

APPENDIX

Appendix—The Grade Levels Compared

S1 Physical Sciences Concepts²³²

Elementary School²³³

The student produces evidence that demonstrates understanding of:

SI.a Properties of objects and materials, such as similarities and differences in the size, weight, and color of objects; the ability of materials to react with other substances; and different states of materials.

SI.b Position and motion of objects, such as how the motion of an object can be described by tracing and measuring its position over time; and how sound is produced by vibrating objects.

SI.c Light, heat, electricity, and magnetism, such as the variation of heat and temperature; how light travels in a straight line until it strikes an object or how electrical circuits work.

Middle School

The student produces evidence that demonstrates understanding of:

SI.a Properties and changes of properties in matter, such as density and boiling point; chemical reactivity; and conservation of matter.

SI.b Motions and forces, such as inertia and the net effects of balanced and unbalanced forces.

SI.c Transfer of energy, such as transformation of energy as heat; light; mechanical motion, and sound; and the nature of a chemical reaction.

High School

The student produces evidence that demonstrates understanding of:

SI.a Structure of atoms, such as atomic composition, nuclear forces, and radioactivity.

SI.b Structure and properties of matter, such as elements and compounds; bonding and molecular interaction; and characteristics of phase changes.

SI.c Chemical reactions, such as everyday examples of chemical reactions; electrons, protons, and energy transfer; and factors that affect reaction rates such as catalysts.

SI.d Motions and forces, such as gravitational and electrical; net forces and magnetism

SI.e Conservation of energy and increase in disorder, such as kinetic and potential energy; energy conduction, convection, and radiation; random motion; and effects of heat and pressure.

SI.f Interactions of energy and matter, such as waves, absorption and emission of light, and conductivity.

²³² The Science standards are founded upon both the National Research Council's *National Science Education Standards* and the American Association for the Advancement of Science's Project 2061 *Benchmarks for Science Literacy*. These documents, each of which runs to several hundred pages, contain detailed explanation of the concepts identified here.

²³³ The elementary school standards are set at a level of performance approximately equivalent to the end of fourth grade. The middle school standards are set at a level of performance approximately equivalent to the end of eighth grade. The high school standards are set at a level of performance approximately equivalent to the end of tenth grade. It is expected that some students might achieve these levels earlier and others later than these grades.

Appendix—The Grade Levels Compared

S2 Life Sciences Concepts

Elementary School

The student produces evidence that demonstrates understanding of:

- S2a** Characteristics of organisms, such as survival and environmental support; the relationship between structure and function; and variations in behavior.
- S2b** Life cycles of organisms, such as how inheritance and environment determine the characteristics of an organism; and that all plants and animals have life cycles.
- S2c** Organisms and environments, such as the interdependence of animals and plants in an ecosystem; and populations and their effects on the environment.
- S2d** Change over time, such as evolution and fossil evidence depicting the great diversity of organisms developed over geologic history.

Middle School

The student produces evidence that demonstrates understanding of:

- S2a** Structure and function in living systems, such as the complementary nature of structure and function in cells, organs, tissues, organ systems, whole organisms, and ecosystems.
- S2b** Reproduction and heredity, such as sexual and asexual reproduction; and the role of genes and environment on trait expression.
- S2c** Regulation and behavior, such as senses and behavior; and response to environmental stimuli.
- S2d** Populations and ecosystems, such as the roles of producers, consumers, and decomposers in a food web; and the effects of resources and energy transfer on populations.
- S2e** Evolution, diversity, and adaptation of organisms, such as common ancestry, speciation, adaptation, variation, and extinction.

High School

The student produces evidence that demonstrates understanding of:

- S2a** The cell, such as cell structure and function relationships; regulation and biochemistry; and energy and photosynthesis.
- S2b** Molecular basis of heredity, such as DNA, genes, chromosomes, and mutations.
- S2c** Biological evolution, such as speciation, biodiversity, natural selection, and biological classification.
- S2d** Interdependence of organisms, such as conservation of matter; cooperation and competition among organisms in ecosystems; and human effects on the environment.
- S2e** Matter, energy, and organization in living systems, such as matter and energy flow through different levels of organization; and environmental constraints.
- S2f** Behavior of organisms, such as nervous system regulation; behavioral responses; and connections with anthropology, sociology, and psychology.

S3 Earth and Space Sciences Concepts

Elementary School

The student produces evidence that demonstrates understanding of:

- S3a** Properties of Earth materials, such as water and gases; and the properties of rocks and soils, such as texture, color, and ability to retain water
- S3b** Objects in the sky, such as Sun, Moon, planets, and other objects that can be observed and described; and the importance of the Sun to provide the light and heat necessary for survival.
- S3c** Changes in Earth and sky, such as changes caused by weathering, volcanism, and earthquakes; and the patterns of movement of objects in the sky.

Middle School

The student produces evidence that demonstrates understanding of:

- S3a** Structure of the Earth system, such as crustal plates and land forms; water and rock cycles; oceans, weather, and climate.
- S3b** Earth’s history, such as Earth processes including erosion and movement of plates; change over time and fossil evidence.
- S3c** Earth in the Solar System, such as the predictable motion of planets, moons, and other objects in the Solar System including days, years, moon phases, and eclipses; and the role of the Sun as the major source of energy for phenomena on the Earth’s surface.

- S3d** Natural resource management.

High School

The student produces evidence that demonstrates understanding of:

- S3a** Energy in the Earth system, such as radioactive decay, gravity, the Sun’s energy, convection, and changes in global climate.
- S3b** Geochemical cycles, such as conservation of matter; chemical resources and movement of matter between chemical reservoirs.
- S3c** Origin and evolution of the Earth system, such as geologic time and the age of life forms; origin of life; and evolution of the Solar System.
- S3d** Origin and evolution of the universe, such as the “big bang” theory; formation of stars and elements; and nuclear reactions.
- S3e** Natural resource management.

Appendix—The Grade Levels Compared

S4 Scientific Connections and Applications

Elementary School

The student produces evidence that demonstrates understanding of:

S4a Big ideas and unifying concepts, such as order and organization; models, form and function; change and constancy; and cause and effect.

S4b The designed world, such as development of agricultural techniques; and the viability of technological designs.

S4c Personal health, such as nutrition, substance abuse, and exercise; germs and environmental safety.

S4d Science as a human endeavor, such as communication, cooperation, and diverse input in scientific research; and the importance of reason, intellectual honesty, and skepticism.

Middle School

The student produces evidence that demonstrates understanding of:

S4a Big ideas and unifying concepts, such as order and organization; models, form, and function; change and constancy; and cause and effect.

S4b The designed world, such as the reciprocal nature of science and technology; the development of agricultural techniques; and the viability of technological designs.

S4c Health, such as nutrition, exercise, and disease; effects of drugs and toxic substances; personal and environmental safety; and resources and environmental stress.

S4d Impact of technology, such as constraints and trade-offs; feedback; benefits and risks; and problems and solutions.

S4e Impact of science, such as historical and contemporary contributions; and interactions between science and society.

High School

The student produces evidence that demonstrates understanding of:

S4a Big ideas and unifying concepts, such as order and organization; models, form and function; change and constancy; and cause and effect.

S4b The designed world, such as the reciprocal relationship between science and technology; the development of agricultural techniques; and the reasonableness of technological designs.

S4c Health, such as nutrition and exercise; disease and epidemiology; personal and environmental safety; and resources, environmental stress, and population growth.

S4d Impact of technology, such as constraints and trade-offs; feedback; benefits and risks; and problems and solutions.

S4e Impact of science, such as historical and contemporary contributions; and interactions between science and society.

