REGION ONE LEARNING SUPPORT CENTER
Irma Zardoya, Regional Superintendent

Imagination is more important than knowledge.
Knowledge is limited. Imagination encircles the world."
Albert Einstein

SCIENCE SYLLABUS GRADE 7

PHYSICAL SCIENCE

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Introduction

How was the Syllabus Developed?

Alignment with NYS/NYC Standards: Our goal was to develop a document that would help teachers to know "what" to teach and "how" to teach it. The "what" was determined by the New York State Intermediate Level Science Core Curriculum (Core Curriculum). This Core Curriculum provides the major conceptual understandings and science process skills that students should attain as they address the Mathematics, Science, and Technology Learning Standards (Standards 1, 2, 4, 6, and 7). The "how" evolved from the belief that students learn science best when they have opportunities to construct scientific knowledge for themselves and develop their inquiry skills. In addition, the NYC Performance Standards provide a framework for assessing student performance in science. As a result a performance-based, or hands-on, minds-on, inquiry-based, approach was developed.

How Is the Document is Organized?

- **Curriculum Map:** The curriculum map provides an overview of the units and concepts to be explored at each grade level as well as suggested times for each unit. The suggested times help to provide a sense for how much a given unit should be emphasized within the syllabus. The curriculum map may be used by teachers and administrators for school-based curriculum mapping, alignment with thematic units, as well as and long-term unit planning.

- **Units:** On each grade, the syllabus is organized into units spanning anywhere from 1 to 8 weeks. Next to each unit heading (in bold type), the suggested time for the unit is provided.

- **Key Ideas:** Within each unit, several key ideas are addressed. The key ideas are italicized, with key words in bold. Each key idea is referenced to the Performance Indicator it addresses in the NYS Intermediate Level Science Core Curriculum. Most of the key ideas are taken directly from the Major Understandings found in the Core Curriculum. Other key ideas provide background or help to specify additional content knowledge that students will require in order to fully meet the NYS content standards.

- **Performance Tasks:** Suggested performance tasks address each key idea, which allow students to develop an understanding of the key idea and demonstrate important science process and inquiry skills. In addition to content, the Core Curriculum incorporates process skills based on Standard 4, the Science content standard (See pages 10 to 11, Core Curriculum.). For example, students are expected to be competent in the use of a metric ruler, triple beam balance, stop watch, graduated cylinder, thermometer, spring scale, and voltmeter, as well as a compound microscope. These and other process skills have been embedded into the performance tasks throughout the curriculum. By incorporating assessment strategies, such as checklists, observations, student self-reflections, written work, and student/teacher-designed rubrics, the performance tasks may also be used as performance assessments.

  The performance tasks are *suggested* activities. Students are not expected to accomplish all the tasks that are provided. Nor are teachers expected to adhere to the

sequence as given. Instead the performance tasks show how students can develop an understanding of each key idea by engaging in hands-on, minds-on, inquiry-based activities. Teachers may substitute other suitable activities that accomplish similar objectives.

- **NYS MST Standards and NYC Performance Standards in Science:** By completing the performance tasks, including analysis and explanation of their observations and results, student work will always address a variety of standards. References to these standards are provided. Nevertheless, these references are highly dependent on how teachers approach instruction and the types of outcomes or student products that are expected. As a result, the references are not all inclusive. In addition, some of the performance tasks for a given key idea may address all the standards cited, while others may not. However, the references help to illustrate how students can address a variety of standards numerous times and in multiple ways on their journey towards meeting and even exceeding them.

  The NYC Performance standards also address the question of, "How good is good enough?" In order to determine whether student work, that might contain all the elements required by the standards, does in fact meet the standards, teachers must also evaluate the quality of the student's work. The NYC edition of the Performance Standards in Science provides work samples with commentaries that help to illustrate ""How good is good enough?"

- **Resources:** The resources section contains references to curriculum guides, such as AIMS or GEMS, and textbooks, where the actual or similar activities to the performance tasks may be found. In addition, this section may also contain suggested classroom library titles. Technology resources are listed in the Technology Connections, including sciLINKS, and other multimedia resources, such as laser discs, videos or CD-ROMS. SciLINKS are Internet resources for teachers, students, and parents, maintained by the National Science Teachers Association. They contain links to Web sites that include additional information about each topic, classroom/home activities, lesson plans, interactive programs, etc. Teachers should preview all Web sites before students explore them on their own.

- **Mathematics, Technology, and Literacy Connections**: The Mathematics, Technology, and Literacy connections help to illustrate the ways in which these skill areas are embedded in the Science curriculum. Typically these connections allow students to engage in analysis, explanation, evaluation, and presentation of their observations and the data they gather. In addition, many of the Technology connections allow students to build or extend their knowledge of Science and to observe scientific processes that would otherwise be difficult to see. It is understood that these connections are more than add-ons to the Science curriculum. Instead, they are an integral part of scientific study, incorporating what scientists do all the time in the conduct of their research.

- **Inquiry Activities:** Inquiry activities provide teachers with ideas about how to integrate the inquiry process and in-depth investigations into virtually every unit in the science curriculum. In addition, these inquiry units lend themselves to Science Exposition or Eighth Grade Exit Projects. Both the NYS Standards and the NYC Performance Standards in Science require students to complete scientific inquiry projects, including controlled experiments, field studies, designs, and secondary research. The NYC Performance Standards in Science indicate that on an annual

basis, students will complete a project that integrates several aspects of Science Standards 1 to 7. In addition, it is expected that over the course of their middle school years, students will have the opportunity to engage in each of the four kinds of in-depth investigations.

Role of Textbooks in Science Instruction: Textbooks are an important resource for students and teachers. The background information, diagrams, illustrations, and practice problems provide a foundation for student learning. Support materials that accompany textbooks typically provide laboratory activities, assessment strategies, etc. that allow teachers to focus more on tailoring the activities and assessments to their students rather than starting from ground zero. However, exclusive use of textbooks without opportunities for hands-on activities is extremely undesirable, as it will not allow students to achieve the standards or become proficient in science process skills.

