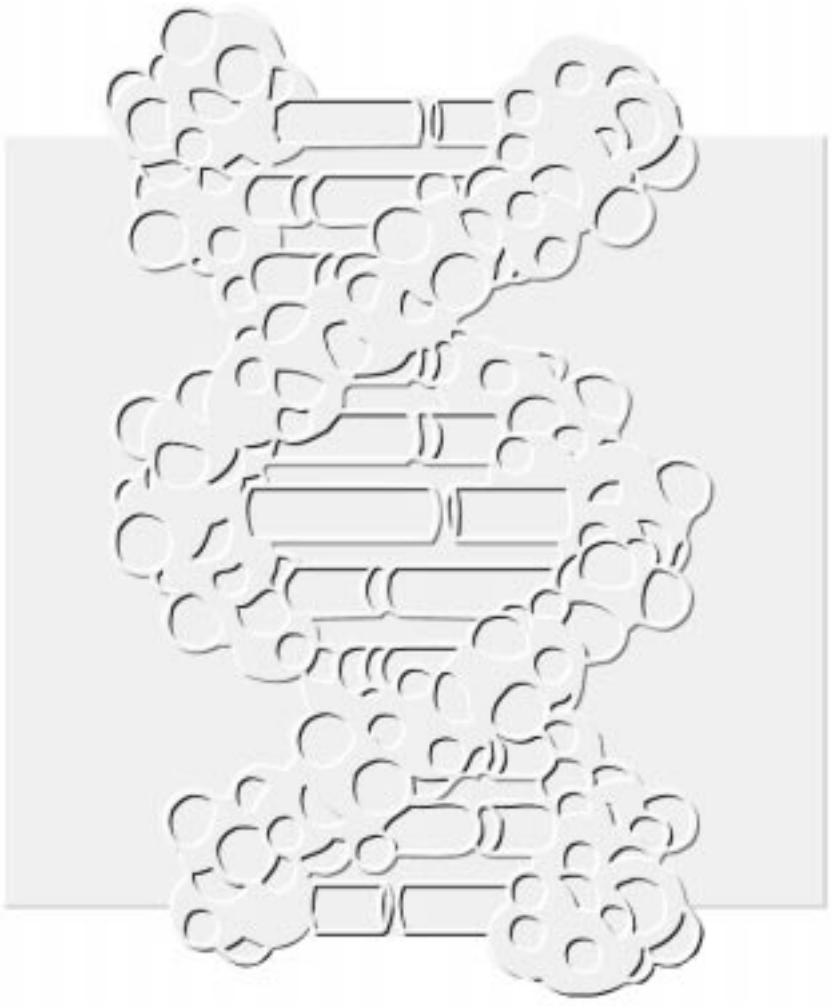
Cold Spring Harbor Laboratory's

DNA Learning Center

Annual Report 1997



ANNUAL REPORT 1997

As John Houseman once stated in a Smith-Barney ad, "We make our money the hard way, we *earn* it." In our case, this means living primarily on the "soft" money provided by gifts and grants. In this lifestyle, one comes to value benefactors who appreciate one's work before it is well known and who provide funding without the usual requirements for detailed reporting. Invariably, the people who practice such "agape" giving become friends and mentors.

In the summer, we mourned the death of one such special friend – Mary Jeanne Harris. She was that rare caliber of women one meets in life who are considered in the same league as one's own mother. She was organized and knew how to get things done. She had a certain can-do sensibility, which likely came from a traditional Midwest upbringing. When something wasn't getting done, she would jump in and do it herself.

Mary Jeanne and her husband Henry were the DNA Learning Center's (DNALC's) first benefactors, and, in a real sense, we owe our careers to them. In the fall of 1987, Mary Jeanne was on the trustee committee that was involved with the Lab's new training program for high school teachers. We were all fretting over taking an initial six months' lease of the old elementary school building in Cold Spring Harbor to use as a base of operations for our educational programs. Of course, we had no money for such an undertaking and weren't even sure in our hearts that it would really work. Everyone knew the risk. Still, we needed $40,000 to move into the building. The weekend after this had been discussed in committee, Mary Jeanne phoned Dave Micklos from a golf outing in Texas to say that she and Henry would donate the first $10,000 toward the initial lease. The DNA Learning Center opened the following year.

On another occasion in 1989, Dave was struggling to find a little quiet time to finish up a textbook he had been working on for several years with our colleague Greg Freyer. In the fall, they were under fairly strict publication deadlines and just couldn't get the writing done in New York. Mary Jeanne suggested a "mini-sabbatical" at Henry's family farm on Squam Lake in New Hampshire. Of course, they agreed immediately and were captivated to find themselves on the "Golden Pond" of movie fame. Between morning and afternoon writing sessions, there was ample time for jogging amidst the splendid fall foliage, antiquing, and listening to otherworldly calls of the resident loons. It was an incredibly productive week, during which the bulk of eight chapters were drafted. *DNA Science* was published the following year.

In 1991, Mary Jeanne and Henry funded an architectural study and made the lead gift toward construction of an addition to the DNA Learning Center. That project has taken longer to percolate, but prospects now are very good for construction to begin in 1998. It makes us terribly sad to think that Mary

Dave Micklos and Mary Jeanne Harris (left), listen to Dr. James Watson at the DNA Learning Center's dedication ceremony in September 1988.

Jeanne will not see the fruition of this project, which will further secure our unique place in American science education. Her death has made us feel more vulnerable in many ways, and we worry that it may be a very long time, indeed, before we find another friend of her stature.

Preparing for an Enlarged Facility

In May, we learned that the Dolan Family Foundation had provided a $1 million grant in support of a 6,000 square-foot *BioMedia* Addition to the DNALC. The Dolan support adds to the lead grant of $50,000 from the Harris Trust and $400,000 in tax exempt funding from the Suffolk County Industrial Development Corporation. Conceptual design was completed, with plans to begin construction late in 1998. We are currently seeking an additional $1.5 million to complete construction and to purchase laboratory, computer, and video equipment.

BioMedia expresses our goal to explore the creative use of computer and telecommunications technology in modern biology education. The focal points of the main level will be an octagonal multimedia computer laboratory, and a new exhibit gallery containing a *Visible DNA Sequencing Laboratory*. The *BioMedia* Addition, and reconstruction of existing space, will create a suite of three teaching laboratories and a student research laboratory – which will allow students to move effortlessly between hands-on science and multimedia computer experiences. A lunchroom and rest rooms are practical elements needed to deal with our ever-increasing number of visitors. The upper level will feature a video studio/production suite and multimedia conference room. Staff offices will be located on the upper and lower levels, according to function.