SS Scientific Thinking

Elementary School

The student demonstrates scientific inquiry and problem solving by using thoughtful questioning and reasoning strategies, common sense and conceptual understanding from Science Standards 1 to 4, and appropriate methods to investigate the natural world; that is, the student:

- SSa** Asks questions about natural phenomena; objects and organisms; and events and discoveries.
- SSb** Uses concepts from Science Standards 1 to 4 to explain a variety of observations and phenomena.
- SSc** Uses evidence from reliable sources to construct explanations.
- SSd** Evaluates different points of view using relevant experiences, observations, and knowledge; and distinguishes between fact and opinion.
- SSe** Identifies problems; proposes and implements solutions; and evaluates the accuracy, design, and outcomes of investigations.
- SSf** Works individually and in teams to collect and share information and ideas.

Middle School

The student demonstrates scientific inquiry and problem solving by using thoughtful questioning and reasoning strategies, common sense and conceptual understanding from Science Standards 1 to 4, and appropriate methods to investigate the natural world; that is, the student:

- SSa** Frames questions to distinguish cause and effect; and identifies or controls variables in experimental and non-experimental research settings.
- SSb** Uses concepts from Science Standards 1 to 4 to explain a variety of observations and phenomena.
- SSc** Uses evidence from reliable sources to develop descriptions, explanations, and models.
- SSd** Proposes, recognizes, analyzes, considers, and critiques alternative explanations; and distinguishes between fact and opinion.
- SSe** Identifies problems; proposes and implements solutions; and evaluates the accuracy, design, and outcomes of investigations.
- SSf** Works individually and in teams to collect and share information and ideas.

High School

The student demonstrates skill in scientific inquiry and problem solving by using thoughtful questioning and reasoning strategies, common sense and diverse conceptual understanding, and appropriate ideas and methods to investigate science; that is, the student:

- SSa** Frames questions to distinguish cause and effect; and identifies or controls variables in experimental and non-experimental research settings.
- SSb** Uses concepts from Science Standards 1 to 4 to explain a variety of observations and phenomena.
- SSc** Uses evidence from reliable sources to develop descriptions, explanations, and models; and makes appropriate adjustments and improvements based on additional data or logical arguments.
- SSd** Proposes, recognizes, analyzes, considers, and critiques alternative explanations; and distinguishes between fact and opinion.
- SSe** Identifies problems; proposes and implements solutions; and evaluates the accuracy, design, and outcomes of investigations.
- SSf** Works individually and in teams to collect and share information and ideas.

Appendix—The Grade Levels Compared

S6 Scientific Tools and Technologies²³⁴

Elementary School

The student demonstrates competence with the tools and technologies of science by using them to collect data, make observations, analyze results, and accomplish tasks effectively; that is, the student:

- S6a** Uses technology and tools (such as rulers, computers, balances, thermometers, watches, magnifiers, and microscopes) to gather data and extend the senses.
- S6b** Collects and analyzes data using concepts and techniques in Mathematics Standard 4, such as average, data displays, graphing, variability, and sampling.
- S6c** Acquires information from multiple sources, such as experimentation and print and non-print sources.

Middle School

The student demonstrates competence with the tools and technologies of science by using them to collect data, make observations, analyze results, and accomplish tasks effectively; that is, the student:

- S6a** Uses technology and tools (such as traditional laboratory equipment, video, and computer aids) to observe and measure objects, organisms, and phenomena, directly, indirectly, and remotely.
- S6b** Records and stores data using a variety of formats, such as data bases, audiotapes, and videotapes.
- S6c** Collects and analyzes data using concepts and techniques in Mathematics Standard 4, such as mean, median, and mode; outcome probability and reliability; and appropriate data displays.
- S6d** Acquires information from multiple sources, such as print, the Internet, computer data bases, and experimentation.
- S6e** Recognizes sources of bias in data, such as observer and sampling biases.

High School

The student demonstrates competence with the tools and technologies of science by using them to collect data, make observations, analyze results, and accomplish tasks effectively; that is, the student:

- S6a** Uses technology and tools (such as traditional laboratory equipment, video, and computer aids) to observe and measure objects, organisms, and phenomena, directly, indirectly, and remotely, with appropriate consideration of accuracy and precision.
- S6b** Records and stores data using a variety of formats, such as data bases, audiotapes, and videotapes.
- S6c** Collects and analyzes data using concepts and techniques in Mathematics Standard 4, such as mean, median, and mode; outcome probability and reliability; and appropriate data displays.
- S6d** Acquires information from multiple sources, such as print, the Internet, computer data bases, and experimentation.
- S6e** Recognizes and limits sources of bias in data, such as observer and sample biases.

²³⁴ **S6** makes explicit reference to using telecommunications to acquire and share information. A recent National Center on Education Statistics survey recently reported that only 50% of schools and fewer than 9% of instructional rooms currently have access to the Internet. We know this is an equity issue—that far more than 9% of the homes in the United States have access to the Internet and that schools must make sure that students' access to information and ideas does not depend on what they get at home—so we have crafted performance standards that would use the Internet so that people will make sure that all students have access to it. New Standards partners have made a commitment to create the learning environments where students can develop the knowledge and skills delineated here.

S7 Scientific Communication

Elementary School

The student demonstrates effective scientific communication by clearly describing aspects of the natural world using accurate data, graphs, or other appropriate media to convey depth of conceptual understanding in science; that is, the student:

- S7a** Represents data and results in multiple ways, such as numbers, tables, and graphs; drawings, diagrams, and artwork; and technical and creative writing.
- S7b** Uses facts to support conclusions.
- S7c** Communicates in a form suited to the purpose and the audience, such as writing instructions that others can follow.
- S7d** Critiques written and oral explanations, and uses data to resolve disagreements.

Middle School

The student demonstrates effective scientific communication by clearly describing aspects of the natural world using accurate data, graphs, or other appropriate media to convey depth of conceptual understanding in science; that is, the student:

- S7a** Represents data and results in multiple ways, such as numbers, tables, and graphs; drawings, diagrams, and artwork; and technical and creative writing.
- S7b** Argues from evidence, such as data produced through his or her own experimentation or by others.
- S7c** Critiques published materials.
- S7d** Explains a scientific concept or procedure to other students.
- S7e** Communicates in a form suited to the purpose and the audience, such as by writing instructions that others can follow; critiquing written and oral explanations; and using data to resolve disagreements.

High School

The student demonstrates effective scientific communication by clearly describing aspects of the natural world using accurate data, graphs, or other appropriate media to convey depth of conceptual understanding in science; that is, the student:

- S7a** Represents data and results in multiple ways, such as numbers, tables, and graphs; drawings, diagrams, and artwork; technical and creative writing; and selects the most effective way to convey the scientific information.
- S7b** Argues from evidence, such as data produced through his or her own experimentation or data produced by others.
- S7c** Critiques published materials, such as popular magazines and academic journals.
- S7d** Explains a scientific concept or procedure to other students.
- S7e** Communicates in a form suited to the purpose and the audience, such as by writing instructions that others can follow; critiquing written and oral explanations; and using data to resolve disagreements.

Appendix—The Grade Levels Compared

S8 Scientific Investigation²³⁵

Elementary School

The student demonstrates scientific competence by completing projects drawn from the following kinds of investigations, including at least one full investigation each year and, over the course of elementary school, investigations that integrate several aspects of Science Standards 1 to 7 and represent all four of the kinds of investigation:

- S8a** An experiment, such as conducting a fair test.
- S8b** A systematic observation, such as a field study.
- S8c** A design, such as building a model or scientific apparatus.
- S8d** Non-experimental research using print and electronic information, such as journals, video, or computers.

A single project may draw on more than one kind of investigation.

A full investigation includes:

- Questions that can be studied using the resources available.
- Procedures that are safe, humane, and ethical; and that respect privacy and property rights.

Middle School

The student demonstrates scientific competence by completing projects drawn from the following kinds of investigations, including at least one full investigation each year and, over the course of middle school, investigations that integrate several aspects of Science Standards 1 to 7 and represent all four of the kinds of investigation:

- S8a** Controlled experiment.
- S8b** Fieldwork.
- S8c** Design.
- S8d** Secondary research, such as use of others' data.

A single project may draw on more than one type of investigation.

