Dolan DNA Learning Center

Annual Report 2004

DOLAN DNA LEARNING CENTER

Preparing students and families to thrive in the gene age

If you needed expert advice on a rare tumor, you would contact the most prominent physician you know. This physician would put you in contact with the most prominent oncologist he/she knows, who, in turn, would put you in contact with the expert you seek. Each of these well-connected individuals is a node in a social network that positions you just four steps from the critical information you need.

This is the premise of the play *Six Degrees of Separation:* We live in a "small world" in which only several social connections separate any two people. Social science research has, indeed, upheld the notion that it takes only a handful of acquaintances to relay a letter to anyone in the United States or an e-mail to anyone in the world! The small-world principle organizes activities on many levels of complex systems. Cells, the basic units of biological function, are networks of communicating molecules. For example, each of the several hundred molecules involved in processing a nervous signal is, on average, separated by less than four connections from any other molecule.

By the same token, people harness the small-world aspect of the Internet—hopping between prominent nodes to quickly locate information about even the most arcane topic. During the past 18 months, we developed the concept for a novel Internet site on modern neuroscience research that is built on this small-world principle. We envisioned a nonlinear "knowledge network" where one can easily move from one piece of information to another through a minimum number of connections.

Public Education in a Revolutionary Science

So we were thrilled when the Dana Foundation announced in October that it would provide $1 million to support the project over 4 years. In a sense, the grant follows up on my 1990 Dana Award for Pioneering Achievement in Education.

The site will be developed in parallel to research emanating from the *Genes to Cognition* (*G2C*) Program at the Wellcome Trust Sanger Institute in Cambridge, England. *G2C* program director Seth Grant, who did postdoctoral work at CSHL, is using network theory to study the gene interactions that result in human thinking and disorders of thinking. This research base will be expanded with insights drawn from CSHL scientists, the neuroscience start-up company Helicon Therapeutics, and neuroscience initiatives supported by the Dana Foundation.

Science education and public outreach typically begin well after a "scientific revolution" has settled down into what Thomas Kuhn called "normal science"—resulting in a set of facts that can be conveniently categorized and presented as unchallenged dogma. Rather than presenting science as a completed endeavor, with nothing important left to discover, we want to involve *G2C Online* users in this revolutionary period of neuroscience research. We want them to be online when new insights into human memory and new treatments for cognitive disorders appear on the horizon.

Thinking about the Biology of Thought

G2C Online essentially will be a three-dimensional, multimedia concept map of the science of the human brain, allowing site users to explore the relationships among concepts and to assess their own learning. In mimicking both the molecules of thought (and resulting human social behaviors), the site will provide users with a real life exercise in "metacognition"—thinking about the biology of thought.

The goal of *G2C Online* is to help people explore the relationship among genes, thinking human behavior, and cognitive and behavioral disorders. Content at the site will embody several key concepts of modern neuroscience:

- Cognition arises from a "thinking machine" whose parts can be understood at different levels of complexity—from anatomical structures of the brain, to neural circuits, to molecular signals.
- Neurons and molecules work together in redundant networks that allow rapid communication through key nodes and can compensate for loss of individual components.
- Cognitive information is encoded in patterns of nervous activity and decoded by molecular listening devices at the junction between nerve cells (the synapse).
- The molecules of learning and memory have been conserved by evolution, allowing scientists to model cognitive processes in simple organisms.
- Although humans inherit genes that set the parameters of learning and memory, the cognitive machinery is continuously altered by experience.
- Cognitive disorders are caused by discrete changes in genes and proteins that can potentially be targeted by therapeutic molecules.
- Understanding human cognition has ethical and social consequences; the eugenics programs of the 20th century illustrate the tragic outcome of misguided efforts to limit the spread of "unfit" behaviors.

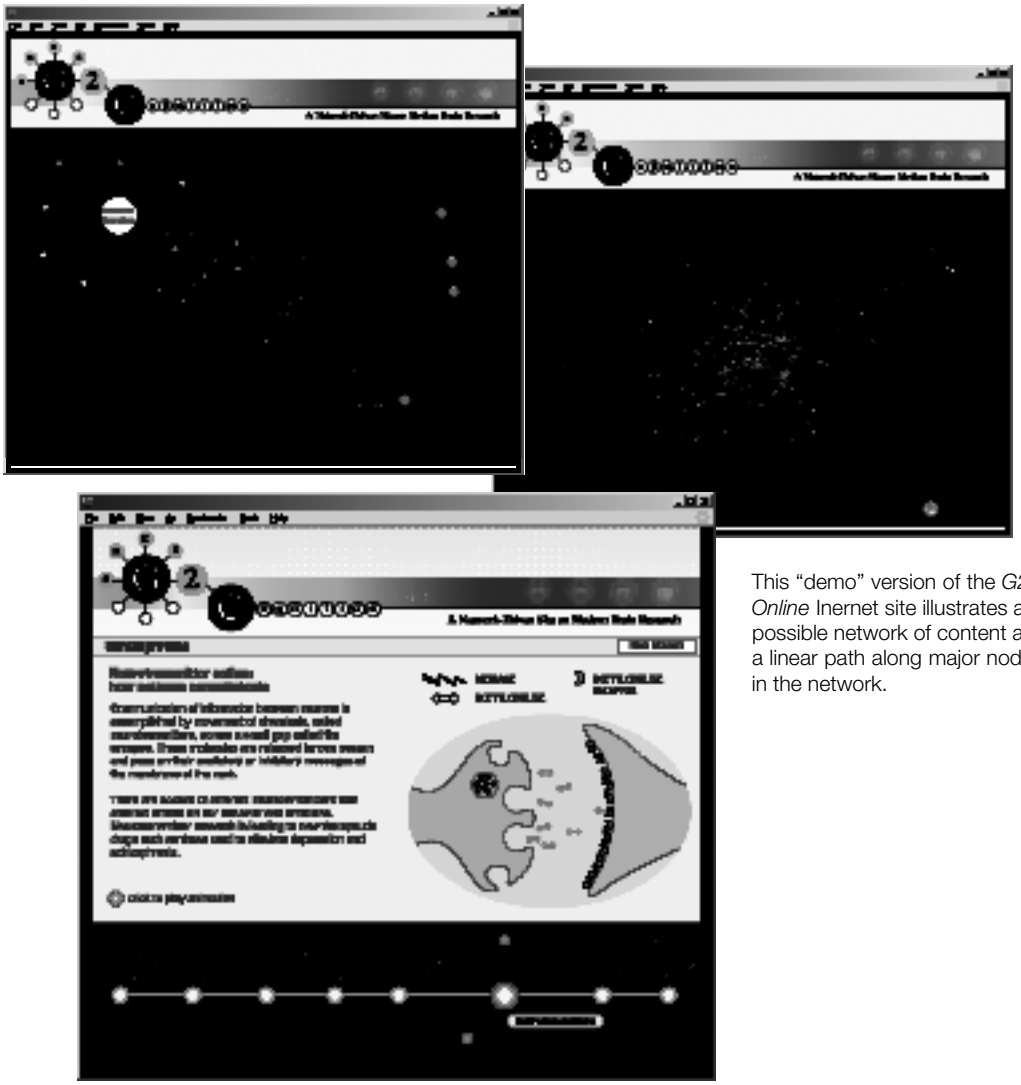
Building a "Knowledge Network"

The computer technology behind *G2C Online* will be every bit as revolutionary as the science it covers. Each content item—and its relationships to other items—will be stored in a database. A "network engine" will draw items from the database to construct a network customized according to the preferences and knowledge level of the user. Rich multimedia modules will form the major nodes of the network. Key among these materials will be narrated animations, which seamlessly integrate video narration with cell and molecular animations, experiment simulations, and bioinformatics tools.

