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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
Table of Contents

Summary and Program Description. .................................. 4
Program Effects and Governance. .................................. 5
The Program. .............................................................. 6
Program Website. ........................................................ 11
Partnerships in Science Education. ................................. 13
Evaluation. ................................................................. 18
Operating Costs. .......................................................... 21
Acknowledgments. ......................................................... 22
References. ................................................................. 23
Appendices

I. Class of 2004................................................................. i
II. Class of 2005.............................................................. iii
III. Class of 2006 ............................................................ v
IV. Demographics ........................................................... vi
V. 2004 Calendar of Group Activities.................................... vii
VI. 2005 Calendar of Group Activities................................. ix
VII. Alumni ................................................................. xi
VIII. Video Library.......................................................... xv
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).

“In 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.
"(After participating in the Summer Research Program) I have more pride in being a teacher."

Jennifer Sullivan, Midwood High School
Class of 2005

### Table 1 - Multiple Program Participants in Same School

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

**m. Creating Supportive Climates for Educational Innovation:** Effective professional development programs stimulate teachers to work with one another. 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).
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. 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
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.
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.

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), and 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.

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,³ 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. Denice 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 study 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).

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“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. 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.

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. 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. 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. School systems spend ~$16,000 to replace a teacher. 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.
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


5. National Science Foundation Award 9812142; http://www.SweptStudy.org


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 (mERG) 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

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 Oncocytma 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

<table>
<thead>
<tr>
<th></th>
<th>2003-05 Applicants (160)</th>
<th>2004 Participants (24)</th>
<th>2005 Participants (23)</th>
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<tbody>
<tr>
<td><strong>Public Schools</strong></td>
<td>94%</td>
<td>96%</td>
<td>96%</td>
</tr>
<tr>
<td><strong>Independent Schools</strong></td>
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<td>0%</td>
</tr>
<tr>
<td><strong>Parochial Schools</strong></td>
<td>1%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>47%</td>
<td>25%</td>
<td>13%</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>53%</td>
<td>75%</td>
<td>87%</td>
</tr>
<tr>
<td><strong>African-American</strong></td>
<td>23%</td>
<td>33%</td>
<td>13%</td>
</tr>
<tr>
<td><strong>Latino</strong></td>
<td>10%</td>
<td>13%</td>
<td>4%</td>
</tr>
<tr>
<td><strong>White</strong></td>
<td>50%</td>
<td>33%</td>
<td>57%</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>17%</td>
<td>21%</td>
<td>26%</td>
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</table>

[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)

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Independent</th>
<th>Parochial</th>
<th>Male</th>
<th>Female</th>
<th>Black</th>
<th>Hispanic</th>
<th>White</th>
<th>Other</th>
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<tr>
<td>87%</td>
<td>9%</td>
<td>4%</td>
<td>40%</td>
<td>60%</td>
<td></td>
<td>21%</td>
<td>7%</td>
<td>55%</td>
<td>17%</td>
</tr>
</tbody>
</table>
Appendix V

2004 Calendar of Group Activities

Tuesday, June 29

**Laboratory Orientation (1st year participants)**
Dr. Greg Freyer, Assoc. Professor, Env. Health Sciences

Wednesday, 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 12

**Workshop: Buoyancy and Light/Optics**, Patsy CeCoster & Dave Vissoe; CPO Science
**Workshop: Sound and Hearing**, Dr. Elizabeth (Lisa) Olson, Otolarynology Department
**Small Group Discussion**: Peer Coaching Groups
**Radiation Safety Training** *(1st year participants)*

Monday, July 19

**2003 Action Plan Presentations**
**Lecture**: *Poilly-le-Fort, May 1881. The Anthrax Experiments of Pasteur, Chamberland and Roux*, Dr. Richard Kessin, Associate Dean of Graduate Students
**Presentation**: *National Board Certification*, Carlos Franco (Class of 2002)
**Lecture**: *Living with Electromagnetic Fields: Are Cell Phones Safe?* - Dr. Martin Blank, Physiology
**Presentation**: *Singapore Teacher Exchange: Science Education Instruction: East Meets West*, Tom Byrne, Denice Gamper, George Stengren, Melissa Webster, Alistair Chew, See Teck Hock and Patrick Soo Mun Keong
**Small Group Discussion**: Peer Coaching Groups

Monday, July 26

**Field Trip** - New York Hall of Science

Monday, August 2

**Action Plan Workgroups**: Mary Elizabeth Wilson (Class of 1996) and Dr. Keith Sheppard (Class of 1992)
**Workshop**: *Seltzer Breath*, Jeanette Kim, NY Academy of Sciences
**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**
### Appendix V (continued)