Anticipated Changes: Science is not a static subject. Rather, science is constantly changing as scientific laws, models, and theories are periodically redefined and our ways of thinking about the world shift. This syllabus will reflect such changes. The Science department will continue to refine and enhance the performance tasks and resource sections and the Technology department will continue to provide updated and enhanced technology connections, such as software titles and student project ideas. More importantly, as teachers begin to actively use the syllabus for lesson planning and other instructional purposes, their suggestions for improvement will guide the revision process.

Seventh Grade Physical Science
Curriculum Map
Key Ideas

Scientific Inquiry
(2 weeks)

- The central purpose of scientific inquiry is to develop explanations of scientific phenomena.
- Scientific inquiry involves testing proposed explanations using conventional techniques and procedures.
- When observations are analyzed using conventional and invented methods, they provide new insights into phenomena.

Motion
(4 weeks)

- Motion is a change in position of an object.
- The motion of an object can be described by its position, direction of motion, and speed.
- An object's speed is the distance it travels in a unit of time.
- Velocity includes both the speed and direction of an object's motion.
- Acceleration of an object may involve increasing speed, decreasing speed, or changing the direction of motion.

Forces and Motion
(5 weeks)

- Interaction between energy and matter creates forces that produce predictable patterns of change.
- When forces acting on an object are unbalanced, changes in its motion occur.
- An object's motion is the result of the combined effect of all forces acting on the object.
- An object at rest will remain at rest.
- A moving object not subjected to a force will continue to move at a constant speed in a straight line.
- Force is directly related to an object's mass and acceleration.
- Friction is a force that opposes motion.
- For every action there is an equal and opposite reaction.
- Every object exerts a gravitational force of attraction on every other object.
- The gravitational force between two objects depends on the distance between them and their relative mass.
- Gravity on the Earth exerts a downward force on objects.
- Weight is a measure of the force of gravity on an object.
- Mass is a measure of the amount of matter in an object.
- Gravity is one of the forces acting on orbiting objects and projectiles.
- Air resistance is a fluid friction force that opposes downward motion of objects.

Seventh Grade Physical Science
Curriculum Map
Key Ideas

Energy, Work, and Machines
(4 weeks)

- Energy is the ability to do work or produce change.
- Objects in motion have kinetic energy.
- Potential energy of an object depends on its relative position or stored energy.
- Energy can be transformed from one form to another. Transformation of energy is involved in most everyday activities. Heat energy is always one of the products of energy transformations.
- Energy cannot be created or destroyed.
- Work is the force exerted on an object that causes it to move over a distance. Energy is transferred from one object to another when work is done.
- Machines can change the direction, speed, or amount of force required to do work.
- A complex machine uses a combination of simple machines.
- A machine can be made more efficient by reducing friction.

Density and Fluid Forces
(2 weeks)

- Density may be described as the amount of matter in a given amount of space.
- The relative densities of an object and a given fluid determine the buoyancy of the object in the fluid.
- An object that is denser than a given fluid sinks in that fluid.
- An object that is less dense than a given fluid floats in that fluid.
- Water and other fluids exert a buoyant force upon objects within them.
- The buoyant force acts in an upward direction against the force of gravity.
- The buoyant force is equal to the weight of the water or fluid displaced by the object.
- An object floats if it displaces a weight of water greater than or equal to its own weight floats.
- An object sinks if it displaces a weight of water less than its own weight.

Temperature and Heat
(4 weeks)

- Temperature is a measure of the average energy of motion of the particles in a substance.
- Heat is the movement of thermal energy from a substance at a higher temperature to a substance at a lower temperature.
- Heat moves in predictable ways.
- Thermal energy is the sum total of the energy of all the particles in a quantity of a substance.
- Heat is transferred through materials by conduction or across space via radiation.
- In a liquid or a gas, convection currents facilitate heat transfer.
- Most substances expand when heated and contract when cooled.
- During a phase change, heat energy is absorbed or released.

Seventh Grade Physical Science
Curriculum Map
Key Ideas

Electricity and Magnetism
(6 weeks)

- Objects can be positively or negatively charged. Without touching, charged materials may either attract or repel other charged materials.
- Electrical circuits provide a means of transferring electrical energy.
- An electric current is the steady flow of electric charges in a wire path.
- Materials may be conductors of electric current or insulators (nonconductors).
- Series and parallel circuits are two basic types of electrical circuits.
- Electrical energy can be produced from a variety of energy sources and can be transformed to almost any other form of energy.
- Magnetism is the force of attraction or repulsion exerted by one object on another object.
- Magnetic forces are strongest at the poles of a magnet.
- The force of a magnet can operate through a variety of materials.
- A magnetic field is a region around a magnet within which magnetic forces operate.
- The alignment of atoms within a magnet creates magnetic domains.
- Objects can behave like magnets if their atoms are aligned.
- Electric circuits and magnets can exert a force on each other.

Waves, Sound, and Light
(4 weeks)

- A wave is a disturbance that transfers energy through matter and space.
- Two types of waves are transverse and longitudinal.
- The basic properties of wave are amplitude, wavelength, frequency, and speed.
- Reflection, refraction, diffraction, and interference are wave interactions with other matter and among themselves.
- Vibrations in materials set up wave-like disturbances that spread away from the source.
- Sound has properties of intensity or loudness, frequency, pitch, and resonance.
- The ear is a specialized organ with compartments that collect, transmit, and convert sound waves.
- Electromagnetic waves are transverse waves that have some electrical and magnetic properties.
- Electromagnetic waves travel outward from a vibrating charge in all directions.
- Different forms of electromagnetic energy have different wavelengths.
- Some examples of electromagnetic energy are radio waves, microwaves, infrared light, visible light, ultraviolet rays, X-rays, and gamma rays.
- Light passes through some materials, sometimes refracting in the process
- Materials absorb, reflect, and may transmit light.
- To see an object, light emitted by or reflected from it must enter the eye.