The site may be used in a linear or nonlinear mode. In the linear mode, one will be able to follow a predetermined path prepared by the editorial team or a path submitted by another user. A person following a linear path will see their course ahead and behind, but may also deviate to explore adjacent nodes. In the nonlinear or exploratory mode, one will enter the network by selecting a node of interest and then follow connections out from that node. Alternatively, one can identify a node or set of nodes that matches terms entered in a search engine. The distribution of these nodes in the graphical view of the network can provide visual clues to locate other relevant content.

To simplify navigation, a selected path will be extracted from the network and displayed as a "subway" map showing only the "stations" (major nodes). Movement along the "subway line" will be tracked, and outward excursions (minor nodes) will be displayed upon arrival at each "station." A database engine will allow site users to generate a view of the network from any point, chart a course through the network, and store a course for analysis or modification.

We envision three target audiences for *G2C Online:* biology students, psychology students, and families who are facing mental health problems. Students and teachers are the DNALC's natural constituency; online surveys show that they make use of DNALC Internet sites for authoritative infor-



This “demo” version of the *G2C Online* Inernet site illustrates a possible network of content and a linear path along major nodes in the network.

mation about a variety of class assignments and projects. By targeting the site to the “bright teenager,” materials will be at a level of science comprehensible to a broad slice of the adult population. Therefore, the second major audience will be families who are facing mental health problems. Many families dealing for the first time with a behavioral or cognitive disorder do not know where to turn for authoritative answers to their questions. Others wish to follow up on cursory information presented by health care providers. This is the audience that we have been specifically building with *Your Genes, Your Health* (www.ygyh.org), our multimedia site on common genetic disorders.

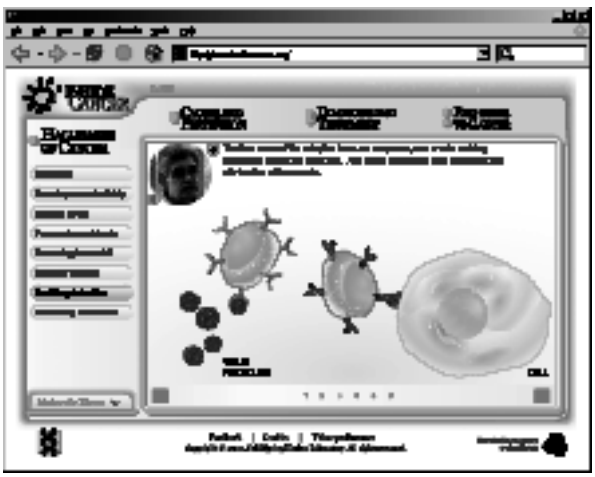
The ability to generate custom entry points and views will allow us to design a unique experience for each audience. By selecting from a list of questions or information preferences, a user may generate an optimized network and suggested path to follow. So, educational audiences might enter the site through major nodes that address key content standards and teaching syllabuses (for example, Advanced Placement biology or psychology), whereas health care audiences might enter the site by way of individual diseases or common questions about cognitive disorders. As a result, an Advanced Placement psychology student will be provided a substantially different network to browse than will a family member interested in autism. Each user will be provided logical “anchor” points from which to enter the knowledge network and from which to launch further explorations.

Inside Cancer Readied for Launch in 2005

When we initiated the *Inside Cancer* project under an NIH Science Education Partnership Award, in 2001, there was no effective way to integrate different media types—such as video, animation, and flat art—into a seamless Web page. The technology for achieving this level of media integration, *Flash MX* by Macromedia, first became available in the summer of 2002. During 2002–2003, the *Biomedia* Group tested the large-scale application of the new *Flash* technology during the construction of *DNA Interactive*. Equipped with this new expertise, in 2003, we resolved to redevelop *Inside Cancer* in *Flash MX*. This decision to substantially upgrade the *Inside Cancer* site required scrapping an earlier HTML design and retooling content—with the result of throwing production behind schedule.

As 2004 drew to a close, the site was more than 90% complete. We think our audience will agree that it is one of the most advanced science content sites on the Internet and that we were justified in waiting for the right media integration technology. Using dynamic animations, we have integrated technology, design, and content to present information that cannot be found in any other educational medium (including medical textbooks). In this unique format, 1 of 28 cancer experts interviewed for the project narrates an animation of cellular and molecular events, with his or her video appearing in a "bubble" analogous to the narrative of a cartoon. When formally launched in 2005, the four major sections of *Inside Cancer* will provide authoritative, and engaging, information on how knowledge of the cancer cell is changing cancer diagnosis and treatment:

- *Hallmarks of Cancer* follows a landmark paper of the same title, published in *Cell* (2000), that summarized the major molecular and cellular aspects of cancer. To our knowledge, *Inside Cancer* offers the first popular treatment of these key tenets of cancer genetics and cell biology. The section features clips from interviews with Douglas Hanahan and Robert Weinberg, the authors of the *Cell* article. In "Growing Uncontrollably," one can see the first example of fully integrated video and animation.



Inside Cancer features video narrations and animations in one screen. In the *Hallmarks of Cancer* section, Bruce Stillman, CSHL President, explains how cancer cells avoid detectiion by normal immune response. In *Pathways to Cancer*, below, growth factor proteins are packaged into vesicles within a cell.

- *Causes and Prevention* uses epidemiological data to highlight behaviors and environmental factors that increase cancer risk. The overview first debunks the common misconception that inheritance and toxic chemicals are major causes of cancer. Then users are challenged to link potential causes of cancer to patterns of cancer incidence worldwide. Individual sections highlight how environment, behavior, and inheritance contribute to different major cancers—and how these insights relate to preventing disease. The influence of mold (afflatoxin), diet, viruses, and inheritance is explained in the context of the key cancers of the liver, prostate, cervix, and colon. Students also explore the events that spurred the rapid increase in cigarette smoking in the 20th century, which is almost wholly responsible for the continuing "epidemic" of lung cancer.
- *Diagnosis and Treatment* shows how cellular and molecular techniques are used to diagnose and tailor cancer treatment according to specific genetic changes in the patient's tumor. A section on pathology gives site users a chance to try their hand at distinguishing normal and tumor cells, as seen under the microscope, and to follow an endoscope through a patient's colon. In pharmacogenetics, narrated animations explain how cell receptors and gene profiling are used to tailor treatment for breast cancer patients. A section on targeted therapies explain how a new generation of drugs block specific molecules that conduct growth signals in the tumor cell—using the examples of Tamoxifen and Herceptin for breast cancer, and Gleevec for chronic myeloid leukemia.
- *Pathways to Cancer* is a high-quality, three-dimensional animation that follows a common signaling pathway through which growth commands are transmitted from cell surface to the nucleus. The tour is narrated by noted voice talent Doug Thomas. The section incorporates a "molecule menu" and freeze-frame rollovers that allow site users to learn more about the molecules that conduct a growth signal through the cell and how they are involved in oncogenesis.

NSF Grant to Develop New Laboratories on RNAi

Our effort to strengthen direct ties to CSHL research received additional affirmation in May when we received a $300,000 grant from the National Science Foundation (NSF) to develop new laboratories on RNA interference (RNAi) and functional genomics. This project follows the template of a project initiated last year to develop new experiments in plant genomics. Like the plant project, the RNAi project received unanimous "excellent" ratings from the five reviewers.

During the past 15 years, high school and college biology faculty have implemented key laboratories that illustrate basic concepts of microbial and molecular genetics. The completion of the Human Genome Project challenges these teachers to move laboratory instruction to a higher level of biological integration—the functional analysis of genes and proteins in eukaryotic organisms. Thus, we will develop a module of investigative laboratories and bioinformatics exercises that engage students in the new technologies of RNA-mediated genetic interference and computer-based genome analysis.