#### 2004 Calendar of Group Activities

<table>
<thead>
<tr>
<th>Date</th>
<th>Participants and Activities</th>
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<tr>
<td><strong>Monday, August 9</strong></td>
<td><strong>Participant Reports:</strong> Tonya Springer, Larissa Raven&lt;br&gt;<strong>Workshop:</strong> Presentations, Jeanette Kim, NY Academy of Sciences&lt;br&gt;<strong>Lecture:</strong> Sparks of Discovery: From Lab Bench to Patient's Bed ... and Back Again, Drs. Stephan Mayer and Marek Mirski&lt;br&gt;<strong>Small Group Discussions:</strong> Best Practices&lt;br&gt;<strong>Demo Lesson</strong>&lt;br&gt;<strong>Final Action Plans Submitted</strong>&lt;br&gt;<strong>Group and Individual Photo Session</strong></td>
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<td><strong>Monday, August 16</strong></td>
<td><strong>Participant Reports:</strong> Linda Vales, Fady Ishak, Steven Oszust, Uzma Shah&lt;br&gt;<strong>Lecture:</strong> Understanding Cognitive Events Using fMRI, Dr. Joy Hirsch, Center for Neurobiology&lt;br&gt;<strong>Presentation:</strong> Responsible Conduct of Research: Ethical Guidelines and Federal Regulations, Jay Dubner, Program Coordinator&lt;br&gt;<strong>Poster Session I</strong>&lt;br&gt;  - Joyce Fruchter, Allison Granberry, Zulema Jones-Enoe, Emily Noto, Sasha O’Connor, Jennifer Sullivan</td>
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<td><strong>Tuesday, August 17</strong></td>
<td><strong>Participant Reports:</strong> Olu Omoloju, Lesia Kaszczak, William Dugan, Judith Exler, Steven Schwartz&lt;br&gt;<strong>Demo Lesson</strong>&lt;br&gt;<strong>Poster Session II</strong>&lt;br&gt;  - Carla Brathwaite, Annie Chien, Jason Choi, Jennifer Clark, Naomi Cook</td>
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<td><strong>Wednesday, August 18</strong></td>
<td><strong>Participant Reports:</strong> Shereen Springer, Jeremy Szerlip, Gregory Linn, Sandy Santillan&lt;br&gt;<strong>Written Research Reports Submitted</strong>&lt;br&gt;<strong>Closing Remarks and Presentation of Certificates</strong></td>
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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

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<thead>
<tr>
<th>Name</th>
<th>Class</th>
<th>School</th>
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<tr>
<td>Twana Adams</td>
<td>1993</td>
<td>Bronx Alternative School, Bronx (last known)</td>
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<tr>
<td>Sasha Alcott</td>
<td>1998</td>
<td>Stuyvesant High School, Manhattan</td>
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<td>Charmaine Alexander</td>
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<td>Thomas Allen</td>
<td>1995</td>
<td>Bayard Rustin HS for the Humanities, Manhattan</td>
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<td>Luis Amaya</td>
<td>1998</td>
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<td>Roy Arezzo</td>
<td>1997</td>
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<td>Harvey Augenbraun</td>
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<tr>
<td>Dora Barlaz</td>
<td>1992</td>
<td>Horace Mann School, Bronx</td>
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<tr>
<td>Michael Barr</td>
<td>2003</td>
<td>Columbia School for Math &amp; Science, Bronx</td>
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<tr>
<td>Rachel Berger-Connolly</td>
<td>1998</td>
<td>American Museum of Natural History</td>
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<tr>
<td>Koshi Bharwani-Dhingra</td>
<td>1996</td>
<td>Adjunct Professor, University of North Texas</td>
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<td>Paul Bianchi</td>
<td>1993</td>
<td>Horace Greeley High School, Westchester County</td>
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<td>Oscar Boglin</td>
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<td>Frederick Douglass High School, Atlanta, Georgia</td>
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<td>Gregory Borman</td>
<td>1994</td>
<td>Dept. of Math &amp; Science, NYC Dept. of Education</td>
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<td>Ana Butler</td>
<td>1994</td>
<td>Our Lady of Victory Catholic School, Pennsylvania</td>
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<td>Tom Byrne</td>
<td>2003</td>
<td>New Rochelle High School, Westchester County</td>
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<td>Terri Lee Campbell-Mehmeti</td>
<td>1991</td>
<td>Valley Central High School, Montgomery, New York</td>
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<td>Freddy Cedeno</td>
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<td>Manhattan Center for Science and Mathematics</td>
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<td>Young Women’s Leadership School, Manhattan</td>
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<td>Caren Cleckley</td>
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<td>Brooklyn Academy of Science and the Environment</td>
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<td>Traci Collier</td>
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<td>Kenneth Daly</td>
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<td>Marilyn Daniel-Paul</td>
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<td>John Dewey High School, Brooklyn</td>
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<td>Richard D’Auria</td>
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<td>Region 7 Local Instructional Superintendent, Bklyn &amp; SI</td>
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<td>Derresa Davis-Tobin</td>
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<td>Joanne DeMizio</td>
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<td>Mercedes Diez-McNicholas</td>
<td>1998</td>
<td>Mott Hall School, Manhattan</td>
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<td>Natalie DiPaolo</td>
<td>2002</td>
<td>Saunders Trade &amp; Technical HS, Westchester County</td>
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<td>Florence Dodier</td>
<td>2003</td>
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<td>Alice Feinberg</td>
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<td>Residency in Radiology, Pennsylvania</td>
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<td>Todd Flomberg</td>
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<td>The Nightingale-Bamford School, Manhattan</td>
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<td>Gary Foote</td>
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<td>Carlos Franco</td>
<td>2002</td>
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<td>David Friedman</td>
<td>2003</td>
<td>General Douglas MacArthur High School, Nassau County</td>
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<td>Denice Gamper</td>
<td>1993</td>
<td>Bard High School Early College, Manhattan</td>
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Appendix VII (continued)