Seventh Grade Physical Science
Curriculum Map
Key Ideas

Atoms, Elements, and Compounds
(2 weeks)

- All matter is composed of elements or combinations of elements.
- Elements are made of tiny particles called atoms.
- The periodic table is a model for classifying and predicting properties of elements.
- Elements cannot be changed into other substances.
- Atoms join together to form molecules or may be arranged in regular geometric patterns.
- Elements combine to produce compounds.

Chemical Reactions and Solutions
(5 weeks)

- During a physical change, a substance keeps it chemical composition and properties.
- During a chemical change, substances with new chemical composition and properties are formed.
- Chemical reactions are the result of changes in the properties of matter. Chemical reactions result in the formation of different substances
- Chemical reactions can be described by chemical equations or formulas.
- The Law of Conservation of Mass states that during a chemical reaction matter cannot be created or destroyed.
- Every chemical reaction involves the release or absorption of energy.
- Solutions are mixtures in which one substance that is more abundant dissolves a substance present in a smaller amount.
- When solutions form, particles of the solute leave each other and become surrounded by particles of the solvent.
- Among the factors that affect the solubility of a substance are temperature, and the type of solvent.
- A solid substance can be separated from liquid substances by filtration, settling, and evaporation.

Science Syllabus: Seventh Grade Physical Science

Scientific Inquiry	**Integrated Science Exposition Projects**
Key Idea	· *The central purpose of **scientific inquiry** is to develop **explanations** of natural **phenomena** in a continuing, creative process.*
NYS MST Standards	· Standard 1: Analysis, Inquiry, and Design: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.
Performance Tasks	· Students explore and develop explanations and hypotheses about scie phenomena.
NYS MST Standards	Standard 1: Analysis Inquiry, and Design: Scientific Inquiry: · Key Idea 1: S1.1- S1.4 Process Skills Based on Standard 4 · General Skills: 4, 5, 8
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Key Idea	· *Scientific inquiry involves the **testing** of proposed explanations of scientific phenomena (hypotheses) using conventional techniques and procedures and usually requiring considerable ingenuity.* · ***Observations** made while testing hypotheses, when analyzed using conventional and invented methods, provide new insights into phenomena.*
NYS MST Standards	· Standard 1: Analysis, Inquiry, and Design: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.
Performance Tasks	· Student groups develop and execute a research plan to test their hypotheses about particular phenomena culminating in a poster board presentation for school Science Expositions
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 2: S2.1-2.2 · Key Idea 3: S3.1- S3.3 Standard 2: Information Systems · Key Idea 1: 1.3 Process Skills Based on Standard 4 · General Skills: 1-4, 5, 8

NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Cothron, J. H, Giese, R, N., and Rezba, R. J. Students and Research: Practical Strategies for Science Classrooms and Competitions. Kendall/Hunt Publishing Company · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Scientific Method* (sciLINKS NUMBER: HSTL004)
Motion	**Suggested Time: 4 weeks**
Key Idea	· ***Motion*** *is a change in* ***position*** *of an object. An object's speed is the* ***distance*** *it travels in a* ***unit*** *of* ***time****.* · *The motion of an object is always judged with respect to some other* ***object*** *or* ***point****. The idea of* ***absolute motion*** *or* ***rest*** *is misleading.*
NYS MST Standards	· Performance Indicator 5.1: Describe different patterns of motion of objects.
Performance Tasks	· Students measure the distance an object travels (i.e., marbles, toy cars, or themselves) and the time it takes. Students then calculate the average speed of the object using their measures of distance and time. Students indicate the reference point for the motion of the object. Students then observe how objects that are carried by another object or person may be moving with respect to the reference point but are not moving with respect to the object or person that is carrying it. · Students construct and interpret distance/time graphs based upon data obtained using rolling objects and inclined ramps, small, motorized vehicles, or themselves walking and/or running a set course.
NYS MST Standards	Standard 1: Analysis, Inquiry and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Key Idea 5: Major Understandings: 5.1a , 5.1b Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16

NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Gravity Rules: *How Fast Can You Walk?; How Fast Can You Run* · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore the concept of rates (distance, time) · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions. · Develop understanding of statistical ideas such as mean to analyze data. · Estimate, make, and use measurements in real-world situations. · Construct line graphs to demonstrate data that has been collected.
Technology Connections	· Use calculators or spreadsheet functions to calculate average velocity. · Create line graphs using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Measuring Motion* (sciLINKS Number: HSTP105) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Measuring Motion*
Literacy Connections	· Write a narrative procedure explaining how measurements of distance and time were made.
Key Idea	· *The motion of an object can be described by its **position**, **direction** of motion, and **speed**. **Velocity** includes both the **speed** and **direction** of an object's **motion**. **Acceleration** of an object may involve **increasing speed, decreasing speed,** or **changing** the **direction** of motion.*
NYS MST Standards	· Performance Indicator 5.1: Describe different patterns of motion of objects.
Performance Tasks	· Students use measuring tapes and compasses to map a set course in the classroom, school or yard. At check points placed every 5-10 meters, students use timers to determine the time it takes several students to walk the course at different rates. Students calculate their average velocity (in meters/second and direction) for each interval and for the whole course. Students then analyze the data for their set course to determine when their acceleration from interval to interval involved increasing speed, decreasing speed, and/or a change in direction.