The facilities in the *BioMedia* Addition will allow us to capitalize on $1.75 million in program grants received this year (described in following sections), which will make the DNALC one of the largest Internet providers of multimedia learning materials for biology education. By pairing high-level computation with video production, we will be able to explore the "convergence" of CD/ROM, video, broadcast, and cable media. Equipment for videoconferencing will leverage the DNALC's unique instructional resources – including the Laboratory's unparalleled pool of resident and visiting scientists. Distance learning will allow us to provide seminars, laboratory training, and follow-up support to many more schools than we can reach by traditional instructional methods. A streaming audio/video server will allow us to incorporate videoconference materials into our Internet site, as well as content from commercial broadcast and cable sources.

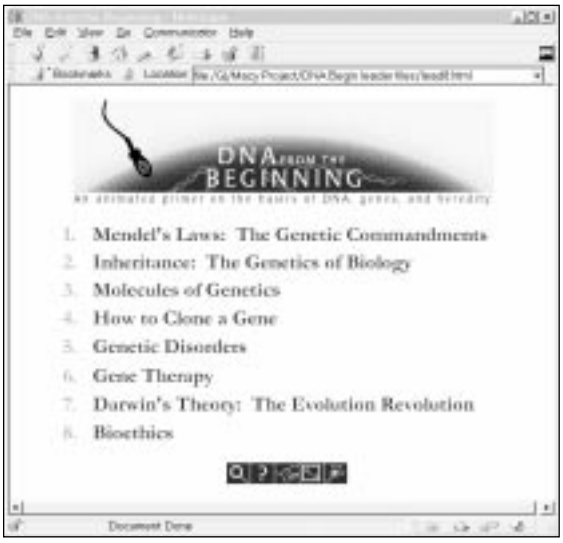
In addition to allowing us to capitalize on new opportunities, the *BioMedia* Addition offers the only solution to very serious space limitations in our existing facility. While lab instruction was increased by over 30% in the 1997-98 academic year, there is no possibility for any further increase in the existing building. The DNALC staff has grown from 9 positions in 1996 to 15 positions in 1998 – a 67% increase. The current staff offices, located in the basement, have become so cramped that it is more and more difficult to maintain a high level of morale and productivity. We do not have reasonable workspaces for several additional staff we are currently recruiting to fulfill contractual obligations on new grants.

The *BioMedia* expansion is in line with the current effort to develop commercial biotechnology on Long Island. Since its inception in 1988, the DNALC has helped develop the science-literate workforce and informed

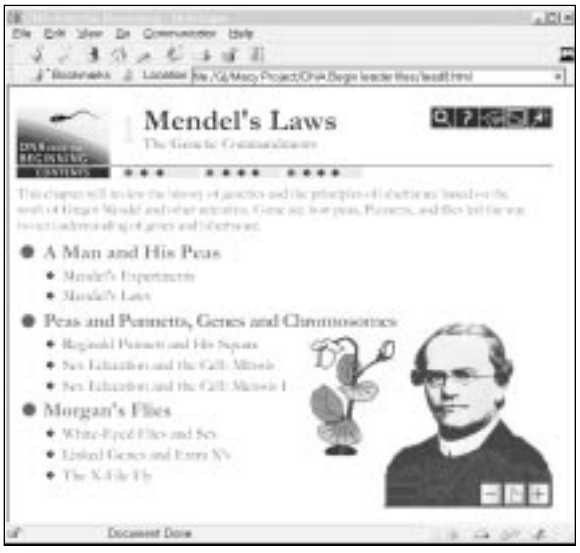
constituency needed to support a biotechnology industry. Due to the on-site and outreach programs of the DNALC, Long Island ranks alongside the San Francisco Bay area as the world leader in advanced biotechnology education. The DNALC remains the nation's largest single provider of biotechnology lab instruction at the precollege level. The DNALC and teaching faculty it has trained provide lab experiences to thousands of local students each year. Students introduced to biotechnology in area schools are now pursuing advanced degrees in science, doing basic biological research, and assuming roles as opinion leaders in nonscience fields.

Creating the First On-line Genetics "Text"

In November, we received a three-year grant of $820,000 from the Josiah Macy, Jr. Foundation to develop an extensive Internet site for genetics education. The first element to be developed will be *DNA From the Beginning* – an animated "primer" to provide background information on classical genetics, DNA and protein structure, the genetic code and protein synthesis, DNA mutations and polymorphisms, and gene mapping and cloning. The primer will make extensive use of multimedia animation, which can enliven unseen molecular events and involve young people accustomed to video games. This component will be the world's first on-line, animated genetics "text." The second element to be



The DNA from the Beginning web site will be tested with visiting students before it is available on-line.



developed, *Gene Almanac*, will be an animated “encyclopedia” of genetic disorders. The object will be to provide detailed information on diseases for which causative or predisposing genes have been identified, including current status of DNA diagnosis and treatments. Reviewed links will direct interested users to research news, patient support groups, clinical trials, and gene/protein sequences.

The Macy project was envisioned by CSHL President James Watson, who for three decades has sought mechanisms to disseminate information on genetics. Several of his works revolutionized science publishing: *The Double Helix* (1968) was the first popular account of the process of scientific discovery, as well as a critical and commercial success. *Molecular Biology of the Gene* (1965) was the first college text in molecular genetics. *Molecular Biology of the Cell* (1983) was the first “super-text” unifying cell and molecular biology. During his tenure, the CSHL Laboratory Press has evolved into a major book and journal publisher. Now, Dr. Watson sees the Internet as the next important channel through which to broadly disseminate genetic literacy.

It is especially appropriate that the Macy Foundation should support this project. Lead support from the Macy Foundation in 1987 provided core staff funding needed to expand laboratory programs to utilize the new DNALC facility, which opened in 1988. Now, a decade later, Macy funding will catalyze a new program to effectively utilize facilities in the *BioMedia* Addition. Initial Macy funding allowed us to demonstrate new laboratory methods in science education; the next generation of funding will allow us to lead development of the Internet as an effective tool in science education.

Creating a Multimedia Communications Group

For several years, we have been keeping a finger in the applications of computer technology in biology education. A key collaboration with John Kruper, at the University of Chicago, allowed us to incorporate custom computer elements into our program to popularize the educational use of human DNA fingerprinting. With funding from the Howard Hughes Medical Institute, we worked with John’s computation group to develop an educational thermal cycler and Internet-accessible database for *Alu* insertion polymorphisms. The receipt of large-scale support from the Macy Foundation provided the impetus to create the multimedia communications group we have dreamed about for several years.

Thus, we were overjoyed when John arrived in November to head the new *BioMedia* Group. John has been a close collaborator since 1987, when he spent several summers here as a graduate intern and based part of his doctoral thesis on our longitudinal survey of *Vector* Workshop participants. We first tried to recruit John in 1991, but our offer was bettered by the University of Chicago, where he stayed until 1996 as Director of Academic Computing for the Biological Sciences Division. While at Chicago, he oversaw the development of a purpose-built computer center, a server system for faculty and students, and over $4 million in grant-funded projects. As Director of Educational Computing at Allegheny College (1996-97), he wrote and began to implement a strategic plan for a campus-wide shift to modern distributed computing.

