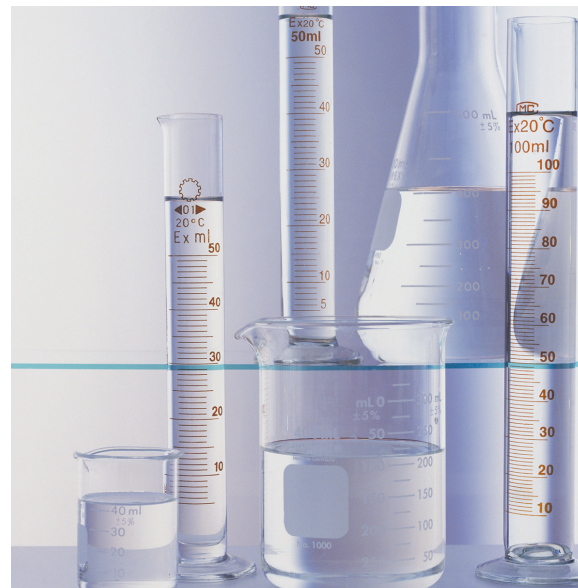
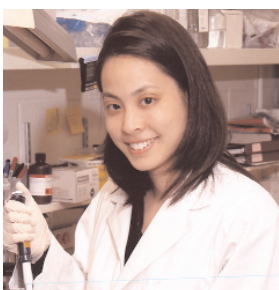
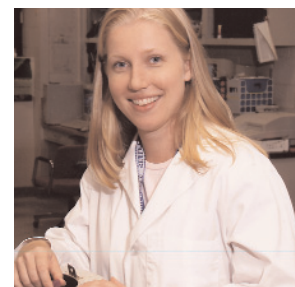
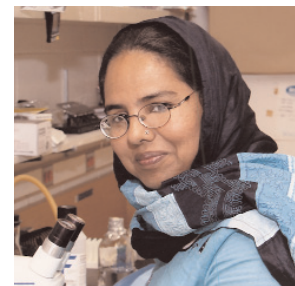
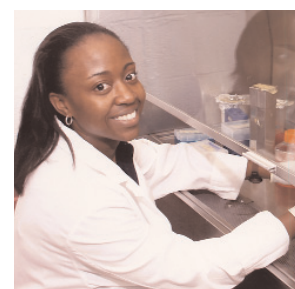


SUMMER RESEARCH PROGRAM FOR SECONDARY SCHOOL SCIENCE TEACHERS

REPORT OF ACTIVITIES

2004

2005



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Irene Matejko, Ph.D.

Teacher Participant, 1990–91

Christian Meyer, Ph.D.

Professor of Civil Engineering

Carl Raab, M.S.

New York City Department of Education, ret.

Britt Reichborn-Kjennerud, B.A.

Teacher Participant, 1997–98

Summer Research Program for Science Teachers

2004 & 2005
Report of Activities



Samuel C. Silverstein, M.D. - Program Director
Jay Dubner, M.S. - Program Coordinator

www.ScienceTeacherProgram.org

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Summary

“This program provides teachers with the opportunity to practice what they teach.”

Dr. Samuel C. Silverstein, Program Founder and Director

*“Before the program, I used to teach about chemistry. Now I **teach** chemistry.”*

Alexandra Bodha, Program Participant (Class of 2000), LaGuardia HS for the Performing Arts

The goal of Columbia University’s *Summer Research Program for Secondary School Science Teachers* is to increase interest and achievement in science among New York metropolitan area middle and high school students. The Program seeks to accomplish these goals by enabling teachers to gain intensive hands-on scientific experience in the practice of science. To this end, the Program has provided fellowships to 152 high school science teachers, 22 middle school science teachers, and two science staff developers, most of whom teach in New York City public schools. These fellowships enable teachers to engage in hands-on research in the biological and physical sciences, under the mentorship of Columbia University faculty for two summers. Teachers are encouraged to share the knowledge, skills, and concepts derived from their experiences at Columbia with their students and fellow educators. Research conducted by the Program shows that student interest (e.g., participation in Intel-type science competitions and science clubs) and performance (New York State Science Regents examinations) improve significantly in the years following teacher entry into the Program compared to students of non-participating teachers in the same science departments and schools.

Program Description

The Program’s central element is the research laboratory experience. Each teacher works as a full-time member of a research team, led by a member of Columbia University’s faculty, for eight weeks each summer for two consecutive summers. In most laboratories, teachers work with a graduate student or a postdoctoral fellow on the student’s or fellow’s research. In others, they work on a project designed specifically for them by their faculty mentor. In all cases, they become full members of the laboratory and participate in all laboratory meetings, discussions, and activities.

In addition to the laboratory experience, all teachers participating in the Program meet weekly during the summer. These meetings are organized and led by **Mr. Jay Dubner**, the Program’s Coordinator. They provide opportunities for teachers to engage in four different types of exercises that are widely acknowledged to be important in all types of professional development, and especially crucial for science educators.

1) Content: Teachers participate in an informal seminar on a science topic of broad general interest, led by a member of Columbia’s faculty or by a speaker from another of New York’s science-rich institutions.

2) Communication: Teachers describe their research to one another at regularly scheduled oral presentations or poster sessions.

3) Pedagogy: Teachers lead hands-on demonstration science lessons, engage in discussions of common classroom problems, and exchange ideas about solving these problems.

4) Peer Coaching: Second-year participants provide guidance and encouragement for first-year participants.

Each teacher receives a stipend of \$6,000 per summer. Upon request, the program provides each participant with a modem or network card to connect his/her school’s computer to the Internet. To facilitate transfer to the

classroom of concepts and technologies learned during the summer at Columbia, each teacher is allocated a budget of \$1,000 following each summer of program participation to purchase classroom materials and equipment. Program participants are also afforded the opportunity to travel to a professional conference during the school year.

Twenty-four secondary school science teachers participated in the Program from June 29 to August 18, 2004 and twenty-three secondary school science teachers participated in the Program from June 29 to August 24, 2005. In 2004, three science teachers from the Anglo-Chinese School in Singapore participated in the Program. In 2005, three new science teachers from the Anglo-Chinese School and two science teachers from Singapore government (public) schools participated in the Program. Program participants conducted research in astrophysics, cell biology, chemistry, developmental biology, environmental science, immunology, materials science, microbiology, molecular biology, nanotechnology, physics, plant biology, and virology, under the mentorship and supervision of members of Columbia's faculty. In addition, in 2004 Columbia's Program provided administrative, logistic, and educational support for 15 other teachers enrolled in research programs at five other institutions in the New York-New Jersey area. Thus, Columbia's *Summer Research Program* aided 41 science teachers in 2004, making it the largest university-based research program for teachers in the United States. It is one of the few research programs for teachers to require two consecutive summers of participation.

Program Effects

Since 1993 the Program has studied not only its effects on teachers, but also the impact of teacher participation on student interest and achievement in science. These studies show that the Program has engaged participating teachers intellectually, provided them with new avenues for professional and personal growth, increased their appreciation for the processes of scientific discovery, and enhanced their ability to communicate the excitement and vitality of science to their students and fellow educators. With respect to their classroom practices, participating teachers report that their experiences at Columbia have enlivened and energized their science teaching and encouraged them to increase laboratory-based constructivist educational practices in their classrooms. They report being better able to guide and counsel students because of their awareness of the personal qualities and skills needed to succeed in science. Most importantly, research conducted by the Program provides quantitative evidence that students of participating teachers exhibited greater enthusiasm for and achievement in science in the years following their teacher's participation in the Program than students of the same teachers in the year prior to entry into the Program. As noted above, a higher percentage of students of teachers who completed two summers in Columbia's Program undertook Intel-type science competition projects and participated in science clubs than students of other teachers in the same science departments and schools. Most importantly, students of Program participants passed a New York State Science Regents examination in science at a higher rate than students of comparison teachers.

Governance

The Program is governed by an Advisory Committee composed of Columbia University faculty, and by teachers selected from the Program's alumni. At the Program's 2005 fall meeting, Advisory Committee members invited **Ms. Uzma Shah** (Class of 2004) and **Ms. Megan Roberts** (Class of 2002) to join the Program's Advisory Committee. Their service will begin in early 2006. **Dr. O. Roger Anderson**, Professor at Lamont-Doherty Earth Observatory and at Columbia's Teachers College, has been a member of the Program Advisory Committee since 1991. Dr. Anderson provides assistance in science pedagogy. Each summer, Dr. Anderson and two Program alumni meet with teachers individually and in small groups to assist them in developing plans for adapting and transferring concepts and techniques learned at Columbia to their classrooms. In 2004, **Ms. Mary Elizabeth Wilson** (Class of 1996) and **Dr. Keith Sheppard** (Class of 1992) met with the teachers. In 2005, Ms. Wilson and **Mr. George Stengren** (Class of 2002) assisted the teachers with their Action Plans.

I. The Program

a. Recruitment of Teachers: In fall 2003 and 2004, posters describing the program were mailed to the science departments of all public, independent and parochial middle and high schools, in New York City, in New York State's Nassau and Westchester Counties and in New Jersey's Bergen County. Appropriate teacher organizations were also contacted (e.g.; NY Chem Club, NSTA).

Teachers completed the electronic application on the *Summer Research Program's* website (www.ScienceTeacherProgram.org). Fifty-four applied by the February 9, 2004 deadline and 54 applied by the February 11, 2005 deadline. Members of the Program's Advisory Committee (see inside front cover) reviewed all applications and chose 23 candidates in 2004 and 23 candidates in 2005 for interviews. Twelve candidates were selected in each of the two years for admission to the Program by the entire Advisory Committee at its spring meeting.

The 12 new participants in 2004 joined 12 returning teachers who had entered the Program the previous summer. The 12 new participants in 2005 joined 11 teachers who entered the Program in 2004. All Program participants held science teaching certificates from the New York City Department of Education and/or their State Education Department, or else provided college or university transcripts confirming their eligibility for such certification.

b. Laboratory Orientation: Dr. Greg Freyer, a member of the Program's Advisory Committee and Associate Professor of Environmental Sciences in Columbia's School of Public Health, conducted laboratory orientations for first-year teachers on June 29, 2004 and 2005. The orientation assures that all teachers are

familiar with standard laboratory equipment (micropipettes, microcentrifuges, electronic balances, and pH meters), and procedures, thereby avoiding potentially costly, embarrassing, and dangerous errors. First-year participants also attended mandatory University seminars in chemical, radiation and laboratory safety.

The Program provides each entering teacher with the textbook *DNA Science*, jointly authored by Dr. Greg Freyer and Dr. David Micklos of Cold Spring Harbor Laboratory. The book describes laboratory experiments in molecular genetics appropriate for high school students.