NYS MST Standards	Standard 1: Analysis, Inquiry and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: 2.1 Standard 4: The Physical Setting · Major Understanding: 5.1b Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Gravity Rules: *How Fast Can You Walk?; How Fast Can You Run* · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore the concept of rates (distance, time) · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions. · Develop understanding of statistical ideas such as mean to analyze data. · Estimate, make, and use measurements in real-world situations. · Construct line graphs to demonstrate data that has been collected.
Technology Connections	· Use calculators or Microsoft Excel spreadsheet to calculate average velocity. · Create line graphs using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Measuring Motion* (sciLINKS Number: HSTP105) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Velocity; Acceleration*
Literacy Connections	· Prepare a lab report incorporating informational writing and a narrative procedure explaining how the course was set up and how measurements of distance, time, and direction were made.
Forces and Motion	**Suggested Time: 4 weeks**
Key Idea	· *The **interaction** between **energy** and **matter** creates **forces** (**pushes** and **pulls**), that produce predictable patterns of **change**. Common forces include **gravity**, **magnetism**, and **electricity**. Other forces include **friction**, **elasticity**, and **buoyancy**. Force is measured in **Newtons** (N).*

NYS MST Standards	· Performance Indicator 5.1: Describe different patterns of motion of objects.
Performance Tasks	· Student groups perform one of the following explorations then prepare poster and oral presentations to explain their observations. Posters should incorporate arrow diagrams that show the forces in action. · buoyant forces (submerging an empty, half full, and full jar in water) · magnetic forces (attraction between magnet and iron-containing object over distance or through paper/glass; repulsion of like poles on two magnets) · electric forces (observing effects of static electricity on plastic strips or between balloon and hair) · gravitational forces (dropping a variety of objects), · elastic forces (using rubber bands to move objects) · frictional forces (effects of smooth vs. rough surfaces on the movement of a toy car).
NYS MST Standards	Standard 1: Analysis, Inquiry and Design: Scientific Inquiry · Key Idea 1: S1.1 - S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Key Idea 5 Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· National Science Resources Center: Science & Technology for Children: Magnets and Motors · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data.

Technology Connections	· Create force diagrams illustrating the direction of forces operating in the above demonstrations using Dabbler or Microsoft draw tools. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Forces* (sciLINKS Number: HSTP107) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Motion and Force*

Literacy Connections	· Each group prepares a poster presentation for the particular force they explored.
	  · Organize what to say using notes or other memory aids (poster display).
	  · Present reports five to seven minutes long for teachers and other students.
	  · Begin by stating a main idea or purpose, support it with details, examples, and reasons, and end by summarizing main points.

Key Idea	· *An object's **motion** is the result of the **combined effect** of all **forces** acting on the object. When forces acting on an object are **unbalanced**, changes in that object's motion **(acceleration**) occur. The changes could include a **change in speed** or a **change in direction** of the object. When the forces are **balanced**, the motion of the object will remain unchanged.*
NYS MST Standards	· Performance Indicator 5.1: Describe different patterns of motion of objects.
Performance Tasks	· Students explore the combined effects of different forces on the motion of an object by playing tug-of-war using two ropes knotted at the center. Different numbers of students are placed at the four ends. Students predict the direction of motion and then begin pulling. Students also vary the angles between the ropes, predict the motion, and then begin pulling. Students observe the direction and speed of motion.
NYS MST Standards	Standard 1: Analysis, Inquiry and Design: Scientific Inquiry · Key Idea 1: S1.1 - S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.1c Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Make and use angular measurements. · Make and use measurements of distance and time.
Technology Connections	· Create a slideshow illustrating how forces combine to produce changes in the speed or direction of motion and how balanced forces produce no change. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Forces* (sciLINKS Number: HSTP107) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Motion and Force; Force and Acceleration*
Literacy Connections	· Summarize observations using narrative procedure and informational writing.
Key Idea	· *An object at **rest** will remain at rest (Inertia: Newton's First Law of Motion). A moving object that is not subjected to a force will continue to move at a **constant speed** in a straight line.*
NYS MST Standards	· Performance Indicator 5.1: Describe different patterns of motion of objects.
Performance Tasks	· Students explore inertia of objects at rest by removing a strip of paper from under a coin without disturbing the coin. · Students explore inertia of objects in motion by rolling a loaded car down a ramp with a barrier at the end. The car stops but objects in the car keep moving. Students then secure the objects in the cart using rubber bands and repeat the exploration.
NYS MST Standards	Standard 1: Analysis, Inquiry and Design: Scientific Inquiry · Key Idea 1: S1.1 - S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.1c Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4, 7 · Physical Setting Skills: 16
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· Glencoe: Physical Science: *MiniLab: Observing Inertia in Action* · NeoSCI: Investigating Force & Motion: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Create diagrams based on their observations of inertia using Dabbler or Microsoft Word draw tools. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Newton's Laws of Motion* (sciLINKS Number: HSTP145) · NeoSCI: Force & Motion: NeoSIMULATION CD-ROM · NeoSCI: Forces & Motion: CD-ROM
Literacy Connections	· Prepare a summary of the observations incorporating narrative procedure and informational writing.
Key Idea	· ***Force*** *is directly related to an object's* ***mass*** *and* ***acceleration****. The greater the force, the greater the change in motion (Newton's Second Law of Motion)*
NYS MST Standards	· Performance Indicator 5.1: Describe different patterns of motion of objects.
Performance Tasks	· Students find the mass of a textbook then attach a paper clip to the textbook so that the paper clip is just over the edge. Students hook a 10N spring scale to the paper clip and pull the book across the floor or table at a slow but constant velocity (being careful not to pull too hard). Students record the force then repeat the activity, once accelerating slowly and once accelerating quickly. Students then place another book on top of the first and repeat all three trials. Students calculate the acceleration in each of the six trials using the formula: Force (F) = mass (m) x acceleration (a). Students analyze and explain their results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.1d Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16

NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Glencoe: Physical Science: *Force and Acceleration* · NeoSCI: Investigating Force & Motion: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use calculators or a Microsoft Excel spreadsheet to calculate the acceleration in each of the trials. · Construct acceleration line graphs in Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Newton's Laws of Motion* (sciLINKS Number: HSTP145) · NeoSCI: Force & Motion: NeoSIMULATION CD-ROM · NeoSCI: Forces & Motion: CD-ROM · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Force and Acceleration*
Literacy Connections	· Write a summary explaining the relationship between force and acceleration when mass is held constant.
Key Idea	· ***Friction** is a force that **opposes motion** of objects. Friction is the force that one object exerts on another object when the two objects are in **contact**. The amount of friction depends on the types of **surfaces** and how hard the surfaces push against each other. Friction is greater when motion is started than when motion is continued.*
NYS MST Standards	· Performance Indicator 5.2: Observe, describe, and compare effects of forces on the motion of objects.

