelphia, Pennsylvania
April 21	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
April 23	CSHL Association Directors, viewing of "Naturally Obsessed: The Making of a Scientist," DNALC
April 23–24	NSF <i>iPlant Collaborative</i> , <i>Genomics in Education</i> Workshop, Spelman College, Atlanta, Georgia
April 24	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
April 26	Site visit by Kevin Shine, Verizon Communications, New York
April 29	G2C <i>Online</i> Workshop, Biogen Idec, Cambridge, Massachusetts <i>Great Moments in DNA Science</i> Honors Seminar: "The Role of Wnt/ $\beta$ -catenin Antagonist chibby in Lung Development," Dr. Damon Love, Weill Cornell College of Medicine, New York
	Site visit by Jackie Dorrance, Beckman Foundation, Irvine, California
	Site visit by Robert Isaksen and Lorraine Aycock, Bank of America Long Island, Melville, New York
	Site visit by Judy Calabrese and Maureen Laness, CSHL Directors, <i>Harlem DNA Lab</i>
April 30	NIH <i>Inside Cancer</i> Workshop, Biogen Idec, Cambridge, Massachusetts
May 3	Meeting with Minister of Higher Education, Sheikh Nahyan bin Mubarak Al Nahyan, Abu Dhabi, United Arab Emirates
May 7–8	NSF <i>iPlant Collaborative</i> , <i>Genomics in Education</i> Workshop, University of Texas, Austin
May 8	HHMI Professional Development Workshop "DNA Isolation, Inheritance, and Variability," <i>Harlem DNA Lab</i>
May 12	Site visit by Roland Jimenez, Community Bank, Hauppauge, New York
May 14–15	HHMI Professional Development Workshop, "PCR and Human DNA Variations, Part 1," <i>Harlem DNA Lab</i>
May 15	<i>Saturday DNA!</i> "Walking Whales and Genetic Tales," DNALC
May 17	Site visit by Srinivasa Rao, Indian Institute of Biotechnology, Hyderabad, India
May 18	<i>Great Moments in DNA Science</i> Honors Seminar: "Thioctans: A Novel Approach to Cancer Chemotherapy," Dr. Zuzana Zachar, Stony Brook University, New York
May 21	HHMI Professional Development Workshop, "PCR and Human DNA Variations, Part 2," <i>Harlem DNA Lab</i> G2C <i>Online</i> Workshop, University of Colorado, Aurora

May 21–22	NSF <i>iPlant Collaborative, Genomics in Education</i> Workshop, Lawrence Berkeley National Laboratory, Berkeley, California
May 22	NIH <i>Inside Cancer</i> Workshop, University of Colorado, Aurora
May 22	HHMI Professional Development Workshop, "PCR and Human DNA Variations, Part 2," <i>Harlem DNA Lab</i>
May 22	2010 S.T.E.M. Expo sponsored by Morningside Area Alliance, "DNA Extraction," Harlem, New York
May 24–26	NSF <i>iPlant Collaborative</i> 2010 Conference, Las Vegas, Nevada
May 26	NSF <i>iPlant Collaborative, DNA Subway</i> Workshop, Las Vegas, Nevada
June 4	Site visit by Kidgie Williams, Hospitality Committee for United Nations Delegations, Inc., and United Nations delegates' family members, New York
June 4–5	NSF <i>Silencing Genomes</i> Follow-up Workshop, St. Louis Science Center, Missouri
June 6	World Science Festival, "Banana DNA Extraction," New York
June 8	17 <sup>th</sup> Annual Golf Outing, Piping Rock Club, Locust Valley, New York
June 11–12	NSF <i>iPlant Collaborative, Genomics in Education</i> Workshop, Howard University, Washington, D.C. NSF <i>Silencing Genomes</i> Follow-up Workshop, Rust College, Holly Springs, Mississippi
June 12	<i>Saturday DNA!</i> "Solved! The Mystery of Anastasia Romanov," DNALC
June 14–18	<i>DNA Science</i> Workshop, <i>Harlem DNA Lab</i> <i>DNA Science</i> Workshop, Trinity School, New York <i>Fun with DNA</i> Workshop, Trinity School, New York
June 17–18	NSF <i>Silencing Genomes</i> Follow-up Workshop, North Carolina Agricultural & Technical State University, Greensboro
