DNA LEARNING CENTER

ANNUAL REPORT 1998

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Laboratory President James Watson is fond of saying, “You get bigger or you get smaller.” Behind this deceptively simple adage lies the business plan for any good institution. Organizations rarely stay the same size for very long. Those that respond to change and take advantage of new opportunities, evolve into large ones. Those that fail to respond and adapt, shrink.

1998 was a year of remarkable change that put the DNALC solidly on the up side of that simple equation. Income increased by 59%, from $878,400 in 1997 to $1,393,100 in 1998. In the past several years, the DNALC has shown a deficit roughly equal to depreciation costs. However, the 1998 budget was balanced after full payment of depreciation. The greatest single source of growth in 1998 was funding from the Josiah Macy, Jr. Foundation. Other sources of strength were three major federal grants, annual giving by the Corporate Advisory Board, and increased receipts for lab instruction.

The organization of our staff masthead is also emblematic of the year. The DNALC staff grew from 9 to 14 positions in 1998. These were in addition to a similar number of personnel changes in the second half of 1997. The large number of new staff members and new grant commitments dictated a functional reorganization. In the past, staff functions were divided by grade level into elementary–middle school instruction and high school–college instruction. Under the reorganization, the staff was divided into three functional groups: Core Administration (three positions), Laboratory Education (five positions), and Multimedia Communications (six positions). One major effect of the reorganization was to move away from our reliance on part-time instructors to a staff of full-time instructors. These changes have simplified administration and increased collaboration among staff members.

Scott Bronson assists a participant at the new ***Genomic Biology & PCR*** Workshop.

Despite an almost complete changeover in instructional staff since mid-1997, our service to local school systems increased in 1998. Most notable was a 34% increase in students performing labs at the DNALC. This increase was mainly due to bringing the middle-school genetics lab into full use, with up to four classes per day. We had our busiest summer yet, administering 25 student workshops, including eight minority workshops held at Stuyvesant High School and Mt. Sinai School of Medicine (Manhattan), John F. Kennedy High School (Bronx), Intermediate School 109 (Queens), and Central Islip High School (Suffolk County). We also collaborated with Mt. Sinai School of Medicine to conduct two Gateway Summer Teacher Institutes, drawing 100 faculty from 15 New York City high schools. With support from Howard Hughes Medical Institute and the William Randolph Hearst Foundation, we have been making a concerted effort to increase learning opportunities for students in New York City. Thanks primarily to multi-year collaborations with Community School District 29 and Mt. Sinai’s Gateway to Higher Education Program, minorities comprised 35% of students participating in 1998 lab programs.

DNA Learning Center Visitation and Instruction

	1994	1995	1996	1997	1998	1997–1998 Change
Student Labs (on-site)	3,961	4,682	6,088	7,105	9,540	34%
Student Labs (off-site)	1,434	2,328	5,045	7,665	8,195	7%
Teacher Labs	302	379	302	392	482	23%
Student Workshops	361	503	437	402	429	7%
Teacher Workshops	177	101	151	245	190	–22%
Lab Subtotal	6,235	7,993	12,023	15,809	18,836	19%
Student Lectures	575	520	575	407	568	40%
Exhibit/LI Discovery	9,943	10,366	10,122	11,150	12,062	8%
Total	16,753	18,879	22,720	27,366	31,466	15%

DNA from the Beginning Goes Online

By year's end, we had made a limited online release of the first installment of ***DNA from the Beginning***, an Internet primer on genetics funded by the Josiah Macy, Jr. Foundation. The initial release covers 14 key concepts in classical genetics, including Mendelian inheritance, the physical basis of heredity, genetic linkage, and the beginning of human genetics. Additional releases in 1999 and 2000 will cover concepts in molecular genetics, gene regulation, genetic manipulation, and genomic biology.

Initially, a confidential Internet address was provided for review by a select group of biology researchers, scholars, and teachers. After incorporating reviewers' feedback, the World Wide Web (WWW) site was officially launched with registration on major search engines and a 4700-piece postcard mailing that included 3000 high school teachers from our national database of leaders in genetics education. We also added links to major genetics education programs, medical and genome research centers, and genetics support groups.

The title of ***DNA from the Beginning*** (***DNAFTB***) can be taken as a metaphor on several levels. On a conceptual level, ***DNAFTB*** stresses DNA as the beginning of human life and health, and as the mediator of the evolution of all life. On a pedagogical level, ***DNAFTB*** builds knowledge following the historical development of genetics—from the beginning, one experiment at a time. ***DNAFTB*** is targeted at the level of a bright teenager and is intended to provide basic information that anyone would find useful in facing a "personal genetic dilemma."

DNAFTB is designed to support the learning styles of two types of Internet users: the casual browser, who wants a quick synopsis of key materials, and the active learner, who wants to build a deeper understanding. We hope that the consistent organization and novel features of the site will actually encourage browsers to become active learners.

In contrast to books, which are organized around chapters, ***DNAFTB*** is organized around key concepts. Approximately 75 concepts will form the narrative backbone of the work—a Readers' Digest of genetics from Mendel to molecular cloning. Thus, the casual reader can take ***DNAFTB*** as a continuous story or work to master "a concept a day." Each concept is carefully chosen to emphasize the progressive development of genetics. Concepts are presented as pure ideas and in relatively nonscientific language. In keeping with research showing that Internet users tend to skim Web pages and get confused by too many "clicks," each concept is limited to a single screen containing a title, collage illustration, and maximum 150 words of text.

Layered behind each concept screen are multimedia elements that allow the active learner to discover the experiments and people behind the concept:

- ***Animations*** created with Macromedia Flash software illustrate exemplar experiments upon which the concept is based, with scientists describing their own experiments in the first person. Animation is especially effective in illustrating multistep experiments and molecular events that are difficult to capture in static text illustrations. We believe that these animations are unique in

biology education; similar animations are the most requested and downloaded pages at our WWW site.