Also arriving in November was Shirley Chan, who will be the content expert and primary author of *DNA from the Beginning* and *Gene Almanac*. Shirley had just received her doctorate from the Department of Molecular and Medical Genetics at the University of Toronto, where she worked in the laboratory of Joseph Culotti. Her thesis research on the cloning of the *unc-40* gene in

C. elegans was published in the journal *Cell*. Despite this early success in research, Shirley desired a position that combined science with her avocation in creative writing. The fact that she developed a demonstration Internet site on genetics education was evidence to us of her intent. Also, appropriately enough, we located Shirley through an advertisement on the Internet.

This nucleus team is rounded out by Creative Director Susan Lauter, who has been with the DNALC since its inception. Over the years, Susan has become a world-class computer animator and scientific illustrator. Sue joined the Laboratory in 1985 as an undergraduate photography intern in the public affairs and development office. She joined the full-time staff after receiving her bachelor's degree in fine arts from The Cooper Union. Sue is among the first generation of computer designers, now working almost exclusively in digital media. She computer rendered over 200 pieces of artwork for the textbooks *DNA Science* (1990) and *Laboratory DNA Science* (1995), and has developed numerous interactive computer tutorials. She led development of the DNALC's Internet site and the early deployment of on-line *Shockwave* animations in 1996.

Moving Biology Education into the Genome Era

Over the past several years, we have worked to develop an accurate analog of human genome research that allows students to learn about science in the same way as modern scientists. We advocate that students experimentally determine their own DNA polymorphisms ("fingerprints"), then use Internet computer resources to analyze and share results. This approach received considerable support in 1997.

At the beginning of the year, we received a three-year grant of $335,000 from the Department of Energy (DOE) for a nationwide training program, *The Science and Issues of Human DNA Polymorphisms.* This three-day workshop introduces high school biology faculty to a laboratory-based unit on human DNA polymorphisms – which provides a uniquely personal perspective on the science and Ethical, Legal and Social Implications (ELSI) of the Human Genome Project. By targeting motivated biology faculty who currently perform student laboratories with viral and bacterial DNA, this program offers a cost-effective means to bring high school biology education up-to-the-minute with genomic biology.

In October-December, we instructed the first of 12 workshops nationwide at Mt. Sinai School of Medicine (New York), Boston University School of Medicine (Massachusetts), and Canada College (California). Each workshop mixed theoretical, laboratory, and computer work with practical and ethical implications. Program participants learned simplified lab techniques for amplifying two types of chromosomal polymorphisms – an *Alu* insertion and a VNTR (D1S80). These polymorphisms illustrate the use of DNA variations in disease diagnosis, forensic biology, and identity testing – and provide a starting point for discussion of the uses and potential abuses of genetic technology.

At mid-year, we received a $600,000 grant from the National Science Foundation (NSF) for a three-year program to develop and disseminate advanced technology units on genomic biology. This project is funded by the Advanced Technological Education (ATE) Program, which focuses on improving technical education in high schools and two-year colleges. Operating under a direct congressional mandate, the ATE program aims to insure U.S. competitiveness in emerging technologies of the 21st century.

The ATE Project made a strong start with a workshop held at Cold Spring Harbor on June 23-28 to bring together DNALC staff with staff from project partners at the Center for Occupational Research and Development (CORD, of Waco, Texas) and members of a national Editorial Advisory Board:

Lesli Adler, Thomas S. Wooton High School, Rockville, MD
Clint Brown, Thomas S. Wooton High School, Rockville, MD
Ginny Brown, Winston Churchill High School, Potomac, MD
DeeDee Glassett, Merced College, Merced, CA
John LaPolla, Stuyvesant High School, New York, NY
Robert McKown, James Madison University, Harrisonburg, VA
Jean McLain, Wilson Technological Center, Dix Hills, NY
KumKum Prabhakar, Nassau Community College, Garden City, NY
Judy Price, Montgomery County Public Schools, MD
Gary Sarinsky, Kingsborough Community College, Brooklyn, NY
Janet Shagam, TVI Community College, Albuquerque, NM
Jerry Watkins, Central Islip High School, Central Islip, NY

The project team reviewed prototype lab materials to be included in the technology that represents a continuum of modern methods of gene identification and analysis. The units stress fundamental themes of evolutionary similarity and individual variation in genetic information. Comparative genomics and evolutionary biology are illustrated by computer manipulations of gene databases - including on-line projects using student-generated data, as well as data from DNA/protein databases. The high school unit focuses on length polymorphisms in human DNA and human population genetics – and articulates with CORD's nationally used curriculum *Applications in Biology/Chemistry* (*ABC*). The college unit analyzes human sequence polymorphisms in mitochondrial DNA, as well as polymorphisms in plants. One experiment examines how CSHL researchers use the *Ds* transposon (discovered by Barbara McClintock) to "tag" genes in the model plant *Arabidopsis.* Another shows the molecular basis of Mendel's wrinkled seed trait in peas. Following a year of development and testing, the *Genomic Biology* units will be introduced to 216 faculty at training institutes held at eight sites nationwide.

The project will be guided by a national mail survey that will reach a purposive sample of 12,000 high school biology teachers – equal to about one fourth of all such faculty in the U.S. This survey should give us the first careful measure of the number of high school students who participate in hands-on DNA labs. These students are the logical targets for *Genomic Biology* units.

Improving PCR for the Classroom

With support from DOE and NSF, we made significant biochemical modifications that will make it much easier for teachers to bring human PCR into high school and college classrooms.

We optimized the DNA extraction protocol from hair follicles, thus removing the potential objection to using cheek scrapings or saliva as a cell source for human DNA typing. For several years, we have advocated isolation of DNA from buccal cells obtained by saline mouthwash and Chelex extraction as the most reproducible method for isolating human template DNA for PCR amplification. Other educational groups advocate the use of buccal cells obtained by cheek scraping. While noninvasive, both methods have the disadvantage of being perceived as "body fluids" potentially harboring pathogens – some school

districts prohibit the use of buccal cells in student experiments. Overall, hair preps are about 10% less effective than mouthwash. While many people believe the root to be a good source of DNA, we have found that reproducible DNA recovery is, in fact, most highly correlated to the presence of a sheath. This structure is a bundle of several thousand squamous cells, which surround the hair shaft above (and usually separate from) the root. Brief incubation with proteinase-K, followed by boiling with Chelex, disrupts the sheath membrane releasing small groups of squamous cells that are readily lysed by boiling. Both sheath cells *and* hair shaft have mitochondria, making hair an ideal source of DNA for sequencing the mitochondrial control region.