A full investigation includes:

- Questions that can be studied using the resources available.
- Procedures that are safe, humane, and ethical; and that respect privacy and property rights.
- Data that have been collected and recorded (see also Science Standard 6) in ways that others can verify, and analyzed using skills expected at this grade level (see also Mathematics Standard 4).

High School

The student demonstrates scientific competence by completing projects drawn from the following kinds of investigation, including at least one full investigation each year and, over the course of high school, investigations that integrate several aspects of Science Standards 1 to 7 and represent all four of the kinds of investigation:

- S8a** Controlled experiment.
- S8b** Fieldwork.
- S8c** Design.
- S8d** Secondary research.

A single project may draw on more than one type of investigation.

A full investigation includes:

- Questions that can be studied using the resources available.
- Procedures that are safe, humane, and ethical; and that respect privacy and property rights.
- Data that have been collected and recorded (see also Science Standard 6) in ways that others can verify, and analyzed using skills expected at this grade level (see also Mathematics Standard 4).

²³⁵ Best practice in science has always included extensive inquiry and investigation, but these are frequently given less emphasis at the elementary level in the face of competing demands from English language arts and mathematics. There are many opportunities to learn science outside of school, including Scouts, Boys and Girls Clubs, 4-H, and Future Farmers of America. The work done in these venues can and should be used to provide evidence of meeting the standards.

Appendix—The Grade Levels Compared

- | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none">• Data that have been collected and recorded (see also Science Standard 6) in ways that others can verify and analyze using skills expected at this grade level (see also Mathematics Standard 4).• Data and results that have been represented (see also Science Standard 7) in ways that fit the context.• Recommendations, decisions, and conclusions based on evidence.• Acknowledgment of references and contributions of others.• Results that are communicated appropriately to audiences.• Reflection and defense of conclusions and recommendations from other sources and peer review. | <ul style="list-style-type: none">• Data and results that have been represented (see also Science Standard 7) in ways that fit the context.• Recommendations, decisions, and conclusions based on evidence.• Acknowledgment of references and contributions of others.• Results that are communicated appropriately to audiences.• Reflection and defense of conclusions and recommendations from other sources and peer review. | <ul style="list-style-type: none">• Data and results that have been represented (see also Science Standard 7) in ways that fit the context.• Recommendations, decisions, and conclusions based on evidence.• Acknowledgment of references and contributions of others.• Results that are communicated appropriately to audiences.• Reflection and defense of conclusions and recommendations from other sources and peer review. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

CALIBRATION TASK FORCE

Board of Education of the City of New York

Roberto Benitez, Partnerships for Year Round-Learning, Office of School Programs and Support Services

Diana Canales, Science Specialist, Queens Multidisciplinary Resource Center

Ed Denecke, Staff Development Specialist, Queens Multidisciplinary Resource Center

Clifford Fee, Staff Development Specialist, Queens Multidisciplinary Resource Center

Gerald A. Haber, Assessment Specialist, Office of Performance Standards Division of Instructional Support

Regina McCarthy, Coordinator, Gateway Environmental Study Center

Carl M. Raab, Director of Academic Initiatives and Publications, Office of School Programs and Support Services

Laura Rodriguez, Assistant Administrative Superintendent

Office of Bilingual Education

Eliezer De Jesus, Mathematics/Science Resource Specialist

Archangelo Joseph, Mathematics/Science Resource Specialist

Annette Strubbe, Field Instructional Specialist

Michael C. Wang, Chinese Resource Specialist

Community School District 1

Merrilee Fiedler, Science Coordinator

John R. Grinins, Science Teacher, P.S. 34

Josie Suarez, Standards Coordinator

Community School District 2

Peter Kindfield, Ph.D., Science Staff Development Consultant

GinGee Moy, Science Staff Developer

Community School District 3

Howard Berger, Science Coordinator

David Getz, Staff Developer

Mary Anita Harvey, Teacher Consultant, CCNY/Students at the Center Program

Garo Tekeyan, Smart Process Coordinator

Community School District 4

Carol Franken, Science Coordinator

Sandra Jenoure, Science Education Consultant

Liza Schneider, Science Teacher, P.S. 50

Community School District 5

Charles McWhales, Project Coordinator, Smart Process

Howard Nadler, Science Coordinator

Carmen W. Williamson, Science Facilitator, P.S. 30

Community School District 6

John Cafarella, former Science Director

Stacy Douglas, Science Facilitator

Marselle Heywood, Staff Developer

Mark Koesterich, Science Facilitator

Lillian Ramos, Science Staff Developer

Odille Santiago, Science Facilitator

Yvette Sy, Science Staff Developer

Community School District 7

Kenneth Harris, Science Teacher, I.S. 184

Anthony J. Viteritti, Director of Mathematics and Science

Community School District 8

Carol A. Rosario, Science Coordinator

Eugene K. Smith, Assistant Principal, P.S. 60X

Community School District 9

Deborah Disbrow, Science Staff Developer

Michael Kreindler, Science Staff Developer

Community School District 10

Judith Abel, Science Staff Developer

Jeffrey Felber, Director of Science

Wilfred Hemans, Assistant Principal, M.S. 143

Community School District 11

Katina Lotakis, Assistant Principal, M.S. 144

Rose Villani, Director of Science

Community School District 13

Maria Davis, Science Coordinator

David Lisbon, Science Resource Specialist

Community School District 14

Angel Brea, Science Teacher

Bruce Gamsey, Science Teacher/Co-Chair, District Science Committee

James R. Novara, Science Coordinator/Co-Chair District Science Committee

Community School District 15

Lisa Gioe-Cordi, Teacher, William Alexander Middle School #51

Judy Zaragoza Maher, Science Staff Developer

Christine Musmanno, Science Coordinator

Community School District 16

Sheila Dunston, District Science Coordinator

Community School District 17

Shellie Cohen, Science Coordinator

Dan Forbes, Science Teacher Trainer

Gueus Robert, Bilingual Science Teacher, M.S. 391

Community School District 18

Barbara Berg, Science Coordinator

Michael E. Checchi, Science Teacher, I.S. 211

Ingrid Thomas-Clark, Science Cluster Teacher, P.S. 235

Community School District 19

Lou Goldstein, Science Coordinator

Henry Smith, Science Teacher, P.S. 190K

Community School District 20

Trudy Adduci, Director of Mathematics and Science

Madeline P. Castañeda, Spanish Bilingual Teacher/Chair, Governance Committee, IMS, Ditmas Educational Complex, IS 62

Manette B. Gampel, Science Teacher, Dyker Heights Intermediate School #201

Community School District 21

Peter Chester, Science Coordinator

Community School District 22

Catherine Abbazia, Science Staff Developer

Joyce Genovesi, Science Coordinator, Principal of Environmental Study Center

Maxine Kovner, Science Staff Developer

Community School District 23

Cynthia Smith, Staff Developer

Michelle White, Science Teacher, JHS 275

Community School District 24

Frank M. Mifsud, Assistant Principal, William Cowper IS 73

Pamela Wasserman, Science Coordinator

Community School District 25

Ronnie Feder, Science Coordinator

Tatiana Gordon, Ed.D., ESL Teacher, P.S. 107Q

Pearl Philindas, Science Specialist, P.S. 184Q

Deborah Winiarski, Health Coordinator

Community School District 26

Joanne Halton, Science Teacher, P.S. 186Q, Castlewood School

Judy Intraub, Science Coordinator

Community School District 27

Denise Brown, Science Teacher Trainer

Mohamed Khan, Mathematics Staff Developer

Phyllis Phillips, Coordinator of Mathematics and Science

Community School District 28

Barbara J. Bellafatto, Science Specialist

Anthony Galitsis, former Science Coordinator

Geraldine Goodstadt, Science Specialist

Audrey Saltsberg, Assistant Principal, JHS 157/Queens

Community School District 29

Harriett Diaz, Staff Developer

Diane Ehrlich, Director of Science

Community School District 30

Delrosa Marshall, Science Coordinator

Phyllis Mueses, Science Teacher, P.S. 152Q

Community School District 31

Luann Martin, Science Cluster Teacher, P.S. 45 John Tyler School

Mary Beth McCarthy, Science Coordinator

Michele Yennella, Science Teacher, Anning S. Prall IS 27

Community School District 32

Michelle G. Cambier, Science Coordinator

Barbara R. Convey, Director of Mathematics, Science & Technology

Alma Walton, Teacher

Community School District 75

Greg Borman, Staff Developer

Derek P. Ramdass, Staff Developer, Citywide Programs

Alternative High Schools and Programs

Melissa Cancel, Science Teacher, Northview Junior High

Juan Lantigeau, Science Teacher, Manhattan Comprehensive Night & Day School

Shawn Reeves, Science Teacher, Coalition School for Social Change

Steve Zbaida, Science Staff Developer, Outreach Program

BASIS High Schools

Randy Barbarash, Assistant Principal, Science Department, Port Richmond High School