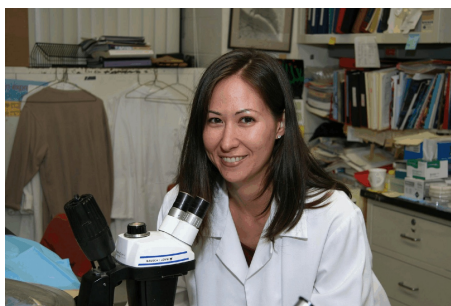
First-year participants also received copies of:

- *At The Bench: A Laboratory Navigator* by Kathy Barker
- *How To Write and Publish A Scientific Paper* by Robert Day
- *National Science Education Standards*
- *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*

c. Laboratory Placements: For more than a decade, scientific societies, the National Science Foundation, and the National Academy of Sciences have encouraged researchers to participate in precollege science education. In general, those researchers who have participated in precollege science education programs have done so as science fair judges, expert speakers or field trip hosts.¹

Columbia's Program engages researchers in the professional development of teachers, and enables researchers to learn from teachers about the challenges of middle and high school science education.

Of the 36 teachers covered by this report, nineteen conducted research under the guidance of faculty at Columbia's Medical Center, fourteen worked with faculty at Columbia's Morningside Campus, and three worked with faculty at Columbia's Lamont-Doherty Earth Observatory (see Appendices I, II and III for individual placements and research projects).



*"I incorporated much more biotechnology
(into my classroom instruction) and felt very
comfortable doing it."*

Naomi Cook, Humanities Prep Academy
Class of 2005

d. Summer Seminars, Lectures and Workshops: As in previous summers, all teachers met on ten mornings each summer. On five of those occasions in 2004, and on four of those occasions in 2005, faculty from Columbia University and other science-rich institutions spoke on topics of broad general scientific interest (see Appendices V and VI). Speakers were selected both for their knowledge of the topic and for their communication skills. Teachers received background reading materials in preparation for many of the seminars. The informal atmosphere of these seminars encouraged lively exchanges between teachers and speakers.

In each of the two summers, workshop facilitators engaged teachers in hands-on activities. Detailed instructions and worksheets provided at these sessions enabled many teachers to implement similar lessons in their classrooms.

In each of the two summers, Mr. Jay Dubner facilitated a workshop for first-year participants on "*Grant Writing for the Classroom Teacher.*"

Dr. Samuel Silverstein led a discussion for second-year participants on preparing and delivering a 30-minute research seminar.

e. Video Library: Videos of four 2004 summer seminars, four 2005 summer seminars and 47 seminars from previous years, are available free of charge to teachers for use in their schools. The Program has distributed 983 videotapes and 102 DVDs of these lectures to participating teachers and others who have requested them (non-program participants are charged \$10 per tape/DVD to cover the costs of production and shipping). A catalog of all 55 lectures can be found in Appendix VII and on the Program's website.

f. Peer Coaching Groups: For most teachers, the *Summer Research Program* is their first experience with a research university and a research laboratory. This new environment poses unanticipated challenges that can be stressful. To help first-year teachers adjust to this new environment, second-year teachers met with them in small groups to offer support and guidance.

g. Teachers Reported on Their Research: Second-year teachers gave 30-minute talks describing their research August 16-18, 2004 and August 22-24, 2005. First-year teachers reported on their summer's research at poster sessions August 16-17, 2004 and August 22-23, 2005. All teachers submitted written reports summarizing their research accomplishments.

h. In-service and Professional Development Training Led by Program Participants: The Program encourages teachers to share knowledge, skills, and experiences with their colleagues. As the number of teachers who have completed Columbia's Program increases, so does the number of in-service workshops led by

its participants. Nineteen Program participants reported that they led a total of 62 in-service workshops during the 2004-05 and 2005-06 school years.

i. Teachers Attend Professional Conferences:

Eleven Program participants attended professional conferences in 2004-05 and 16 Program participants attended professional conferences in 2005-06. Their travel and registration fees were supported by funds from the Howard Hughes Medical Institute, M.J. Murdock Charitable Trust, and the National Institutes of Health.

j. Access to Columbia's Libraries:

Few school or local public library branches subscribe to scientific journals or maintain up-to-date collections of books on science. Therefore, at the Program's request, the University generously provides Program participants with borrowing privileges at the University's libraries, including access to its online resources. It also makes the University's libraries available, on request, to the Program's alumni and to their students.

k. Students Visit Columbia Laboratories:

During the two school years, three current and five former Program participants brought a total of 125 students to Columbia for laboratory demonstrations presented by the teachers'

mentors and laboratory colleagues. Some laboratories gave students materials for follow-up use in their own school laboratories.

In April 2005, for the first time, the Program hosted an elementary school class. Fourteen fourth grade students, their teacher and the school's principal, traveled from the George M. Davis, Jr. Elementary School in New Rochelle to meet Columbia scientists. The students visited research laboratories, examined chick embryo eggs through a microscope, learned about gross anatomy and took petri dishes covered with bacteria back to their school for classroom examination.

l. Assistance to Columbia's Science and Technology Entry Program (STEP):

Columbia's School of Dental and Oral Surgery sponsors a Science and Technology Entry Program (STEP) for minority students. STEP prepares underrepresented minority or economically disadvantaged secondary school students for entry into postsecondary degree programs in scientific, technical, and health-related fields, and the licensed professions. Classes for students in Columbia's STEP meet on Saturdays from September through June and daily in July. As in previous summers, in July 2004 and July 2005, teachers from the *Summer Research Program* led laboratory exercises for STEP students.



Table 1 - Multiple Program Participants in Same School

	Number of teachers at indicated school who completed Columbia's Program in the period 1990-2003	Number of teachers at indicated school enrolled in Columbia's Program in 2004	Number of teachers at indicated school enrolled in Columbia's Program in 2005	Total Number of Columbia Program participants teaching at indicated schools in 2005-06
Adlai Stevenson HS	4	1	0	4
Bronx HS of Science	5	0	0	5
George Wingate HS	6	0	0	4
Hastings-on-Hudson HS	2	0	0	2
Jamaica HS	2	0	0	2
John Dewey HS	4	0	0	3
Manhattan Cntr for Science & Math	5	0	1	4
Midwood HS	0	2	0	2
Mott Hall School	3	0	0	2
NY Harbor School	1	0	1	2
Sleepy Hollow HS	1	1	0	2
Teachers Preparatory HS	2	0	0	2
William Maxwell HS	2	1	0	3
Susan E. Wagner HS	3	0	0	3
				40

m. Creating Supportive Climates for Educational Innovation: Effective professional development programs stimulate teachers to work with one another.² Thus, it was of great concern to the Columbia's Program leaders when participants reported encountering resistance from their fellow teachers when they sought to introduce more inquiry-based, hands-on lessons and labs in their classes. Believing that this problem is more likely to be solved by peer pressure than by administrative fiat, the Program has sought to enroll multiple teachers from the same schools and science departments. To date, it has enrolled 47 teachers from 14 schools (see Table 1).

"(After participating in the Summer Research Program) I have more pride in being a teacher."
 Jennifer Sullivan, Midwood High School
 Class of 2005



Forty (85%) of these 47 teachers are still teaching in these schools (of the seven teachers who left, two retired, one is on maternity leave and four are teaching elsewhere). Consequently, their science faculties now have two or more teachers trained in Columbia's Program.

The Program is presently evaluating whether the presence of multiple teachers with similar attitudes toward inquiry-based, constructivist educational practices affects the practices of other teachers in the school. To date, we have seen little evidence of such effects.

n. Action and Lesson Plans: Program participants are required to develop written "action plans" for transferring concepts and skills acquired at Columbia to their schools and classrooms. They also are required to develop lesson plans that support their action plans. Second-year participants are asked to present a brief oral report on the implementation of their plans and on the ways they intend to revise and improve them at one of the Program's weekly meetings. In this way the teacher who created the action and lesson plans, and the other teachers in the Program, obtain useful feedback on using concepts and skills learned at Columbia for the benefit of their students and schools. Copies of each teacher's action and lesson plans are distributed to all teachers in the Program. Each lesson plan references the relevant National Science Standards.³ Through August 2005, more than 250 lab and lesson plans developed by teachers participating in Columbia's Program have been placed on the Program's website.

o. Alumni Reunion and Dinner: An Alumni Reunion in April of each year provides an opportunity for current participants to meet alumni, with whom they might otherwise have had no contact. One recent Program participant and one guest speaker gave talks following Program updates from Dr. Silverstein and Mr. Dubner who reported on new Program activities

and on the impact of teacher participation on student interest and achievement in science. In 2004, **Ms. Leslie Koch**, CEO for The Fund for Public Schools gave a talk on the efforts the NYC Department of Education makes to elicit support from the private sector and **Mr. David Friedman** (Class of 2003) gave a talk on his Columbia University research project and the ways he has incorporated his newfound skills into his classroom instruction. In 2005, the featured speaker was **Dr. Julia Rankin**, Director of Science for the NYC Department of Education. **Ms. Uzma Shah** (Class of 2004) gave a talk on her Columbia University research project and the impact it has had on her classroom instruction. All past and present *Summer Research Program* and *Partners in Science* participants were invited (see Appendix VII). More than one-third of the past and present participants attended each of the two dinners.

p. School Visitation Program: The *Summer Research Program* has long sought ways to interact with and support participating teachers within their schools during the academic year. With support from the Howard Hughes Medical Institute, graduate students, who worked with teachers during the summer received a stipend for assisting teachers ten hours each month. This includes one day in the classroom and five hours of pre-visit planning. The graduate students help teachers implement inquiry-based exercises and labs, and assist teachers in creating school science club programs. The graduate students assist the precollege students in designing independent research projects.

q. Awards: Dr. Samuel Silverstein, Founder and Director of the *Summer Research Program*, received a Westie Award on June 30, 2004. The award recognizes outstanding citizens of Manhattan's West Side. On December 11, 2005, Dr. Silverstein received the American Society of Cell Biology's Bruce Alberts Award for Excellence in Science Education. Both awards

honored Dr. Silverstein for creating, and continuing to direct, the *Summer Research Program*.



“(The Award) indicates the importance the Mayor and the public place on your achievements as teachers, for it is truly your success with your students that the award recognizes.”

Samuel C. Silverstein, M.D., Program Director

Ms. Adrienne Rubin (Class of 2000) received the New York Times Company Foundation *Teachers Who Make a Difference Award*.

Ms. Allison Granberry (Class of 2005) received the *Dedication of Service Award* for her combined time in the *Summer Research Program for Science Teachers* and the Peace Corp.

r. Radio Show: The *Summer Research Program for Science Teachers* was the featured topic on former New York City mayor David Dinkins’ radio show *Dialogue With Dinkins*. The July 4, 2004 broadcast provided the audience with an overview of the *Summer Research Program* followed by interviews with

Jay Dubner, Program alumni Uzma Shah (Class of 2004), and **Derresa Davis** (Class of 1999).



s. Program Replication: The Program receives requests for information and guidance in providing professional development experiences to secondary school teachers. During Mr. Dubner’s visit to Singapore, **Dr. Joanna Rubinstein**, Senior Associate Dean for Columbia’s Global and Strategic Initiatives, arranged for him to meet with administrators from Singapore’s Ministry of Education (MOE) and its Agency for Science, Technology and Research (A*STAR).