We optimized PCR reaction conditions for Pharmacia "Ready-to-Go-Beads," which incorporate *Taq* polymerase in a dried bead. Each bead comes in its own reaction tube and is stable at room temperature. Use of Ready-to-Go Beads simplifies set up of PCR reactions, insures reagent consistency, and reduces contamination. Primers and DNA template (from buccal or hair cells) are simply added to the beads. As another time saver, we incorporate the loading dye cresol red into the primer mix. This has no effect on PCR amplification and saves the step of adding loading dye prior to loading samples in an agarose gel.

We have synthesized new primers that amplify *Alu* alleles of approximately 500 basepairs (bp) and 800 bp, as compared to the 100-bp and 400-bp alleles we have amplified in the past. These larger alleles stain reproducibly with methylene blue (as well as with ethidium bromide). The larger alleles can be resolved in a lower percentage agarose gel (1.2% vs. 2.0%), reducing cost and staining time.

Our several-year effort to develop and disseminate an inexpensive DNA thermal cycler culminated in February with receipt of a license from PE Applied Biosystems to distribute the *Biogenerator* as an "authorized thermal cycler for PCR." This is, to our knowledge, the first thermal cycler specifically licensed for educational use. Although the *Biogenerator* is clearly a "Rube Goldberg" apparatus, it gives results comparable to commercial machines, and its open design allows students to better understand the process of thermal cycling. In anticipation of scaling up to the first production run of 100 machines, in October, we invested in a custom-printed circuit board for the key analog-digital controller. By year's end, we had sold 43 *Biogenerators,* through the DNALC Internet site and to distributor Carolina Biological Supply Company.

Sequencing Mitochondrial DNA

In collaboration with staff at the CSHL *Arabidopsis* Genome Sequencing Center, run by Dick McCombie, we developed reliable methods for generating mitochondrial (mt) DNA sequence from cheek and hair cells. Sequencing the variable "control region" proved an immense hit at a June workshop for members of the advisory board of our NSF Advanced Technological Education program. This technology proved readily reproducible at teacher workshops presented by Dave Micklos in Great Britain during the month of September. Two-day workshops were conducted at the University of Edinburgh, the University of Newcastle, and the Sanger Center at Hinxton Hall. Dave also gave a special lecture, "Cloning the DNA Classroom" at the London headquarters of the Wellcome Trust, which was the primary sponsor of the "tour." The enthusiastic response to mitochondrial DNA sequencing abroad encouraged us to immediately introduce this new technology at teacher-training workshops conducted under our DOE grant.

John Kruper speaks to Editorial Advisory Board at June workshop.

In this example the on-line sequence analysis tutorial was used to compare modern human mitochondrial DNA sequence with neandertal DNA.

While several educational groups have programs in student DNA sequencing, these focus on hand-sequencing of unknown sequences. Conversely, our program focuses on the student's own DNA sequence, developed from colorimetric sequencing, as an entree to modern bioinformatics. We advocate a system where an initial PCR amplification and dye labeling reactions are done in class (a several hour commitment). Then, the ready-to-sequence DNAs are sent to regional centers for sequencing. Under our new NSF program, we are developing a model *Sequencing Service*, which will develop student sequences and post the results via Internet.

Experience gained in generating mtDNA sequence for over 125 teachers at the Wellcome Trust and DOE workshops has demonstrated the feasibility of the *Sequencing Service*. We can obtain clean sequence from about 80% of buccal and hair samples; we are testing reagent modifications that can potentially put us within our projected total cost of $3.00 per sequence. While we are currently using an Applied Biosystems 377 sequencer in the *Arabidopsis* Genome Sequencing Center, our objective is to obtain a sequencer for the DNALC site. We envision a functioning, mini-sequencing lab – enclosed by picture windows – as a permanent exhibit in the new gallery of the *BioMedia* Addition.

In the fall, we published our first sequence analysis tutorial on the DNALC's web site (http://darwin.cshl.org/SequenceAnalysisExercise/index1.html). This exercise is designed to allow students and teachers to use their own mtDNA sequences to explore online genome resources, to test theories of human evolution, and to "solve" cases in forensic biology. In the exercise, site users choose a sequence from a database of mtDNA sequence submitted by teachers and students. The chosen sequence is then used as a query in a BLAST search to identify similar sequences in the Genome Project's primary repository, *Genbank*. After determining that the chosen sequence is from the control region of mtDNA, students then perform a CLUSTAL analysis to localize this

area within the entire mitochondrial genome (16,569 bp).

Students then apply these bioinformatics tools to perform three comparisons that use mitochondrial sequence variations as a "molecular clock" to determine whether Neanderthal hominids were our direct ancestors:

- How similar are the mtDNA sequences of different modern humans?
- How similar are modern human sequences to Neanderthal sequences?
- How similar are modern human sequences to chimpanzee sequences?

The tutorial uses current *Frames* and *JavaScript* technologies to present an inquiry-based exercise that "wraps" difficult-to-use genome resources within an easy-to-use contextual guide. The sequence analysis tutorial quickly became the second most popular destination on the DNALC's Internet site – demonstrating the success of this novel approach.

Local Programs Expand Greatly

As shown in the table below, student and teacher participation in DNALC programs topped 27,000 in 1997 – an increase of nearly 5,000 over 1996. Most importantly, lab instruction for local students increased by 31%. Virtually all of this growth came from the middle school program, *Genetics as a Model for Whole Learning (GMWL).* The majority of the increase came from in-school instruction, which can be scheduled independent of lab use at the DNALC. Additional lab field trips to the DNALC were made possible by redeveloping the computer laboratory into a genetics laboratory for middle school students. The low lab tables are well scaled for younger children, and the lab was further equipped with a projection microscope. The existence of a dedicated middle school laboratory allowed us to schedule "block" visits during which a single district completes all its lab field trips over several consecutive days. It also freed up the *Bio2000* Laboratory for 30 additional high school classes per year. Despite this significant increase in capacity, demand for labs was so keen that all available lab dates for the 1997-98 academic year were essentially filled in May. Thus, any further increase in on-site instruction will have to await new laboratory space in the *BioMedia* Addition.