Derresa Davis, Science Instructional Specialist

Verona Moncrieffe, Assistant Principal Science, John Jay High School

Brooklyn High Schools

Nicholas Almonor, Bilingual Chemistry Teacher

Alan Ascher, Assistant Principal-Supervision
Science, South Shore High School

Marianita Damari, Science Congruence Specialist,
Brooklyn High Schools

Cynthia Edwards, Assistance Principal Science,
George Wingate High School

Mara Ganeles, Assistant Principal Biology,
Midwood High School

David Kiefer, Assistant Principal Physical Science,
Midwood High School

Edmond Nurse, Physics Teacher, East New York
Transit Tech

Veronica Peterson, Science Congruence Specialist

Yves Raymond, Bilingual Coordinator, Erasmus
Hall Campus: High School for Science and Math

Bronx High Schools

Bart Bookman, Assistant Principal Science, A.E.
Stevenson High School

Beatrice G. Werden, Science Congruence Specialist

Manhattan High Schools

Mingling Chang, Bilingual Teacher, Seward Park
High School

Barbara Poseluzny, Assistant Principal Science, A.
Philip Randolph Campus High School at City
College

DeAnna Roberson, Science Congruence Specialist

Jinni Xu, Bilingual Teacher, Seward Park High
School

Marion Gaita Zachowski, Science Congruence
Specialist

Queens High Schools

Marc-Eddy Bellabe, Science Teacher, John
Harvard School, P.S. 34

Yvette Bohlman, Chemistry Teacher, Forest Hills
High School

Richard D. D'Auria, Director of Technology

Rick Hallman, Director of Instruction

Hedy Hoffman, Science Congruence Specialist

Svetlana I. Livdan, Bilingual Chemistry Teacher,
Newcomers High School

Michael F. Renna, Assistant Principal Science,
Hillcrest High School

Bank Street College

Don Cook, Project Director

Brooklyn College

Eleanor Miele, Assistant Professor, Science
Education

City College of New York

Ellen Goldstein, Director, NASA TRC

Kingsborough Community College

Dr. Delores Lowe Friedman, Professor of Early
Childhood Education

Lehman College

Dr. Fernando Espinoza, Assistant Professor,
Program Advisor, Science Education

Marc Lazarus, Professor of Chemistry

Frederick T. Marin, PH.D., Teacher/Science Chair,
W. Manhattan Outreach Center and Lehman
College Leadership Group

Queens College

Dr. June Kasuga Miller, Professor of Science
Education, Department of Secondary Education
and YS

Rockefeller University

Dr. Bonnie Kaiser, Director, Precollege Science
Education Programs

Council of Supervisors and Administrators

Arlene L. Shapiro, Supervisory Support Program

United Federation of Teachers/Professional Development Program Teachers Centers

Rose Cavalluzzo, Teacher Center Staff, Campus
Magnet High School

Robert Kleppel, Teacher Center Staff

Phyllis Walker, Teacher Center Staff, SESP

American Museum of Natural History

Dr. Maritza Macdonald, Director of Professional
Development

Brooklyn Children's Museum

Karen Jarmon, Teacher Services Manager

City Parks Foundation

Dr. Mary J. Leou, Director of Education

Educational Equity Concepts, Inc.

Merle Froschl, Co-Director

Barbara Sprung, Co-Director

Maryann Stimmer, Science Program Associate

NASA

Frank Scalzo, Goddard Institute for Space Studies

New Visions for Public Schools

Elaine Morales-Thomason, Program Officer

New York Botanical Gardens

Donald C. Lisowy, Manager of Teacher
Enhancement

New Standards/National Center on Education and the Economy

Ann Borthwick, Director, Standards Development and Applied Learning, LRDC

Gary Brockman, Consultant, New Standards, University of California, Office of the President

Gary Eggan, Senior Associate, Learning Research and Development Center

Georgia Makris, Science Program Assistant, New Standards, University of California, Office of the President

Annette Seitz, Research Associate, Learning Research and Development Center

Elizabeth Stage, Director of Science, New Standards, University of California, Office of the President

New York City Urban Systemic Initiative

Betty D. Burrell, Senior Associate Director, NYC Urban Systemic Initiative

Stephanie Caporale, Associate Director, NYC Urban Systemic Initiative

Elsie Chan, Director, NYC Urban Systemic Initiative

Dr. Robert J. Kane, Deputy Director, NYC Urban Systemic Initiative

Jonathan Molofsky, Associate Director, NYC Urban Systemic Initiative

Lawrence J. Pero, Senior Associate Director, NYC Urban Systemic Initiative

Myrna Rodriguez, Associate Director, NYC Urban Systemic Initiative

Judy Walsh, Associate Director, NYC Urban Systemic Initiative

ACKNOWLEDGMENTS

Phyllis Arnette, Director of Government Relations and Educational Field Markets, Texas Instruments Incorporated

Kathleen Bergin, Program Officer, National Science Foundation

Dr. James V. Bruni, Dean of Education, Lehman College

Michael Cascio, District 14, JHS 50K

Stephen DeMeo, York College

Jay Dubner, College of Physicians and Surgeons, Columbia University

Dr. Barbara C. Freeouf, Project Director, Streamline Certification, Brooklyn College

Dr. Alan Friedman, President, New York Hall of Science

Aminda Gentile, Director, United Federation of Teachers

Janet Kaminsky, Director of Professional Development, Chancellors District

Jeanette Kim, Program Coordinator, Education Department, New York Academy of Sciences

Dr. Noel Kriftcher, David Packard Center, Polytechnic University, Brooklyn

Linda Linton, Director of Public Affairs, Consolidated Edison of New York, Inc.

Lee Livney, Bronx Zoo/Wildlife Conservation Park

Frank Nappi, Council of Supervisors and Administrators

John W. Nassivera, Teacher Consultant, Institute for Literacy Studies, Lehman College

Ann Robinson, Director, Bronx Zoo/Wildlife Conservation Park

Elizabeth Schnee, Chancellor's Parent Advisory Council

John Schoener, John Schoener & Associates, Inc.

Frank Signorello, New York Hall of Science

Dr. Samuel Silverstein, College of Physicians and Surgeons, Columbia University

Dr. Morton Slater, Director of Gateway Schools, Mount Sinai Hospital

Marian Sloane, Staff Development Specialist, Brooklyn Multidisciplinary Resource Center

Louise Squitieri, Dean, Research & Grants, New York City Technical College

Dr. Rosamond Welchman, School of Education, Brooklyn College

Louisa Wuebbens, Director, Middle School Initiative, NYC Board of Education

MATERIALS USED WITH PERMISSION

American Association for the Advancement of Science. (1993). *Benchmarks for Science Literacy: Project 2061*. New York: Oxford University Press.

"The Density of Sand" task and the task's "Self-reflection Sheet." From the *Golden State Examination*. Copyright by California Department of Education, 721 Capital Mall, 4th Floor, Sacramento, CA 95814.