- ***Gallery*** contains still images collected from primary scientific archives, often rare photographs not found in science textbooks. The images are displayed in a linear, scrolling loop, which gives the sense of browsing pictures on a gallery wall. Each image can be enlarged for closer inspection.
- ***Audio/Video*** contains primarily short video clips from interviews with scientists and historians that highlight the human side of discovery. Clips are served to users as "streaming video." This system avoids long download delays by quickly delivering an initial segment, and then loading the remaining footage while the scene is playing.
- ***Bio*** provides details about the scientists closely associated with the concept. Biographies highlight scientific "heroes" and attempt to reflect the person behind the science.
- ***Links*** provides several jumping off points to related WWW sites outside of ***DNAFTB***. Our editors have judged each link especially relevant and appealing. A review is provided for each external resource.
- ***Problem*** provides an animated tutorial that tests comprehension, usually by means of an experiment that builds upon experiments presented in the ***Animation*** section. Each problem presents a series of connected investigations. At appropriate checkpoints within the problem, multiple-choice questions test for concept mastery before allowing the user to continue.
- ***Gene the Gene*** is an animated cartoon character who presents entertaining facts and stimulating thought questions that challenge users to make associations or to consult other resources.

DNAFTB incorporates a number of unique programming features. Each "page" downloaded by a user is dynamically constructed, at the time of a user request, from individual narrative and media elements stored on the ***DNAFTB*** database server. A customized authoring shell allows the project editors to easily edit, add, or delete elements without reconstructing or reprogramming an entire page layout. The site's dynamic structure also makes possible a unique ***Relational Navigator***, which allows users to explore ***DNAFTB*** according to their own interests, in a nonlinear manner. Depending on the page from which it is activated, the ***Relational Navigator*** draws a unique "map" of internal links to related concepts and media elements.

Although anyone may access ***DNAFTB*** as a "guest," users are encouraged to register to take advantage of additional features, including setting browser preferences, bookmarking pages, tracking sections read, and searching by key words. Registered users are also provided a personalized score sheet on ***Problems*** they have answered, which can be printed out and turned in to the classroom teacher as a homework assignment. The registered user database also provides accurate measures of ***DNAFTB*** site use, according to both content viewed and user demographics.

Genes, Teens, and the World Wide Web Affirms Our Methods

In preparation for the initial release of ***DNAFTB***, in November we collaborated with our favorite Brit Jan Witkowski to sponsor a Banbury meeting on the future of online genetics education. ***Genes, Teens, and the World Wide Web*** drew together experts from the worlds of biological research, science publishing, and Internet computation. The meeting was cohosted by CSHLpresident James Watson and Bruce Alberts, President of the National Academy of Sciences. Keynote speaker Alan Kay, Vice President of Walt Disney Imagineering, was a member of the Xerox Palo Alto Research Center (PARC), which invented modern personal and networked computing. Other participants included Lubert Stryer and Neil Campbell, authors of mega-selling biochemistry and biology texts; Phillip Greenspun, who constructed database-driven WWW sites for Fortune 500 companies; Robert Semper, Vice President of the San Francisco Exploratorium; and Ted Hanss, Vice President of Internet II.

Left: Dr. Alan Kay, Walt Disney Imagineering, addresses participants of the ***Genes, Teens, and the World Wide Web*** meeting in November. Right:: Philip Greenspun (seated), Matt Christensen and John Kruper of the DNALC, Joe Perpich of Howard Hughes Medical Institute, and Cathy Marshall of Xerox PARC browse ***DNA from the Beginning***.

In many ways, discussion at the meeting affirmed our methods for online publishing. First, our home page, ***Gene Almanac***, was reconceived in July as "the source for timely information about genes in education." Far from the standard organizational mouthpiece, it is a dynamic information source that changes daily. ***Gene News*** posts four to six daily news articles generated by a customized Internet search engine, which scans numerous national news sources, including ***The New York Times***, ***Los Angeles Times***, ***Boston Globe***, ***MSNBC***, ***Fox News***, and ***BBC Online*** feature articles highlight science methods and people in the news, using animations and video elements to make the topics engaging to nonscientific audiences.

Several ***Gene Almanac*** elements aim to involve students in research and build a community of online learners. ***Student Allele Database*** and the new ***DNA Sequence Server*** allow students to use their own DNA "fingerprints" as a starting point for online investigations. ***BioForms*** provide case studies on DNA sequence analysis and custom interfaces that allow students to easily use statistical tools available at genome servers. ***Gene Talk*** includes bulletin boards and chat rooms, including special areas for teacher groups trained at summer workshops.

The freshness of the ***Gene Almanac*** content is made possible because each page is "made from scratch," drawing items and design features from a number of sources to create the page seen by a user. Some pages draw information from databases maintained at the DNALC, and others send requests to other WWW sites and package the returned information in our own forms. This sort of dynamic page construction is common to the most advanced sites on the WWW. Users seem to appreciate the changes. Traffic at the site increased threefold during the year, to more than 18,500 unique user sessions per month, including visitors from 50 countries.

We Look Forward to a Major Addition to the DNALC

Since opening in 1988, the DNALC has been the largest provider of genetics and biotechnology labs. Now, our new multimedia projects have made the DNALC one of the largest Internet providers of multimedia learning materials for biology education. However, realistically, our current facilities

will not allow us to maintain this advantage very far into the future. In 1998, our two teaching labs were saturated, and our super-talented Internet developers joined the rest of the staff in our dreary basement office.

So, we were buoyed by news in the spring that the Dolan Family Foundation had agreed to provide $1 million toward construction of a 7600-square-foot ***BioMedia*** addition that will double the size of the DNALC. ***BioMedia*** expresses our goal to explore the creative use of computer and telecommunication technology in modern biology education. Computer and video facilities in the addition will allow students to move effortlessly between multimedia experiences and hands-on science in adjacent biochemistry and genetics laboratories.