Together, MOE and A*STAR expressed a strong interest in replicating Columbia’s *Summer Research Program for Science Teachers* utilizing Singapore’s rich resources and their recently completed biomedical science center, Biopolis. Personnel from MOE and A*STAR visited with Mr. Dubner and faculty mentors in early 2004 followed by a return visit to Singapore by Mr. Dubner. Singapore accepted the first group of Singaporean teachers into *The Local Attachment Programme for Science Teachers* in June 2004.

II. Program Website

<http://www.ScienceTeacherProgram.org>

The Program’s website, established in 1995, provides a comprehensive menu of information and resources for program participants, applicants, and science educators. Applicants use it to apply for admission.

The website currently contains more than 250 research-inspired National Science Standards-linked lesson plans created by Program participants, and 55 videotapes and DVDs of the Program’s summer seminars. It lists the names

Lesson Plans
Web Resources
Program Participants
Program Alumni
Videotaped Lectures
Advisory Committee
Events Calendar
Program Support
Contact Information

Summer Research Program for Science Teachers




2006 Program Application


Supported by a Science Education Partnership Award (SEPA) from the National Center for Research Resources

Program Partnerships
2003 Report of Activities
(19MB PDF file)
Program Video
(video requires Real Player, free download)

Columbia University's **Summer Research Program** was founded in 1990 by Dr. Samuel C. Silverstein, Professor of **Physiology** in the **College of Physicians & Surgeons**. The Program is administered on a daily basis by **Jay Dubner**, Program Coordinator.

The primary aim of the Program is to provide New York metropolitan area middle and high school science teachers with sustained hands-on experience in scientific research so they can better understand the practice of science, and better transmit to their students and fellow teachers a feeling for its practice. Each teacher spends two consecutive summers working as a laboratory research assistant under the supervision of a Columbia faculty mentor. Opportunities are available in astronomy, biological sciences, chemistry, earth sciences, engineering, environmental sciences, genetics, material science and engineering, medicine, microbiology, nanotechnology, physics, physiology, toxicology, and other specialties.

Program Description



Site updated on December 21, 2005

[Lesson Plans](#) [Web Resources](#) [Participants](#) [Program Alumni](#)
[Events Calendar](#) [Videotapes](#) [Advisory Committee](#)
[Program Support](#) [Contact Information](#)


Doctors choose. Teachers ed. You choose. Students learn.

12/11/05: Samuel C. Silverstein, M.D., Program Director, received the 8th Annual American Society for Cell Biology **Bruce Alberts Award for Excellence in Science Education**. [Photo of presentation](#)

9/29/05: **Allison Granberry**, Program Participant (2004-05) received an award for Dedication of Service (combined for time in the Peace Corps and NYC science teacher). Award presented by Caroline Kennedy. [Photo of presentation](#)

11/16/04: The Singapore Ministry of Education, in partnership with A*STAR (Agency for Science, Technology and Research), has launched the **Local Attachment Programme for Science Teachers**, a teacher research program modeled after Columbia's **Summer Research Program for Science Teachers**.

7/4/04 - The Summer Research Program for Science Teachers was featured on the *Dialogue With Dinkens* radio show. Guests were **Jay Dubner** (Program Coordinator), **Uzma Shah** (Program Participant) and **Deres Davis-Tobin** (Program Alum). [On Air Photos](#)

6/30/04: **Samuel C. Silverstein, M.D.** received the **2004 Westy Award** for being an outstanding citizen of the West Side of Manhattan.

10/8/03: **Samuel C. Silverstein, M.D.**, Founder and Director of the **Summer Research Program**, received the NYC Mayor's Award for Public Understanding of Science and Technology. The award was bestowed upon Dr. Silverstein for his work with the **Summer Research Program**. [Ceremony photos](#). **PRESS RELEASE**

and schools of teachers currently enrolled in the Program, and of the Program's alumni, Advisory Committee members, and supporters.

In a section entitled "Web Resources," the website has links to over 600 high-quality educational resources, most of special interest to secondary school science educators. Its efficiency is enhanced by an Atomz™-powered search engine that allows visitors to explore the site by entering a word or phrase, and to view through hyperlinks all matches within the site.

Through December 2005, the site had more than 78,000 hits from visitors from nearly all 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, Guam, and over 85 foreign

countries. Presently, the site hosts in excess of 1,000 visits each month.

In November 2005 the Program assumed administrative responsibility for the National Science Foundation-sponsored RET (Research Experiences for Teachers) website (<http://www.RETNetwork.org>). The RET website was developed in 2002 just prior to the first National RET Conference. The site's primary purpose is to connect the community of approximately 70 RET Programs through announcements of national meetings and activities. A proposal has been submitted to the National Science Foundation to update the site and to expand its directory of research programs for science teachers.

III. Partnerships in Science Education

Columbia University's *Summer Research Program*'s administrative strengths and fiscal stability has enabled it to achieve a remarkable level of success in developing partnerships with other programs that share its focus and goals. By partnering with other programs, teachers in both programs gain experience with other cultures and professional perspectives. The Program's ongoing partnerships with other programs and institutions are described below.

*"(The) laboratory experience has humbled me
to be more patient with (my) students."*

Tonya Springer-DeCaul, William H. Maxwell Career and
Vocational High School
Class of 2004



Partnerships with U.S. Programs

a. Materials Research and Science Engineering Center (MRSEC): MRSEC, a National Science Foundation-supported program, brings together an interdisciplinary team of scientists and engineers from Columbia University, industry, and U.S. National Laboratories to develop and test new types of mixed organic/inorganic materials and structured thin films. **Irving Herman**, Professor of Applied Physics and Mathematics at Columbia, is the Center's Director. **Ms. Justine Herrera** is the Assistant Director of Outreach for the MRSEC program.

Columbia's MRSEC program includes a *Research Experiences for Teachers* (RET) component. Cost-sharing between the *Summer Research Program* and the RET provided fellowships in 2004 for four high school teachers (**Mr. Fady Ishak**, **Ms. Tonya Springer-DeCaul**, **Ms. Carla Brathwaite** and **Ms. Jennifer Clark**), enabling them to participate in laboratory research under the mentorship of MRSEC faculty. Carla Brathwaite and Jennifer

Clark returned for a second summer of materials science research and were joined by **Ms. Ann Meyer** and **Mr. Andrew Hall** in 2005. This partnership will continue in 2006.

b. Nanotechnology Science and Engineering Center (NSEC): NSEC, also a National Science Foundation-supported research center at Columbia, aims to advance miniaturization technology. Its goal is to transform the design and manufacture of equipment and materials used in many fields. NSEC facilitates collaborations in synthetic chemistry and electron physics between Columbia faculty and investigators at Bell Laboratories and at IBM Research. **James Yardley**, Professor of Chemical Engineering and Applied Chemistry at Columbia, directs the Program. He is assisted by Justine Herrera, Assistant Director of Outreach.

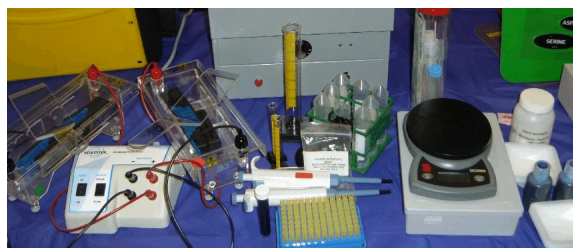
Like MRSEC, NSEC includes a RET outreach component. Cost-sharing between the *Summer Research Program* and the NSEC RET provided fellowship support for three high school teachers (**Ms. Annie Chien**, **Ms. Zulema Jones-Enoe** and **Mr. Jason Choi**), in

the summers of 2004 and 2005. They were joined in 2005 by **Ms. Ghulam Firdaus**. This partnership will continue in 2006.

C. New York Hall of Science: c1. Columbia's *Summer Research Program*, in partnership with the New York Hall of Science's Education Department, was awarded a \$675,000 three-year SEPA (Science Education Partnership Award) grant in 2003 by the National Institutes of Health National Center for Research Resources. The partnership reflects both partners' recognition that many New York City intermediate and high schools lack the dedicated laboratory space and equipment needed to teach contemporary biology and chemistry, and that even well trained science teachers have difficulty assembling the supplies and protocols needed to conduct high quality laboratory exercises. It also illustrates the importance of the *Summer Research Program's* stability. This stability enables the Program's leaders to reassess the needs of participating teachers for specific types of resources.

The partnership's goals were to modify, develop, and pilot test portable laboratory kits for use in intermediate and high school laboratories. The kits contain all the equipment (e.g., microscopes, balances, computer), supplies (e.g., bacterial growth medium, sterile water), manuals, and other materials needed to conduct a wide spectrum of laboratory exercises in ordinary classrooms equipped only with tables and electrical outlets. In the event, **Ms. Preeti Gupta**, Vice President of the New York Hall's Science Education Department, and *Summer Research Program* leaders and teachers, redeveloped an outdated microbes and health kit (Microlab), for use in intermediate and high school life science courses, and developed from scratch a new cell and molecular biology kit (Molecules and Health) for use in high school biology and chemistry courses. In line with the *Summer Research Program's* philosophy that teachers should be supported for educational endeavors outside of their regular school duties,

the grant provided stipends enabling Program participants and alumni to assist in the development of the kits and in pilot testing them in their schools and classrooms. This ensured that all exercises included in the kits were aligned with New York City's Science Performance Standards. Preliminary reports indicate the kits are highly regarded by teachers and that students are engaged and challenged by the exercises they contain. In short, the kits meet the needs of their intended audiences.



c2. In fall 2005, supported by a three-year grant from the National Science Foundation, the *Summer Research Program* initiated a second partnership with the New York Hall of Science, this time bringing in two other partners, MRSEC and NSEC. The Research and Rolling Exhibits (RARE) project supports collaborations between Columbia faculty, graduate students, and *Summer Research Program* participants and alumni and New York Hall of Science staff in developing five "Discovery Carts" to illustrate the many uses of materials and concepts emerging from research in materials science and nanotechnology. The carts will be portable and available for visitor use on the floors of the New York Hall of Science. RARE illustrates yet another way the *Summer Research Program* creates opportunities for its participants and alumni to use skills acquired in Columbia labs in creating new educational resources for use by a wide audience of students, parents, teachers, and general museum visitors. Through such experiences, skilled teachers become master teachers, and master teachers become empowered and encouraged to create entirely new educational resources and methods.

d. Third National Research Experiences for Teachers (RET) Meeting: Mr. Jay Dubner (Columbia University), **Dr. Marni Goldman** (Stanford University), and **Dr. Fiona Goodchild** (University of California Santa Barbara), co-organized and co-hosted a third National Science Foundation-supported meeting for RET programs. The RET conference was held in Redwood City, California, April 29-30, 2004. Its theme, *Assessing, Determining, and Measuring the Impacts of the Research Experience (ADMIRE)*, continued a theme introduced in the 2003 RET meeting. The attendees adapted the Pre- and Post-Program Surveys and the Mentor Survey developed during the NSF-supported SWEPT multi-site study for use with the RET



programs. The instruments are available on the RET website at <http://www.RETNetwork.org>.

e. 2004 and 2005 Partners in Science National Conferences: In January 2004, twenty-one *Summer Research Program* members (10 participating teachers, 7 alumni, and 4 members of the Program's Advisory Committee), attended the Partners in Science National Conference in San Diego at the invitation of the M.J. Murdock Charitable Trust.