Performance Tasks	· Students explore and measure frictional forces with a spring scale, by moving one or more blocks or other regular objects, such as books across different surfaces, with and without straws underneath, with the narrow/wide sides down. Students may also measure frictional forces for opening a door or drawer. Students measure both starting and sliding frictional forces and find the difference between the two. Students summarize their observations by drawing a conclusion about when the difference between starting and sliding or moving frictional forces are greatest and when they are the least. · A student positions an ice cube at one end of a metal and/or plastic tray, then slowly lifts the end of the tray. A partner measures the height of the tray at which the object slides to the other end of the tray. Students repeat this procedure for a rock, an eraser, a square of aluminum foil, a wood block, or other suitable items. Students analyze and explain their results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.2d Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Glencoe: Physical Science: *MiniLab: Comparing Friction* · Holt, Rinehart, and Winston: Holt Science & Technology: Physical Science*: Quick Lab: The Friction 500* · NeoSCI: Investigating Force & Motion: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data. ·

Technology Connections	· Organize data using a spreadsheet in Microsoft Excel. · Eyewitness: Science Encyclopedia: CD-ROM · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Force and Friction* (sciLINKS Number: HSTP110) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Friction and Air Resistance* · NeoSCI: Force & Motion: NeoSIMULATION CD-ROM · NeoSCI: Forces & Motion: CD-ROM
Literacy Connections	· Read a series of steps to accomplish a task. · Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· *For every **action**, there is an equal and **opposite reaction** (Newton's Third Law of Motion). If one object exerts a force on another object, the second object exerts a force of **equal strength** in the opposite direction of the first.*
NYS MST Standards	· Performance Indicator 5.1: Describe different patterns of motion of objects.
Performance Tasks	· Students observe equal reaction forces by pulling on two connected spring scales, or pushing against two back-to-back bathroom scales. Students draw and label arrow diagrams to illustrate the equal reaction forces. · Students observe opposite reaction forces by observing the deflation and motion of an air-inflated balloon upon release. Students draw and label arrow diagrams to illustrate the equal reaction forces.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.1e Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· NeoSCI: Investigating Force & Motion: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data. · Estimate, make, and use measurements in real-world situations.
Technology Connections	· Draw and label arrow diagrams using Inspiration. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Newton's Laws of Motion* (sciLINKS Number: HSTP145) · NeoSCI: Force & Motion: NeoSIMULATION CD-ROM · NeoSCI: Forces & Motion: CD-ROM · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Pairs of Forces*
Literacy Connections	· Summarize observations about the relationship between equal reaction forces in a laboratory notebook.
Key Idea	· *Every object exerts **gravitational force** of **attraction** on every other object **(Universal Gravitation)**. Gravitational force depends on how much **mass** the objects have and the **distance** between them.* · ***Gravity** on the Earth exerts a **downward force** on objects. **Weight** is a measure of the force of gravity on an object. **Mass** is a measure of the amount of matter in an object.*
NYS MST Standards	· Performance Indicator 5.2: Observe, describe, and compare effects of forces on the motion of objects.
Performance Tasks	· Given a softball, basketball, pingpong ball, tennis ball, a sinker, and two sheets of paper (one rolled, one flat), students take turns holding one of the objects up to a set height, dropping (without pushing) the object, and measuring how long it takes for the object to fall to the floor. Students measure the mass of each object using a triple beam balance, then graph mass vs. time. Students explain what factors prevent a direct relationship between mass and the time the object takes to fall. · Students distinguish between mass (measured in kg) and weight (measured in Newtons) by using a spring scale to measure gravitational forces exerted on a variety of small objects of known and unknown mass. Students measure the mass of each object using a triple beam balance. Students compare and contrast the two values to determine their mathematical relationship.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.2a Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16

NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· NeoSCI: Investigating Gravity: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions. · Construct line graphs to demonstrate data that has been collected.
Technology Connections	· Construct line graphs using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Matter and Gravity* (sciLINKS Number: HSTP115)*; The Force of Gravity* (sciLINKS Number: HSTP130) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Pairs of Forces; Gravity; Weight; Relative Weights*
Literacy Connections	· Read a series of steps to accomplish a task. · Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· *Gravity is one of the forces acting on* ***projectiles****.*
NYS MST Standards	· Performance Indicator 5.2: Observe, describe, and compare effects of forces on the motion of objects.
Performance Tasks	· Students push a coin horizontally off a table and time how long it takes to reach the floor. Students also measure the distance from the table to the point where the coin first touches the floor and then repeat this procedure 4 more times. Students then drop a coin from the same height as the table five times. Students time how long the coin takes to reach the ground. Students compute the average time of drop for each trial then compare and contrast the results for the two trials. Students draw diagrams of each trial, using arrows to indicate the direction of the forces acting on the coin. Students explain what forces account for the horizontal and vertical motion of the projectile in the first trial.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.2a Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16

NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· NeoSCI: Investigating Gravity: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions. · Construct line graphs to demonstrate data that has been collected.
Technology Connections	· Construct line graphs using Microsoft Excel. · Use Inspiration to create diagrams of projectile motion. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Matter and Gravity* (sciLINKS Number: HSTP115)*; The Force of Gravity* (sciLINKS Number: HSTP130) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Motion and Forces: *Pairs of Forces; Gravity; Weight; Relative Weights*
Literacy Connections	· Read a series of steps to accomplish a task. · Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· ***Air resistance*** *is a* ***fluid friction*** *force that opposes the downward motion of objects. Air resistance* ***opposes*** *the force of* ***gravity****. The greater the* ***surface area*** *of an object, the greater the air resistance.*
NYS MST Standards	· Performance Indicator 5.2: Observe, describe, and compare effects of forces on the motion of objects.
Performance Tasks	· Students explore effects of air resistance by dropping folded, loosely crumpled, tightly crumpled, and flat pieces of paper of the same size from the same height. Students record the time it takes for each piece of paper to reach the floor, calculate the speed at which the objects fell using the formula: Speed (v) = distance (d) x time (t), and explain why the different shaped papers fell at different rates. Students are then challenged to shape a piece of paper, by cutting, tearing, or folding it into any design, so that it will fall slowly and very quickly. Students record the slowest and fastest times.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.2d Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 16
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Glencoe: Physical Science: *Measuring the Effects of Air Resistance.* · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data. · Explore the concept of rates (distance, time) · Describe functions and generalize them by the use of algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Prepare a PowerPoint slideshow to animate the process of air resistance. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Force and Friction* (sciLINKS Number: HSTP110)
Literacy Connections	· Summarize observations and conclusions in a laboratory notebook.
Energy, Work, and Machines	**Suggested Time: 4 weeks**
Key Idea	· ***Energy*** *is the ability to do* ***work*** *or produce* ***change****. Objects in* ***motion*** *have* ***kinetic energy*** *(i.e., a rock rolling downhill). The more mass or speed a moving object has, the more kinetic energy it has. The* ***potential energy*** *of an object depends on its* ***relative position*** *(i.e., a rock at the top of a hill). Potential energy also consists of* ***stored energy*** *(i.e., fossil fuels).*
NYS MST Standards	· Performance Indicator 4.1: Describe the sources and identify the transformations of energy observed in everyday life.

Performance Tasks	· Students use spring scales or force meters and measuring tapes to calculate the potential energy (PE) of various objects placed at different heights around the room. [PE (Nm) = weight (N) x height (m); units given in parentheses]. · Students observe changes in potential and kinetic energy that take place in a swinging pendulum. Students analyze the energy transfers that occur and indicate when potential and kinetic energy are maximized.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.1e Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Glencoe: Physical Science: *Swinging Energy* · Challoner, J. Eyewitness Books: Energy · Gardner: Science Projects About Physics in the Home · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use calculators or a Microsoft Excel spreadsheet to calculate potential energy. · Use a Microsoft Excel spreadsheet to organize pendulum data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *What Is Energy?* (sciLINKS Number: HSTP205) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Work, Energy, and Machines: *Work and Not Work; Potential and Kinetic Energy*
Literacy Connections	· Read a series of steps to accomplish a task. · Prepare a lab report incorporating informational and narrative procedure writing.

Inquiry Activity	· Students vary the length of the string, mass of the stopper, starting height or angle, or the height of an interruption bar and observe the effects on the motion of the pendulum.
Key Idea	· *Different **forms** of energy include **heat, light, electrical, mechanical, sound, chemical**, and **nuclear**. Energy is **transformed** in many ways. Energy in the form of heat, is always one of the **products** of energy transformations.* · *Most activities in everyday life involve one form of energy being transformed into another. For example, the chemical energy in gasoline is transformed into mechanical energy in an automobile engine.*
NYS MST Standards	· Performance Indicator 4.1: Describe the sources and identify the transformations of energy observed in everyday life. · Performance Indicator 4.5: Describe situations that support the principle of conservation of energy.
Performance Tasks	· Students list common household objects and living things and describe how they transform energy from one form to another or classify them according to the types of energy transformations they perform (i.e. houseplants convert light energy to chemical energy; muscles convert chemical energy to mechanical energy; lamps convert electrical energy to light energy. Students then develop and use a dichotomous key to classify appliances by their types of energy transformations.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 Standard 4: The Physical Setting · Major Understanding: 4.1c-d, 4.5b Process Skills Based on Standard 4 · General Skills: 4, 6
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4d-e Scientific Thinking · S5a-f Scientific Communication · S7a-e
Resources	· Challoner, J. Eyewitness Books: Energy · Gardner: Science Projects About Physics in the Home
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Use Inspiration to construct a dichotomous key. · Create a PowerPoint slideshow to animate the ways in which energy is transformed. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Forms of Energy* (sciLINKS Number: HSTP210)*; Energy Conversions* (sciLINKS Number: HSTP215)
Literacy Connections	· Construct an attribute chart to organize and display information about types of energy and energy transformations

Key Idea	· *Energy cannot be **created** or **destroyed**, but only **changed** from one form into another **(Law of Conservation of Energy).** In the process, some energy is always converted to **heat**. Some systems transform energy with less loss of heat than others.*
NYS MST Standards	· Performance Indicator 4.5: Describe situations that support the principle of conservation of energy.
Performance Tasks	· Students observe heat loss from energy transformations by observing light bulbs, small motors, or heat loss from their own bodies with exercise. For example, students use a thermometer to measure the temperature of their closed fist, exercise for a set period of time then measure the temperature of their closed fist again. Students explain the types of energy transformations that are occurring and how heat is lost.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 Standard 4: The Physical Setting · Major Understanding: 4.1e Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a,S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Estimate, make, and use measurements in real-world situations.
Technology Connections	· Use temperature probes and computers to collect, organize and display temperature data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Law of Conservation of Energy* (sciLINKS Number: HSTP217) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Work, Energy, and Machines: *Conservation of Energy.*
Literacy Connections	· Summarize observations and findings in a laboratory notebook.
Key Idea	· ***Work** is the **force** exerted on an object that causes it to move over a **distance**. In order to do work, the object must move and the exerted force must be in the same direction as the object's motion. **Energy** is **transferred** from one object to another when work is done.*
NYS MST Standards	· Performance Indicator 5.2: Observe, describe, and compare effects of forces on the motion of objects.