Centerbrook Architects and Planners, of Essex, Connecticut, are designing the addition. This firm has done the bulk of the Laboratory's architectural design for the past 20 years and was responsible for the DNALC's major renovation in 1993. Centerbrook received the coveted 1998 Architectural Firm Award presented by the American Institute of Architects. So we were not surprised when architect Jim Childress came up with a brilliantly simple solution to our problem of how to make a two-story addition look like only one. He simply continued the ground floor partially below grade, so that the second floor merges with the natural break in the hill behind our building. The net effect—the elevation at the back of the facility—gives the impression of a single-story ranch house!

The centerpiece of the addition will be an octagonal computer laboratory to support hands-on instruction in bioinformatics, explorations using interactive and virtual reality technologies, and distance learning programs. To allow us to fully explore the "convergence" of CD/ROM, video, broadcast, and cable media, the upper level will feature a video studio/production suite and a multi-media conference room. A lunchroom and rest rooms are practical elements needed to deal with our ever-increasing number of young visitors. Staff offices will be located on the upper and lower levels, according to function.

The ***BioMedia*** addition, and reconstruction of existing space, will create a suite of three teaching laboratories and a student research laboratory. Believing that sequencing will become a substantial part of future laboratory programs, we have included a dedicated DNA sequencer in the capital budget for the ***BioMedia*** addition. A ***Visible DNASequencing Laboratory*** will perform double duty as an exhibit to showcase DNA technology and as a working laboratory. On a daily basis, high school interns will process DNA samples submitted by high school and college classes around the nation. Visitors can watch all phases of sequencing, culminating with a real-time output of finished sequence on a scrolling ticker. The DNA sequences processed in the visible laboratory will be returned ***via*** the Internet to participating schools, where they will be the starting points for a series of online exercises.

Shedding Light on an Important Lesson from the Past

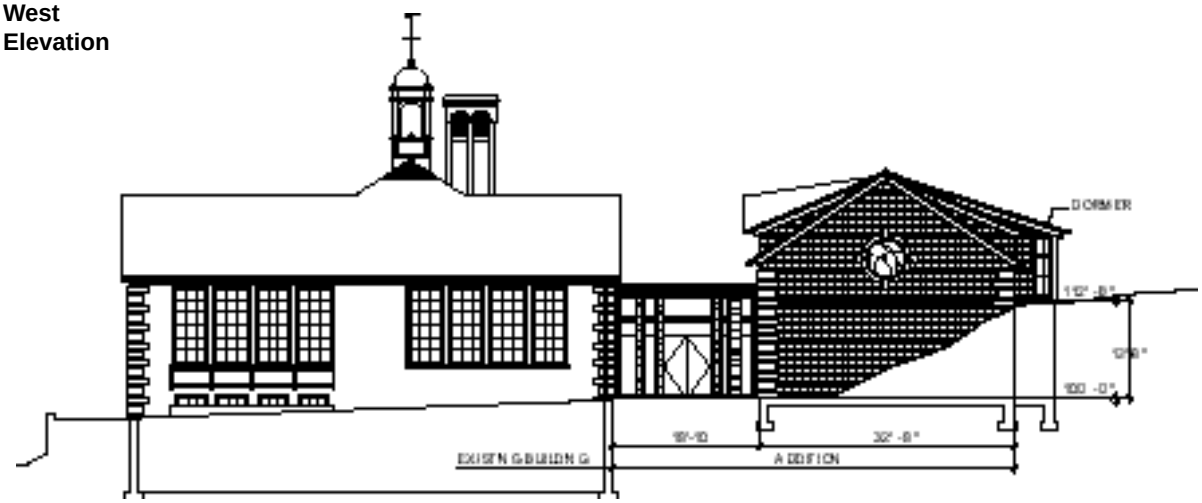
Early in the year, we received a 2-year grant of $404,000 from the Ethical, Legal, and Social Issues (ELSI) Program of the National Human Genome Research Institute to establish a ***Digital Image Archive on the American Eugenics Movement***. We considered this award an important vote of confidence in our work, since it is the first grant the ELSI Program has made to explore this sensitive issue.

The ***Archive*** will be drawn from the corpus of the Eugenics Record Office at Cold Spring Harbor, which was the primary repository of American eugenical thought and activity from 1910 to 1940. Some documents remain in the CSHL Archives, but the bulk have come to rest at the American Philosophical Society (APS) Library in Philadelphia and the Harry Laughlin Archives at Truman State University in Kirksville, Missouri. Nearly 700 images—toward our goal of 1000—were collected at Cold Spring Harbor and during two trips to APS in Philadelphia. Collected items included photographs, family records, personal correspondence, quotations, clippings, pedigrees, tables, and sample publications.