Participating teachers, **Mr. Ben Stevens** (Manhattan Center for Science and Math), Mr. David Friedman (General McArthur High School), **Ms. Melissa Webster** (Hastings-on-Hudson High School), **Mr. Matthew Nanes** (Park West High School), and **Ms. Florence Dodier** (Malverne High School) were invited speakers. Ms. Lesia Kaszczak (Yonkers High School), Mr. Fady Ishak (Legacy High School),

Ms. Uzma Shah (Baruch College Campus High School), **Mr. William Dugan** (High School for Math, Science & Engineering) and Ms. Tonya Springer-DeCaul (William H. Maxwell Career & Technical High School) were invited to present posters describing their research accomplishments. Their interactions with the teachers, program managers, and scientists who attended these poster sessions was a testament to the skills they acquired through their research experiences in Columbia University laboratories.

Program alumni **Ms. Najla Hallak** and Mr. George Stengren facilitated workshops at the conference.

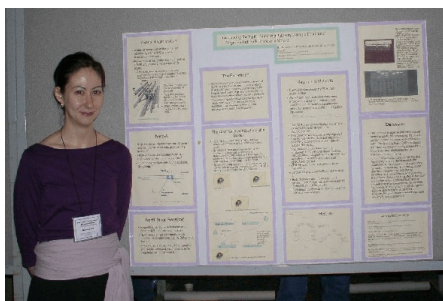
In January 2005 the Murdock Charitable Trust again invited 19 *Summer Research Program* members (10 participating teachers, 5 alumni, and 4 members of the Program's Advisory Committee), to attend the Partners in Science National Conference in San Diego.

Participating teachers, Ms. Lesia Kaszczak (Yonkers High School), **Mr. Jeremy Szerlip** (Scarsdale High School), Mr. William Dugan (High School for Math, Science and Engineering), **Ms. Sandra Santillan** (Susan E. Wagner High School), Mr. Fady Ishak (Legacy High School), **Ms. Linda Vales** (John Dewey High School)



and Ms. Uzma Shah (Baruch College Campus High School) were invited speakers. **Ms. Naomi Cook** (Humanities Preparatory Academy), Ms. Allison Granberry (Hostos-Lincoln Academy), and Mr. Jason Choi (Sleepy Hollow High School) presented posters describing their research accomplishments. As in 2004, their interactions with the teachers, program managers, and scientists who attended these

sessions was a testament to the skills they acquired through their research experiences in Columbia University laboratories.



International Partnerships

f. Singapore International Teacher Exchange:

According to a recent United Nations Study,⁴ the United States has one of the least effective K-12 education systems among the world's richest countries. In contrast, Singapore, which ranks 39th among nations in Gross Domestic Product, appears to have one of the most successful K-12 educational systems among developed nations.

In 2004, the *Summer Research Program* initiated a teacher exchange with Singapore's Anglo-Chinese School (Independent) in which four *Summer Research Program* alumni visited Singapore and three Anglo-Chinese School science teachers participated in research in Columbia labs and in the *Summer Research Program*'s professional development activities. In this way, U.S. teachers learned about the investments and programs Singapore has implemented that contribute to its extraordinary success in preparing students in science, and Singaporean teachers gained hands-on experience in research in Columbia University research laboratories and were able to learn about American precollege science education.

In the inaugural exchange, three Anglo-Chinese School science teachers (**Mr. Alistair Chew** [Dean of Science], **Mr. See Teck Hock** [Biology], and **Mr. Patrick Soo Mun Keong** [Physics and Math]) participated in the 2004

Summer Research Program and four *Summer Research Program* alumni (**Mr. Tom Byrne** [New Rochelle High School], **Ms. Denise Gamper** [Bard High School Early College], Mr. George Stengren [Heritage High School] and Ms. Melissa Webster [Hastings High School] spent two weeks in Singapore working with, and observing classes taught by, Anglo-Chinese School science teachers. Immediately upon returning to New York, the four *Summer Research Program* alumni and the three Anglo-Chinese School teachers presented a joint seminar at which they described their respective experiences in Singapore and New York. The U.S. teachers reported that Singapore science teachers work even harder and longer hours than their already hardworking U.S. counterparts. They were impressed by Singapore's investment in first-class science education facilities and the speed with which facilities are constructed and programs implemented once the Ministry of Education has granted approval.

The Singaporean teachers described how highly they valued their laboratory research experiences at Columbia. They also described their impressions of the New York City public high schools they visited. They were impressed by the imagination of New York City science teachers in designing exercises and laboratory experiments that engage students and bring relevance to science education. They especially admired the creativity and willingness to take intellectual risks of the best U.S. students. In an effort to be supportive of New York City public high school teachers participating in the *Summer Research Program*, with whom they had interacted for several weeks, they reported being impressed by the accomplishments of New York City teachers whose classes they had visited given the "run-down facilities and scarcity of science resources" available to them. This last comment about facilities and resources led Dr. Silverstein to reflect that "for the first time in my life I knew what it must feel to live in an underdeveloped country."

The Exchange Program continued in 2005 with the addition of a partnership with the Singapore Ministry of Education. This time three science teachers from the Anglo-Chinese School (**Ms. Kar Wei Yeap** [Physics], **Mr. Paul Cheong Yuen** [Life Sciences], and **Ms. Lydia Yap Sheau Wei** [Chemistry]) and two science teachers from government schools (**Mr. Edwin Cher Chuan Lim** [Chemistry] from Victoria Junior College and **Ms. May Cheok Lai Ling** [Biology] from Christ Church Secondary School) participated in Columbia's *Summer Research Program*. At about the same time, three *Summer Research Program* alumni Ms. Lesia Kaszczak [Yonkers Middle High School], Ms. Mary Elizabeth Wilson [Harrison School District] and Ms. Uzma Shah [Baruch College Campus High School] spent three weeks in Singapore. The majority of their time was spent at the Anglo-Chinese School. Through the *Summer Research Program's* partnership with the Ministry of Education, Ms. Kaszczak, Ms. Wilson and Ms. Shah were able to visit two government schools (Beatty Secondary School and Dunman Secondary School). As in 2004, immediately upon the U.S. teachers' return from Singapore, they and the three Singaporean teachers organized lively and informative seminars for all *Summer Research Program* participants. As in 2004, the three Singaporean teachers commented on the spontaneity and creativity of the best

U.S. high school students, while the three U.S. teachers were impressed by the quality of the science teaching facilities at the Singapore government secondary schools they visited.

This U.S.-Singapore teacher exchange will continue in 2006 in modified form. Beginning in 2006 all four Singaporean teachers will come from Ministry of Education government schools, and three *Summer Research Program* alumni will spend at least four days each at three Singapore government schools. The three teachers will visit two schools as a group on weeks one and three. In week two, each of the U.S. teachers will visit a different school. By these means, the three teachers will gain experience in five Singapore schools.

In a newly formed partnership with Knowledge Exchange Institute, in 2006 Columbia's Program will provide support for two Program alumni to do research for five weeks in a Thailand research laboratory at Mahidol University.

While the Program has not formally evaluated the benefits of these teacher exchanges, it is evident from the seminar presentations of the U.S. and Singaporean teachers that they have grown professionally and personally from their experiences.

"Besides the techniques, I think the most amazing thing is that they have meetings to discuss, analyze, and promote internal as well as external sharing almost every other day. I am truly impressed."

Paul Cheong Yuen
Anglo-Chinese School, Singapore



IV. Evaluation

a. The Impact of Teacher Participation in Columbia's Program on Students: Program managers of *Science Work Experience Programs for Teachers* (SWEPTs) and RET programs have long sought information about whether teacher participation in these programs affects student interest and academic performance. Few program managers have had the expertise, and none have had the administrative infrastructure and financial resources required to undertake such research. Moreover, prior to the 2001 No Child Left Behind Act, only a handful of states used standardized tests to assess academic progress and performance. Absent such tests, there was no practical way to compare the academic performance of students in classes taught by different teachers in the same school, to say nothing about comparing academic performance of students in different schools.

With respect to evaluation of impacts of teacher participation on student interest and achievement in science, Columbia's *Summer Research Program* has from its inception been an exception to this generalization. There are many reasons for this difference, but four are unique to this Program and its special circumstances. First, the Program's founder, Dr. Samuel Silverstein, is a physician-scientist with a strong interest in educational outcomes assessment. Second, the Program's long-term Coordinator, Mr. Jay Dubner, is a former New York City special education teacher and administrator whose understanding of New York's public school system has enabled him to obtain the cooperation of the New York City Department of Education's *Division of Assessment and Accountability*. Third, the Program is centered in a research-intensive university whose faculty and administrators have been extraordinarily supportive of it.

Fourth, the Program has benefitted from the availability of New York State Regents examination scores for all students in science classes of participating teachers for the academic year prior to their entry into Columbia's Program and for every year thereafter that they teach Regents level courses in a school in New York City. New York State Regents examinations are well designed and carefully validated tests that provide objective measures of student mastery and achievement. While no standardized test can capture the full range of a student's abilities and knowledge, they provide the single most widely used and accepted objective measure of mastery of subject material. Indeed, standardized tests are the measure by which society licenses many different types of professionals (e.g., physicians, lawyers).

b. Student interest in science: The Program assesses the impact of teacher participation in the Program on student interest in science by comparing engagement of students of participating teachers in Intel-type science competitions, science fairs, science clubs, and other extracurricular science activities pre-post teacher participation in the Program with that of students in classes taught by non-participating teachers in the same school.

Science Clubs: These comparisons show that in the academic year preceding a teacher's entry into Columbia's Program, about three times as many of his/her students are engaged in science clubs and other extracurricular science activities as students of non-participating teachers in the same school. In the academic year following a teacher's completion of his/her second year in Columbia's Program, nearly six times as many of his/her students participated in science clubs as compared to students of non-participating teachers.

Intel Science Talent Competition: Similarly, in the academic year preceding teacher entry into Columbia's Program, nearly twice as many students of participating teachers engaged in Intel Science Competition projects and school science fairs as students of non-participating teachers in the same school. Moreover, in the academic year following a teacher's completion of his/her second year in Columbia's Program, nearly three-times as many of his/her students were engaged in Intel and science fair projects as students of non-participating teachers.

c. Student achievement in science: In the academic year prior to teacher entry into Columbia's Program, four percent fewer of his/her students passed a New York State Regents exam in science than students studying the same subject in classes of other teachers in the same school. In contrast, in the academic year after a teacher completes Columbia's Program, eight percent more of his/her students passed a New York State Regents exam in science than students studying the same subject in classes of other teachers in the same school. Statistical analysis performed by Dr. Jon Miller of Michigan State University confirms the significance of these findings.