The *C. elegans* worm on the lower right illustrates the "blister" phenotype.

Until recently, targeted gene inactivation ("knock-out") or rescue ("knock-in") by homologous recombination required significant resources and was confined to research labs. RNAi offers a remarkably simple system in the roundworm *Caenorhabditis elegans*. Bacteria are transformed with a plasmid encoding "antisense" RNA to the worm gene of interest, and a lawn of the bacteria is grown on an agar plate. The RNAi response is triggered when worms are released on the agar plate and ingest the transformed bacteria expressing the antisense RNA. (Bacteria are a normal food source for *C. elegans*.) The effects of the loss of gene function are then observed in the offspring (either embryos or larvae) of hermaphrodite worms.

We believe that the RNAi/*C. elegans* experimental system is simple and robust enough to join bacterial transformation and gel electrophoresis as a mainstay of the high school and college teaching laboratory. After learning basic RNAi techniques, students can make use of freely available resources to design their own experiments to explore the function of virtually any of the predicted

19,427 genes of *C. elegans*. The premise that RNAi labs may prove broadly useful in biology education led to unusual joint funding of the project by NSF's precollege and collegiate curriculum development programs.

The project is a collaboration among staff at the DNALC, faculty at 2- and 4-year colleges, and scientists in Greg Hannon's lab at CSHL, which pioneered RNAi technology. An Advisory Panel of college faculty from diverse geographic locations will be involved in all aspects of the project, including development and testing. Following a year of development, the experiments and computer exercises will be tested with 72 biology teachers at three sites around the United States. Instructional and bioinformatics resources developed in this project will be disseminated via the DNALC's Internet site, Cold Spring Harbor Laboratory Press, and Carolina Biological Supply Company.

National Science Foundation Fellowships

In summer 2004, two pairs of Faculty-Student Fellows spent 3 weeks at Cold Spring Harbor participating in the NSF-sponsored "Building Leadership to Expand Participation of Underrepresented Minorities in Plant Genetics and Genomics" program: Dr. Javier Gozalez-Ramos and Adriana Robbins of Texas A&M University, and Dr. Olga Kopp and Elise Unice of Utah Valley State College. The Fellows participated in a mix of activities at the Dolan DNALC and the Hazen Genome Sequencing Center. During the first week, Fellows conducted an integrated set of experiments from the NSF-sponsored *Greenomes* course. Designed for use in high school and college biology courses, these experiments use plant systems to illustrate major concepts of molecular and genomic biology, including the relationship between molecular genotype and phenotype, transposon mutagenesis, chromosome mapping, homeotic development, functional analysis, and transgene detection. These experiments have been specifically designed for ease of replication in high school and college teaching laboratories. In the fall, we began working with Dr. Ramos and Dr. Kopp to organize regional training workshops on *Plant Genetics and Genomics* to introduce the plant labs to high school and college faculty. The workshops—to be held in summer 2005—will be co-taught by the Fellows and DNALC staff.

NSF Fellows Bob Wheeler and Debra Burhans.

A second NSF-sponsored fellowship, "Building Leadership to Develop Educational Bioinformatics Tools in Plant Genomics," was a collaboration between the Dolan DNALC and Gramene, an Internet resource for comparative genome analysis of grasses. The main objective of this fellowship is to assist with the production of a *Student Genome Viewer* that will allow advanced high school and college classes to directly participate in the annotation of the rice genome. Two fellowship positions were awarded in summer 2004: Mr. Robert Wheeler from Pine Creek High School (Colorado Springs, Colorado) and Dr. Debra Burhans from Canisius College (Buffalo, New York).

The USDA also provided funds for fellowships at Cold Spring Harbor Laboratory for two underrepresented minorities in biological sciences. Cesar Gutierrez, a biology teacher at Jon H. Reagan High School in Austin, Texas and a lead teacher in the NSF-sponsored Bio-Link Center for Advanced Technological Education at Austin Community College, spent 2 weeks working with DNALC staff doing advanced development of the *Student Genome Viewer*. Paul De La Rosa, a biology student at the Univeristy of Texas, spent 1 week learning about DNA polymorphisms at the DNALC and 1 week learning large-scale sequencing techniques at the Hazen Genome Sequencing Center.

Pfizer *Leadership Institute*

In July, we completed the fourth *Leadership Institute* under support from the Pfizer Foundation. We had initiated this program in the early 1990s with support from the NSF, only to see it wither when the NSF shifted its focus to central school authorities. Pfizer support allowed us to reinstate what we believe is the most advanced activity to reward the nation's top biology teachers with a summer sojourn at Cold Spring Harbor. However, with the lapse of Pfizer funding in 2005, we will again need to search for support for this jewel in the DNALC's crown of training courses for biology faculty.

Participants in the Pfizer *Leadership Institute* and the NSF Fellowship Program wrap-up a 3-week stay in Cold Spring Harbor.

The 2004 Pfizer *Leadership Institute* participants represented a diverse range of backgrounds and experience. The Institute drew 18 faculty representing 12 different states. One third came from schools with high percentages of minority or disadvantaged students, and one third were from rural regions. The American faculty were joined by four teachers from Singapore, who visited as part of our ongoing collaboration with the Singapore Ministry of Education.

During their 3-week stay, the *Leadership* participants lived and breathed science—walking in the footsteps of Nobel Prize winners and taking meals with some of the brightest researchers in the world. The 2004 workshop focused on the study of human and plant genomes. All topics were addressed in a three-pronged approach of lectures/seminars, wet-labs, and computer work. Included in the lab work was the opportunity to test the DNALC's very latest lab protocols, in advance of their availability at other institutions or from commercial suppliers. The Institute curriculum also drew heavily on the Laboratory, with scientist seminars, and visits to Uplands Farm agricultural field station and the Hazen Genome Sequencing Center. *Leadership* teachers were introduced to a number of computer-based utilities that collect, analyze, and display DNA data, including several developed at the DNALC. A tutorial held by the DNALC WWW designers introduced participants to technology that enabled them to create personal teaching environments.

Four days were dedicated to independent study or group projects to increase mastery and/or to adapt materials for classroom use. Projects included screening supermarket foods for genetic modification, sequencing dog mitochondrial DNA, mutating the "glow" gene for green fluorescent protein, and designing a polymerase chain reaction (PCR)-based method to examine polymorphisms in human olfactory receptor genes. Other teachers expanded computer-based studies on bioinformatics and Web page construction.