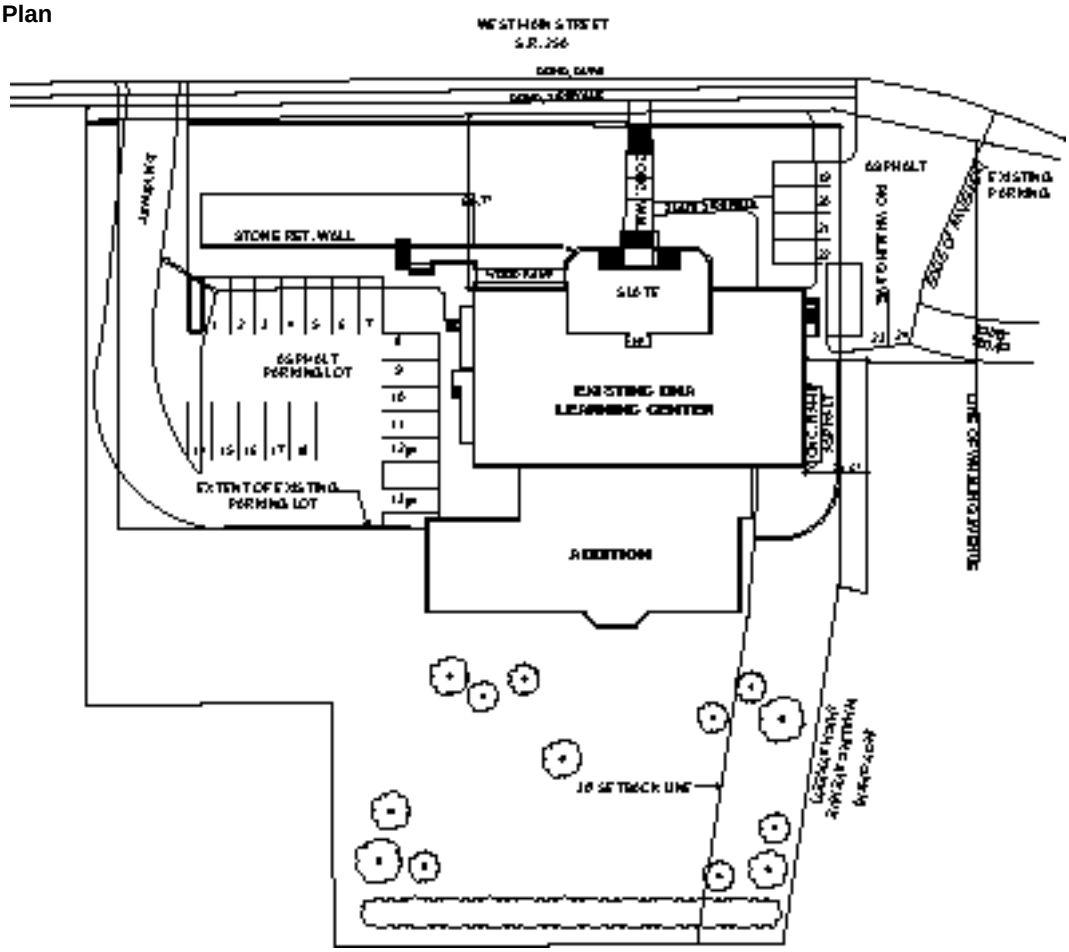
The American Philosophical Society Library in Philadelphia.