"Erosion" task. From *FOSS Landforms Module*, Activity 3, "Go with the Flow," 1992: The Regents of the University of California. Developed at the Lawrence Hall of Science, University of California at Berkeley, CA 94720-5200. Published and distributed by Delta Education, Inc., 80 Northwest Blvd., Nashua, NH 03060.

"The Invincible Cockroach" task, by Matthew Morrell. From *The Young Naturalist Awards*, 1998. The American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024-5192.

“Light or Dark?” task. From SCIS3, Chapter 16, Transferring Solar Energy to Water. pp. 39-41. Delta Education, Inc., 80 Northwest Blvd., Nashua, NH 03060.

National Research Council. (1996). *National Science Education Standards*, Washington, D.C.: National Academy Press.

University of the State of New York and the State Education Department, *Learning Standards for Mathematics, Science, and Technology*, Albany, NY 12234.

“Water Tolerance” task. From FOSS *Environmental Module*, Activity 3, “Water Tolerance,” 1992: The Regents of the University of California. Developed at the Lawrence Hall of Science, University of California at Berkeley, CA 94720-5200. Published and distributed by Delta Education, Inc., 80 Northwest Boulevard, Nashua, NH 03060.

REFERENCES

American Association for the Advancement of Science. (1993). *Benchmarks for Scientific Literacy: Project 2061*. New York: Oxford University Press.

American Association for the Advancement of Science. (1997). *Resources for Science Literacy: Professional Development*. New York: Oxford University Press.

American Association for the Advancement of Science. (1990). *Benchmarks: Science for All Americans: Project 2061*. New York: Oxford University Press.

American Federation of Teachers. (1994). *Defining World Class Standards: A Publication Series*. Vol. 1-3. Washington, D.C.: Author.

American Federation of Teachers. (1995). *Making Standards Matter: A Fifty-State Progress Report on Efforts to Raise Academic Standards*. Washington, D.C.: Author.

Black, Paul, and Arkin, Myron. eds. (1996). *Changing the Subject: Innovations in Science, Mathematics, and Technology Education*. London and New York: Organisation for Economic Co-operation and Development.

The Business Task Force on Student Standards. (1995). *The Challenge of Change: Standards To Make Education Work For All Our Children*. Washington, D.C.: Business Coalition for Education Reform.

National Education Goals Panel, Technical Planning Group. (1993). *Promises to Keep: Creating High Standards for American Students*. Washington, D.C.: Author.

National Research Council. (1996). *National Science Education Standards*. Washington, D.C.: National Academy Press.

New Standards. (1997). *Performance Standards*. Washington, D.C. and Pittsburgh, PA: National Center on Education and the Economy and the University of Pittsburgh.

New Standards. (1995). *New Standards: Performance Standards—Consultation Draft*. Washington, D.C. and Pittsburgh, PA: National Center on Education and the Economy and the University of Pittsburgh.

Secretary’s Commission on Achieving Necessary Skills. (1992). *Learning A Living: A Blueprint for High Performance—A SCANS Report For America 2000*. Washington, D.C.: U.S. Department of Labor.

SELECT BIBLIOGRAPHY

Board of Education of the City of New York. (1995). *Curriculum Frameworks: Knowledge, Skills, and Abilities*. Grades Pre-K - 12. New York: Author.

Doran, Rodney et al. (1998). *Science Educator’s Guide to Assessment*. Virginia: National Science Teachers Association.

Loucks-Horsley, Susan et al. The National Institute for Science Education (1998). *Designing Professional Development for Teachers of Science and Mathematics*. Thousand Oaks, CA: Corwin Press, Inc.

National Science Resources Center. (1998). *Resources for Teaching Middle School Science*. Washington, D.C.: National Academy Press.

National Science Resource Center. (1996). *Resources for Teaching Elementary School Science*. Washington, D.C.: National Academy Press.

International Association for the Evaluation of Educational Assessment. (1996). *Third International Mathematics and Science Study*. (TIMSS).

National Education Goals Panel. (1998). *National Education Goals Report*. Washington, D.C.: Author.

University of the State of New York and the State Education Department. (1996). *Learning Standards for Mathematics, Science, and Technology*. Albany, NY: Author.

University of the State of New York and the State Education Department. (1997). *Mathematics, Science, and Technology Resource Guide*. Albany, NY: Author.

Resources

As indicated in the introduction, the high expectations in these standards will require adequate resources for teachers and students, in some cases substantially more than currently in place. The kinds of resources and the rationale for having them are presented here, quoting the *National Science Education Standards* (National Research Council, 1996). A partial listing of science resources is provided to acquaint educators with some of the many organizations and programs that are available to support science education in New York City. Listed geographically and citywide, their services are offered to all teachers.

Program Standard D (National Research Council 1996, pp. 218-221)²³⁶

The K-12 science program must give students access to appropriate and sufficient resources, including quality teachers, time, materials and equipment, adequate and safe space, and the community.

Learning science requires active inquiry into the phenomena of the natural world. Such inquiry requires rich and varied resources in an adequate and safe environment. The specific criteria for a science learning environment will depend on many factors such as the needs of the students and the characteristics of the science program. A student with rich experience in a topic might need access to additional resources within or outside the school; a student with a different language background might need supporting materials in that language; a student with a physical disability might need specially designed equipment; and a student with little experience using computer technology might need a tutor or a tutorial program. District policy makers and those in charge of budget allocations must provide the resources, and then school-level administrators and teacher must make sure that, once allocated, the resources are well used.

The most important resource is professional teachers. Needless to say, students must have access to skilled, professional teachers. Teachers must be prepared to teach students with diverse strengths, needs, experiences, and approaches to learning. Teachers must know the content they will teach, understand the nature of learning, and use a range of teaching strategies for science. Hiring practices must ensure that teachers are prepared to teach science and should include successful teachers of science in the selection of their new colleagues.

Districts should use professional development standards to provide teachers with opportunities to develop and enhance the needed capabilities for effective science teaching. Funding and professional time for such development is an essential part of district budgets.

The emphasis on the need for professional teachers of science does not diminish the need for other school personnel who enhance the science program. In addition to an administrative team and teaching colleagues, other support personnel might include the resource librarian, a laboratory technician, or maintenance staff.

Time is a major resource in a science program. Science must be allocated sufficient time in the school program every day, every week, and every year. The content standards define scientific literacy; the amount of time required to achieve scientific literacy for all students depends on the particular program. The time devoted to science education must be allocated to meet the needs of an inquiry-based science program. No matter what the scheduling model, a school schedule needs to provide sufficient and flexible use of time to accommodate the needs of the students and what is being learned. In addition to time with students and with colleagues, teachers of science also spend considerable time preparing materials, setting up activities, creating the learning environment, and organizing student experiences. This time must be build into the daily teaching schedule.

Conducting scientific inquiry requires that students have easy, equitable, and frequent opportunities to use a wide range of equipment, materials, supplies, and other resources for experimentation and direct investigation of phenomena. Some equipment is general purpose and should be part of every school's science inventory, such as magnifiers or microscopes of appropriate sophistication, measurement tools, tools for data analysis, and computers with software for supporting investigations. Other materials are topic specific, such as a water table for first graders or a reduced resistance air table for physics investigations. Many materials are consumable and need to be replenished regularly. Furthermore, policy makers need to bear in mind that equipment needs to be upgraded frequently and requires preventive maintenance.

Given that materials appropriate for inquiry-based science teaching are central to achieving the goals set forth in the Standards, it is critical that an effective infrastructure for material support be a part of any science program. School systems need to develop mechanisms to identify exemplary materials, store and maintain them, and make them accessible to teachers in a timely fashion. Providing an infrastructure frees teachers' time for more appropriate tasks and ensures that the necessary materials are available when needed. Because

²³⁶ Reproduced with permission from *National Science Education Standards*. Copyright 1996 by the National Academy of Sciences. Complete report available from the National Academy Press, 2102 Constitution Ave., N.W., Washington, D.C. 20055.

science inquiry is broader than first-hand investigation, print, video, and technology sources of information and simulation are required. These are included in the materials-support infrastructure.