Genetic Origins

Genetic Origins is one of the most unique programs developed here at the DNALC. It consists of an integrated set of experiments, gratis DNA sequencing, and online tools that allow students to use their own DNA polymorphisms as the starting point for investigations on human relatedness, evolutionary history, and pharmacogenetics. *Genetic Origins* presents an accurate analog of human genome research, which incorporates the highest aspirations of "hands-on" learning. This program was initiated with federal grants, but has been maintained with DNALC cash flow during the last several years. To

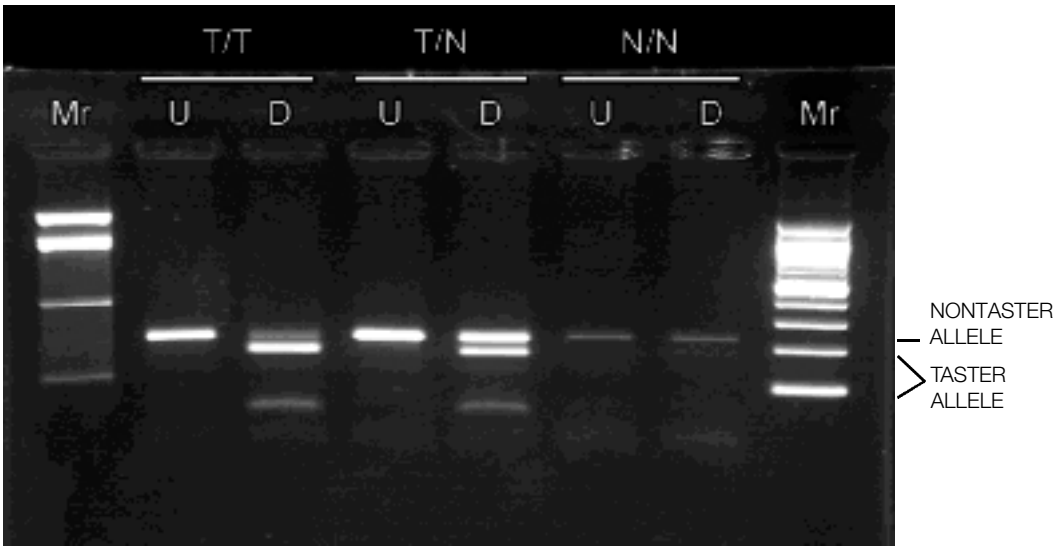
maintain *Genetic Origins* as a free program to students around the United States and to make needed upgrades to the Internet components, we gratefully received a $50,000 grant from our friend and colleague Mike Gillman, Senior Vice President of Research at Biogen Idec, and a $10,000 grant from William A. Haseltine, President of the William A. Haseltine Foundation for Medical Science and the Arts.

The redeveloped sites will conform to simple rules for intuitive use: consistent and logical placement of tool bars, minimum use of submenus or "nested" screens, and minimal text. Redevelopment will make cost-effective use of templates developed for recent DNALC projects and will employ highly designed "skins" that give tools and media players the sense of being real onscreen objects. The *Genetics Origins* labs will be ported through a lab virtual lab notebook player similar to the *Greenomes* Internet site we are currently developing. The *BioServers* workspaces and data functions will be repackaged in attractive skins in the manner of *Bioinformatics Calculator* and *Gene Boy*.

New Mammalian PCR Labs

Our repertoire of advanced PCR experiments on DNA polymorphisms was significantly strengthened in 2004. We added two new laboratories that demonstrate the use of single nucleotide polymorphisms (SNPs) in predicting phenotypes. Both experiments use a hybrid method termed amplified restriction-length polymorphism (ampliFLP), in which a PCR product is subsequently cut with a restriction enzyme. A restriction enzyme recognition sequence is incorporated into one PCR primer. Then, a SNP located at the restriction site is detected as a length polymorphism on an agarose gel.

SNPs and Human Taste examines an SNP in the bitter taste receptor (TAS2R) that correlates with the ability to taste phenylthiocarbamide (PTC). CSHL researcher Albert Blakeslee determined in 1932 that tasting the bitter PTC chemical is inherited as a dominant character. Since that time, it has been a classic demonstration of Mendelian inheritance in high school genetics classes. However, a new analysis, on which our experiment is based, shows that the inheritance of PTC tasting ability is not as simple as students have long been taught. Like many SNPs of medical importance, the SNP we test for combines with two other SNPs to produce complex combinations (haplotypes) that predict tasting ability—but not perfectly!



Human PTC polymorphism genotypes detected by restriction digest (D) of PCR products (U). Genotypes shown are taster/taster (T/T), taster/nontaster (T/N), and nontaster/nontaster (N/N).

Canine Ivermectin Sensititvity is real test of pharmacogenetic importance to dog owners who give their pets Ivermectin to control heartworm and other parasites. DNA is isolated from cheek swabs of pet dogs, amplified by PCR, and examined for an SNP in the *mdr1* (multidrug resistance) gene. Dogs that are homozygous for the *mdr1* mutation cannot metabolize Ivermectin and may have a toxic or fatal reaction. Collies, Shetland sheepdogs, Australian shepherds, and Old English sheepdogs are among the breeds most at risk for Ivermectin sensitivity.

New Visitor Highs in 2004

Visitation to the DNALC facility and to its family of Internet sites reached new highs in 2004. DNALC hosted 37,617 visitors, with cumulative visitation topping one-quarter million since our founding in 1988! Lab instruction increased 23%, to 27,142 students, with *DNALC West* allowing us to expand our reach in Nassau County and New York City. Of these students, 16,903 received instruction at the DNALC or *West* facilities, and 10,239 received instruction at their own schools. (It is worth noting that in-school instruction typically amounts to four class visits by a DNALC educator, so that the number of DNALC-taught labs is several times the number of students reported!)

These numbers keep us solidly in the lead of institutions that offer hands-on instruction in genetics and DNA for precollege students. Ironically, our next closest competitor is the Singapore Science Center, whose instructional program we helped develop under a partnership with the Singapore Ministry of Education. In 2004, its first full year of operation, the Science Center provided labs for 17,141 students, teachers, and members of the general public!

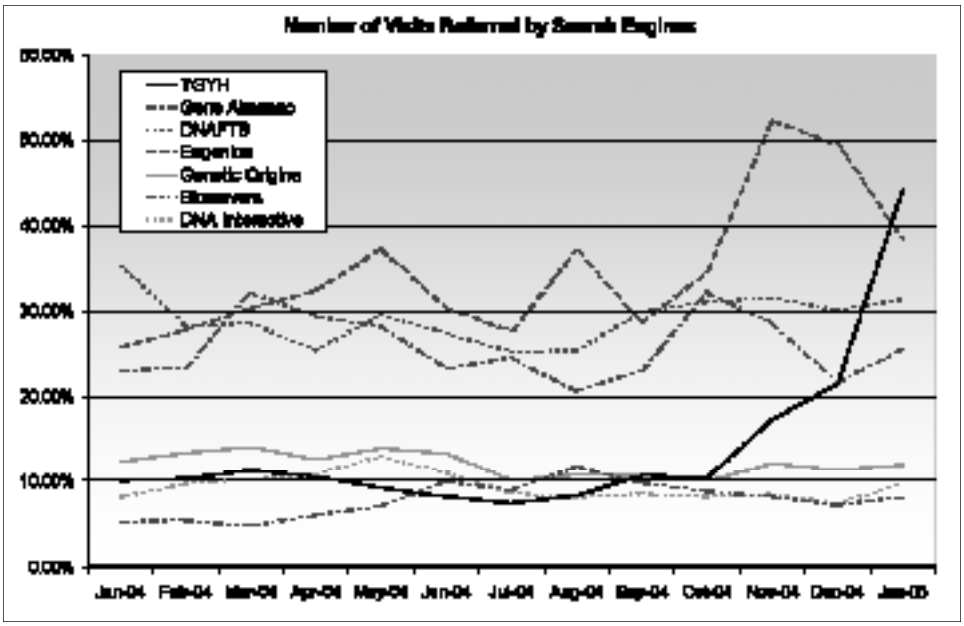
"Virtual" visitors to the family of Internet sites reached via the DNALC's portal, *Gene Almanac*, reached 5.44 million—an increase of 11% over 2003. Visitors spent an average of about eight minutes at the informational sites, *DNA Interactive* and *Your Genes, Your Health*, and about 10 minutes at our animated text, *DNA from the Beginning.* Visits averaged substantially longer at our historical resource, the *Image Archive on the American Eugenics Movement* (11.5 minutes) and *Bioservers* (16 minutes).