DNA Learning Center *BioMedia* Addition Elevation, Site Plan, and Floor Plans

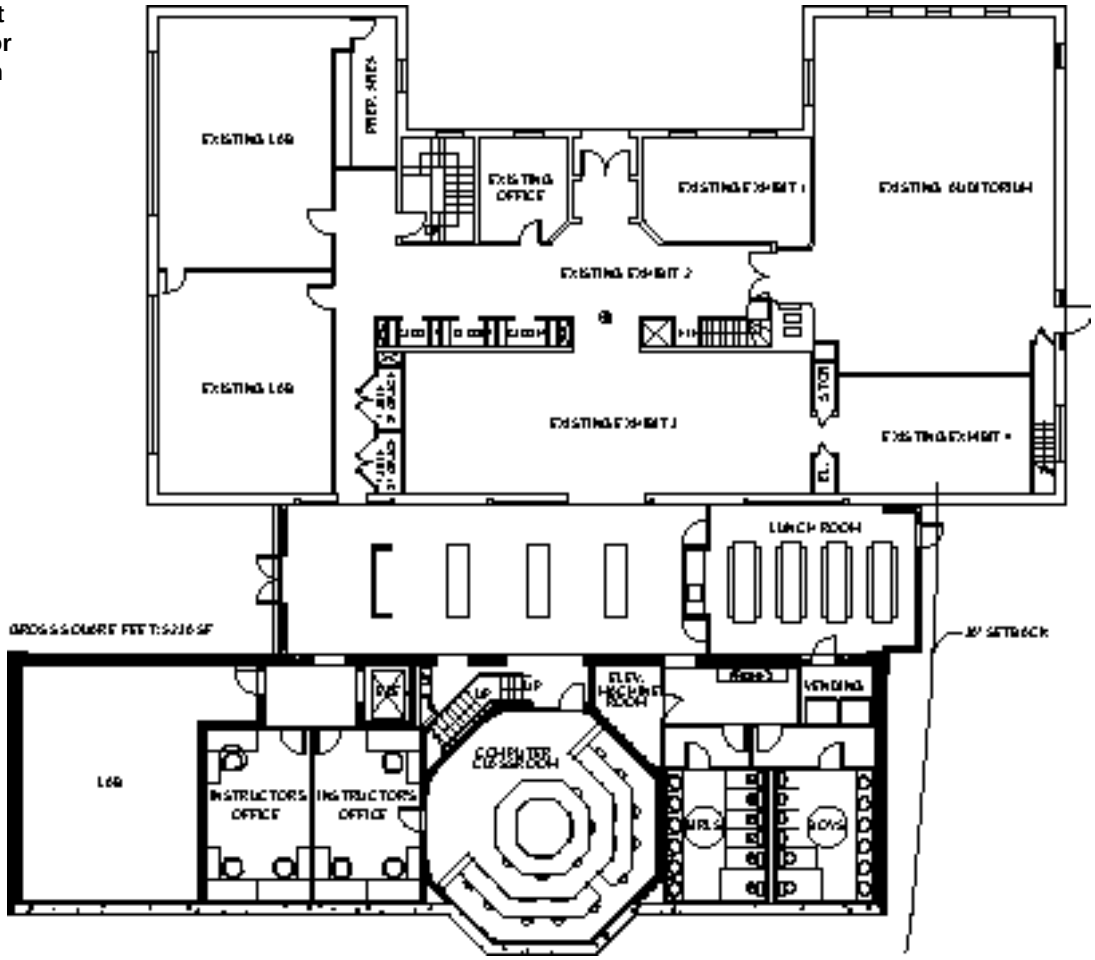
West Elevation



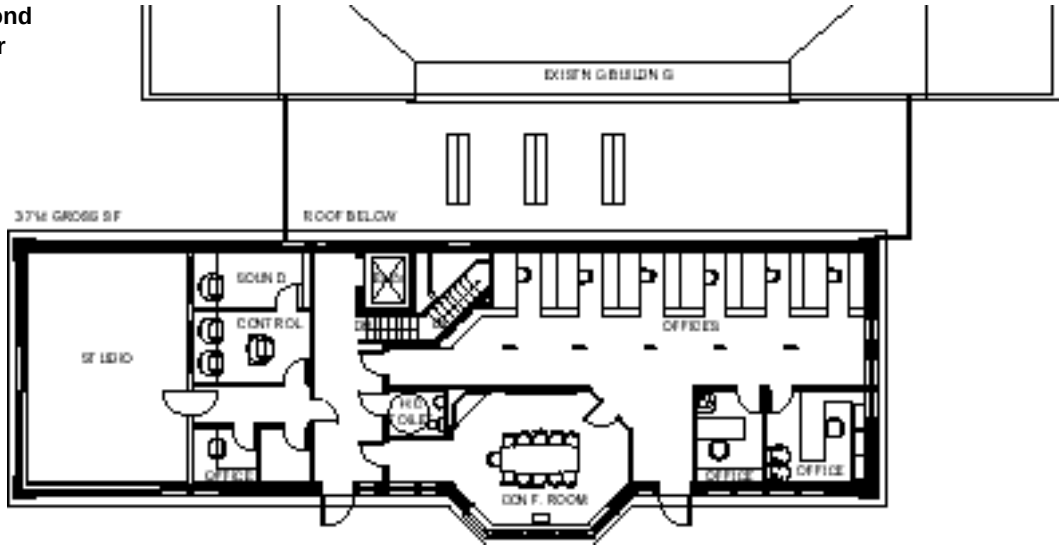
Site Plan



First Floor Plan



Second Floor Plan



The major aim of the ***Digital Image Archive*** is to provide materials that will stimulate independent, critical thinking about the parallels between eugenics and modern genetics research. The ***Archive*** is intended as an educational tool to allow individuals to learn about society's past involvement in genetics by exploring primary materials that heretofore have been inaccessible to the layperson. By basing the ***Archive*** on primary materials, users assume the role of historian/researcher, finding materials according to their own preferences and drawing inferences based on their own synthesis. By focusing primarily on visual documents, we hope to engage young people who are accustomed to visual media and others who would not normally access a scholarly collection.

While we want to allow users to form their own opinions about the eugenics movement and its parallels to modern genetics research, we also recognize that people need to have some sense of the historical, social, and ethical context in which the eugenics movement flourished. Thus, construction of the ***Archive*** involves formal review by an Editorial Advisory Panel, which includes historians, clinical geneticists, educators, bioethicists, philosophers of science, and healthcare advocates:

Garland E. Allen, Washington University of St. Louis
Elof Carlson, State University of New York, Stony Brook
Patricia Colbert-Cormier, NASA
Nancy L. Fisher, Washington State Department of Social and Health Services
Henry Friedlander, Department of Justice
Daniel J. Kevles, California Institute of Technology
Philip Kitcher, University of California, San Diego
Martin L. Levitt, American Philosophical Society
Paul Lombardo, University of Virginia, Charlottesville
Nancy Press, Oregon Health Sciences University
Philip R. Reilly, Shriver Center for Mental Retardation, Inc.
Pat Ryan, Hopkins High School
Marsha Saxton, World Institute on Disability
Steven Selden, University of Maryland, College Park
G. Terry Sharrer, National Museum of American History

The first of four EAP meetings took place at CSHL Banbury Center in September. Lengthy discussions resulted in a policy that takes every reasonable effort to protect people's privacy and confidentiality, without sacrificing the historical integrity of documents. Panel discussion also led to

Dan Kevles (gesturing, near center) addresses the Editorial Advisory Panel.

Left: Henry Friedlander, Elizabeth Thompson and Jan Witkowski during a break in the meeting.

Right: Dave Micklos talks with Garland Allen.

development of the site's narrative outline, consisting of 11 context topics. Several panel members took on the challenge of writing 750–1000-word "theme essays" to introduce key persons and events in the context of social and historical events. We hope that this rigorous, participatory review process will provide a model for other ELSI educational efforts that demand cultural, racial, and ethnic sensitivity.

Bringing the Human Genome Project into the Science Classroom

During the year, we continued our work to involve students and teachers in human molecular genetics—through grants from the Howard Hughes Medical Institute, the National Science Foundation's Advanced Technological Education Program, and the Department of Energy's ELSI program. We are striving to develop a robust and accurate analog of human genome research that allows students to use their own chromosomal and mitochondrial DNApolymorphisms as the basis of explorations into contemporary genomic biology.

The DOE Program introduces high school biology faculty to a laboratory-based unit on human DNA polymorphisms, which provides a uniquely personal perspective on the science and ELSI aspects of the Human Genome Project. We conducted three training workshops, drawing a total of 65 teachers, at the Mills Godwin Specialty Center (Richmond), Eccles Institute of Human Genetics (Salt Lake City), and the University of Denver. 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. These polymorphisms illustrate the use of DNAvariations in disease diagnosis, forensic biology, and identity testing and provide a starting point for discussion of the uses and potential abuses of genetic technology.

DOE workshop participants also learned how to use their ***Alu*** insertion data as an ***entrée*** to human population genetics and evolution, using our ***Student Allele Database***. This online facility, developed with Howard Hughes funding, contains more than 3000 student DNA types, as well as archival data from populations around the world. Several statistical functions are available: testing Hardy-Weinberg equilibrium within a single population, measuring genetic distance between two populations, and comparing two populations using contingency Chi square. A Hardy-Weinberg simulator shows the effect of genetic drift and gene fixation in small populations. Working with the ***Student Allele Database*** stresses the shared ancestry of all human beings and sets the stage for further investigations of human origins using mitochondrial DNA.

Under the NSF program, we are developing a hands-on curriculum to bring students up to the minute with the techniques and applications of genomic biology. The curriculum merges the DNALC's content expertise with the vocational-technical expertise of project collaborator CORD (Center for Occupational Research and Development) of Waco, Texas. The project targets participation by leading high school and community college faculty interested in technology education and instructional innovation.