The teaching standards consistently make reference to the responsiveness and flexibility to student interests that must be evidenced in classrooms that reflect effective science teaching. The content standard on inquiry sets the expectation that students will develop the ability to perform a full inquiry. For such inquiry-based teaching to become a reality, in addition to what is regularly maintained in the school and district, every teacher of science needs an easily accessible budget for materials and equipment as well as for unanticipated expenses that arise as students and teachers pursue their work.

Collaborative inquiry requires adequate and safe space. There must be space for students to work together in groups, to engage safely in investigation with materials, and to display both work in progress and finished work. There also must be space for the safe and convenient storage of the materials needed for science. At the lower grade levels, schools do not need separate rooms for laboratories. In fact, it is an advantage in terms of long-term studies and making connections between school subject areas to have science as an integral part of the classroom environment. At the upper grade levels, laboratories become critical to provide the space, facilities, and equipment needed for inquiry and to ensure that the teacher and students can conduct investigations without risk. All spaces where students do inquiry must meet appropriate safety regulations.

Good science programs require access to the world beyond the classroom. District and school leaders must allocate financial support to provide opportunities for students to investigate the world outside the classroom. This may mean budgeting for trips to nearby points of interest, such as a river, archaeological site, or nature preserve; it could include contracting with local science centers, museums, zoos, and horticultural centers for visits and programs. Relationships should be developed with local businesses and industry to allow students and teachers access to people and the institutions, and students must be given access to scientists and other professionals in higher education and the medical establishment to gain access to their expertise and the laboratory settings in which they work. Communication technology has made it possible for anyone to access readily people throughout the world. This communication technology should be easily accessible to students.

Much of this standard is acknowledged as critical, even if unavailable, for students in secondary schools. It must be emphasized, however, that this standard applies to the entire science program and all students in all grades. In addition, this standard demands quality resources that often are lacking and seem unattainable in some schools or districts. Missing resources must not be an excuse for not teaching science. Many teachers and schools “make do” or improvise under difficult circumstances (e.g., crowded classrooms, time borrowed from other subjects, and materials purchased with personal funds). A science program based on the National Science Education Standards is a program constantly moving toward replacing such improvisation with necessary resources.

Citywide

New York City Board of Education: Division of Instructional Support, responsible for supporting instruction in all schools in all districts in New York City, (718) 746-4258; In-Service Courses (718) 935-5753; Multidisciplinary Resource Centers (MRC), provide professional development in science for New York City teachers; staff development specialists are familiar with many aspects of science instruction and have compiled many resources for teachers of science, 154-60 17th Avenue, Whitestone, NY 11357, (718) 746-3392; and 7102 Avenue T, Brooklyn, NY 11234, (718) 763-5492; Division of Management Information Services, (718) 488-3922; Office of School Programs and Support Services, (718) 935-5155; Science in the Seamless Day, (718) 574-2800 or (718) 927-5131; School Based Elementary Science Restructuring Program; (212) 795-8032 x421; SMART process, (212) 678-2918 or (212) 769-7553.

Alliance for Minority Participation (AMP), (212) 650-8854.

Chemistry Teachers Club of New York, c/o Al Delfiner, 207 Lincoln Place, Eastchester, NY 10707.

City University of New York: All CUNY colleges have specialized programs which address science education. For further information contact these colleges:

Baruch College (212) 802-2000,
Borough of Manhattan Community College (212) 346-8100,
Bronx Community College (718) 289-5100,
Brooklyn College (718) 951-5000,
City College of New York (212) 650-7000,
CUNY Law School (718) 575-4200,
CUNY Medical School/Sophie Davis School of Biomedical Education (718) 650-5275,
The Graduate School and University Center (212) 642-1600,
Hostos Community College (718) 518-4444,
Hunter College (212) 772-4000,
Hunter College School of Social Work (212) 452-7000,
John Jay College of Criminal Justice (212) 237-8000,
Kingsborough Community College (718) 368-5000,

LaGuardia Community College (718) 482-5000,
Lehman College (718) 960-8000,
Medgar Evers College (718) 270-4900,
Mount Sinai School of Medicine (212) 241-6500,
New York City Technical College (City Tech)
(718) 260-5000,
Queens College (718) 997-5000,
Queensborough Community College (718) 631-
6262,
The College of Staten Island (718) 982-2000,
York College (718) 262-2000.
Consolidated Edison, Inc., (212) 674-5470.
Council of Supervisors and Administrators (CSA),
(718) 852-3000.
Educators for Gateway c/o Roberta Wallach, 1106
East 19th Street, Brooklyn, NY 11230.
EDUNET, (212) 838-0230
Elementary School Science Association (ESSA) c/o
Dawn Adams, 1264 Sterling Place, Flushing, NY
11213.
Greenwall Foundation, (212) 679-7266.
National Action Council for Minorities in
Engineering, Inc.: The TechForce Partnership for
Scientific Learning (212) 279-2626.
New York Academy of Sciences, Education
Department: New York City MaSTER Guide,
published by the Academy is a comprehensive
listing of professional development, curriculum
materials, student and family programs mostly in
and around the New York City metropolitan area.
Their Internet site has much of the same
information. 2 East 63rd Street, New York, NY
10021, (212) 838-0230, www.nyas.org.
New York Biology Teachers Association, Otto
Burgdorf Student Science Conference and
Competition (718) 846-7891. P.O. Box 192,
Brooklyn, NY 11236, (718) 846-7891
www.nybta.org
New York City Department of Environmental
Protection: Guided Facility Tours, Printed
Resource Materials, Staff Development Workshops
(718) 595-3506.
New York City Urban Systemic Initiative (NYC
USI) (718) 260-4966.
New York Collaborative for Excellence in Teacher
Preparation (718) 951-3113.
New York Urban League: New York City Project
PRISM (Partners for Reform in Science and Math)
(718) 756-3032.
Physics Teachers Club c/o John Augenstein, 269-
15 79th Avenue, New Hyde Park, NY 11040
Science Council of New York City, Science
Conference (212) 673-9030.
Teaching Matters, Inc., (212) 870-3505.
United Federation of Teachers (UFT), (212) 777-
7500.

Bronx

Albert Einstein College of Medicine: YES To
Science (718) 430-2093.
Bronx Zoo/Wildlife Conservation Park: Diversity
of Lifestyles, Habitat Ecology Learning Program,
Staff Development for Teachers, Grades K-12,(718)
220-6856; Wildlife Adventures for School Classes
K-12 (718) 220-5131; Wildlife Inquiry through
Zoo Education (WIZE) (718) 220-5114.
Herbert H. Lehman College: Dwight D.
Eisenhower Professional Development Program
(718) 960-8569.
Hostos Community College: Center for Pre-College
Initiatives, TERRA Environmental Summer Science
Camp (718) 518-4189.
Manhattan College: Dwight D. Eisenhower
Professional Development Program (718) 862-
7416.
New York Botanical Garden: School Programs
(718) 817-8748, Teacher Enhancement Program
(718) 817-8175.
Wave Hill: Environmental Science Camp for Girls,
Forest Project Collaborative, School Program (718)
549-3200 x221

Brooklyn

Aquarium for Wildlife Conservation: School and
Family Programs (718) 265-3453.
Brooklyn Botanic Garden: Junior Botanist Summer
Program, Project GreenReach, School Workshops
and Exploration Tours, Student Internships,
Teacher Education Programs: What Did A Plant
Ever Do For You? (718) 622-4433.
Brooklyn Center for the Urban Environment:
Afterschool Programs and Afterschool Intern
Program, Environmental Education Advisory
Council, Environmental Science Summer Camp,
Professional Development Workshops, School
Programs (718) 788-8540.
Brooklyn Children's Museum: Animals Eat,
EVIDENTS, Plants and People (718) 735-4440.
Brooklyn College: Center for Educational Change
(718) 951-5209, New Frontier Collaborative for
Secondary Mathematics and Science Teachers
(718) 951-5214, Science and Technology Entry
Program (718) 951-5741.
Brooklyn Museum (718) 638-5000.
Brooklyn Union: Engineering Explorer Program;
(718) 403-2808, Science in Industry Summer
Academy (SISA) (718) 403-2511.
Catholic Science Council, Diocese of Brooklyn:
Science Fair (718) 857-2700 x231.
Community School District #23: Summer Science
Camp (718) 270-8663.
Environmental Quest: Questing Course (718) 941-
9835.