Internet Site	Average visit length (in minutes)	Visits in 2004	Increase from 2003 (%)
Gene Almanac	8:23	2,135,981	4.77
DNA from the Beginning	10:06	1,264,919	0.68
Your Genes, Your Health	8:48	860,583	15.46
DNA Interactive	8:04	650,096	72.23
Image Archive on the American Eugenics Movement	11:25	283,405	14.72
Bioservers	16:06	137,988	4.92
Genetic Origins	9:05	109,022	20.90
All Sites	**10:17**	**5,441,994**	**11.37**

A midyear analysis of our Internet traffic found that only about 10% of visits to *Your Genes, Your Health (YGYH)* resulted from referrals by Internet search engines. This was surprising to us, because this site contains information on individual genetic diseases that we knew was the subject of many searches by families and medical professionals. It then dawned on us that the multimedia content developed in Macromedia *Flash* was not "visible" to popular search engines, such as *Google.* "Spiders" and other indexers sent out by search engines could not find content contained in *Flash* multimedia files; thus, words in the text of animations and videos in several of most technologically advanced sites were not being found by relevant Internet searches!

In 2004, we found a solution to this problem. The text files for each animation and video were constructed into a skeleton of "meta" pages, linked to the homepage, which reflected each site's

content and architecture. As indexers revisited the sites, they detected the updated body of text and rebuilt comprehensive indexes that are now searchable. The results were dramatic. Within 2 months of implementing the meta-indexing scheme, searches rose sharply to account for more than 40% of visits to *YGYH*.



Learning the Effects of Our Summer DNA Camps

We began teaching intensive, week-long "camps" for students in the summer of 1985, when we offered *DNA Science* at the Wheatley School in Old Westbury. Since that time, more than 6700 middle and high school students have spent one week at one of seven camps offered each summer. Beginning with *Fun With DNA* in the fifth grade, a student can take a different workshop each summer—culminating with *DNA Science* and *Vertebrate Genomic Biology* in high school. Although we know that a number of graduates of the summer camp program become interns at the DNALC, we have long wondered about what the others do after taking one or more of our summer courses. So in 2004, we completed a major survey of students who took summer camps from 1990 to 2001.

We received completed surveys from 789 past participants—475 were in high school at the time they took the survey and 314 were in college. Clearly, the DNALC's workshops cater to a clientele of interested and able students. Majorities of secondary school (62%) and college (82%) respondents said they had been very interested in science in high school. Virtually all of the students in both groups (97%) said they maintained "A" or "B" averages in their high school science courses.

The DNALC has apparently done a good job of building a clientele for its summer camps. Majorities of both groups rated all seven of the DNALC summer courses as very good or excellent. While the average college respondent had attended two DNALC camps during his/her precollege years, current secondary school students had averaged three camps (with three quarters of respondents still having one or more years until graduation).

Participation in DNALC camps resulted in a number of beneficial effects for the high school and college respondents. Majorities had discussed topics or issues from a workshop with their families (72–75%) and friends (55–59%). Majorities in both groups said that participation in DNALC workshops had increased their understanding of science stories in the media, increased their general interest in science, improved their confidence in science classes, and encouraged them to take more science

offerings. Participation in DNALC workshops strongly influenced 46% of college students to consider majoring in science.

Most importantly, the DNALC experience appears to be part of an education that encourages students to value science and technology and to support scientific research. Note the similar proportions of high school and college respondents who agree with the following statements:

Agreeing	Percent	
	High School	College
Science and technology will open up more opportunities for my generation.	93	94
Science and technology are making our lives healthier, easier, and more comfortable.	92	93
Many scientists want to work on things that will make life better for the average person.	87	88
The benefits of biotechnology outweigh the risks.	71	73
The United States government spends too much money on scientific research.	16	12

The respondents discriminated in similar ways among a number of different applications of gene technology—favoring most, but drawing the line at the selection of physical traits.

Favoring	Percent	
Using genetic engineering to produce essential pharmaceuticals.	88	94
Using genetic engineering to treat diseases in adults.	88	94
Using genetic engineering to treat diseases in the embryo.	79	82
Using genetic engineering to produce agricultural crops.	67	72
Using genetic engineering to clone animals, such as sheep, to make drugs and vaccines.	61	68
Using embryonic stem cells in research.	63	64
Using genetic engineering to select for physical traits in the embryo.	21	17

Complete survey results can be viewed at www.dnalc.org/studentsurveys/.

Saturday DNA!

From the DNALC's wealth of offerings, the ongoing, popular *Saturday DNA!* program has emerged to provide an in-depth view of our genetic book of life and science education to the general public. Using catchy topics such as "CSI: Learning Center" and "Of Lice and Men" as a framework, *Saturday DNA!* allows children, teens, and adults to conduct hands-on DNA experiments and learn about the latest developments in the biological sciences.

Each 2-hour program is designed to be a thorough and exciting exploration of genetics, genes, and DNA through the use of innovative, intriguing topics. The DNALC staff works to ensure that topics are current and appropriate for two different age groups: groups of students ages 10–13 (with an accompanying chaperone) and groups ages 14–adult (with accompanying chaperone for participants under 15).

Although programs change and rotate each season, topics such as "Poochie Pedigrees" and "The Mystery of Anastasia Romanov" are mainstays. In examining the disappearance of the Romanov ruling family, visitors use a mitochondrial DNA database to determine whether Anna Anderson and Anastasia Romanov are indeed one and the same. Along the way, they collect evidence and use a variety of forensic analyses.

In the *Jumping Genes* session of *Saturday DNA!* in October, participants got a close look at the life and work of Nobel Prize recipient Barbara McClintock. Through laboratory and computer activities, they learned about the history of classical genetics, and the world of jumping genes.

"Poochie Pedigrees" offers the opportunity to extract DNA from your dog's cells and compare it to the DNA of different dogs and their ancestors. Analysis between the various samples raises—and answers—compelling questions such as What is the origin of man's best friend?, Does Fido have wolf or coyote in his bloodlines?, and Are different breeds of dogs really genetically the same? The related program, "Doggie Diagnosis," works with the older age group to take the information a step further to determine how breeding has affected your pet's ability (or lack thereof) to metabolize antibiotics.

Staff and Interns

During the summer, we bid farewell to three senior staff members who made significant contributions to the development of the DNALC. Danielle Sixsmith, Manager of External Relations, moved to New Jersey with her family and began online graduate study at the University of Phoenix. Danielle joined the DNALC staff in 1999 as a laboratory instructor, teaching at both the middle and high school levels. In 2002, she collaborated with North Shore–Long Island Jewish Health System to bring into operation our satellite facility, DNALC *West*. Laboratory Manager Scott Bronson left for a position as Educational Programs Administrator at Brookhaven National Laboratory. Scott joined the DNALC in 1999, and his prior bench experience with Jacek Skowronski was evident as he simplified PCR for education and developed our successful *DNA Sequencing Service*. Media Producer Bronwyn Terrill left for Cambridge, England to manage public outreach at the prestigious Wellcome Trust Sanger Institute. Arriving at the DNALC in 2001, she proved herself to be a world-class science communicator—first producing the 1500-square-foot exhibit "The Genes We Share" and then leading production of the Internet sites *DNA Interactive* and *Inside Cancer.*

Junior staff members Kim Kessler and Mike O'Brien went in different directions in education. Kim enrolled in the genetic counseling program at Northwestern University, while Mike joined the New York City Teaching Fellows to prepare for a teaching position at the High School for the Humanities. Senior Development Officer Erin Wahlgren, who had so effectively run the DNALC golf tournament and annual

fund drive, left for a position at the Marfan Foundation.