The *GMWL* Program expanded to reach 8,440 students from 40 elementary and middle schools from 13 school districts in New York City, Nassau County, and Suffolk County (see following table). This was a 72% increase over 1996 participation. Thirty-eight percent of program participants were minority students – 25% Black, 6% Hispanic, 7% Asian/Pacific Islander, and 1% Native American.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Total
Student Labs (on-site)	2,031	3,753	3,758	4,248	4,624	3,422	3,961	4,682	6,088	7,105	**43,672**
Student Labs (off-site)				291	435	1,305	1,434	2,328	5,045	7,665	**18,503**
Teacher Labs	58	278	270	234	270	254	302	379	302	392	**2,739**
Student Workshops	32	13	24	176	234	351	361	503	437	402	**2,533**
Teacher Workshops	496	285	314	333	441	249	171	110	183	245	**2,827**
Lab Subtotal	2,617	4,329	4,366	5,282	6,004	5,581	6,235	7,993	12,023	15,809	**70,239**
Student Lectures	553	449	660	600	1,000	734	575	520	575	407	**6,073**
Exhibit/LI Discovery	3,231	2,547	2,964	1,480	848	6,416	9,943	10,366	10,122	11,150	**59,067**
Total	**6,401**	**7,325**	**7,990**	**7,362**	**7,852**	**12,731**	**16,753**	**18,879**	**22,720**	**27,366**	**135,379**

GMWL offers each school district a unique program based on its individual needs. The program encompasses three components – teacher training, in-school instruction, and field trips to the DNA Learning Center (DNALC). Typically, DNALC staff work with district science coordinators to create a sequential program that targets at least two grade levels. Prior to in-school instruction, a teacher training session is held to expose classroom teachers to the various labs their students will perform. A DNALC middle school instructor visits each class multiple times to perform a core of hands-on labs designed to increase genetic literacy while enhancing critical and creative thinking. This core experience is then supplemented with follow-up activities that classroom teachers design with the assistance of DNALC staff. Most schools include a field trip to the DNALC as the culmination of the *GMWL* unit. This field trip includes an instructional tour of the *Story of a Gene* Exhibit and a hands-on laboratory.

Tricia Harrison instructs a DNA extraction experiment to middle-school students in the former *BioMedia* Computer Lab.

Making Inroads into New York City

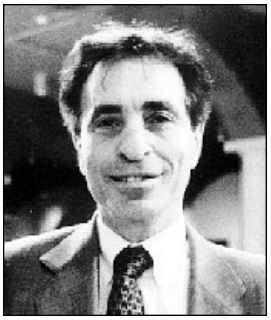
Our ongoing studies of instructional innovation have documented that about 175,000 hands-on DNA experiments are performed annually in American high schools. However, this has been largely a suburban movement – effectively excluding the vast majority of students in urban settings. Likewise, younger children in city schools are much less likely to receive the benefits of hands-on learning stipulated by the *National Science Education Standards*. Sadly, this is true of the New York City schools in our own backyard.

However, within the last year we have forged important partnerships that will provide opportunities in modern genetics education to large numbers of minority and disadvantaged students in New York City Public Schools. A collaboration with Community School District 29 in south-east Queens is a model for the large-scale implementation of the *GMWL* program, while a collaboration with the Gateway to Higher Education Program has provided a means to reach large numbers of high school students.

Located immediately to the north of Kennedy Airport, District 29 serves 25,000 students in grades K-8 – of whom 95% are minorities, 67% are eligible for lunch assistance, and 31% have limited English proficiency. By working closely with Superintendent Celestine Miller, Director of Funded Programs Ellen Schlesinger, and Supervisor of Science Diane Ehrlich, we have developed a program for *systemic change* that maximizes involvement at all levels in the district. Parents and school board members participated in three workshops –

giving them a chance to do some of the same activities done by the students. Faculty participated in 25 hours of after-school and Saturday workshops designed to increase their command of multidisciplinary lab instruction. Administrators, school board members, and faculty also participated in a recognition dinner at Cold Spring Harbor Laboratory.

In 1997, we doubled the number of District 29 students involved in the *GMWL* program. DNALC staff presented 29 days of in-school instruction, reaching 90 sixth grade classes. Students performed four labs in school – constructing cell models, observing cells under compound microscopes, constructing DNA models, and extracting DNA from bacteria. A fifth lab – observing fruit fly mutations under stereo microscopes – was conducted during field trips to the DNALC. We further expanded the program by piloting a follow-up chemistry program for 7th graders. The chemistry lab sequence includes experiments on molecular modeling, enzyme structure and function, practical enzymology, and bioreactors.



Mort Slater, director of the Gateway to Higher Education Program.

Mort Slater, of Mount Sinai School of Medicine, has been our guide into city high schools. Mort runs the Gateway to Higher Education Program, a four-year program that prepares minority and low-income students to graduate from high school and smoothly transition into university science programs. The program involves 2,000 students in seven high schools representing all five boroughs of New York City. In the past year, we have begun to effectively merge the DNALC's content expertise in hands-on lab instruction with Gateway's expertise in school change.

Tangible evidence of this unique instruction/infrastructure partnership was the opening in the spring of a dedicated DNA laboratory in Brooklyn Technical High School. Mort found about $20,000 to purchase research-quality electrophoresis and cell culture equipment, refrigerator/freezer, autoclave, and ice maker. With Mort's deft guidance, the project miraculously sidestepped the notoriously slow New York City bureaucracy, and was finished in several months. Support for the project was as surprising as it was heartwarming: learning disabled students fabricated lab benches from discarded lunchroom tables; custodians arranged to paint the room in non-institutional colors; central administration approved the installation of heavy duty air conditioners so that the lab can effectively be used for summer courses.

The Brooklyn Tech laboratory found immediate use in the spring semester, serving 306 students in Advanced Placement (AP) biology and genetics classes. During the summer, the laboratory was the site of two workshops sponsored by the Greenwall Foundation, which were attended by 40 teachers from throughout New York City. Two student workshops drew 33 students, of whom 82% were minorities. In the fall, the DNA Laboratory was a key stop in a tour of Gateway schools by Luther Williams, head of the Directorate for Education and Human Resources at the National Science Foundation.

Gateway High School	**NYC Borough**	**Enrollment**	**Poverty Level***	**Demographics (%)**				
				Asian	Hispanic	White	Black	Other
Stuyvesant	Manhattan	3,100	31%	47	3.9	44.8	4.7	-
Jamaica	Queens	2,600	35%	17	14	-	60	9
John F. Kennedy	Bronx	5,000	73%	5	71	5	17	1
Port Richmond	Staten Island	2,000	22%	5	16	58	21	-
Brooklyn Tech	Brooklyn	4,500	30%	32	14	16	37	-

***Poverty levels determined from Lunch Eligible Program (LEP) statistics.

Acclaim for the lab was so great that the Board of Education approved $175,000 to equip additional DNA laboratories in each of the five boroughs. Each of the DNA laboratories will also be wired for Internet communication, so these schools will be able to fully participate in both the experimental and on-line aspects of our genomic biology curriculum. When fully operational, with integrated experimental and computation, the DNA laboratories in New York City will have no peer in illustrating the modern synthesis of science and technology. As shown by the demographics for five participating schools, the DNA laboratories will serve populations that are truly representative of urban America (see table above).