Overall, 12 percentage points more students of participating teachers passed a New York State Regents exam in science in the academic year following teacher completion of the Program than in the academic year prior to their entry into it. Even with this improvement, each year only about fifty-five percent of students of teachers who have completed Columbia's Program pass a Regents science exam. Thus, a 12 percent pre-post Program increase in student

Regents science exam pass rate means that approximately 22 percent more students of participating teachers pass a Regents science exam in the year following teacher completion of the Program than in the year prior to entry into it. By any standard, this is a remarkably large increase.

Control data obtained in the course of a National Science Foundation-supported multi-site SWEPT study⁵ show that these pre-post improvements in student interest and academic achievement in science are not due to differences in educational background of participating vs. non-participating teachers or to the assignment of "better" students to the classes of teachers participating in Columbia's Program.

d. Mentor surveys: The Program surveys each teacher's faculty mentor at the end of each summer's activities. In 2004 and 2005 faculty mentors completed a ten-item questionnaire that inquired about teacher adaptation to the laboratory and research environment, teacher understanding and completion of assigned tasks, and teacher communication skills. The survey uses a five point Likert-type scale, with five as the highest rank. In 2004, 23 of the 24 mentors completed and returned the ten-question survey. Teachers received an average score of 4.4, a very good rating and one similar to that earned in previous years. In 2005, 19 of the 24 mentors completed and returned the survey. Again the teachers received an average score of 4.4.

"I expect to continue my relationship with Larissa (Raven) in support of her plans to bring her experience back to her classroom."
Dr. Jeffrey Holmes, Biomedical Engineering Dept.

e. Teacher surveys: In the spring prior to entering the Program, and after each of their two summers in the Program, teachers are surveyed regarding their classroom instruction methods and the impact of their participation in Columbia's *Summer Research Program* on these methods. Twenty of the 23 teachers participating in the Program in 2004 completed and returned the 2005 Spring Survey.

- ▶ One hundred percent of those who completed the survey reported increasing problem-solving activities in their classes.
- ▶ Ninety percent reported developing new or revised content to lessons and/or labs since participating in Columbia's Program.
- ▶ Ninety-five percent reported increasing hands-on activities in their classrooms and/or new laboratory exercises in response to their experiences at Columbia.
- ▶ Eighty-five percent reported that they shared Columbia-derived information, materials, and/or resources with other school personnel.
- ▶ Eighty-five percent reported more rigorous requirements for formal written reports and/or oral presentation.

- ▶ Eighty percent reported introducing new technologies in their classroom instruction (e.g.; chromatography, pipetting, PowerPoint).
- ▶ Seventy percent reported including lessons regarding science careers and related job requirements as part of their instruction.
- ▶ Fifty-five percent reported increased reading of scientific journals.
- ▶ Fifty percent reported assuming new leadership roles/responsibilities in their school/district/region (e.g., Assistant Principal, Department Chair, Regional Instructional Supervisor).

"I didn't have any skills to help the students in the research class. The past summer at Columbia made a tremendous difference in my confidence."

Margie Savitzky

Thomas A. Edison Vocational/Technical High School
Class of 2006



V. Operating Costs

Each participant received a stipend of \$6,000 each summer and an allowance of \$1,000 following each summer of Program participation to enhance hands-on science activities in his/her school. Teachers used these "enhancement" funds to purchase classroom supplies, educational materials, and equipment; to take students on field trips; to subscribe to professional journals; and to pay for memberships in scientific and educational organizations. Additional funds were made available to teachers for travel to professional conferences, and to purchase a modem or network card for their school computer. Each mentor's laboratory received \$1,000 as reimbursement for expenses incurred by the teacher.

Program expenses were \$407,754 in 2004, and \$433,481 in 2005. The increase in Program expenses from 2004 to 2005 reflects the inclusion of expenses incurred in connection with the New York Hall of Science Partnerships (see Section IIIc). An increase from 2003 to 2004 is attributed to the Singapore International Exchange (see Section IIIf). Since its inception in 1990, the Program has expended approximately \$4,350,000 for teacher professional development, an average cost of \$24,431 per program participant. After further analysis, this proves to be very cost-effective.

To earn a regular high school diploma in New York State, a student must pass five Regents exams, at least one of which must be in science.⁶ The proportion of New York City high school students passing a science Regents exam is lower than for all other subject areas. This means that passing a Regents exam in science is the highest academic hurdle a student must surmount to earn a diploma.⁷

Since 22% more students of teachers from Columbia's Program pass a Regents exam in science, it is very likely that a few more students will graduate from high school with a Regents diploma because he or she studied science in a class taught by teacher from Columbia's *Summer Research Program*. An increase in students passing a Regents science exam reduces the number of students who must enroll in summer school or repeat a high school science course and potentially fulfill one of the most difficult requirements to obtain a high school diploma.

New York City spends \$12,930 per year to educate each public school student.⁸ Most high school students take five courses per year. Thus, New York City spends an average of \$2,586 per course per high school student.

High school graduates earn \$273,000 more in a lifetime than students who complete 12th grade but do not earn a high school diploma.⁹ The tax revenues generated by \$273,000 in additional lifetime earnings, at a 20% tax rate, are \$54,600.

An additional economic impact of a teacher's participation in Columbia's Program is teacher retention. In the 16 years since the *Summer Research Program*'s inception, the attrition rate has been 4% per year. In contrast, nationwide ~12.5% of science teachers drop out of education annually.¹⁰ School systems spend ~\$16,000 to replace a teacher.¹¹ In total, each teacher's participation in Columbia's Program has the potential of bringing a return of at least \$73,000, triple the cost of their Program participation. As additional students pass the science Regents Exam, the return on the Program's investment continues to increase.

Acknowledgments

The Program gratefully acknowledges funding in 2004 and/or 2005 from the *Braitmeyer Foundation, Bristol-Myers Squibb Foundation, Camille and Henry Dreyfus Foundation, Howard Hughes Medical Institute, JP Morgan Chase Foundation, Mellam Family Foundation, NASA, National Institutes of Health, National Science Foundation, and New York Times Company Foundation*. Renewed support will be requested from past and current uncommitted donors. The Program continues to seek new sources of support for teacher stipends, Program costs, and evaluation research.

The Program is grateful to **Columbia University** for in-kind support. A special thanks go to **Columbia's Library Services**, which provides library borrowing privileges to Program participants, and library access to Program alumni and their students.

The Program thanks the many unnamed **Columbia faculty, postdoctoral fellows, graduate students and staff** who have so generously contributed their time, knowledge, and laboratories to benefit the science teachers in the New York metropolitan area. Special thanks are due to the Chairmen and faculty of the Departments of Physiology and Cellular Biophysics and of Anatomy and Cell Biology for making their departmental meeting rooms available to the *Summer Research Program* for its weekly summer seminars and meetings and its end of summer symposia, and to **Ms. Sharry Wilson** for editing this report.

"I enjoyed taking what I learned last summer and using it to create an epidemiology/infectious disease unit. My enthusiasm for the topic spread to the students – it was infectious!"

Kathleen Rucker, Brooklyn International High School
Class of 2006



References

- ¹ Loucks-Horsley, S., Love, N., Stiles, K.E., Mundry, S., Hewson, P.W., *Designing Professional Development for Teachers of Science and Mathematics*, Corwin Press, 2003.
- ² Michael Garet, Beatrice Birman, Andrew Porter, Laura Desimone, R. Herman, Kwang Suk Yoon, *Designing Effective Professional Development: Lessons From the Eisenhower Program*, Washington, D.C., U.S. Department of Education, 1999.
- ³ National Resource Council (U.S.), *National Science Education Standards*; Washington, D.C.: National Academy Press, 1996.
- ⁴ United Nations Children’s Fund, *A League Table of Educational Disadvantage in Rich Nations*; Florence, Italy; Innocenti Report Card, November 2002.
- ⁵ National Science Foundation Award 9812142; <http://www.SweptStudy.org>
- ⁶ New York State Education Department, *New York State Total Public Report Card*, March 18, 2005, <http://www.emsc.nysed.gov/repcrd2004/statewide/2004statewidecir.pdf>
- ⁷ New York City Regents examination data from school report cards 2003-2004; <http://schools.nyc.gov/OurSchools/default.htm>
- ⁸ The New York Sun, *New York Outpacing Other States in School Spending U.S. Data Show*, April 4, 2006; <http://www.nysun.com/article/30299>
- ⁹ Cantu, R., *Texas Labor Market Review*, Labor Market Information Department, Texas Workforce Commission, December 2003.
- ¹⁰ Weisbaum, K. and Huang, D., *IISME Teacher Retention and Program Impact Evaluation 1985-2000*. Cupertino, CA: Industry Initiatives for Science and Math Education, 2001.
- ¹¹ Texas Center for Educational Research, “*The Cost of Teacher Turnover*,” Austin, TX, November 2000; <http://www.sbec.state.tx.us/SBECOnline/txbess/turnoverrpt.pdf>



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APPENDICES

Appendix I

Class of 2004

Columbia Participants

- WILLIAM DUGAN**, The High School for Math, Science and Engineering, Manhattan
Mentor: Professor Peter Schlosser, Earth & Environmental Sciences
Project: *Visualization of Transport and Fate of Output from Newtown Creek: A Tracer Release Experiment*
- FADY ISHAK**, Legacy High School, Manhattan
Mentor: Professor David Adams, Chemistry
Project: *A Molecular Switch Based on a Biologically Important Redux Reaction*
- LESIA KASZCZAK**, Yonkers Middle High School, Westchester
Mentor: Dr. Saul Silverstein, Microbiology
Project: *Expression of Human Papillomavirus Type 18E6 Protein from Viral Vectors and the Effect on hInaDL Cellular Interactions*
- MATTHEW NANES**, Park West High School, Manhattan
Mentor: Professor Martin Stute, Research Scientist, Geochemistry
Project: *Arsenic mobilization in groundwater as observed from Bangladesh, Winthrop, ME & Vineland, NJ*
- OLUWASEGUN OMOLOJU**, Bronx High School of Science
Mentor: Professor Thomas Pedersen, Applied Physics & Applied Math
Project: *Construction of the Columbia Non-neutral Torus*
- STEVEN OSZUST**, Gateway School of Environmental Research & Technology, Bronx
Mentor: Dr. Hari Bhat, Environmental Health Services
Project: *The Inhibitory Effect of the Phytoestrogen Genistein on Estrogen Metabolism in MCF-7 Cells*
- LARISSA RAVEN**, Emerson High School, New Jersey
Mentor: Professor Jeffrey Holmes, Biomedical Engineering
Project: *Cell Size Change During Growth and Remodeling of Heart Muscle*
- SANDRA SANTILLAN**, Susan E. Wagner High School, Staten Island
Mentor: Professor Martin Stute, GeoChemistry
Project: *Arsenic Geochemistry and Remediation at U.S. Superfund Sites*
- UZMA SHAH**, Baruch College Campus High School, Manhattan
Mentor: Dr. Lorraine Symington, Microbiology
Project: *What Role do the Proteins Rad55 and Rad57 Have in Repairing DNA Damage in Saccharomyces Cerevisiae?*