Alumni

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<tr>
<th>Alumni</th>
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<tr>
<td>Mary-anne Garcia</td>
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<td>Bronx Aerospace Academy</td>
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<td>Arthur Geen</td>
<td>1998</td>
<td>I.S. 227, Brooklyn</td>
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<td>JoAnn Gensert</td>
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<td>P. Mathew George</td>
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<td>Bat Torah - Alisa M. Flatow Yeshiva, Suffern, NY</td>
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<td>Najla Hallak</td>
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<td>Lettie Hartwell</td>
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<td>Shirley Hopkins</td>
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<td>Robert F. Wagner Collaborative H.S., Queens</td>
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<td>Amber Howes</td>
<td>2002</td>
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<td>Cherryann Joseph</td>
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<td>Penina Karp</td>
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<td>Bhuall Nand-Kumar</td>
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## Appendix VII (continued)

### Alumni

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<td>Maria Perez</td>
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<td>Professional Performing Arts School, Manhattan</td>
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<td>Bibiane Petutschnig</td>
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<td>Melinda Pittis-Leitch</td>
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<td>Trudy Prout-Phillips</td>
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<td>Britt Reichborn-Kjennerud</td>
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<td>Tehilla Rieser</td>
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<td>SAR Academy, Bronx</td>
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<td>Megan Roberts</td>
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<td>Region 9 Regional Instructional Supervisor, Manhattan</td>
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<td>Marc Rosner</td>
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<td>Adrienne Rubin</td>
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<td>Keith Sheppard</td>
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<td>Sausen Silmi</td>
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<td>Charles Simic</td>
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<td>Central Park East Secondary School, Manhattan</td>
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<tr>
<td>Jassy Ubhi</td>
<td>2000</td>
<td>Bayard Rustin HS for the Humanities, Manhattan</td>
</tr>
<tr>
<td>Khadija Vann</td>
<td>2002</td>
<td>Far Rockaway High School, Queens</td>
</tr>
<tr>
<td>Diane Walsh</td>
<td>1991</td>
<td>Regis High School, Manhattan</td>
</tr>
<tr>
<td>Raymond Walsh</td>
<td>1992</td>
<td>Southwestern U. Medical School, Texas (last known)</td>
</tr>
<tr>
<td>Youning Wang</td>
<td>2003</td>
<td>Murry Bergtraum High School, Manhattan</td>
</tr>
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Appendix VII (continued)

Alumni

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

Partners in Science Alumni

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

Acknowledgments 22

Activities
  2004 Calendar of Group Activities vii
  2005 Calendar of Group Activities ix
  Action and Lesson Plans  5, 10, vii, viii, ix, x
  Alumni Reunion and Dinner 10
  Orientation 6, vii, ix
  Recruitment 6
  Research Projects 7, i, iii, v
  Seminars 7, 11, 17, 22, vii, ix

Advisory Committee 5, 6, 12, 15, inside front cover

Alumni 5, 8, 10, 11, 12, 14, 15, 16, 17, 22, xi

Awards 10

Demographics vi

Evaluation 18

Funding 8, 22, inside back cover

Operating Costs 21

Partnerships
  Anglo-Chinese School (Singapore) 5, 16, 17, ii, iv
  Knowledge Exchange Institute 17
  MRSEC 13, 14
  NSEC 13, 14
  New York Hall of Science 14, 21, v, viii
  Partners in Science 10, 15, ii, xiv
  Science and Technology Entry Program (STEP) 8, vii, ix
  Singapore Ministry of Education 11, 17, ix

Program Website 6, 7, 10, 11

References 23

Video Library 7, xv
2004 AND 2005 PROGRAM SUPPORTERS

The Braitmayer Foundation
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