The major staff changeover brought a raft of new faces and ideas to the DNALC. During the year, we welcomed two Ph.D.-level Laboratory Managers—Tom Bubulya and Craig Hinkley. Although Craig came from University of Michigan, he had formerly shared a bench with Tom as a postdoctoral fellow in the lab of Winship Herr. Tracy Behar, Jeanette Collette, and Lauren Weidler took positions as Laboratory Instructors. Tracy grew up on Long Island and recently graduated from SUNY College at Old Westbury with a degree in Secondary Education in Biology. Jeanette, who also grew up on Long Island, has relocated from Buffalo where she attended college and started a family. While working on her degree in human biology from SUNY, Albany, Lauren worked as a library aide in the CSHL Library. Local resident Karen Orzel, who has a background in marketing, took over management of the Corporate Advisory Board, annual golf tournament, and annual fund.

Other new additions to the DNALC "family" came in July when middle school educator Elna Carrasco was married to Michael Gottlieb. Media designer Chun-Hua Yang was married to Shiuh-Jyh Lin in October. Middle school educator Amanda McBrien and her husband, Michael, welcomed their third son, Robert Michael, in November.

High school interns continued to provide key support for our teaching labs, and several carried out independent research projects under the direction of DNALC and CSHL staff. As part of our new NSF grant, David Wagman used RNA interference to silence a gene in *C. elegans*—resulting in visible "blisters" in the worm's outer cuticle. Daisy Choi injected the human cancer gene, *p53,* into *C. elegans* to study tumor suppression. While working in the lab of Dr. Rob Martienssen, Kimberly Izzo used fluorescent in situ hybridization (FISH) to study centromere function in the model plant *Arabidopsis thaliana*.

Our sequencing service continues to grow with the help of college interns Alina Duvall (Hofstra University) and Andrew Diller (Dowling College). To process the growing number of requests, we now collaborate with Dr. Dick McCombie's group at the Woodbury Genome Center. The high-throughput capillary sequencing available at Woodbury has greatly reduced the turnaround time for completing sequencing requests.

Joining the intern program in 2004 were Andrew Langer (John H. Glenn High School, Elwood), Elena Meliuso (Oyster Bay High School), Tama Mizuno (Northport High School), and Benjamin Tully (Nassau Community College). Several interns returned from college to assist with summer workshops: Lara Abramowitz (University of Rochester), Yan Huang (Notre Dame University), Marie Mizuno (Binghamton University), and Alex Witkowski (SUNY, Albany).

In August, we bid farewell to the following interns as they began their freshman year at college: Benjamin Blond (Syosset High School) is studying biology at Amherst College; Bryn Donovan (Freeport High School) is studying wildlife conservation at the University of Delaware; Alexander Hogg (Friends Academy) began a 5-year biology/fine arts program at Brown University; and Michelle Louie (Kings Park High School) began a 7-year biology/M.D. program at George Washington University.

David Micklos
Executive Director

2004 Workshops, Meetings, and Collaborations

January 6	Site visit by Alastair Balls and Linda Conlon, Life Science Centre, Newcastle, United Kingdom
January 8–12	Site visit by Cheong Kam Khow, Singapore Science Center
January 10	*Saturday DNA!* Seminar, DNALC
January 24	*Saturday DNA!* Seminar, DNALC
January 26	*Inside Cancer* interview, Ken Culver, Executive Director, Early Clinical Development, Novartis Oncology, East Hanover, New Jersey
February 7	*Saturday DNA!* Seminar, DNALC
February 11	Site visit and museum tour by members of the Association of Suffolk Superintendents for Education Technology
January 12	Site visit by Alan Fleischman, Senior Vice President, New York Academy of Medicine, New York
	Site visit by Don McGranaghan, Artistic Resources, LLC
February 21	*Saturday DNA!* Seminar, DNALC
February 24	West Side School Lecture
March 6	*Saturday DNA!* Seminar, DNALC
March 10	Site visit by Cynthia Joyce, Executive Director, and Loren Eng, President, Spinal Muscular Atrophy Foundation, New York
March 15	West Side School Lecture
March 19	*Saturday DNA!* Seminar, DNALC
March 20	*Saturday DNA!* Seminar, DNALC
March 23	Site visit by Jeremiah Barondess, President, and Patricia Volland, Senior Vice President, The New York Academy of Medicine, New York, and Lawrence Scherr, Dean and Chief Academic Officer, North Shore–Long Island Jewish Health System, Great Neck, New York
	Site visit by Caroline Lieber, Director, Human Genetics Program, Sarah Lawrence College, Bronxville, New York
March 26	Site visit and museum tour of DNALC for representatives of "Best of New York" publication
March 30	*Great Moments in DNA Science* Honors Students Seminar, CSHL
April 3	*Saturday DNA!* Seminar, DNALC
April 17	*Saturday DNA!* Seminar, DNALC
April 20	*Great Moments in DNA Science* Honors Students Seminar, CSHL
	Site visit by Ed Rover, President, and Barbara Gill, Vice President, the Dana Foundation, New York
April 26	Site visit by Jon Fry, President; Bruce Pipes, Provost; Fred Owens, Associate Dean of Faculty and Professor of Psychology; and Kathy Triman, Professor of Biology, Franklin & Marshall College, Lancaster, Pennsylvania
	Presentation at Garden City Public Library, Advocacy for Gifted and Talented Education in New York State, Inc.
April 27	*Great Moments in DNA Science* Honors Students Seminar, CSHL
April 29	Site visit by Bryan Sykes, Professor of Human Genetics, University of Oxford, United Kingdom
May 14	Site visit by Kidgie Williams, diplomats, and family members of UN representatives, Hospitality Committee for United Nations Delegations, Inc., New York
	Site visit by John Monaghan and Alan Minz, Canadian Consulate General's Office, and Jay Amer, President, Ontario East Economic Development Corporation, Canada
May 15	*Saturday DNA!* Seminar, DNALC
May 20	Museum tour and lab participation by Estee Lauder European Beauty Editors
May 31–June 4	Teacher-training workshops, National Institute of Education and Singapore Science Centre, Singapore
June 9	Site visit by Caroline Lieber, Sarah Lawrence College, Bronxville, New York
June 11	Presentation of *Award of Appreciation* from Kings Park Central School District, New York
June 12	*Saturday DNA!* Seminar, DNALC
June 15	Site visit by Karl Kuchler, University of Vienna, Austria
June 21–25	NSF *Plant Molecular Genetics and Genomics Workshop*, Austin Community College, Texas
June 22	Site visit by Jacinta Duncan, Gene Technology Access Centre, Melbourne, Australia
June 23	*Inside Cancer* interview, William Nelson, The Sidney Kimmel Comprehensive Cancer Center, and Jennifer E. Axilbund, Genetic Counselor, Cancer Risk Assessment Program, The Johns Hopkins Hospital, Baltimore, Maryland
June 24	*Inside Cancer* interview, Louis M. Staudt and Kenneth H. Kraemer, National Cancer Institute, Bethesda, Maryland