Getting Out Word on Marfan Syndrome

As a complement to the *GMWL* program, we took on a key collaboration with the National Marfan Foundation (NMF). Our task was to develop a teacher's guide to complement *How Do Your Genes Fit?,* an award winning video on Marfan Syndrome for middle-school students. To expand the video's usefulness, we used Marfan Syndrome as a means to introduce general concepts of cell biology, DNA structure/function, and genetics. The teacher's guide incorporates three laboratories from the *GMWL* curriculum – baggie cell model of a fibroblast, DNA extraction, and Punnett square statistics.

The guide is currently undergoing final editing and review by NMF staff, and is scheduled for publication in the near future. The guide will be distributed nationally along with 700 free copies of the video, with additional copies provided at cost. The first major distribution will take place at the annual meeting of the National Science Teachers' Association, to be held in April in Las Vegas.

We believe that this project provides a particularly important outlet for our curriculum expertise. Perhaps more than any other genetic disorder, it is critical to get the word out about Marfan Syndrome to young people and their parents. Only within the last several years have physicians and geneticists realized that there are a large number of related disorders caused by defects in the Marfan gene, which produces the structural protein fibrillin. Outward physical effects tend to be subtle, so all of these disorders are difficult to diagnose. Experts believe that there are tens of thousands of young people with undiagnosed Marfan Syndrome or related fibrillin disorders, who need to be evaluated by a physician.

All fibrillin disorders weaken connective tissue, which provides strength and resiliency to muscle and bone. The weakening of the wall of the aorta, the major artery carrying blood from the heart, is the only life-threatening risk of undiagnosed Marfan Syndrome. Over time, the connective tissue in the aorta weakens and the high pressure of blood pumped out of the heart causes the aorta wall to bubble out and burst – an aneurysm. There have been several publicized cases of apparently healthy athletes who died of aneurysms during exercise, and who later proved to have undiagnosed Marfan Syndrome. We feel that our guide can help raise awareness of this "ticking time bomb," and encourage the early diagnosis of the disorder. With early intervention, blood pressure can be regulated to minimize damage to the aorta and affected children can limit strenuous exercise.

Corporate Advisory Board

The Corporate Advisory Board (CAB) provides a crucial link to local businesses that serve the same population base as the DNALC. Represented on the board are companies of all kinds – from family-owned to multi-national and from biotech-

nology to banking. A major goal of the board is to raise awareness of the DNALC among opinion leaders on Long Island and to involve others in our work.

To support this goal, two hands-on workshops were held at the DNALC for CAB members, family and friends. Each of the 48 participants produced their own DNA fingerprint, illustrating the uses of DNA typing in court cases. To show appreciation for the CAB's achievements, CSHL Director Bruce Stillman hosted a dinner party at Airslie for CAB members and other DNALC donors on May 4th. The evening began on the main campus with a briefing on breast cancer by Mike Wigler, and lab tours by Jerry Yin and Dick McCombie.

Under the leadership of Jack Leahy, the CAB raised $181,361 in support of the DNALC, a 13% increase over 1996. Key to this huge success was the 4th annual golf tournament, held on June 18th at Piping Rock Club. Under the chairmanship of Horst Saalbach, the tournament drew 156 players and netted $97,714. J.P Morgan was the major corporate sponsor; other corporate sponsors were Cablevision, Chase Manhattan Bank, Festo Corporation, Luitpold Pharmaceuticals, and Price Waterhouse.

Staff and Interns

Malissa Hewitt took over the management of the rapidly-growing middle school programs after the departure of Jane Conigliaro and Diane Jedlicka in March. We are much indebted to Malissa for rising to the task under difficult circumstances and insuring the continued quality of the *GMWL* program. Her complex position involves liaising with superintendents, principals, and faculty at 13 different school districts; coordinating in-school and on-site instruction, conducting teacher training, and managing four other staff members. Patricia Harrison joined the middle school staff as a laboratory instructor in January, and ably assisted Malissa in managing the *GMWL* program. Tricia has a bachelor's degree in

New staff to the DNALC in 1997 (top left to lower right): John Kruper, Shirley Chan, Patricia Harrison, and Scott Bronson.

elementary education from the University of Scranton and is currently a Masters candidate in special education and reading at Long Island University. In the fall, middle school instructor Andrew Morotti began to divide his time between teaching at the DNA Learning Center and working in a half-time position as a lab tech with CSHL Scientist Jerry Yin.

Scott Bronson joined the full-time DNALC staff as laboratory instructor, and in the summer assumed responsibility for managing the teaching and prep labs, as well as the student intern program. Scott brings to the staff expertise in current research methods in molecular biology. He formerly worked for three years as a technician in the laboratory of CSHL scientist Jacek Skowronski, where he investigated the role of the *nef* protein in HIV pathogenesis. Scott holds bachelor's degrees in molecular and marine biology, and he is currently pursuing a master's degree in science education.

The laboratory and computational staff was ably assisted by a number of veteran interns: Trevor Carlson (Central Islip High School), Gerry DeGregoris (Chaminade High School), Karin Glaizer (Portledge School), Mera Goldman (Walt Whitman High School), Hana Mizuno (Cold Spring Harbor High School), Rachael Neumann (Syosset High School), Trevor Sammis (Huntington High School), and Jermel Watkins (New York Institute of Technology). Stacey Trotter (Cornell University) and Salley Ann Gibney (Johns Hopkins University) returned during the summer to assist with the student and faculty workshops. In August, we bid farewell to Dan Gibson (Cold Spring Harbor High School) who began his freshman year at Lehigh University. Newcomers Michele Hollander (Jericho High School) and Jennifer Kirschenbaum (Jericho High School) joined the staff in fall.

Amy Cross, a valuable and popular member of our administrative team, left her position as program assistant in August to teach 1st through 3rd grade science at Friends Academy**.** Her sunny disposition and office support have been greatly missed. Staff Associate Jerry Watkins, of Central Islip High School, once again dedicated several weeks of his summer break to instructing student workshops hosted at the American Museum of Natural History (AMNH) in Manhattan. Joining him as lab assistants were his sons Jermel (a veteran DNALC lab intern) and Justin.