Appendix I (continued)

SHEREEN SPRINGER, Teachers Preparatory School, Brooklyn

Mentor: Dr. Howard Lieberman, Radiation Oncology

Project: *The Effect of Mrad9 on the Abundance of Specific Proteins Involved in Cell Cycle Control*

TONYA SPRINGER-DE CAUL, William H. Maxwell Career & Technical High School, Brooklyn

Mentor: Professor Irving Herman, Applied Physics & Applied Math

Project: *Fabrication of Micro-nanochannels for Fluidic Studies*

JEREMY SZERLIP, Scarsdale High School, Westchester

Mentor: Dr. Lloyd Greene, Pathology

Project: *The Effect of PUMA in Neuronal Cells in a DNA Damage Model*

LINDA VALES, John Dewey High School, Brooklyn

Mentor: Dr. Howard Kaufman, Surgery

Project: *Measurement of Cytokines, IL-12(p70) and IFN- γ , From Dendritic Cells Infected with 4-1-BBL*

New York University Partners in Science

JUDITH EXLER, Norman Thomas High School, Manhattan

Mentor: Dr. Alexander Vologodskii, Chemistry

Project: *Formation of Opened Regions in Supercoiled DNA*

GREGORY LINN, High School of Economic and Finance, Manhattan

Mentor: Dr. Young-Tae Chang, Chemistry

Project: *Synthesizing REDOX Indicators*

STEVEN SCHWARTZ, New Dorp High School, Staten Island

Mentor: Dr. Alexej Jerschow, Chemistry

Project: *How Do Frescoes Fade?*

Singapore Exchange Teachers

SOO MUN KEON PATRICK, Anglo-Chinese School

Mentor: Professor Richard Osgood, Physics & Applied Math

ALISTAIR CHEW, Anglo-Chinese School

Mentor: Professor Brian Gibney, Chemistry

SEE TECK HOK, Anglo-Chinese School

Mentor: Dr. Christian Schindler, Microbiology

Appendix II

Class of 2005

CARLA BRATHWAITE, Midwood High School, Brooklyn

Mentor: Professor Siu-Wai Chan, Applied Physics and Applied Math
Project: *Nanocrystalline Cerium Oxide (CeO₂) Synthesis and the Redox Titration of Cerium Oxide*

ANNIE CHIEN, School of the Future, Manhattan

Mentor: Professor Ronald Breslow, Chemistry
Project: *Synthesis of Molecular Wires Using OTEs and OPEs Potential Models for Molecular Wires*

JASON CHOI, Sleepy Hollow High School, Westchester

Mentor: Professor Philip Kim, Physics
Project: *The Synthesis of Carbon Nanotubes and a Study of Their Electron Transport Properties*

JENNIFER CLARK, Talent Unlimited High School, Manhattan

Mentor: Professor Nicholas Turro, Chemistry
Project: *A New Treatment for Cancer*

NAOMI COOK, Humanities Preparatory Academy, Manhattan

Mentor: Dr. Joseph Gogos, Physiology and Cellular Biophysics
Project: *Interrupting the NgR1 Signaling Pathway Using a Dominant/Negative Inducible Knockout Mouse*

JOYCE FRUCHTER, Yeshiva of Flatbush HS, Brooklyn

Mentor: Dr. Li Zhang, Environmental Health Science
Project: *Characterization of the Topographical Relationship of Hap1 and the Molecular Chaperones by FRET*

ALLISON GRANBERRY, Hostos-Lincoln Academy, Manhattan

Mentor: Dr. Stephen Goff, Biochemistry and Molecular Biophysics
Project: *Role of Ribosomal S3a and L4 in Viral Protein Production of Moloney Murine Leukemia Virus*

ZULEMA JONES-ENOE, Juan Morel Campos IS 71, Brooklyn

Mentor: Professor Colin Nuckolls, Chemistry
Project: *Fabrication of PDMS Microfluidic Systems to Develop Nanotube Sensors*

EMILY NOTO, East Side Middle School, Manhattan

Mentor: Professor Arlin Crotts, Astronomy
Project: *Microlensing Exploration of the Galaxy Andromeda: An Analysis of Stellar Images and Light Curves*

SASHA O'CONNOR, William H. Maxwell Vocational & Technical High School, Brooklyn

Mentor: Professor Donald Hood, Ophthalmic Sciences
Project: *Using the Multifocal Electroretinogram (mfERG) to Observe an Ordered Effect in Sequential Testing*

Appendix II (continued)

JENNIFER SULLIVAN, Midwood High School, Brooklyn
Mentor: Dr. Franklin Costantini, Genetics & Development
Project: *Search for GDNF-inducible Cis-regulatory Genetic Elements*

Singapore Exchange Teachers

CHEOK LAI LING MAY, Christ Church Secondary School
Mentor: Professor Hilary Callahan, Biological Sciences, Barnard College

CHEONG YUEN PAUL, Anglo-Chinese School
Mentor: Dr. Christian Schindler, Microbiology

CHER CHUAN LIM EDWIN, Victoria Junior College
Mentor: Professor Irving Herman, Physics

YAP SHEAU WEI LYDIA, Anglo-Chinese School
Mentor: Dr. Liza Pon, Anatomy

YEAP KAR WEI, Anglo-Chinese School
Mentor: Professor Philip Kim, Applied Physics & Applied Math

Appendix III

Class of 2006 (*entered in 2005*)

BRIGETTE BRADY, Forest Hills High School, Queens

Mentor: Dr. Oliver Hobert, Biochemistry and Molecular Biophysics
Project: *Genetic Analysis of Factors Regulating Asymmetric Fates of ASEL/ASER Neurons in Caenorhabditis Elegans*

KATHERINE CALLAGHAN, Bronx Leadership Academy II

Mentor: Dr. Gary Struhl, Genetics and Development
Project: *A F1 Screen in Drosophila for Enhancers/Suppressors of a Dominant Eye Phenotype From Mutations in Patched, Engrailed and Flamingo*

GHULAM FIRDAUS, Law and Public Service High School, Manhattan

Mentor: Professor Irving Herman, Applied Physics and Applied Math
Project: *Controlled Dielectrophoretic Alignment of Single Walled Carbon Nanotubes (SWNTs)*

ANDREW HALL, Manhattan Center for Science and Mathematics

Mentor: Dr. Nicholas Turro, Chemistry
Project: *Oxidation of Carbon Monoxide Using Copper Oxide Nanoparticles*

ELLEN HSI, John F. Kennedy High School, Nassau

Mentor: Dr. Donald Landry, Medicine
Project: *High Throughput Detection of Thermostable Mutants of Cocaine Esterase (CocE)*

NANCY LEE, Briarcliff High School, Westchester

Mentor: Dr. Eric Schon, Neurology
Project: *Positional Cloning of the Region in an Oncocytoma With a Duplication at 11q13.3*

ANN MEYER, New Explorations into Science, Math & Technology, Manhattan

Mentor: Professor Rastislav Levicky, Chemical Engineering
Project: *Silicone Gel Thin Films*

SHANE RIORDAN, New York Harbor School, Brooklyn

Mentor: Dr. Aleksey Kaplan, Research Scientist
Project: *An Investigation into the Relationships Between Sea Surface Temperature, Sea Air Temperature and Coastal Air Temperature*

KATHLEEN RUCKER, Brooklyn International High School

Mentor: Dr. Ian Lipkin, Epidemiology
Project: *Preliminary Study of Bacterial and Fungal Diversity in Times Square Subway Station*

MARGARET SAVITZKY, Thomas A. Edison Vocational/Technical High School, Queens

Mentor: Dr. Rodney Rothstein, Genetics and Development
Project: *RAD52 Splice Variants Affect Homology-directed DNA Repair*

MICHELLE SEELEY, Elmont Memorial Junior/Senior High School, Nassau

Mentor: Dr. Hari Bhat, Environmental Health Science
Project: *Phytoestrogens and Estrogen-metabolizing Genes*

SUSAN VINCENT, Young Women's Leadership School of East Harlem, Manhattan

Mentor: Professor Peter Schlosser, Earth and Environmental Engineering
Project: *Is it Possible to Have a Sustained, Biologically Healthy Estuarine System in the Midst of a Highly Populated Industrial Area?*

Appendix IV

Demographics

	2003-05 Applicants (160)	2004 Participants (24)	2005 Participants (23)
Public Schools	94%	96%	96%
Independent Schools	5%	0%	0%
Parochial Schools	1%	4%	4%
Male	47%	25%	13%
Female	53%	75%	87%
African-American	23%	33%	13%
Latino	10%	13%	4%
White	50%	33%	57%
Other	17%	21%	26%

[Note that of the 24 participants in 2004, 12 entered the Program in 2003 and 12 entered in 2004. Of the 23 participants in 2005, 11 entered the Program in 2004 and 12 entered in 2005.]

The 36 teachers who participated in the 2004 and 2005 Programs had an average of six years teaching experience; 72% held master's degrees, 97% worked in co-educational schools. Of the schools represented, 32 were public schools and one was a parochial school.