June 18	Site visit by Mike Scanlon, Cornell University, Ithaca, New York
June 20–25	Milwaukee School of Engineering Workshop, SMART protein modeling training, New York
June 21–22	<i>Charter Membership High School Professional Development</i> Workshop, The Chapin School, "Human Genomics," New York
June 21–25	<i>Fun with DNA</i> Workshop, The Chapin School, New York <i>Human Genomics</i> Workshop, The Chapin School, New York
June 22	Site visit by Theresa Chilianis, Michael Lardner, and Phil Summers, MSG Varsity, Woodbury, New York
June 23–24	<i>Charter Membership Middle School Professional Development</i> Workshop, The Chapin School, "Fun with DNA," New York
June 24–25	NSF <i>Silencing Genomes</i> Follow-up Workshop, Pasadena City College, California
June 25–26	NSF <i>iPlant Collaborative, Genomics in Education</i> Workshop, The Rockefeller University, New York
June 28	HHMI Professional Development Workshop, "DNA Transformation and Protein Isolation," <i>Harlem DNA Lab</i>
June 28–July 2	<i>DNA Science</i> Workshop, DNALC <i>Fun with DNA</i> Workshop, DNALC <i>World of Enzymes</i> Workshop, DNALC <i>Fun with DNA</i> Workshop, DNALC West
June 29	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
June 29–30	NSF <i>Silencing Genomes</i> Follow-up Workshop, Howard University, Washington, D.C.
June 30	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 1" <i>Harlem DNA Lab</i>
July 1	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 2," <i>Harlem DNA Lab</i>
July 6	HHMI Professional Development Workshop, "DNA Structure and Isolation," <i>Harlem DNA Lab</i>
July 6–9	<i>Green Genes</i> Workshop, DNALC <i>Plant Genomics</i> Workshop, DNALC <i>World of Enzymes</i> Workshop, DNALC West
July 7	HHMI Professional Development Workshop, "Variability and Inheritance," <i>Harlem DNA Lab</i>
July 8	HHMI Professional Development Workshop, "DNA Transformation and Protein Isolation," <i>Harlem DNA Lab</i>
July 8–9	NSF <i>iPlant Collaborative, Genomics in Education</i> Workshop, University of Chicago, Illinois
July 9	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
July 12	HHMI Professional Development Workshop, "DNA Transformation and Protein Isolation," <i>Harlem DNA Lab</i>
July 12–16	<i>DNA Science</i> Workshop, DNALC <i>Human Genomics</i> Workshop, DNALC <i>World of Enzymes</i> Workshop, DNALC <i>DNA Science</i> Workshop, DNALC West
July 13	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
July 14	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 1," <i>Harlem DNA Lab</i>
July 15	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 2," <i>Harlem DNA Lab</i> Site visit by Suzi Lewis, University of California, Berkeley
July 16	HHMI Professional Development Workshop, "Genetically Modified Foods," <i>Harlem DNA Lab</i>
July 19–23	<i>Fun with DNA</i> Workshop, DNALC <i>Green Genes</i> Workshop, DNALC <i>Silencing Genomes</i> Workshop, DNALC <i>Green Genes</i> Workshop, DNALC West

July 19–30	HHMI New York City <i>Leadership Symposium, Harlem DNA Lab</i>
July 20	Site visit by Rafael Palacios, Universidad Nacional Autónoma de México, Cuernavaca Center for Genomic Sciences, Cuernavaca, Mexico
July 26–30	<i>DNA Science Workshop, DNALC</i> <i>Genetic Horizons Workshop, DNALC</i> <i>World of Enzymes Workshop, DNALC</i> <i>Genetic Horizons Workshop, DNALC West</i>
July 29	Site visit by Mort Slater, Gateway to Higher Education, New York, and Arthur Registre, Uniondale High School, New York
July 31	Botanical Society of America, <i>DNA Subway Hands-on Workshop</i> , Providence, Rhode Island
July 31–Aug. 4	American Society of Plant Biologists Annual Conference, <i>DNA Subway Demonstrations and Poster</i> , Montreal, Canada