DNA Learning Center 1997 Grants

Federal Grants Funding		**Term of Grant**	**1997 Funding**
National Science Foundation	A Two-part Program to Develop and Support a Nationwide Corps of Human & Molecular Genetics Resource Teachers at the Secondary Level, David Micklos	4/93-6/97	$10,434.87
	A Novel Mechanism for Introducing Human Genome Research in Freshman Biology Classes, Mark Bloom	4/95-4/98	$89,556.37
	A Partnership to Develop Advanced Technology Units on Genomic Biology	8/97-7/00	$49,953.79
Department of Energy	The Science and Issues of Human DNA Polymorphisms: An ELSI Training Program for High School Biology Teachers	1/97-1/00	$67,755.17
Non-Federal Grants			
Genentech, Inc	*Story of a Gene* Exhibit	4/95-4/97	$721.63
Hearst Foundation	Genetics as a Model for Whole Learning	1/97-12/97	$50,000.00
Howard Hughes Medical Institute	Precollege Science Education Initiative for Biomedical Research Institutions	7/94-8/99	$35,738.48
Josiah Macy, Jr. Foundation	Gene Almanac	10/97-9/00	$57,555.39

The following schools each awarded a grant for the *Genetics as a Model for Whole Learning Program:*

China Town School District 1	$5,040
Community School District 29	$26,700
East Meadow Union Free School District	$2,450
Elwood Union Free School District	$3,425
Green Vale School	$2,375
Half Hollow Hills Central School District	$2,750
Jericho Union Free School District	$4,700
Lawrence Union Free School District	$10,000
Locust Valley Central School District	$7,160
Plainview-Old Bethpage Central School District	$1,175
South Huntington Union Free School District	$10,400
Syosset Central School District	$14,700

The following schools each awarded a grant for *Curriculum Study* of $1,100:

Commack Union Free School District
East Meadow Union Free School District
Elwood Union Free School District
Garden City Union Free School District
Great Neck Union Free School District
Half Hollow Hills Central School District
Harborfields Central School District
Herricks Union Free School District
Island Trees Union Free School District
Jericho Union Free School District
Lawrence Union Free School District
Locust Valley Central School District
Massapequa Union Free School District
North Shore Central School District
Oyster Bay-East Norwich Central School District
Plainedge Union Free School District
Plainview-Old Bethpage Central School District
Portledge School
Port Washington Union Free School District
Ramaz School
Roslyn Union Free School District
Sachem Central School District
West Hempstead Union Free School District

of **$1,500:** Long Beach School District

of **$2,000**: East Woods School
Friends Academy
Green Vale School
Oceanside Union Free School District

Workshops, Meetings, and Collaborations

January 7	Laboratory for *Women in Science and Engineering Program*, SUNY Stony Brook, DNALC
January 9	Presentation to McClintock Book Club, Hofstra University, Long Island, New York
January 10	Community School District 29 Meeting, Rosedale, New York
January 14	Site Visit by Betty Faber, Liberty Science Center, Jersey City, New Jersey
January 16	*Science for the 21st Century*, Seminar given at Chicago Academy of Science, Illinois
January 30-31	Workshop, Brooklyn Technical High School, Brooklyn, New York
February 6-7	National Science Foundation Grant Review, Washington, D.C.
February 11	Laboratory for *Women in Science and Engineering Program*, SUNY Stony Brook, DNALC
February 16-17	American Association for the Advancement of Science Meeting, Seattle, Washington
February 22	Laboratory for Corporate Advisory Board, DNALC
February 28	Site visit by Alan Thaw, Brooklyn Technical High School, Brooklyn, New York
	Site visit by Andrea Thompson, *Newsday*
March 4-5	Howard Hughes Medical Institute Grant Review, Bethesda, Maryland
March 11	Site visit by Jinx Perullo and John LaPolla, Stuyvesant High School, New York, New York
March 12	Site visit by Bonnie Kaiser, Rockefeller University, New York, New York
March 13	Laboratory for parents of students in Community School District 29, Queens, New York
March 28	Site visit by Monica Volkmann, Miles Gordon, and Nancy Hechinger, American Museum of Natural History, New York, New York
April 4	Site visit by Rob Kelly, Computer Associates, Islandia, New York
April 4-6	National Science Foundation Workshop, *Human Genome Diversity-Student Allele Database*, University of Chicago, Illinois
April 8	*Great Moments in DNA Science* Honors Students Seminar, CSHL
April 11-12	National Science Foundation Follow-up Workshop, University of Alaska, Fairbanks
April 14	*Applications of Recombinant DNA* Seminar, Westpoint, New York
April 15	*Great Moments in DNA Science* Honors Students Seminar, CSHL
April 18-20	National Science Foundation Workshop, *Human Genome Diversity-Student Allele Database*, Foothill College, Los Altos Hills, California
April 23	National Institute of Social Sciences Meeting, Harvard Club, New York, New York
April 29	*Great Moments in DNA Science* Honors Students Seminar, CSHL
May 1	Site visit by Diane Ehrlich and Ellen Schlesinger, Community School District 29, Queens, New York
May 9	Site visit by June Osborn, Macy Foundation, New York, New York, and David Luke, Chairman of CSHL Board of Trustees
May 9-11	National Science Foundation Workshop, *Human Genome Diversity-Student Allele Database*, Washington University, St. Louis, Missouri
May 20	Brinkmann Instruments Meeting, Westbury, New York
May 29	*Creating Futures*, Seminar at C.W. Post/Long Island University, New York
June 16	Site visit by Cablevision, filming Oceanside #8 Middle School
June 23-28	Editorial Advisory Board Workshop, DNALC
June 30-July 3	*World of Enzymes* Workshop, DNALC
July 7-11	*Fun With DNA* Workshop, IS59, Queens, New York
	DNA Science Workshop, DNALC
	DNA Science Minority Teacher Training Workshop, Brooklyn Technical High School, New York
July 7-16	*Advanced DNA Science* Minority Workshop, Central Islip, New York
July 10-14	Center for Image Processing Meeting, Rochester, Minnesota
July 14-18	*Fun With DNA* Minority Teacher Training Workshop, Brooklyn Technical High School, New York
	Introduction to Computer Design Workshop, DNALC
July 14-22	*Advanced DNA Science* Workshop, DNALC

July 19 Site visit by Phil Talbot, Skyline High School, Salt Lake City, Utah

July 21-25 *Fun With DNA* Minority Workshop, IS 59, Queens, New York

DNA Science Minority Workshop, Brooklyn Technical High School, New York

July 28-August 1 *Fun With DNA* Workshop, DNALC

August 4-8 *DNA Science* Workshop, DNALC

DNA Science Minority Workshop, Brooklyn Technical High School, Brooklyn, New York

DNA Science Minority Workshop, American Museum of Natural History, New York, New York

August 11-15 *Fun With DNA* Workshop, DNALC

DNA Science Minority Workshop, American Museum of Natural History, New York, New York

August 14-22 *Advanced DNA Science* Workshop, Delbruck Laboratory, CSHL

August 18-22 *Fun With DNA*, Portledge School, Locust Valley, New York

DNA Science Workshop, DNALC

DNA Science Minority Workshop, American Museum of Natural History, New York, New York

Introduction to Computer Design, DNALC

August 21 Site visit by Mark Schoofs, *Village Voice*

August 25-29 *Fun With DNA* Workshop, DNALC

DNA Science Workshop, Delbruck Laboratory, CSHL

September 10-11 The Wellcome Trust Workshop, *Science and Issues of Human DNA Polymorphisms*, University of Edinburgh, Scotland