1990-2005 Participants (176)

Public	Independent	Parochial	Male	Female	Black	Hispanic	White	Other
87%	9%	4%	40%	60%	21%	7%	55%	17%

Appendix V (continued)

2004 Calendar of Group Activities

Monday, August 9

Participant Reports: Tonya Springer, Larissa Raven
Workshop: *Presentations*, Jeanette Kim, NY Academy of Sciences
Lecture: *Sparks of Discovery: From Lab Bench to Patient's Bed ... and Back Again*, Drs. Stephan Mayer and Marek Mirski
Small Group Discussions: Best Practices
Demo Lesson
Final Action Plans Submitted
Group and Individual Photo Session

End of Summer Symposium

Monday, August 16

Participant Reports: Linda Vales, Fady Ishak, Steven Oszust, Uzma Shah
Lecture: *Understanding Cognitive Events Using fMRI*, Dr. Joy Hirsch, Center for Neurobiology
Presentation: *Responsible Conduct of Research: Ethical Guidelines and Federal Regulations*, Jay Dubner, Program Coordinator
Poster Session I
Joyce Fruchter, Allison Granberry, Zulema Jones-Enoe, Emily Noto, Sasha O'Connor, Jennifer Sullivan

Tuesday, August 17

Participant Reports: Olu Omolaju, Lesia Kaszczak, William Dugan, Judith Exler, Steven Schwartz
Demo Lesson
Poster Session II
Carla Brathwaite, Annie Chien, Jason Choi, Jennifer Clark, Naomi Cook

Wednesday, August 18

Participant Reports: Shereen Springer, Jeremy Szerlip, Gregory Linn, Sandy Santillan
Written Research Reports Submitted
Closing Remarks and Presentation of Certificates

Appendix VI

2005 Calendar of Group Activities

- Wednesday, June 29** **Laboratory Orientation** (*1st year participants*)
Dr. Greg Freyer, Assoc. Professor, Env. Health Sciences
Presentation: *Responsible Conduct of Research: Ethical Guidelines and Federal Regulations*, Jay Dubner, Program Coordinator
(*1st year participants*)
- Thursday, June 30** **Opening Remarks**
Program and University Orientation
Laboratory Safety/Chemical Hygiene Seminar
(*1st year participants*)
STEP Program Discussion, Dr. Klyvert (*2nd year participants*)
- Monday, July 11** **Workshop:** *Chemistry in Our Lives*, Dr. Anju Sharma, Stevens Institute of Technology
Presentation: *Singapore Teacher Exchange: Anglo-Chinese School*, Yeap Kar Wei, Paul Cheong Yuen and Lydia Yap Sheau Wei
Small Group Discussion: Peer Coaching Groups
2004 Action Plan Presentations
Radiation Safety Training (*1st year participants*)
- Monday, July 18** **Field Trip**
Sleepy Hollow High School, Westchester
- Monday, July 25** **Presentation:** *Singapore Teacher Exchange: Ministry of Education*, Edwin Cher Chuan Lim and May Cheok Lai Ling
Small Group Discussions: Best Practices
Workshop: *Using the New York Science Times as an Instructional Tool*, Stanley Shapiro
- Monday, August 1** **Presentation:** *Using Data to Inform Curriculum, Instruction, and Professional Development in Science Education*, Mary Elizabeth Wilson (Class of 1996)
Lecture: *Bioterrorism and Emerging Infections*, Dr. Ian Lipkin, Department of Epidemiology
Lecture: *Hypothesis Testing: Historical Research on Individual and Group Decision Making in Grasslands Agriculture*, Sabena Marx and Dr. Roberta Balstad, Center for Research on Environmental Decisions
Presentation: *Singapore Teacher Exchange: Columbia Participants*, Mary Elizabeth Wilson (Class of 1906), Lesia Kaszczak (Class of 2004), and Uzma Shah (Class of 2004)

Appendix VI (continued)

2005 Calendar of Group Activities

Monday, August 8

Action Plan Workgroups

Mary Elizabeth Wilson (Class of 1996) and George Stengren (Class of 2002)

Discussion: *Embryonic Stem Cells and Chimeras*, Dr. John Loike, Department of Physiology

Discussion: *How to give a lecture*, Dr. Samuel Silverstein, Program Director (2nd year participants)

Presentation: *Grant Writing For the Classroom Teacher*, Jay Dubner, Program Coordinator (1st year participants)

Presentation: *Preparing your poster board*, Jay Dubner, Program Coordinator (1st year participants)

Preliminary Action Plans Submitted

Monday, August 15

Workshop: - *Powerful Polymers*, New York Hall of Science

Lecture: *Vertical Farming*, Dr. Dickson Despommier, School of Public Health

Group and Individual Photo Session

Final Action Plans Submitted

End of Summer Symposium

Monday, August 22

Participant Reports: Jason Choi, Emily Noto, Jennifer Sullivan

Lecture: *Human Population*, John Bongaarts, Population Council

Demo Lesson: *Using Candy to Calculate Average Mass of Isotopes*, Jennifer Clark (Class of 2005)

Demo Lesson: *Biotechnology on a Shoestring* (Class of 2005)

Poster Session I

Brigette Brady, Ghulam Firdaus, Ann Meyer, Margaret Savitzky, Michelle Seeley, Susan Vincent

Tuesday, August 23

Participant Reports: Jennifer Clark, Joyce Fruchter, Allison Granberry, Zulema Jones-Enoe

Demo Lesson: *Magic Water*, Annie Chien (Class of 2005)

Demo Lesson: *Genetics and Addiction*, Marietta Cleckley (Class of 2000)

Poster Session I

Katherine Callaghan, Andrew Hall, Ellen Hsi, Nancy Lee, Shane Riordan, Kathleen Rucker

Wednesday, August 24

Participant Reports: Carla Brathwaite, Annie Chien, Naomi Cook, Sasha O'Connor

Written Research Reports Submitted

Closing Remarks and Presentation of Certificates

Appendix VII

Alumni

<u>Alumni</u>	<u>Class</u>	<u>School</u>
Twana Adams	1993	Bronx Alternative School, Bronx (last known)
Sasha Alcott	1998	Stuyvesant High School, Manhattan
Charmaine Alexander	2000	Martin Van Buren High School, Queens
Thomas Allen	1995	Bayard Rustin HS for the Humanities, Manhattan
Luis Amaya	1998	Flushing High School, Queens
Roy Arezzo	1997	New York Harbor School, Brooklyn
Harvey Augenbraun	1997	Retired
Dora Barlaz	1992	Horace Mann School, Bronx
Michael Barr	2003	Columbia School for Math & Science, Bronx
Rachel Berger-Connolly	1998	American Museum of Natural History
Koshi Bharwani-Dhingra	1996	Adjunct Professor, University of North Texas
Paul Bianchi	1993	Horace Greeley High School, Westchester County
Oscar Boglin	1996	Frederick Douglass High School, Atlanta, Georgia
Gregory Borman	1994	Dept. of Math & Science, NYC Dept. of Education
Ana Butler	1994	Our Lady of Victory Catholic School, Pennsylvania
Tom Byrne	2003	New Rochelle High School, Westchester County
Terri Lee Campbell-Mehmeti	1991	Valley Central High School, Montgomery, New York
Freddy Cedeno	1995	Theodore Roosevelt High School, Bronx
Sau Ling (Charlene) Chan	1998	Manhattan Center for Science and Mathematics
Eugene Cho	1995	Martin Van Buren High School, Queens (last known)
Meihwa Chow	1991	Young Women's Leadership School, Manhattan
Jerry Citron	1996	Stuyvesant High School, Manhattan
Caren Cleckley	1999	Brooklyn Academy of Science and the Environment
Traci Collier	2003	High School for Information Technology, Queens
Kenneth Daly	1993	Retired
Marlyn Daniel-Paul	1995	John Dewey High School, Brooklyn
Richard D'Auria	1993	Region 7 Local Instructional Superintendent, Bklyn & SI
Derresa Davis-Tobin	1999	Region 8 Local Instructional Superintendent, Brooklyn
Joanne DeMizio	2003	Archdiocese of New York, Manhattan
David Deutsch	2001	Manhattan Center for Science and Mathematics
Mercedes Diez-McNicholas	1998	Mott Hall School, Manhattan
Natalie DiPaolo	2002	Saunders Trade & Technical HS, Westchester County
Florence Dodier	2003	Malverne High School, Nassau County
Felix Duah	1994	John F. Kennedy High School, Bronx
Gusteau Duclos	1996	DeVry University, Queens
Neil Farley	1998	Bronx High School of Science
Alice Feinberg	1996	Residency in Radiology, Pennsylvania
Todd Flomberg	2001	The Nightingale-Bamford School, Manhattan
Gary Foote	1991	South Carroll High School, Maryland
Mitchell Fox	1994	Bronx High School of Science, Bronx
Carlos Franco	2002	Sleepy Hollow High School, Westchester County
David Friedman	2003	General Douglas MacArthur High School, Nassau County
Denice Gamper	1993	Bard High School Early College, Manhattan

Appendix VII (continued)

Alumni

<u>Alumni</u>	<u>Class</u>	<u>School</u>
Mary-anne Garcia	2000	Bronx Aerospace Academy
Arthur Geen	1998	I.S. 227, Brooklyn
JoAnn Gensert	1991	Columbia University, Ph.D. Candidate (last known)
P. Mathew George	1998	George Wingate High School, Brooklyn
Jennifer Giddings	1993	UN International School, Manhattan (last known)
Joanne Giordano	1999	St. George School, Staten Island
Jennifer Girard	2001	Lawrence High School, New Jersey
Michael Gresko	1994	Bat Torah - Alisa M. Flatow Yeshiva, Suffern, NY
Najla Hallak	2002	Martin Van Buren High School, Queens
Lettie Hartwell	1998	Frederick Douglass Academy, Manhattan
Peter Hoey	1992	Columbia University, Ph.D. Candidate (last known)
Shirley Hopkins	1991	Robert F. Wagner Collaborative H.S., Queens
Amber Howes	2002	Middle School, Douglas County, Georgia
Helen Hurh	2000	Private Industry
Neil Jaffee	1992	Retired
Cherryann Joseph	2001	Brooklyn Technical High School
George Joseph	1991	Taft High School, Bronx
Martine Joseph	2001	George Wingate High School, Brooklyn
Penina Karp	1993	Shulamith High School, Brooklyn
Diane Kelly	2002	Maternity leave
Edwin Klibaner	1994	Retired
Robert Kluberanz	1995	Middle College High School, Queens
Justine Kohlmann	2000	Manhattan International School
Ditta Korbeogo	1997	Samuel J. Tilden High School, Brooklyn
Jennifer Kosnik	1999	Convent of the Sacred Heart, Manhattan
Nicole Kram-Rosen	1999	Region 10 Mentor Program Coordinator, Manhattan
Harold Kucine	2000	JHS 126-K & Shaare Torah High School, Brooklyn
Jennifer Lagnado	2002	Lawrence High School, Nassau County
Philip Lalli	1996	Adlai Stevenson High School, Bronx
Richard Lee	1991	Bronx High School of Science, Bronx
Barbara Lillien	2002	South Shore High School, Brooklyn
Compton Mahase	1993	Fieldston School, Bronx
Mary Mallia	1997	Archibishop Malloy High School, Queens
Irene Matejko	1991	Riverdale Country School, Bronx
Anthony Mauro	1999	Fort Hamilton High School, Brooklyn
Tonya McKie	1994	JHS 275, Brooklyn
Maudlin McLean	1994	Jamaica High School, Queens
Gustavo Medina	1994	Jamaica High School, Queens
Paul Melkonian	1999	Satellite Academy High School, Manhattan
Jose Merced	1996	John Dewey High School, Brooklyn
Verona Moncrieffe	1992	New Dorp High School, Staten Island
Kathleen Monroe	1991	North Forsyth HS, Winston-Salem, North Carolina
Spiridoula Moulinos	2000	Leave of absence
Bhuall Nand-Kumar	1993	Wagner College, Staten Island

Appendix VII (continued)