August 2	HHMI Professional Development Workshop, “DNA Transformation and Protein Isolation,” <i>Harlem DNA Lab</i>
August 2–6	<i>Fun with DNA Workshop, DNALC</i> <i>Green Genes Workshop, DNALC</i> <i>Human Genomics Workshop, DNALC</i> <i>Fun with DNA Workshop, DNALC West</i>
August 3	HHMI Professional Development Workshop, “DNA Analysis and Forensics,” <i>Harlem DNA Lab</i>
August 4	HHMI Professional Development Workshop, “PCR and Human DNA Variation, Part 1,” <i>Harlem DNA Lab</i>
August 5	HHMI Professional Development Workshop, “PCR and Human DNA Variation, Part 2,” <i>Harlem DNA Lab</i>
August 6	HHMI Professional Development Workshop, “Genetically Modified Foods,” <i>Harlem DNA Lab</i>
August 9	HHMI Professional Development Workshop, “DNA Transformation and Protein Isolation,” <i>Harlem DNA Lab</i>
August 9–13	<i>DNA Science Workshop, DNALC</i> <i>Genetic Horizons Workshop, DNALC</i> <i>World of Enzymes Workshop, DNALC</i> <i>World of Enzymes Workshop, DNALC West</i>
August 10	HHMI Professional Development Workshop, “DNA Analysis and Forensics,” <i>Harlem DNA Lab</i>
August 11	HHMI Professional Development Workshop, “PCR and Human DNA Variation, Part 1,” <i>Harlem DNA Lab</i>
August 12	HHMI Professional Development Workshop, “PCR and Human DNA Variation, Part 2,” <i>Harlem DNA Lab</i>
August 16–20	<i>Forensic Detectives Workshop, DNALC</i> <i>Fun with DNA Workshop, DNALC</i> <i>Green Genes Workshop, DNALC</i> <i>DNA Science Workshop, DNALC West</i> <i>DNA Science Workshop, Mentors in Medicine, Harlem DNA Lab</i>
August 17	Site visit by Esther Baena, Harvard Medical School, Cambridge, Massachusetts
August 18	Site visit by Ted Scovell and Mark Stoeckle, The Rockefeller University, New York
August 19–20	NSF <i>Silencing Genomes Follow-up Workshop</i> , Houston Community College, Texas
August 23–27	<i>DNA Science Workshop, DNALC</i> <i>Fun with DNA Workshop, DNALC</i> <i>World of Enzymes Workshop, DNALC</i> <i>Human Genomics Workshop, DNALC West</i>
Aug. 30–Sept. 3	<i>DNA Science Workshop, DNALC</i> <i>Green Genes Workshop, DNALC</i> <i>World of Enzymes Workshop, DNALC</i> <i>Green Genes Workshop, DNALC West</i>
September 2	Site visit by Pauline Charman, University of Western Australia, Perth
September 14	Eugenics Exhibit, Holocaust Memorial and Tolerance Center, Glen Cove, New York
September 15	Site visit by Torbert Rocheford, Purdue University, West Lafayette, Indiana
September 16–17	NSF <i>iPlant Collaborative, Genomics in Education Workshop</i> , University of Washington, Seattle
September 17	Site visit by Anne and Walter Meier, The Robertson Foundation for Government, Juno Beach, Florida
September 25	HHMI Professional Development Workshop, “DNA Structure and Isolation, Part 2,” <i>Harlem DNA Lab</i>
October 5	Site visit by Denise Smith, Vincent Torti, and Rick Garrett, Saint Dominic’s Church and Schools, Oyster Bay, New York
October 15	HHMI Professional Development Workshop, “Inheritance and Variability,” <i>Harlem DNA Lab</i>
October 16	HHMI Professional Development Workshop, “Inheritance and Variability,” <i>Harlem DNA Lab</i> New York Academy of Sciences Graduate Training, New York <i>Saturday DNA! “Classify Me!” DNALC</i>
October 18–19	NIH SEPA Grant Review, Bethesda, Maryland
October 22	HHMI Professional Development Workshop, “Bacterial Transformation and Protein Isolation,” <i>Harlem DNA Lab</i>
October 23	HHMI Professional Development Workshop, “Bacterial Transformation and Protein Isolation,” <i>Harlem DNA Lab</i>
November 2–3	NSF <i>iPlant Collaborative, Genomics in Education Workshop</i> , University of Minnesota, Saint Paul