Performance Tasks	· Students use spring scales to measure the force required to raise, lower, or slide a series of objects a measured distance. Students calculate the amount of work done in each case [Work (Nm) = force (N) x distance (m)]. Students can experiment with different surfaces (smooth, carpet, or sand) as well as inclined planes to see the effects of the type of surface or angle of the inclined plane on the amount of work done.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.1c Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a, S4e Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas
Mathematics Connections	· Explore methods of collecting and organizing data. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use calculators or Microsoft Excel spreadsheets to calculate work. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Work and Power* (sciLINKS Number: HSTP180) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Work, Energy, and Machines: *Work and Not Work; determining Work Done*
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· ***Machines*** *can* ***change*** *the* ***direction, speed (distance or time****), or* ***amount of force*** *required to do* ***work****. Machines* ***transfer*** *mechanical energy from one object to another.* ***Simple machines*** *include the* ***lever, pulley, wheel and axle, screw, wedge,*** *and* ***inclined plane****. A* ***complex machine*** *uses a combination of simple machines (i.e., bicycle).*
NYS MST Standards	· Performance Indicator 5.2: Observe, describe, and compare effects of forces on the motion of objects.

Performance Tasks	· Students use a spring scale to measure the amount of effort force required, to lift a known weight, using a lever and fulcrum apparatus (i.e., meter stick and wood block). Students explore and record the effects of moving the fulcrum to different positions. Students measure the height of the lever at each end to analyze how a lever changes the amount of distance required to do work. · Students use a spring scale to measure the amount of effort force required, to lift various objects, with and without a pulley and string apparatus. Students compare the two amounts. Students draw diagrams to illustrate how the pulley system changes the direction of work.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.2f Standard 6: Interconnectedness: Common Themes: Patterns of Change · Key Idea 5: 5.1-5.2 Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· NeoSCI: Simple Machines: Lab Investigation Kit · Bender, L. Eyewitness Books: Invention · Macaulay, D. The Way Things Work. · Porter, A. and Davies, E. The Nature Company Discoveries Library: How Things Work · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces; Machines & Inventions · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas; Máquinas e Inventos · Wood, R. The Nature Company Discoveries Library: Great Inventions
Mathematics Connections	· Explore methods of collecting and organizing data. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.

Technology Connections	· Draw diagrams of the pulley systems using Dabbler or Microsoft draw tools. · Create flyers using Dabbler or Microsoft draw tools. · Construct tables and graphs using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Simple Machines* (sciLINKS Number: HSTP190)*; Compound Machines* (sciLINKS Number: HSTP195) · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Work, Energy, and Machines: *Levers; Effort and Output Forces; Classes of Levers; Wheels and Gears; Pulleys; Inclined Planes; Wedges and Screws; Compound Machines*
Literacy Connections	· Prepare a sales flyer detailing the design, uses, advantages, and efficiency ratings of the pulley systems.
Key Idea	· *A machine can be made more **efficient** by reducing **friction**. Some common ways of reducing friction include **lubricating** or **waxing surfaces.***
NYS MST Standards	· Performance Indicator 5.2: Observe, describe, and compare effects of forces on the motion of objects.
Performance Tasks	· Students use spring scales or force meters to measure the amount of effort force required, to slide various objects, across a lubricated and nonlubricated surface. Students calculate the amount of work done in each trial.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 5.2e Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1b Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· NeoSCI: Simple Machines: Lab Investigation Kit · Bender, L. Eyewitness Books: Invention · Macaulay, D. The Way Things Work. · Porter, A. and Davies, E. The Nature Company Discoveries Library: How Things Work · Riley, P. Forces and Movement · Time Life: Understanding Science and Nature: Physical Forces; Machines & Inventions · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: Fuerzas físicas; Máquinas e Inventos · Wood, R. The Nature Company Discoveries Library: Great Inventions
Mathematics Connections	· Explore methods of collecting and organizing data. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use Microsoft Excel to organize friction data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Mechanical Efficiency* (sciLINKS Number: HSTP185)
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Density and Fluid Forces	**Suggested Time: 2 weeks**
Key Idea	· ***Density*** *may be described as the amount of* ***matter (mass)*** *in a given amount of* ***space (volume****).*
NYS MST Standards	· Performance Indicator 3.1: Observe and describe properties of materials, such as density, conductivity, and solubility.
Performance Tasks	· Students measure the mass and volume of a variety of regular and irregular objects, calculate the density of each object [Density (D) = mass (m) / Volume (V)], then rank the objects according their density. · Given 30-ml of water, students are challenged to develop a procedure to find the density of the water. Once their procedure has been approved, students find the density of the water sample and use the same procedure to find the density of 3-4 other liquids.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 10, 11 Standard 4: The Physical Setting · Major Understanding: 3.1a, 3.1h
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· Abramson, D. D. Mastering Basic Skills in Science: *Determining the Density of a Liquid; Determining the Density of a Regularly Shaped Solid; Determining the Density of an Irregularly Shaped Solid.* · Holt, Rinehart, and Winston: Holt Science & Technology: Physical Science: *Determining Density* · Prentice Hall: Science Explorer Integrated Science Laboratory Manual: *Determining the Density of Liquids* · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Make and use metric measurements of length, mass, and volume. · Find the volume of rectangular prisms. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use calculators or Microsoft Excel spreadsheets to calculate density. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Buoyant Force* (sciLINKS Number: HSTP165)
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· *The **relative densities** of an object and a given fluid determine the **buoyancy** of the object in the fluid. An object that is denser than the fluid it is placed in sinks. An object that is less dense than the fluid floats.*
NYS MST Standards	· Performance Indicator 3.1: Observe and describe properties of materials, such as density, conductivity, and solubility.
Performance Tasks	· Students estimate the density of a substance by comparing it to liquids of known density. Using a 10 mL graduated cylinder, students add 2 mL of glycerine (1.3 g/cm^3), then 2 mL water (1.0 g/cm^3), then 2 mL of mineral oil (0.9 g/cm^3), then alcohol (0.8 g/cm^3). Students add a small chunk of hard-boiled egg white to the cylinder and observe what layers it passes through and which layer it stops on top of. Students then add a small piece of ice and record their observations. Students draw and label diagrams of their observations and estimate the densities of both substances. · Students compute the density of a variety of wooden blocks, then compare their calculated densities to the density of water to determine whether the blocks will sink or float. If the block will float, students determine how much of the wood would be submerged and how much would float using percentages. Students then mark the blocks with their predicted water line, then test their predictions by placing the blocks in water. · Extension: Students conduct similar investigations using salt water.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 10 Standard 4: The Physical Setting · Major Understanding: 3.1i
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Abramson, D. D. Mastering Basic Skills in Science: *Estimating Densities.* · AIMS: Floaters and Sinkers: *Floating Wood; Afloat* · NeoSCI: Investigating Gravity: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Make and use metric measurements of length and mass. · Find the volume of rectangular prisms. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use Dabbler or Microsoft draw tools to create diagrams of the blocks illustrating the percentage that would float above the waterline for the calculated density. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Buoyant Force* (sciLINKS Number: HSTP165)
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing as well as labeled diagrams of the wood blocks and their position relative to the waterline.
Key Idea	· *Water and other fluids exert a **buoyant force** upon objects within them. The buoyant force acts in an **upward direction**, against the force of **gravity**. Objects seem to weigh less in water due to the buoyant force.*
NYS MST Standards	· Performance Indicator 3.1: Observe and describe properties of materials, such as density, conductivity, and solubility.
Performance Tasks	· Students use spring scales to determine the weight of a variety of objects when in air and when submerged in water. Students compare the values and calculate the buoyant force.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 Standard 4: The Physical Setting · Major Understanding: 3.1i
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· NeoSCI: Investigating Gravity: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Make and use metric measurements of force. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use Dabbler or Microsoft draw tools to create force diagrams illustrating the buoyant and other forces operating in each trial. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Buoyant Force* (sciLINKS Number: HSTP165)
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing as well as labeled diagrams of the objects, their position relative to the waterline, and the buoyant and gravitational forces acting upon them.
Key Idea	· *The buoyant force is equal to the weight of the water or fluid* ***displaced*** *by the object. An object* ***floats*** *if it displaces a weight of water greater than or equal to its own weight. An object* ***sinks*** *if it displaces a weight of water less than its own weight.*
NYS MST Standards	· Performance Indicator 3.1: Observe and describe properties of materials, such as density, conductivity, and solubility.