June 28–July 2	*Fun With DNA* Workshop, DNALC
	World of Enzymes Workshop, DNALC
	DNA Science Workshop, DNALC
July 5–9	*Fun With DNA* Workshop, DNALC
	Green Genes Workshop, DNALC
	DNA Science Workshop, DNALC
	Genomic Biology and PCR Workshop, DNALC
July 6	*Inside Cancer* interview, John Condeelis, Albert Einstein College of Medicine, New York
July 7	*Inside Cancer* interview, Glorian Sorensen, Harvard School of Public Health, Boston, Massachusetts
July 8	*Inside Cancer* interviews, Nancy Mueller and Graham Colditz, Department of Epidemiology, and Walter Willett, Department of Nutrition, Harvard School of Public Health, Boston, Massachusetts
July 12–16	*Bioinformatics in the Classroom* Workshop, Union College, Schenectady, New York
	World of Enzymes Workshop, DNALC
	Green Genes Workshop, DNALC
	DNA Science Workshop, DNALC
July 12–30	Pfizer *Leadership Institute in Human and Plant Genomics,* DNALC
	NSF Faculty Fellowship, *Plant and Rice Genomics*: Javier Gonzalez-Ramos, Adriana Robbins, Olga Kopp, Elise Unice, Paul DeLaRosa
	NSF Faculty Fellowship, *Gramene Bioinformatics*, Cesar Gutierrez
	Teacher training for *Singapore Ministry of Education* collaborators, Daniel Chua Wei Sheong and Yin Leng Tan, and Eugene Wambeck of the Singapore Science Center
July 18–23	*Fun With DNA* Workshop, DNALC
	Genetic Horizons Workshop, DNALC
July 26–30	*World of Enzymes* Workshop, DNALC
	Green Genes Workshop, DNALC
July 27	Site visit by Arthur Spiro, CSHL Trustee and DNALC Committee Chairman; Russ Hotzler, John Mogulescu, Nicholas Michelli, Gillian Small, and Tracy Meade, The City University of New York; Sy Fliegel, Cole Glenn, and Reggie Landeau, Center for Educational Innovation–Public Education Association, New York; Edward Travaglianti, Commerce Bank Long Island, New York; and Lawrence Scherr, North Shore–Long Island Jewish Health System, Great Neck, New York
July 30	Site visit by members of the American Association of University Women, Washington, D.C.
August 2–6	*Fun With DNA* Workshop, DNALC
	World of Enzymes Workshop, DNALC
	Genetic Horizons Workshop, DNALC
	DNA Science Workshop, DNALC
	NSF *Plant Molecular Genetics and Genomics Workshop*, Clemson University, South Carolina
August 5–6	Site visit by Beverly Matthews, Harvard University, Cambridge, Massachusetts
August 9–13	*Fun With DNA* Workshop, DNALC
	World of Enzymes Workshop, DNALC
	Green Genes Workshop, DNALC
	NSF *Plant Molecular Genetics and Genomics Workshop*, University of Wisconsin-Madison/Madison Area Technical College, Madison, Wisconsin
August 12	Site visit by members of the New York Center for Teacher Development
August 16–20	*Fun With DNA* Workshop, DNALC
	World of Enzymes Workshop, DNALC
	DNA Science Workshop, DNALC
	Genomic Biology and PCR Workshop, DNALC
August 17	*Continuing Medical Education* meeting, Lawrence Sherr, Robin Wittenstein, and Irene Leff, North Shore–Long Island Jewish Health System, Great Neck, New York; Caroline Leiber and Jamie Speer, Sarah Lawrence College, Bronxville, New York
August 19	Site visit by Daniel G. Kaufmann, Joan Japha, Chandrika Kulatilleke, Seymour Schulman, Edward Tucker, Mary Jean Holland, and Valerie Schawaroch, faculty members, Department of Natural Sciences, Baruch College, New York
August 20	*Inside Cancer* interview, Charles Sawyers, University of California, Los Angeles
August 23–27	*Fun With DNA* Workshop, DNALC
	Genetic Horizons Workshop, DNALC
Aug. 30–Sept. 3	*Fun With DNA* Workshop, DNALC
	World of Enzymes Workshop, DNALC
	Genetic Horizons Workshop, DNALC
September 1	Site visit by Jean Caron, Abby Demars, and Holly Harrick, DNA EpiCenter, New London, Connecticut

September 6–12	Tour and lab instruction for members of the Marino Golinelli Foundation, coinstructed by Marina and Marcello Siniscalco of the Marino Golinelli Foundation, Bologna, Italy
September 16	Site visit by John Phelan, Trustee and Managing Partner, MSD Capital, New York
September 25	*Saturday DNA!* Seminar, DNALC
September 30	Site visit to DNA EpiCenter, New London, Connecticut
October 15	Site visit by students from Zhejiang University, Hangzhou, China
October 16	*Saturday DNA!* Seminar, DNALC
October 21	Site visit by Jennifer Heim, Richard Osborn, and Cindy Encarnacion, St. Louis Science Center, St. Louis, Missouri
October 26	Site visit by Kevin Ward, George Stranahan, and Andrei Rukinstein, Aspen Institute for Physics, Aspen, Colorado
October 27	West Side School Lecture
November 5	Site visit by Patricia Volland and Julia Rankin, New York Academy of Medicine, Board of Education, New York
November 8	Site visit by Glenda Leslie, School of Education at Murdoch University, Australia
November 9	American Association of University Women reception, Washington, D.C.
November 9–19	Teacher training for *Singapore Ministry of Education* collaborators, Tan Hong Kim, Christine Sim, Chan Ter Yue, and Margaret Wong
November 13	*Saturday DNA!* Seminar, DNALC
November 15–17	Site visit by Abby Demars and Holly Harrick, DNA EpiCenter, New London, Connecticut
November 17	West Side School Lecture Site visit by Jacqueline Dorrance, Executive Director, Beckman Foundation, Irvine, California
November 18	Site visit by Caroline Fostel, Astoria Federal Savings, New York
November 20	*Saturday DNA!* Seminar, DNALC
Nov. 22–Dec. 3	Teacher-training workshops, National Institute of Education and Singapore Science Centre, Singapore
Nov. 29–Dec. 10	Training for *Singapore Ministry of Education* collaborators, Mohan Krishnamoorthy, Chng Swee How James, Andrea Guo Li Ling, Regina Lim, Yap Lih Min Samuel, Goh Su Fen, Lim Lay Khim, Sixtus Goh Wee Leng, and Nora Teo
December 2	Site visit by staff from DNA EpiCenter, New London, Connecticut