Gateway Environmental Study Center: (718) 252-7307.

Long Island University, Brooklyn Campus (718) 488-1010.

Metropolitan New York Forest Ecosystem Council: (718) 965-6590.

National Space Society Education Chapter: NSS Student Competition (212) 724-5919, Space Science Technology Opportunities Education Conference (718) 531-8375.

New York City Technical College: Projects Room (718) 260-5206.

Polytechnic University: Center for Youth in Engineering and Science, Mathematics, Science, and Technology Fair (718) 260-3033.

State University of New York Health Science Center, Brooklyn: Genetics in Medicine (718) 745-0443.

Science Skills Center, Inc.: Summer Science Institute (718) 636-6213.

Wildlife Conservation Center. (718) 220-5131

Manhattan

American Committee for the Weizmann Institute of Science: Dr. Bessie F. Lawrence International Summer Science Institute (212) 779-2500.

American Museum of Natural History: Biodiversity Counts (212) 769-5938; College Courses for Teachers, Customized Professional Development, Summer Institutes (212) 769-5182; Teachers Workshops (212) 769-5141.

Bank Street College: Liberty Environmental Science Academy; (212) 875-4506, New Perspectives (212) 875-4656, Tiorati Workshop for Environmental Learning (914) 351-5354.

Central Park Conservancy: School Partnership Program, Student Field Programs, Teacher Resources, Teacher Workshops (212) 360-2720.

Central Park Wildlife Center/Wildlife Conservation Society: Children's Workshops, School Programs (212) 439-6517.

Children's Museum of Manhattan: High School Internships, In-School Programs, Museum Visits, Professional Development (212) 721-1223.

City College of New York: Environmental Studies; (212) 650-7953, Middle School Science Consortium (212) 650-6226, Teachers Restructuring Science Education (212) 650-7162, The Young Scholars Discovery Program (212) 650-6226, Young Scholars Program in Molecular Biology and Related Sciences (212) 650-6601, Workshop Center (212) 650-8436.

City Parks Foundation: Family Programs at the Urban Forest Ecology Center (212) 360-2746, Internships (212) 360-2740, Learning Garden Project (212) 360-2746, New York City Woodlands Teacher Training Institute (212) 360-

2745, New Youth Conservationists (212) 360-2746, ParkLinks (212) 360-2745, School Programs at the Urban Forest Ecology Center (212) 360-2746, Teacher Resources (212) 360-2740, Teacher Training (212) 360-2745, Trees, Tales, and Woodland Trails (212) 360-2745.

City of New York/Parks and Recreation: Internship Program (212) 360-1349, Urban Park Rangers-Parks Conservation Corps (212) 360-8722.

City University of New York: Graduate School & University Center, Project STIR (212) 410-1100, Medical School, Bridge to Medicine (212) 650-8183 x 7740, Research Foundation, Summer Science Camp (212) 650-5471.

Classroom, Inc.: Model Site Program (212) 545-8814, System Initiative (212) 545-8814.

College Board: EQUITY 2000 (212) 713-8000.

Columbia University Double Discovery Center: Talent Search Program, Upward Bound Program (212) 854-3897.

Columbia University Teachers College: Colloquium Series on Advances in the Teaching of Math (212) 678-3381; Hollingworth Science Camp, Sunday Math and Science Enrichment Program (212) 678-3851; The New York Youth Network and The Center for Urban Youth and Technology (212) 678-3829.

Columbia University College of Physicians and Surgeons: State Pre-College Enrichment Program, Summer Minority High School Student/Teacher Initiative Program (212) 305-4157; Summer Research Program for Secondary School Science Teachers (212) 305-6899.

Cooper-Hewitt Museum: Summer Design Institute for Educators (212) 860-6977.

Council on the Environment of New York City: The Training Student Organizers Program (212) 788-7900.

Education Development Center/ Center for Children and Technology: Performance Assessment Videos for Teachers, Urban Mathematics, Science, and Technology Leadership Project, Young Scientist Club (212) 807-4200.

Educational Equity Concepts, Inc.: Playtime is Science (212) 725-1803.

Exxon Corporation: The Exxon Energy Cube (212) 685-9290.

Fordham University: Dwight D. Eisenhower Professional Development Program.

Gateway Program: The Mt. Sinai School of Medicine (212) 731-5990.

Girls Inc.: Operation SMART (Science, Math, and Relevant Technology) (212) 989-2438.

Horticultural Society of New York: Apple Seed, Library (212) 757-0915

Humane Education Committee: Humane Education in Our Schools, Humane Science Awards (212) 410-3095.

Hunter College: Biotechnology Workshops (212) 772-5297, In Service Program to Certify Out-of-License Middle School/Junior High School Science Teachers (212) 642-2910, In Service Science Program for NYC Elementary School Teachers (212) 772-4287.

International Education and Resource Network (IEARN) (212) 870-2693.

Intrepid Sea-Air-Space Museum: Seaworthy Saturdays, Ships Ahoy! Science-Based Staff Development, Student Science Workshops, Teacher Familiarization Tour (212) 957-7050.

John Jay College of Criminal Justice: DDE II2 (212) 237-8923, John Jay Summer Computer Camp (212) 237-8926.

Marymount Manhattan College: Dwight D. Eisenhower Professional Development Program (212) 517-0522.

NAACP New York City ACT-SO (212) 783-0813.

NASA Regional Teacher Resource Center: Plane Talk Science Network (212) 650-6798, Resource Dissemination (212) 650-6993.

Nature Conservancy of New York: Student Internships (212) 997-1880.

New York Academy of Sciences: Junior Academy, Science Education Section, Science Research Training Program, Scientific Process, Practice, and Presentation: Applying Resources and Knowledge (SP3ARK) (212) 838-0230.

New York State Office of Parks, Recreation, and Historic Preservation: Operation Explore (212) 694-372.

New York University: Teacher Opportunity Corps and Dwight D. Eisenhower Professional Development Program (212) 998-5208.

Ninety Second Street YW-YMCA: Camp Tevah for Science and Nature (212) 415-5613, On the Brink: Breakthroughs In Science (212) 415-5615, Sunday Science Spectaculars (212) 415-5600.

Pace University: The Pace University DDE Integrated Math-Science-Technology Partnership Program (212) 346-1816.

Research Corporation: Partners in Science (212) 305-6899.

Rockefeller University: Science Outreach for Students (212) 327-7431.

Salomon Brothers Inc: Salomon-Robeson School Partnership (212) 783-7467.

Salvadori Educational Center on the Built Environment: Salvadori Educational Materials, Salvadori Middle School Program, Specialist-on-Site (212) 650-5497.

Settlement College Readiness Program: Science and Technology Entry Program; (212) 410-4444 x519, Big Sister Program (212) 509-9577.

Society of Women Engineers: Higher Education Outreach Program (212) 509-9577.

South Street Seaport Museum: Expeditionary Learning, Internships, Short-Format Courses, Teacher Training, Urban Archaeology: Digging Into History (212) 748-8590.

The River Project: Field Trips, Internships (212) 431-5787.

Urban Park Rangers: The Parklands Partnership, School Programs, Walks and Workshops (800) 201-7275.

Ventures in Education (212) 696-5717.

Queens

Alley Pond Environmental Center: Class Visits, Junior High and High School Programs, Outreach (718) 229-4000.