As part of this program, we began development of a new PCR (polymerase chain reaction) experiment of extraordinary promise. The object is to visualize the insertion polymorphism responsible for wrinkled pea seeds—one of the seven original traits investigated by Gregor Mendel. This experiment provides a bridge between the "old" classical genetics and the "new" molecular genetics, and emphasizes the connection between genotype and phenotype. The transposon responsible for the wrinkled phenotype appears related to the ***Ac/Ds*** system discovered at Cold Spring Harbor Laboratory by Barbara McClintock. Although this pea experiment illustrates a natural mutation caused by a transposon, a parallel experiment shows the use of transposon mutagenesis as a research tool for exploring the plant genome. The transposon insertion in peas is also analogous to the human ***Alu*** insertion used in the DOE Workshop.

The most novel aspect of the NSF program is a ***Sequencing Service*** to provide low-cost sequencing of mitochondrial DNA samples. Over the past year, we have worked closely with Dick

McCombie at the ***Arabidopsis*** Genome Sequencing Center of CSHLto provide proof of concept for processing DNA samples submitted from around the country. During each DOE workshop, teacher participants amplified the mitochondrial control region from DNA prepared from their hair roots or cheek cells. The amplified DNA was returned to the DNALC, where dye terminator reactions were performed; the samples were then passed to the Genome Center for sequencing. The completed sequences were then posted at the DNALC's WWW site on the ***DNA Sequence Server***, which currently contains 350 sequences. This process was further replicated with 60 student samples submitted, by mail, from teachers in New York, Maryland, Utah, and Virginia.

Bioinformatics on the World Wide Web

During the year, we developed case materials that use sequence and polymorphism data to illustrate key principles of biology, including evolutionary relatedness and conservation of function. In addition, we introduced several step-by-step Internet templates that allow teachers and students to analyze their own mitochondrial DNA sequences, including similarity searches and multiple sequence alignments.

To support these investigations, we developed two novel computer tools: ***Bioforms*** and ***DNA Sequence Server***. ***Bioforms*** let students explore realistic, meaningful biology problems in a guided environment. By "wrapping" difficult-to-use genome resources within an easy-to-use contextual guide, the innovative ***Bioform*** interface lets participants easily select and submit data sets for analysis to Internet genome servers. Results returned by the remote servers are intercepted by the ***Bioform*** data processor and reformatted to a simplified display. In this manner, ***Bioforms*** allow students to focus on the biological question at hand, rather than being overwhelmed by navigating their way through complex research sites.

Our first ***Bioform*** allows students to solve the "mystery of the Romanovs" by using mitochondrial DNAsequence polymorphisms to determine whether a set of bones found in a Russian mass grave were those of the murdered Russian royal family. A second ***Bioform*** improves on an existing unit where students' mitochondrial DNA sequences are compared with reference sequences to determine whether Neandertal hominids were our direct ancestors.

In contrast to the guided framework used in ***Bioforms***, ***DNA Sequence Server*** is an open-ended "exploratorium" that puts powerful computational biology tools in the hands of the beginning learner. ***DNA Sequence Server*** is a full-featured database and sequence analysis application built upon Microsoft SQL Server database technology. The application lets users access DNALC sequence data sets, search external databases, and directly manipulate personal sequence collections. In addition, ***DNA Sequence Server*** lets users easily analyze sequences using a number of built-in resources, including BLAST and CLUSTALW. Additional analysis tools—including evolutionary tree drawing, restriction mapping, and open reading frame determination—will be added over time.

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 multinational, and from biotechnology 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.

Under the chairmanship of Jack Leahy, the CAB raised $200,000 in support of the DNALC and the Partners for the Future Program, a 20% increase over 1997. Key to this huge success was the 5th Annual Golf Tournament, held on June 18th at Piping Rock Club. Organized by John Kean, the tournament netted $125,000, a 28% increase over 1997. The tournament's founding sponsor is J.P.

Corporate Advisory Board

Chairman
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Vice Chairman
Gary E. Frashier, OSI Pharmaceuticals, Inc.

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Morgan & Co. Cablevision and Luitpold Pharmaceuticals, Inc. were major corporate sponsors. Other corporate sponsors were Badge Agency, Inc.; Conde Nast Publications; Festo Corporation; Kean Development Company; KPMG Peat Marwick LLP; Motors and Armatures, Inc.; Price Waterhouse Coopers; RMC Industrial Supply; and The Rosyln Savings Foundation.

Staff and Interns

Malissa Hewitt went on maternity leave in the summer and, after giving birth to Charles Fowler Lindsay, decided to become a full-time mom. Malissa came to the DNALC in 1994, becoming our first full-time staff member devoted to middle-school instruction. On short notice, she gamely stepped in to manage the burgeoning program in 1997 and set the stage for this year's large expansion. The DNALC will miss her can-do attitude, and the students will miss her attentive and caring style.

Then, in the fall, we bid farewell to Assistant Director Mark Bloom, as he prepared to take a new position at the Biological Sciences Curriculum Study in Colorado Springs. Mark joined CSHL in 1987, when our educational programs shared offices (and staff) with the Public Affairs and Development Departments. Mark was there when we embarked on the initial renovation of the DNALC facility, and he initiated the student lab field trip program. Over the years, he personally instructed more than 1000 biology faculty at workshops sponsored by the National Science Foundation and the Howard Hughes Medical Institute. Students and teachers alike responded to his friendly and down-to-earth way of presenting science. On many occasions, he helped the DNALC go through the "eye of the needle"—a pressing grant or other crisis—to survive to become the institution we now are. For that, we owe him a large debt of gratitude.

Mark Bloom in a photo from 1989.

The departures of Malissa and Mark provided opportunities for expanded responsibility for Trisha Harrison and Scott Bronson, who were each promoted to the rank of Education Manager. Trish maintained the momentum of the middle school program, while Scott assumed responsibility for managing

the laboratory program and our growing cadre of student interns. Working together, they fostered a collaborative management style that has provided a common vision for our education programs at all levels.

The educational staff was bolstered by the arrival of two new laboratory instructors—Amanda Broege and Martha Mullally. Having come from a family of dog breeders, Amanda started her biology degree at SUNY, Stony Brook with an eye toward a career in veterinary medicine. It is our gain that she later decided to become NYS-certified in secondary science education. A native of Halifax, Nova Scotia, Martha became our second Canadian staff member. While working on her bachelor's degree in biochemistry at Dalhousie University, Martha conceived of the ***World Weavers***, a province-wide environmental education program for precollege students.