Sites of Major Faculty Workshops 1985–2004

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	**California State University, Fullerton**	**2000**
	Canada College, Redwood City	1997
	Contra Costa County Office of Education, Pleasant Hill	2002
	Foothill College, Los Altos Hills	**1997**
	Harbor-UCLA Research & Education Institute, Torrance	2003
	Laney College, Oakland	1999
	Lutheran University, Thousand Oaks	1999
	Pierce College, Los Angeles	**1998**
	Salk Institute for Biological Studies, La Jolla	2001
	San Francisco State University	**1991**
	University of California, Davis	1986
	University of California, Northridge	**1993**
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
FLORIDA	North Miami Beach Senior High School	1991
	University of Western Florida, Pensacola	1991
	Armwood Senior High School, Tampa	1991
	University of Miami School of Medicine	2000
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**
INDIANA	Butler University, Indianapolis	1987
IDAHO	University of Idaho, Moscow	1994
IOWA	Drake University, Des Moines	1987
KANSAS	University of Kansas, Lawrence	1995
KENTUCKY	Murray State University	1988
	University of Kentucky, Lexington	1992
	Western Kentucky University, Bowling Green	1992
LOUISIANA	Jefferson Parish Public Schools, Harvey	1990
	John McDonogh High School, New Orleans	1993
MAINE	Bates College, Lewiston	1995
	Foundation for Blood Research, Scarborough	2002
MARYLAND	Annapolis Senior High School	1989
	Frederick Cancer Research Center, Frederick	1995
	McDonogh School, Baltimore	1988
	Montgomery County Public Schools	1990–1992
	St. John's College, Annapolis	*1991*
	University of Maryland, School of Medicine, Baltimore	**1999**
	National Center for Biotechnology Information, Bethesda	2002
MASSACHUSETTS	Beverly High School	1986
	Biogen, Cambridge	2002
	Boston University	**1994, 1996**
	CityLab, Boston University School of Medicine	1997
	Dover-Sherborn High School, Dover	1989
	Randolph High School	1988
	Winsor School, Boston	1987
	Whitehead Institute for Biomedical Research, Cambridge	2002
MICHIGAN	Athens High School, Troy	1989
MISSISSIPPI	Mississippi School for Math & Science, Columbus	1990, 1991
MISSOURI	Stowers Institute for Medical Research, Kansas City	2002
	Washington University, St. Louis	1989
	Washington University, St. Louis	**1997**
NEW HAMPSHIRE	**New Hampshire Community Technical College, Portsmouth**	**1999**
	St. Paul's School, Concord	1986, 1987
NEVADA	University of Nevada, Reno	1992
NEW JERSEY	Coriell Institute for Medical Research, Camden	2003
NEW YORK	Albany High School	2004
	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	1988–1995, 2001–2004
	DNA Learning Center	**1990, 1992, 1995, 2000**
	DNA Learning 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*
	The Rockefeller University, New York	2003
	State University of New York, Purchase	1989
	State University of New York, Stony Brook	1987–1990
	Stuyvesant High School, New York	1998–1999
	Titusville Middle School, Poughkeepsie	*1991, 1993*
	Trudeau Institute, Lake Saranac	2001
	Union College, Schenectady	2004
	U.S. Military Academy, West Point	**1996**
	Wheatley School, Old Westbury	1985
NORTH CAROLINA	CIIT Center for Health Research, Triangle Park	2003
	North Carolina School of Science, Durham	1987
OHIO	Case Western Reserve University, Cleveland	1990
	Cleveland Clinic	1987
	North Westerville High School	1990
OKLAHOMA	**Oklahoma City Community College**	**2000**
	Oklahoma Medical Research Foundation, Oklahoma City	2001
	Oklahoma School of Science and Math, Oklahoma City	1994
OREGON	Kaiser Permanente–Center for Health Research, Portland	2003
PENNSYLVANIA	Duquesne University, Pittsburgh	1988
	Germantown Academy	1988
SOUTH CAROLINA	**Clemson University, Clemson**	**2004**
	Medical University of South Carolina, Charleston	1988
	University of South Carolina, Columbia	**1988**
TEXAS	Austin Community College, Rio Grande Campus	2000
	J.J. Pearce High School, Richardson	1990
	Langham Creek High School, Houston	1991
	Southwest Foundation for Biomedical Research, San Antonio	2002
	Taft High School, San Antonio	1991
	Trinity University, San Antonio	**1994**
	University of Texas, Austin	**1999, 2004**
UTAH	University of Utah, Salt Lake City	1993
	University of Utah, Salt Lake City	**1998, 2000**
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	Fred Hutchinson Cancer Research Center, Seattle	1999, 2001
	University of Washington, Seattle	**1993, 1998**
WASHINGTON, D.C	**Howard University**	**1992, 1996**
WEST VIRGINIA	Bethany College	1989
WISCONSIN	Blood Center of Southeastern Wisconsin, Milwaukee	2003
	Madison Area Technical College	**1999**
	Marquette University, Milwaukee	1986, 1987
	University of Wisconsin, Madison	1988, 1989
	University of Wisconsin, Madison	**2004**
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	Porto Conte Research and Training Laboratories, Alghero	1993
	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
SINGAPORE	National Institute of Education	2001–2004
SWEDEN	Kristineberg Marine Research Station, Fiskebackskil	1995
	Uppsala University, Uppsala	2004

DOLAN DNA LEARNING CENTER GRANTS

Grantor	*Program/Principal Investigator*	*Duration of Grant*	*2004 Funding*[+]
FEDERAL GRANTS			
National Institutes of Health			
ELSI Research Program	*Eugenics Archive* Internet Site	3/98–3/04	$ 25,168
Science Education Partnership Award	*Inside Cancer* Internet Site	1/01–12/04	100,089
National Science Foundation	Plant Molecular Genetics and Genomics	2/03–1/06	186,799
Course, Curriculum, and	RNA Interference	6/04–5/06	58,627
Laboratory Improvement Program	Rice Genome Sequencing Education	9/03–8/05	78,726
	Gramene Genome Annotation Education	12/03–11/06	105,017
NONFEDERAL GRANTS			
Biogen Idec Foundation	*Genetic Origins* Program	2004	$ 50,000
Carolina Biological Supply Company	Research support	2004	75,000
Clemson University	License, training, and development	2004	50,000
DNA EpiCenter	License, training, and development	2004	1,250
William A. Haseltine Foundation	*Genetic Origins* Program	2004	10,000
Howard Hughes Medical Institute	*DNA Interactive*	1/02–6/04	25,369
North Shore–LIJ Health System	DNALC *West* support	2004	50,000
Pfizer Foundation	Leadership Institute	2004	75,000
Pfizer Foundation	DNA EpiCenter support	2004	17,000
Edwin S. Webster Foundation	Unrestricted support	2004	20,000
Roberson Museum and Science Center	License, training, and development	2004	6,250
Singapore Ministry of Education	License, training, and development	2004	177,715

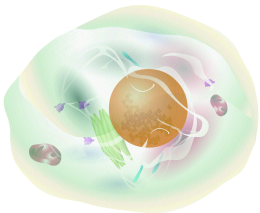
The following schools each awarded a grant of $1000 or more for the *Curriculum Study* Program:

Bellmore–Merrick Central High School District	$ 1,250	Long Beach City School District	$ 1,250
East Meadow Union Free School District	1,250	Massapequa Union Free School District	2,500
Elwood Union Free School District	1,250	North Shore Central School District	2,500
Fordham Preparatory School	2,750	North Shore Hebrew Academy High School	2,750
Great Neck Union Free School District	2,500	Oceanside Union Free School District	1,250
Green Vale School	1,250	Oyster Bay–East Norwich Central School District	2,500
Harborfields Central School District	1,250	Plainedge Union Free School District	1,250
Herricks Union Free School District	2,500	Plainview–Old Bethpage Central School District	1,250
Island Trees Union Free School District	2,500	Port Washington Union Free School District	1,250
Jericho Union Free School District	1,250	Syosset Central School District	1,250
Kings Park Central School District	1,500	West Hempstead Union Free School District	1,250
Levittown Union Free School District	1,250		

The following schools each awarded a grant of $1000 or more for the *Genetics as a Model for Whole Learning* Program:

Baldwin Union Free School District	$ 1,200	Kings Park Central School District	$ 1,595
Bay Shore Union Free School District	2,160	Lawrence Union Free School District	7,200
Bellmore Union Free School District	2,750	Locust Valley–Bayville Central School District	19,180
Bellmore–Merrick Central School District	13,075	Mamaroneck Union Free School District	2,800
East Meadow Union Free School District	2,870	North Bellmore Union Free School District	2,055
East Williston Union Free School District	2,380	Oyster Bay–East Norwich Central School District	2,107
Elwood Union Free School District	3,712	Port Washington Union Free School District	1,180
Farmingdale Union Free School District	2,450	Region 3, Queens	1,625
Friends Academy	3,050	Rockville Center Union Free School District	4,735
Garden City Union Free School District	6,935	Sachem Central School District	1,700
Great Neck Union Free School District	9,050	Scarsdale Union Free School District	3,500
Green Vale School	1,180	South Colonie Central School District	2,490
Half Hollow Hills Central School District	5,512	St. Dominic School	3,500
Harborfields Central School District	12,360	St. Edward School	1,520
Huntington Union Free School District	5,427	Syosset Central School District	26,200
Jericho Union Free School District	13,962	Three Village Central School District	1,925

[+]Includes direct and indirect costs.



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Cover and above: Illustration of a cell, including nucleus and organelles, from the *Inside Cancer* Internet site.