November 3–6	National Association of Biology Teachers Conference, "Orphaned Data," "Frontiers in Genomics," "DNA Subway," "RNAi/CBSC," "Iceman," "CSI," "Lab Center," Minneapolis, Minnesota
November 4	Site visit by Paula Olsiewski, Alfred P. Sloan Foundation, <i>Harlem DNA Lab</i>
November 5	Site visit by Verizon Fios One MYLITV for filming
November 8	<i>iPlant Collaborative</i> NSF site visit, Tucson, Arizona
November 8–9	Science Teachers Association of New York State Conference, presentations on DNALC family of websites, Rochester, New York
November 12	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab</i>
November 13	HHMI Professional Development Workshop, "DNA Analysis and Forensics," <i>Harlem DNA Lab Saturday DNA!</i> "DNA Barcoding," DNALC
November 22	Baruch College, " <i>iPlant Collaborative</i> DNA Subway," New York Marcus Foundation "Gene Screen," Victor Centers for Jewish Genetic Diseases, Albert Einstein Medical Center, Philadelphia, Pennsylvania
Nov. 29–Dec. 11	Singapore Primary Teachers Attachment, DNALC
December 3	Site visit by Mohammad Alshehri, King Saud University, and Talal Al-Malki, Taif University, Saudi Arabia HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 1," <i>Harlem DNA Lab</i>
December 4	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 1," <i>Harlem DNA Lab</i>
December 9	Site visit by Suzanne Sunshine, S. Sunshine & Associates, New York
December 11	HHMI Professional Development Workshop, "PCR and Human DNA Variation, Part 2," <i>Harlem DNA Lab Saturday DNA!</i> "What Does Your Nose Know?" DNALC
December 14–15	Site visit by Steve Goff and Eric Lyons, <i>iPlant Collaborative</i> , Tucson, Arizona
December 15–16	NSF <i>iPlant Collaborative</i> , <i>Genomics in Education</i> Workshop, University of Texas, Brownsville and Texas Southmost College, Brownsville
December 16	Site visit by James Jorasch and Megan Kingery, Science House, <i>Harlem DNA Lab</i>

### Sites of Major Faculty Workshops 1985–2010

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

ALABAMA	University of Alabama, Tuscaloosa	1987–1990
ALASKA	University of Alaska, Fairbanks	1996
ARIZONA	Arizona State University, Tempe	2009
	Tuba City High School	1988
ARKANSAS	Henderson State University, Arkadelphia	1992
CALIFORNIA	<b>California State University, Dominguez Hills</b>	<b>2009</b>
	<b>California State University, Fullerton</b>	<b>2000</b>
	<b>California Institute of Technology, Pasadena</b>	<b>2007</b>
	Canada College, Redwood City	1997
	City College of San Francisco	2006
	Contra Costa County Office of Education, Pleasant Hill	2002, 2009
	<b>Foothill College, Los Altos Hills</b>	<b>1997</b>
	Harbor–UCLA Research & Education Institute, Torrance	2003
	<b>Los Angeles Biomedical Research Institute (LA Biomed), Torrance</b>	<b>2006</b>
	Laney College, Oakland	1999
	Lutheran University, Thousand Oaks	1999
	Oxnard Community College, Oxnard	2009
	<b>Pasadena City College, Pasadena</b>	<b>2010</b>
	<b>Pierce College, Los Angeles</b>	<b>1998</b>
	Salk Institute for Biological Studies, La Jolla	2001, 2008
	<b>San Francisco State University</b>	<b>1991</b>
	<b>San Jose State University</b>	<b>2005</b>
	Santa Clara University	2010
	<b>University of California, Berkeley</b>	<b>2010</b>
	University of California, Davis	1986
	<b>University of California, Northridge</b>	<b>1993</b>
COLORADO	Aspen Science Center	2006
	Colorado College, Colorado Springs	1994, 2007

	<b>United States Air Force Academy, Colorado Springs</b>	<b>1995</b>
	University of Colorado, Denver	1998, 2009, 2010
CONNECTICUT	Choate Rosemary Hall, Wallingford	1987