Hetty Ashton talks with a parent of a ***Fun With DNA*** participant.

In recognition of his leadership in establishing the ***BioMedia*** Group, John Kruper was named assistant director of the DNALC. Three new staff members, programmer Matt Christensen and media designers Gisella Walter and Mark Feingold, joined ***BioMedia*** group members Sue Lauter and Shirley Chan. Born in Chile and raised in San Francisco, Gisella received a fine arts degree from Alfred University. Several years in the New York art world and working as a free-lance Web designer have made her a superb computer animator. Mark also received a fine arts degree from Alfred University, but got his start in art as a graffiti artist on the streets of Manhattan.

The expansion of the staff put added pressures on core administrators Dave Micklos and Judy Cumella-Korabik, so we were pleased when Janeen Russo joined the administrative group as secretary. A native of Brooklyn, Janeen provides the DNALC with needed clerical and administrative support. She assumed responsibility for scheduling and introducing Cablevision's multimedia presentation Long Island Discovery.

An intern program funded by the Howard Hughes Medical Institute allows high school students to assist the instructional staff in preparing the teaching laboratories and to undertake independent research projects. The independent work allows interns to push themselves intellectually while gaining technical expertise they can carry to the university level. Intern research projects also contribute to new lab experiences offered as student field trips or as part of summer workshops.

Hana Mizuno, of Cold Spring Harbor High School, received highest honors in the Long Island Science Congress, as well as a cash award from the Suffolk County Science Teachers Association, for her work using green fluorescent protein (GFP) as a reporter molecule in subcloning experiments. Much of her work was incorporated into a special summer workshop entitled "Green Genes" and also helped to update lab field trips on bacterial transformation. Hana later began research on programmed cell death (apoptosis) with CSHL scientist Yuri Lazebnik. Rachael Neumann, of Syosset High School, was one of only six students selected to participate in the Partners for the Future Program, working under the tutelage of CSHL scientist Grigori Enikolopov.

The instructional staff was ably assisted by veteran interns Jermel Watkins (New York Institute of Technology), Karin Glaizer (Portledge High School), and Gerry DeGregoris (Chaminade High School). Salley Anne Gibney returned from her freshman year at Johns Hopkins University to assist with the summer workshops. Hetty Ashton, a native of Australia, visited the DNALC in July to volunteer and participate in the middle school summer workshops. Using her education background, Hetty worked closely with the instructors and students to aptly assist in the laboratories and activities. She has returned to Australia to pursue her interest in education. In August, we bid farewell to Trevor Sammis, who began his freshman year at the University of Virginia at Richmond, and to Mera Goldman, who started at Barnard College. In the fall, we welcomed newcomers Gina Conenello (John Glenn High School), Sunjay Kelkar (Syosset High School), Stephen Mak (Syosset High School), Laura Roche (Cold Spring Harbor High School), and Rebecca Yee (Huntington High School).

1998 GRANTS

Grantor	Program/Principal Investigator	Duration of Grant	1998 Funding[+]
FEDERAL SUPPORT			
NATIONALINSTITUTESOFHEALTH National Human Genome Research Institute	Creation of a Digital Archive on the American Eugenics Movement	2/98–1/00	$148,358
NATIONAL SCIENCE FOUNDATION	A Novel Mechanism for Introducing Human Genome Research in Freshman Biology Classes, Mark Bloom	4/95–4/98	$16,245
	A Partnership to Develop Advanced Technology Units on Genomic Biology	8/97–7/00	$138,856
DEPARTMENT OF ENERGY	The Science and Issues of Human DNA Polymorphisms: An ELSI Training Program for High School Biology Teachers	1/97–1/00	$91,073
NONFEDERAL GRANTS			
Hearst Foundation	Genetics as a Model for Whole Learning	7/98-6/99	$22,234
Howard Hughes Medical Institute	Precollege Science Education Initiative for Biomedical Research Institutions	7/94-8/99	$77,169
Josiah Macy, Jr. Foundation	Gene Almanac	10/97-9/00	$264,418
NYS Education Department		1/98-12/98	$48,954*

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

China Town School District 1	4,950	Mamaroneck Union Free School District	500
Community School District 29	18,400	Massapequa Union Free School District	950
East Meadow Union Free School District	3,150	Oceanside Union Free School District	1,050
Elwood Union Free School District	2,725	Plainedge Union Free School District	1,075
Friends Academy	8,024	Port Washington Union Free School District	4,875
Garden City Public School	5,725	Old Westbury School of the Holy Child	3,896
Great Neck Union Free School District	14,515	South Huntington Union Free School District	10,150
Green Vale School	3,550	St. Dominic Elementary School	3,175
Harborfields Central School District	8,800	Syosset Central School District	17,125
Jericho Union Free School District	6,700		

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
Herricks Union Free School District
Island Trees Union Free School District
South Huntington Union Free School District
Syosset Central School District
West Hempstead Union Free School District

of 1,500:

Green Vale School
Hicksville Union Free School District
Plainview-Old Bethpage Central School District