Alumni

<u>Alumni</u>	<u>Class</u>	<u>School</u>
Matthew Nanes	2003	James Madison High School, Brooklyn
Keshaw Narine	1997	Bishop Kearney High School, Brooklyn
Robert Nociti	1999	Retired
Stephen Pearl	1995	White Plains High School, Westchester County
Jose Pena	1999	North Rockland High School, Rockland County
Maria Perez	2003	Professional Performing Arts School, Manhattan
Bibiane Petutschnig	2003	Maternity Leave
Melinda Pittis-Leitch	2001	BOCES of Southern Westchester County
Trudy Prout-Phillips	2000	Chattahoochee High School, Georgia
Kiran Purohit	2002	Manhattan Academy of Technology (last known)
Britt Reichborn-Kjennerud	1998	Graduate Student, Columbia University
Palma Repole	2002	Fieldston Ethical Culture School, Bronx
Tehilla Rieser	1998	SAR Academy, Bronx
Megan Roberts	2002	Region 9 Regional Instructional Supervisor, Manhattan
Wendy Rokach	2000	Maternity leave
Anthony Romano	1992	John Bowne High School, Queens
Marc Rosner	1995	Hastings High School, Westchester County
Adrienne Rubin	2000	Eleanor Roosevelt High School, Manhattan
Steven Running	1993	Xavier College Preparatory, Phoenix, Arizona
Dean Saghafi- Ezaz	1999	Pelham Memorial High School, Westchester County
Stephanie Sanchez	1992	Harry Truman High School, Bronx (last known)
David Sappin	1997	Middletown North High School, New Jersey
Keith Sheppard	1992	Teachers College (Assistant Professor)
Sausen Silmi	1997	Susan E. Wagner High School, Staten Island
Charles Simic	1996	Bayside High School, Queens
Carmen Simon	2001	Teacher Preparatory, Brooklyn
Savitri Singh	1997	Nyack High School, Rockland County
Gail Sobel	1994	Grover Cleveland High School, Queens (last known)
Dana Solecki-Okeson	1996	St. Ann's School, Brooklyn
Mary Ann Spicijaric	1995	St. Francis Prep High School, Queens
Gila Stein	2002	Maayanot Yeshiva High School, New Jersey
George Stengren	2002	Heritage High School, Manhattan
Ben Stevens	2003	Manhattan Center for Science and Mathematics
Michelle Stinvil	2000	William H. Maxwell Career and Technical HS, Brooklyn
Elliot Stolowitz	1993	Susan Wagner High School, Staten Island
Alex Thomas	1994	JHS 231, Queens
Peter Torpie	2001	New Milford High School, New Jersey
Hoa Tu	2001	Henry Street International School, Manhattan
Mardi Tuminaro	1991	Central Park East Secondary School, Manhattan
Jassy Ubhi	2000	Bayard Rustin HS for the Humanities, Manhattan
Khadija Vann	2002	Far Rockaway High School, Queens
Diane Walsh	1991	Regis High School, Manhattan
Raymond Walsh	1992	Southwestern U. Medical School, Texas (last known)
Youning Wang	2003	Murry Bergtraum High School, Manhattan

Appendix VII (continued)

Alumni

<u>Alumni</u>	<u>Class</u>	<u>School</u>
Kenneth Wasserman	1995	Highland Park High School, New Jersey
Melissa Webster	2003	Hastings-on-Hudson High School, Westchester County
Michelle White	1996	University Preparatory Academy, Detroit, Michigan
Mary Elizabeth Wilson	1996	Evaluation Consultant
Robert Winston	1992	Thomas A. Edison Voc/Tech High School, Queens
Nelly Zapana	1999	Park West High School, Manhattan
Jane Zeng	2002	HS for Dual Language & Asian Studies, Manhattan
Zihwa Zheng	1998	George Wingate High School, Brooklyn

Partners in Science Alumni

Ayorinde Ayetiwa	1999	Washington Irving High School, Manhattan
Caren Birchwood-Taylor	2000	Region 3 Mentor, Queens
Monika Biro	2000	Gilmour Academy, Ohio
H. Alexandria Bodha	2000	LaGuardia HS for the Performing Arts, Manhattan
Marietta Cleckley	2000	Uniondale High School, Nassau County
Shalton Colquhoun	2000	Mt. Vernon High School, Westchester Country
Nirmala Darmarajah	2001	Leon Goldstein High School, Brooklyn
Valentine Edobor-Osula, Jr.	2000	Fort Hamilton High School, Brooklyn
Paul Englehart	1999	Syosset High School, Nassau County
Annilisse Falzone	1998	Bronx High School of Science
Gregory Fisher	1999	Ridgefield High School, Connecticut
Denice Gamper	1999	Bard High School Early College, Brooklyn
Mary-anne Garcia	2002	Bronx Aerospace Academy
Kelly Iwaki	1999	Private Industry
Rosa Jimenez	1999	Washington Irving High School, Manhattan (last known)
Compton Mahase	2001	Fieldston School, Bronx
Anthony Mauro	1999	Ft. Hamilton High School, Brooklyn
Robert Nociti	1999	George Washington High School, Manhattan
Michael O'Leary	1999	Teaching in upstate New York
Martin Olivieri	2000	High School of American Studies, Bronx
Vanessa Parkinson	1997	Benjamin Banneker Academy, Brooklyn
Eric Paul	2000	Bergen Academies, New Jersey
Shanti Rywkin	2000	Borough of Manhattan Community College
Rodolfo Santos	2001	HS of International Business and Finance, Manhattan
Ibrahim Sesay	1998	Theodore Roosevelt High School, Bronx
Jerry Snowwhite	1999	Brooklyn Technical High School
Horace Walcott	2002	Brooklyn Technical High School
Jacqueline Watt-Daniels	1998	Marta Valle Model High School, Manhattan
Hossein Zamani	1998	Roosevelt Jr.-Sr. High School, Nassau County

Appendix VIII

Video Library

2005

Human Population, *Dr. John Bongaart*

Vertical Farming, *Dr. Dickson Despommier*

Bioterrorism and Emerging Infections, *Dr. Ian Lipkin*

Historical Research on Individual and Group Decision Making in Grasslands Agriculture, *Sabine Marx & Roberta Balstad*

2004

Understanding Cognitive Events Using fMRI, *Dr. Joy Hirsch*

Sparks of Discovery: From Lab Bench to Patient's Bed...and Back Again, *Drs. Stephan Mayer & Marek Mirski*

Poilly-le-Fort, May 1881. The Anthrax Experiments of Pasteur, Chamberland and Roux, *Dr. Richard Kessin* Living With Electromagnetic Fields: Are Cell Phones Safe?, *Dr. Martin Blank*

2003

Where Do New Infectious Diseases Come From?, *Dr. Dickson Despommier*

Paradigms Found & Paradigms Lost, *Dr. Nicholas Turro*

How Superman Sees the Stars, *Dr. David Helfand*

2002

Bioterrorism: The Invisible Enemy, *Dr. Phyllis Della-Latta*

The Effects of Temperature on Respiration: What Can Biosphere 2 Teach Us About the Forests of New York and New Zealand?, *Dr. Kevin Griffin*

Polar Bears Don't Play Nintendo: Enrichment Programs in Modern Zoo, *Dr. Don Moore*

Stem Cells: Science, Policy and Ethics, *Dr. Gerald Fischbach*

The West Nile Virus: Deja Vu All Over Again, *Dr. Dickson Despommier*

2001

How Humans Defend Against Bacterial Infections, *Dr. Samuel Silverstein*

How I Stopped Worrying and Learned to Love the Genome Project, *Dr. Joel Buxbaum*

Reflections on Dolphin Communication & Cognition, *Dr. Diana Reiss*

Watching the Mind at Work, *Dr. Joy Hirsch*

The West Nile Story, *Dr. Dickson Despommier*

2000

Beta Oxidation of Unsaturated Fatty Acids, *Dr. Horst Schulz*

Gene Therapy, *Dr. Ronald Crystal*

Self-Assembled Nano Scale Materials, *Dr. Charles Michael Drain*

Symbiosis Ecology of Reef-Building, *Dr. Andrew Baker*

Viruses: Friend or Foe, *Dr. Hamish Young*

X-Ray Vision for the 21st Century, *Dr. David Helfand*

Appendix VIII (continued)

1999

The Cage Effect: From the Gas Phase to the Molecular Solvent Cage to the Supra Molecular Cage to the Superduper Molecular Cage, *Dr. Nicholas Turro*
HLA: Autoimmunity in HIV, *Dr. Ned Braunstein*
The Human Genome Project, *Dr. Isidore Edelman*
The Science of Substance Abuse Treatment, *Dr. Herbert Kleber*
The World View From One Billionth of an Inch: Scanning Tunneling Microscopy of Molecular Adsorbates, *Dr. George Flynn*

1998

Antioxidants, Bioflavonoids, and Chalcones, *Dr. Nanette Wachter-Jurcsak*
Astronaut Training, *NASA Astronaut Fernando (Frank) Caldeiro*
Disorders in Cell Circuitry in Human Cancer, *Dr. I. Bernard Weinstein*
Electromagnetic Fields in the Environment: An Update, *Dr. Martin Blank*
How Trichinella Spiralis Makes Itself At Home, *Dr. Dickson Despommier*
Synapse Formation in Developing Mouse Brain, *Dr. Carol Mason*
White Blood Cells: How They Travel and How They Eat, *Dr. Samuel Silverstein*

1997

Cytoskeletal Control of Intercellular Organelle Movement, *Dr. Liza Pon*
The Evolution of Galaxies in Different Environments, *Dr. Jacqueline Van Gorkom*
The Second Brain, *Dr. Michael Gershon*
The Tree as a Focal Point for Environmental Education, *Dr. Dickson Despommier*
Understanding the Chemistry of Electronic Materials, *Dr. Stacey Bent*

1996

Generating Male and Female Brains, *Dr. Darcy Kelley*
The Human Genome Project, *Dr. Isidore Edelman*
New View of the Radio Universe, *Dr. David Helfand*
Using Computer Graphics to Study Protein Structure & Function, *Dr. Barry Honig*
Why Large Earthquakes Occur at Subduction Zones, *Dr. Chris Scholz*

1995

Earthquakes Happen When Expected and Not Expected, *Dr. Leonardo Seeber*
Electromagnetic Fields in the Environment, *Dr. Martin Blank*
Repair of Double Strand Breaks in Mammalian Cell DNA, *Dr. Hamisch Young*

1994

Fifty Years of Protein Phosphorylation, *Dr. David Brautigan*
Looking at Atoms & Molecules on the Surface of Materials, *Dr. Brian Bent*
Parasite Control of Host Genomic Expression, *Dr. Dickson Despommier*

1993

Developmental Neurobiology, *Dr. Carol Mason*
Diseases Associated With Mitochondria, *Dr. Eric Schon*
NYC Department of Health Report on Tuberculosis, *Gail Cairns*

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Marion, Massachusetts

Bristol-Myers Squibb Foundation

New York, New York

Camille and Henry Dreyfus Foundation

New York, New York

Howard Hughes Medical Institute

Chevy Chase, Maryland

JP Morgan Chase Foundation

New York, New York

Mellam Family Foundation

Redwood City, California

NASA/New York Space Grant

Cornell University

Ithaca, New York

National Institutes of Health

Bethesda, Maryland

National Science Foundation

Arlington, Virginia

New York Times Company Foundation

New York, New York