September 12-13 The Wellcome Trust Workshop, *Science and Issues of Human DNA Polymorphisms,* Newcastle-On-Tyne, Great Britain

September 16 Site visit by Lalita Khosla, *Metro News*

September 17 *Cloning the DNA Classroom,* Seminar presented at The Wellcome Trust, London, Great Britain

September 19-20 The Wellcome Trust Workshop, *Science and Issues of Human DNA Polymorphisms,* Cambridge, Great Britain

October 9 Site visit by Dr. Mort Slater, Gateway to Highway Education

October 14 *Cold Spring Harbor Laboratory and It's Place in Science*, seminar presented at Banbury Center, CSHL

October 18 Laboratory for Corporate Advisory Board, DNALC

October 24-26 Department of Energy Workshop, *The Science & Issues of Human DNA Polymorphisms*, Mt. Sinai School of Medicine, New York, New York

November 8-10 Department of Energy Workshop*, The Science & Issues of Human DNA Polymorphisms*, CityLab, Boston University School of Medicine, Massachusetts

November 11-13 Department of Energy Meeting, Santa Fe, New Mexico

November 14-16 Department of Energy Workshop*, The Science & Issues of Human DNA Polymorphisms*, Canada College, Redwood City, California

November 21-23 National Science Foundation Advanced Technological Education Meeting, Washington, D.C.

December 5-7 Department of Energy Workshop*, The Science & Issues of Human DNA Polymorphisms*, Morehouse College, Atlanta, Georgia

December 11 National Institutes of Health ELSI Grant Review

December 18 Site visit by Rockefeller University, New York,

Sites of Major Faculty Workshops 1985-96

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

ALABAMA	University of Alabama, Tuscaloosa	1987-90
ALASKA	University of Alaska, Fairbanks	1996
ARIZONA	Tuba City High School	1988
ARKANSAS	Henderson State University, Arkadelphia	1992
CALIFORNIA	**Foothill College, Los Altos Hills**	**1997**
	University of California, Davis	1986
	San Francisco State University	**1991**
	University of California, Northridge	**1993**
	Canada College, Redwood City	1997
COLORADO	Colorado College, Colorado Springs	1994
	United States Air Force Academy, Colorado Springs	**1995**
CONNECTICUT	Choate Rosemary Hall, Wallingford	1987
DISTRICT OF COLUMBIA	**Howard University**	**1992, 1996**
FLORIDA	North Miami Beach Senior High School	1991
	University of Western Florida, Pensacola	1991
	Armwood Senior High School, Tampa	1991
GEORGIA	Fernbank Science Center, Atlanta	1989
	Morehouse College, Atlanta	**1991, 1996**
	Morehouse College, Atlanta	1997
HAWAII	Kamehameha Secondary School, Honolulu	1990
ILLINOIS	Argonne National Laboratory	1986, 1987
	University of Chicago	**1992, 1997**
IINDIANA	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	Jefferson Parish Public Schools, Harvey	1990
	John McDonogh High School, New Orleans	1993
MAINE	Bates College, Lewiston	1995
MARYLAND	Annapolis Senior High School	1989
	Frederick Cancer Research Center, Frederick	1995
	McDonogh School, Baltimore	1988
	Montgomery County Public Schools	1990-92
	St. John's College, Annapolis	*1991*
MASSACHUSETTS	Beverly High School	1986
	CityLab, Boston University School of Medicine	1997
	Dover-Sherborn High School, Dover	1989
	Randolph High School	1988
	Winsor School, Boston	1987
	Boston University	**1994, 1996**
MICHIGAN	Athens High School, Troy	1989
MISSISSIPPI	Mississippi School for Math & Science, Columbus	1990, 1991
MISSOURI	Washington University, St. Louis	1989
	Washington University, St. Louis	**1997**
NEW HAMPSHIRE	St. Paul's School, Concord	1986, 1987
NEVADA	University of Nevada, Reno	1992

NEW YORK	Albany High School	1987
	Bronx High School of Science	1987
	Columbia University, New York	**1993**
	Cold Spring Harbor High School	1985, 1987
	DeWitt Middle School, Ithaca	*1991, 1993*
	DNA Learning Center	1988-95
	DNA Learning Center	**1990, 1992, 1995**
	DNA Learning Center	*1990-92*
	Fostertown School, Newburgh	*1991*
	Huntington High School	1986
	Irvington High School	1986
	Junior High School 263, Brooklyn	*1991*
	Lindenhurst Junior High School	*1991*
	Mt. Sinai School of Medicine, New York	1997
	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
	Titusville Middle School, Poughkeepsie	*1991, 1993*
	Wheatley School, Old Westbury	1985
	US Military Academy, West Point	**1996**
NORTH CAROLINA	North Carolina School of Science, Durham	1987
OHIO	Case Western Reserve University, Cleveland	1990
	Cleveland Clinic	1987
	North Westerville High School	1990
OKLAHOMA	School of Science and Mathematics, Oklahoma City	1994
PENNSYLVANIA	Duquesne University, Pittsburgh	1988
	Germantown Academy	1988
SOUTH CAROLINA	Medical University of South Carolina, Charleston	1988
	University of South Carolina, Columbia	1988
TEXAS	J.J. Pearce High School, Richardson	1990
	Langham Creek High School, Houston	1991
	Taft High School, San Antonio	1991
	Trinity University, San Antonio	**1994**
UTAH	University of Utah, Salt Lake City	1993
VERMONT	University of Vermont, Burlington	1989
VIRGINIA	Eastern Mennonite University, Harrisonburg	1996
	Jefferson School of Science, Alexandria	1987
	Mathematics and Science Center, Richmond	1990
WASHINGTON	**University of Washington, Seattle**	**1993**
WEST VIRGINIA	Bethany College	1989
WISCONSIN	Marquette University, Milwaukee	1986, 1987
	University of Wisconsin, Madison	1988, 1989
WYOMING	University of Wyoming, Laramie	1991

AUSTRALIA	Walter and Eliza Hall Institute and University of Melbourne	1996
CANADA	Red River Community College, Winnipeg, Manitoba	1989
ITALY	International Institute of Genetics and Biophysics, Naples	1996
PANAMA	**University of Panama, Panama City**	**1994**
PUERTO RICO	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
RUSSIA	Shemyakin Institute of Bioorganic Chemistry, Moscow	1991
SWEDEN	Kristineberg Marine Research Station, Fiskebackskil	1995

334 Main Street in Cold Spring Harbor Village

Mailing Address:
One Bungtown Road, Cold Spring Harbor, New York 11724

Phone (516) 367-7240
Fax (516) 367-3043

e-mail: dnalc@cshl.org
WWW home page “http://darwin.cshl.org/”