American Museum of the Moving Image: Science and the Moving Image (718) 784-4520.

Association of Computer Education: Computer Workshops (718) 898-7114.

City University of New York, Medical School: Dwight D. Eisenhower Professional Development Program, Queens Bridge to Medicine (718) 523-0960.

New York Hall of Science: After-School Science Club, Big Science Days, Family Programs, Junior High School Career Days, Outreach Lesson Modelling, Science Access Center, Science Career Ladder, Science Kid's Club and Young Explorer's Club, Student Workshops and Science Access Center Workshops, Teacher Training Workshops and Rental, (718) 699-0005.

Queens Botanical Garden: Adult Tours and Workshops, Children's Garden - Outdoor Learning Center, Children's Tours & Workshops, Student Work-Study Programs, Teacher Training/Consultation (718) 886-3800.

St. John's University: Metro New York Junior Science and Humanities Symposium (718) 969-8000 x6336.

York College: Math, Science, Technology Awards Program, Science Teachers Enhancement Program in the Physical Sciences, Summer Science Camp (718) 262-2716.

Staten Island

Clay Pit Ponds State Park Preserve: Gericke Farm Visit, Park Preserve Walk, Project Wild/Aquatic Wild, The Magic of Maple Sugaring (718) 967-1976.

College of Staten Island: Goals 2000, Net Tech, Project Discovery, Science and Technology Entry Program, Teaching Internship, Tech-Prep and

Discovery Tech, Honors Research Internship, (718) 982-2325.

New York State Institute for Basic Research in Developmental Disabilities: Neuroscience Exploration Program and Science Apprentice Program (718) 494-5354.

Staten Island Children's Museum: Micro-Monsters, Science Help Line, Science Works, Setting the Stage for Science: In School Residency Program, Summer Mini-Camp (718) 273-2060 x156.

Staten Island Institute of Arts and Sciences: School Programs; (718) 727-1135.

Staten Island Science Teachers Association (SISTA) c/o Lenore Miller, 296 Arlene Street, Staten Island, NY 10314.

Staten Island Zoo: School at the Zoo, Teacher Workshops, Traveling Zoo Programs (718) 442-3174.

Long Island

Brookhaven National Laboratory: Science Museum School Programs (516) 344-4495.

Cold Spring Harbor Laboratory - DNA Learning Center: Advanced DNA Science, DNA Science, Field Trips, Fun with DNA, Introduction to Computer Design, World of Enzymes (516) 367-7240.

Dowling College: Adventures in Aviation and Transportation, Sky High Day Camp (516) 244-3320.

Goudreau Museum of Mathematics in Art and Science: Pi Day, Saturday Workshops: Enrichment Math For Students of Grades 5-8, Saturday Workshops: Graphing Calculator TI-82 for Beginners (516) 747-0777.

Hofstra University: Dwight D. Eisenhower Professional Development Program (516) 463-5561.

State University of New York, Old Westbury: Annual Long Island Mathematics Conference (LIMACON), Institute of Creative Problem-Solving for Gifted and Talented Students (516) 876-3261, Science Educators Enhancement and Development (SEED) Program; (516) 876-2733.

Upstate New York

Health, Safety and Research Alliance of New York State, Inc.: Speakers Bureau (914) 291-1944.

Hudson River Reserve: Educational Programs (914) 758-5193.

Hudson River Sloop Clearwater: Clearwater's Classroom of the Waves (914) 454-7673.

Mercy College (914) 693-7000.

Pace University: Urban Ecology Seminar (914) 773-3789.

Science Teachers Association of New York State–Westchester: Project Learning Tree Workshop (914) 639-6978.

State University of New York, Purchase: Elementary Science Leadership Institutes, Summer Earth Science Study for Classroom Teachers, Westchester Conference on Science, Math, and Technology Education, Woodrow Wilson Teacher Outreach Programs (914) 251-6675.

Taconic Outdoor Education Center: Environmental Education Programs, Skins and Skulls (914) 265-3773.

Statewide

New York State Education Department: Mathematics, Science, and Technology (518) 473-9471.

New York State Department of Environmental Conservation: DEC Summer Environmental Education Program (518) 457-3720.

New York State Marine Education Association (NYSMEA), Box 705, Mineola, NY 11501

New York State Science Leadership Association, 489 Echo Road, Vestal, NY 13850.

New York State Science Olympiad (914) 328-4209.

Science Teachers Association of New York State: Brooklyn, Queens, and Staten Island Section, Harry Kranpool, 31-31 138 St., Apt. 4-D Cheshire, Linden Hill, NY 11354-2625; Bronx, Manhattan, Westchester and Rockland Section, Marilyn Reiner, 9 Dalewood Drive, Suffern, NY 10901.

New Jersey

College Gifted Programs: Summer Institute For The Gifted (201) 334-6991.

Liberty Science Center: Birthday Parties, Camp In Program, Courses, Discovery Trails and Electronic Discovery, Teacher Sabbatical Program, Teacher Workshops (201) 451-0006.

New Jersey Institute of Technology: Summer Science Camp (201) 596-3550.

Rutgers University–Cook College: Camp Promise (908) 932-9164.

Woodrow Wilson National Fellowship Foundation: High School Biology Program (609) 452-7007.

National

American Association for the Advancement of Science (AAAS)

1200 New York Avenue, N.W., Washington, DC 20005, (202) 326-6400, www.aaas.org/

American Association of Physics Teachers: High School Photo and Physics Video Contests, Metrologic Physics Bowl Contest, Physics Teaching Resource Agents, The Physics Teacher, United States Physics Team (301) 209-3300.

American Chemical Society: Journal of Chemical Education, Say YES to a Youngster's Future (202) 986-1460, United States National Chemistry Olympiad (202) 872-6328, www.acs.org.

American Geological Institute: Geotimes, (703) 379-2480.

Association for Supervision and Curriculum Development (ASCD) (703) 578-9600.

Earthwatch: Teacher Fellowships for Worldwide Field Research (617) 926-8200 x118.

Johns Hopkins University Institute for the Academic Advancement of Youth: Distance Learning Project (410) 456-0277.

Museum of Science: Science-By-Mail (800) 729-3300.

National Academy of Sciences, www.nas.gov;
National Research Council; Smithsonian Institute;
National Science Resources Center.

National Aeronautics and Space Administration (NASA), Education Division: NASA provides many resources for aerospace education, including curriculum materials, information, resources, and links to many Internet sites. Code FE, NASA Headquarters, 300 E Street, S.W., Washington, DC 20546, (202) 358-1110, www.hq.nasa.gov/office/codefe/education.

National Association of Biology Teachers, The American Biology Teacher, (800) 406-0775.

National Earth Science Teachers Association: The Earth Scientist, (800) 966-2481.

National Science Education Leadership Association: Perspectives on Science Education (703) 524-8646.

National Science Foundation, www.nsf.gov.

National Science Teachers Association (NSTA): NSTA is the largest national organization of science teachers. It publishes journals at each level of schooling: Science and Children, Science Scope, The Science Teacher, and Journal of College Science Teaching. It also publishes lists of science equipment and textbook suppliers, conducts competitions (e.g., Duracell Scholarship, Toshiba Explora Vision) and its website has information about science education, a comprehensive book store, and links to many other sites. 1840 Wilson Blvd., Arlington, VA 22201-3000 (703) 243-7100, www.nsta.org.

Science Service, Inc.: International Science and Engineering Fair, Westinghouse Science Talent Search (202) 785-2255.

Student Conservation Association: Resource Assistant Program (603) 543-1700.

United States Department of Education, Office of Educational Research and Improvement; Eisenhower National Clearinghouse for Mathematics and Science Education: ENC provides a comprehensive collection of curriculum resources in many formats (print, audio, multimedia, video, kits, and games). The Ohio State University, 1929 Kenny Rd, Columbus, OH 43210-1079, (800) 621-5785, www.enc.org.

Zero Population Growth, Inc.: Population Education Program (202) 332-2200.