FLORIDA	Armwood Senior High School, Tampa	1991
	Florida Agricultural & Mechanical University, Tallahassee	2007–2008
	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
	<b>Morehouse College, Atlanta</b>	<b>1991, 1996, 1997</b>
	<b>Spelman College, Atlanta</b>	<b>2010</b>
HAWAII	Kamehameha Secondary School, Honolulu	1990
ILLINOIS	Argonne National Laboratory	1986–1987
	iBio Institute/Harold Washington College, Chicago	2010
	Illinois Institute of Technology, Chicago	2009
	<b>University of Chicago</b>	<b>1992, 1997, 2010</b>
INDIANA	Butler University, Indianapolis	1987
IDAHO	University of Idaho, Moscow	1994
IOWA	Drake University, Des Moines	1987
KANSAS	University of Kansas, Lawrence	1995
KENTUCKY	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
MAINE	Bates College, Lewiston	1995
	Foundation for Blood Research, Scarborough	2002
MARYLAND	Annapolis Senior High School	1989
	Frederick Cancer Research Center, Frederick	1995
	McDonogh School, Baltimore	1988
	Montgomery County Public Schools	1990–1992
	National Center for Biotechnology Information, Bethesda	2002
	<i>St. John's College, Annapolis</i>	1991
	<b>University of Maryland, School of Medicine, Baltimore</b>	<b>1999</b>
MASSACHUSETTS	Beverly High School	1986
	Biogen Idec, Cambridge	2002, 2010
	<b>Boston University</b>	<b>1994, 1996</b>
	CityLab, Boston University School of Medicine	1997
	Dover-Sherborn High School, Dover	1989
	Randolph High School	1988
	The Winsor School, Boston	1987
	Whitehead Institute for Biomedical Research, Cambridge	2002
MICHIGAN	Athens High School, Troy	1989
MINNESOTA	Minneapolis Community and Technical College	2009
	University of Minnesota, St. Paul	2005
	<b>University of Minnesota, St. Paul</b>	<b>2010</b>
MISSISSIPPI	Mississippi School for Math & Science, Columbus	1990–1991
	<b>Rust College, Holly Springs</b>	<b>2006–2008, 2010</b>
MISSOURI	<b>St. Louis Science Center, St. Louis</b>	<b>2008–2009, 2010</b>
	Stowers Institute for Medical Research, Kansas City	2002, 2008
	<b>Washington University, St. Louis</b>	<b>1989, 1997</b>
NEVADA	University of Nevada, Reno	1992
NEW HAMPSHIRE	Great Bay Community College, Portsmouth	2009
	<b>New Hampshire Community Technical College, Portsmouth</b>	<b>1999</b>
	St. Paul's School, Concord	1986–1987
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	2007
	Bronx High School of Science	1987
	Canisius College, Buffalo	2007
	Cold Spring Harbor High School	1985, 1987
	<b>Columbia University</b>	<b>1993</b>
	<b>Cornell University, Ithaca</b>	<b>2005</b>
	<i>DeWitt Middle School, Ithaca</i>	1991, 1993
	Dolan DNA Learning Center	1988–1995, 2001–2004, 2006–2009
	<b>Dolan DNA Learning Center</b>	<b>1990, 1992, 1995, 2000</b>
	<i>Dolan DNA Learning Center</i>	1990–1992
	DNA Learning Center West	2005
	<i>Fostertown School, Newburgh</i>	1991
	Harlem DNA Lab, East Harlem	2008–2009
	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
	Mt. Sinai School of Medicine	1997
	New York City Department of Education	2007
	New York Institute of Technology	2006
	<b>New York Institute of Technology</b>	<b>2006</b>
<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	1987–1990	
Stuyvesant High School	1998–1999	
The Rockefeller University	2003	
<b>The Rockefeller University</b>	<b>2010</b>	
<i>Titusville Middle School, Poughkeepsie</i>	1991, 1993	
Trudeau Institute, Lake Saranac	2001	
Union College, Schenectady	2004	
<b>United States Military Academy, West Point</b>	<b>1996</b>	
Wheatley School, Old Westbury	1985	
NORTH CAROLINA	CIIT Center for Health Research, Triangle Park	2003
	<b>North Carolina Agricultural &amp; Technical State University, Greensboro</b>	<b>2006–2007, 2009–2010</b>