*New Grants Awarded in 1998 [+]Includes Direct and Indirect Cost

1998 Workshops, Meetings, and Collaborations

January 10	Laboratory for Town of Huntington Senior Citizens Center
January 17	Laboratory for Queens Bridge to Medicine High School
February 7	Laboratory for Rampart and Sierra High Schools, Colorado Springs, Colorado
February 18–19	National Human Genome Research Institute ELSI Project, ***Eugenics Image Archive*** image collection visit to American Philosophical Society Library, Philadelphia, Pennsylvania
March 9–11	National Science Foundation Grant Review Site Visit, City College of San Francisco, California
March 20	Site visit by Linda Conlon, International Center for Life, Newcastle, Great Britain
March 26–28	Department of Energy Workshop, ***The Science & Issues of Human DNAPolymorphisms***, University of Utah, Salt Lake City, Utah
April 3	Seminar at Trudeau Institute, Saranac Lake, New York
April 3–5	National Science Foundation Workshop, ***Human Genome Diversity–Student Allele Database Workshop***, Pierce College, Woodland Hills, California
April 10	Site visit by Ray Gladden and Maria Rapoza, Carolina Biological Supply Company, Burlington, North Carolina
April 16	Site visit by National Science Foundation National Visiting Committee
April 21	***Great Moments in DNA Science*** Honors Students Seminar, CSHL
April 22	Seminar for National Institute of Social Sciences, Harvard Club, New York, New York
April 23	Site visit by Topaz Conway, Garvan Research Foundation, Sydney, Australia
April 23–25	Visiting Scholar Program, Mills Godwin Specialty Center, Richmond, Virginia
April 28	Site visit by Simon Collier, University of Virginia, Charlottesville, Virginia
May 1–3	National Science Foundation Workshop, ***Human Genome Diversity–Student Allele Database Workshop***, University of Washington, Seattle, Washington
May 5	***Great Moments in DNAScience*** Honors Students Seminar, CSHL
May 8–10	National Science Foundation Workshop, ***Human Genome Diversity–Student Allele Database Workshop***, Kingsborough Community College, Brooklyn, New York
May 12	***Great Moments in DNAScience*** Honors Students Seminar, CSHL
May 18–19	Site visit by Sylvia Metcalfe, University of Melbourne, Australia
June 4	National Human Genome Research Institute ELSI Review Panel, Washington, D.C.
June 9	Site visit by June Osborn, Josiah Macy, Jr. Foundation, New York, New York
June 10-11	Gateway Summer Teachers Institute Reception, New York, New York
June 29–July 2	***World of Enzymes*** Workshop, DNALC ***DNA Science*** Minority Workshop, Central Islip, New York
June 29–July 8	***Advanced DNAScience*** Workshop, DNALC
June 29–July 29	Gateway Summer Teachers Institute, Stuyvesant High School, New York, New York
July 6–10	***Fun With DNA*** Workshop, DNALC ***Fun With DNA*** Minority Workshop, Intermediate School 109, Queens, New York
July 6–17	***Advanced DNA Science*** Minority Workshop, Central Islip, New York
July 13–17	***Fun With DNA*** Minority Workshop, Intermediate School 109, Queens, New York ***Green Genes*** Workshop, DNALC
July 20–24	***World of Enzymes*** Minority Workshop, Intermediate School 109, Queens, New York ***World of Enzymes*** Workshop, DNALC ***DNA Science*** Minority Workshop, John F. Kennedy High School, Bronx, New York ***DNAScience*** Workshop, DNALC
July 27–31	***Fun With DNA*** Workshop, DNALC ***DNA Science*** Workshop, DNALC
August 3–7	***Fun With DNA*** Workshop, DNALC ***DNA Science*** Minority Workshop, Stuyvesant High School, New York, New York ***DNA Science*** Workshop, DNALC
August 10–14	***Fun With DNA*** Workshop, DNALC ***DNAScience*** Minority Workshop, Mt. Sinai School of Medicine, New York, New York

August 17–19	National Human Genome Research Institute ELSI Project, ***Eugenics Image Archive*** image collection visit to American Philosophical Library Society, Philadelphia, Pennsylvania
	Genomic Biology & PCR Workshop, DNALC
August 17–21	***Fun With DNA*** Workshop, DNALC
	Reading the Code of Life Workshop, DNALC
August 20–28	***Advanced DNA Science*** Workshop, DNALC
August 24–28	***World of Enzymes*** Workshop, DNALC
	DNAScience Workshop, DNALC
September 21–22	National Human Genome Research Institute ELSI Project, ***Eugenics Image Archive***, Advisory Panel Meeting, Banbury Center, CSHL
October 7	Site visit by Bronwyn Terrill, Museum Victoria, Australia
October 9–12	National Science Foundation ATE Project, ***Genomic Biology***, Editorial Advisory Board Meeting, DNALC
October 20–24	Western States Courts and Genetic Testing Conference, Snowbird, Utah
October 21–23	Howard Hughes Medical Institute Directors Meeting, Rockville, Maryland
October 29	Site visit and laboratory for participants in ***The Art of Judging: Perspectives of Science*** Banbury Center Meeting
October 30	Mid-Atlantic Judicial Conference, Ocean City, Maryland
November 3	Laboratory for science faculty from High School for the Humanities, New York, New York
November 3	National Institutes of Health ELSI Grant Review
November 12–14	Department of Energy Workshop, ***The Science & Issues of Human DNAPolymorphisms***, Mills Godwin Specialty Center, Richmond, Virginia
November 20–21	National Science Foundation ATE Director's Meeting, Washington, D.C.
November 22–24	Macy Foundation Meeting, ***Genes, Teens, and the World Wide Web***, Banbury Center, CSHL
December 3–5	Department of Energy Workshop, ***The Science & Issues of Human DNAPolymorphisms***, University of Denver, Colorado

Sites of Major Faculty Workshops 1985–1998

Key: High School	**College**	***Middle School***
ALABAMA	University of Alabama, Tuscaloosa	1987–1990
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
	Pierce College, Los Angeles	**1998**
COLORADO	Colorado College, Colorado Springs	1994
	United States Air Force Academy, Colorado Springs	**1995**
	University of Colorado, Denver	1998
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	1990–1992
	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**

NEW YORK cont.	Cold Spring Harbor High School	1985,1987
	DeWitt Middle School, Ithaca	***1991,1993***
	DNALearning Center	1988–1995
	DNA Learning Center	**1990,1992,1995**
	DNALearning Center	***1990–1992***
	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	1987–1990
	Titusville Middle School, Poughkeepsie	***1991,1993***
	Wheatley School, Old Westbury	1985
	US Military Academy, West Point	**1996**
	Stuyvesant High School, New York	1998
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
	University of Utah, Salt Lake City	**1998**
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
WASHINGTON	**University of Washington, Seattle**	**1993, 1998**
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