OHIO	North Carolina School of Science, Durham	1987
	Case Western Reserve University, Cleveland	1990
	Cleveland Clinic	1987
	Langston University, Langston	2008
OKLAHOMA	North Westerville High School	1990
	Tulsa Community College, Tulsa	2009
	<b>Oklahoma City Community College</b>	<b>2000</b>
	Oklahoma City Community College	2006–2007, 2010
OREGON	Oklahoma Medical Research Foundation, Oklahoma City	2001
	Oklahoma School of Science and Math, Oklahoma City	1994
PENNSYLVANIA	Kaiser Permanente-Center for Health Research, Portland	2003
	Duquesne University, Pittsburgh	1988
RHODE ISLAND	Germantown Academy	1988
	Kimmel Cancer Center, Philadelphia	2008
SOUTH CAROLINA	Botanical Society of America, Providence	2010
	<b>Clemson University, Clemson</b>	<b>2004</b>
	Medical University of South Carolina, Charleston	1988
	<b>University of South Carolina, Columbia</b>	<b>1988</b>

TENNESSEE	NABT Professional Development Conference, Memphis	2008
TEXAS	Austin Community College–Rio Grande Campus	2000
	<b>Austin Community College–Eastview Campus</b>	<b>2007–2009</b>
	<b>Houston Community College Northwest, Houston</b>	<b>2009, 2010</b>
	J.J. Pearce High School, Richardson	1990
	Langham Creek High School, Houston	1991
	Midland College, Midland	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
	<b>Trinity University, San Antonio</b>	<b>1994</b>
	<b>University of Texas, Austin</b>	<b>1999, 2004, 2010</b>
	<b>University of Texas, Brownsville</b>	<b>2010</b>
UTAH	University of Utah, Salt Lake City	1993
	<b>University of Utah, Salt Lake City</b>	<b>1998, 2000</b>
	<b>Utah Valley State College, Orem</b>	<b>2007</b>
VERMONT	University of Vermont, Burlington	1989
VIRGINIA	Eastern Mennonite University, Harrisonburg	1996
	Jefferson School of Science, Alexandria	1987
	Mathematics and Science Center, Richmond	1990
	Mills Godwin Specialty Center, Richmond	1998
	<b>Virginia Polytechnic Institute and State University, Blacksburg</b>	<b>2005, 2008–2009</b>
WASHINGTON	Fred Hutchinson Cancer Research Center, Seattle	1999, 2001, 2008
	<b>University of Washington, Seattle</b>	<b>1993, 1998, 2010</b>
WASHINGTON, D.C.	<b>Howard University</b>	<b>1992, 1996,</b> <b>2009–2010</b>
WEST VIRGINIA	Bethany College	1989
WISCONSIN	Blood Center of Southeastern Wisconsin, Milwaukee	2003
	<b>Madison Area Technical College</b>	<b>1999, 2009</b>
	Marquette University, Milwaukee	1986–1987
	University of Wisconsin, Madison	1988, 1989
	<b>University of Wisconsin, Madison</b>	<b>2004</b>
WYOMING	University of Wyoming, Laramie	1991
PUERTO RICO	University of Puerto Rico, Mayaguez	1992
	<b>University of Puerto Rico, Mayaguez</b>	<b>1992</b>
	<b>University of Puerto Rico, Rio Piedras</b>	<b>1993</b>
	University of Puerto Rico, Rio Piedras	1994
<hr/>		
AUSTRALIA	Walter and Eliza Hall Institute and University of Melbourne	1996
AUSTRIA	<b>Vienna Open Lab</b>	<b>2007</b>
CANADA	Red River Community College, Winnipeg, Manitoba	1989
CHINA	<b>Ho Yu College, Hong Kong</b>	<b>2009</b>
GERMANY	Urania Science Center, Berlin	2008
ITALY	Porto Conte Research and Training Laboratories, Alghero	1993
	International Institute of Genetics and Biophysics, Naples	1996
MEXICO	ASPB Plant Biology, Merida	2008
PANAMA	<b>University of Panama, Panama City</b>	<b>1994</b>
RUSSIA	Shemyakin Institute of Bioorganic Chemistry, Moscow	1991
SINGAPORE	National Institute of Education	2001–2005
SWEDEN	Kristineberg Marine Research Station, Fiskebackskil	1995
	Uppsala University, Uppsala	2000
THE NETHERLANDS	<b>International Chromosome Conference, Amsterdam</b>	<b>2007</b>



## **DNA LEARNING CENTER**

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