Performance Tasks	· Students use spring scales to determine the weight of a variety of objects (include some that sink and some that float), then use overflow cans to measure the amount of water displaced when the different objects are placed in the can. Students compare the weight of the water displaced to the weight of the object in air (Weigh a container using a spring scale, put the water in the container and weigh the water plus the container. Find the weight of the water by subtraction). Students use their findings to explain the relationship between the weight of an object and the weight of water it displaces. · Given 30 g of plasticene clay, students are challenged to design a boat that holds the most cargo. Students first find the density of the clay using a triple beam balance to measure the mass and a large graduated cylinder or overflow cans to find the volume. Students observe that the clay sinks because its density is greater than 1 g/cm^3. Once students have a shape that floats, they sketch it, find the mass, then put the boat in water and add gram masses until the boat sinks. Students are given three tries to adjust their designs and find a shape that holds the most gram masses. Students compare and contrast the mass of the boat to the amount of mass it could hold for each of their trials, then analyze and explain their observations.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4, 8 · Physical Setting Skills: 10, 11 Standard 4: The Physical Setting · Major Understanding: 3.1i
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Floaters and Sinkers: Mass, Volume, and Density: *Clay Boats* · NeoSCI: Investigating Gravity: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia

Mathematics Connections	· Explore methods of collecting and organizing data. · Make and use metric measurements of force (weight), mass, and volume. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use a digital camera to document clay boat investigation. · Use a Microsoft Excel spreadsheet to collect, organize, and display data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Buoyant Force* (sciLINKS Number: HSTP165)
Literacy Connections	· Prepare and give a poster presentation showing the design process.
Temperature and Heat	**Suggested Time: 4 weeks**
Key Idea	· *Atoms and molecules are perpetually in **motion**. The greater the **temperature**, the greater the motion. **Temperature** is a measure of the **average energy of motion**, or the average **kinetic energy**, of the **particles** in a substance.*
NYS MST Standards	· Performance Indicator 3.3: Develop mental models to explain chemical reactions and changes in states of matter. · Performance Indicator 4.2: Observe and describe heating and cooling events.
Performance Tasks	· Students use their hands to compare the "temperatures" of a variety of materials (wood, metal, plastic foam, rock, plastic, cardboard, etc.). Students rank the materials from coolest to warmest then use thermometer strips to measure the actual temperatures of the materials. Students explain their results. · Students measure the temperature of ice water, room temperature water, and hot water. Students predict what will happen when they place a drop of food coloring in each cup. Students test their prediction and explain their results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 Standard 4: The Physical Setting · Major Understanding: 3.3b, 4.2a
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· Gardner, R. and Kemer, E. Science Projects about Temperature and Heat · NeoSCI: How Heat Flows: Lab Investigation Kit · Strauss: Where Puddles Go: Investigating Science with Kids · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Make and use measurements of time and temperature. · Explore methods of collecting and organizing data.
Technology Connections	· Use temperature probes to collect temperature data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *What Is Temperature?* (sciLINKS Number: HSTP230) · NeoSCI: Heat & Energy: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: Heat and Temperature: *Heat vs. Temperature; Molecular Motion: The Thermometer*
Literacy Connections	· Write a lab report incorporating informational and narrative procedure writing.
Key Idea	· ***Heat** is the **movement** of **thermal energy** from a substance at a **higher temperature** to a substance at a **lower temperature**. Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.* · *Heat is a **calculated value**, which includes the **temperature change** of the material, the **mass** of the material, and the type of material (specific heat capacity). **Temperature** is not a measurement of heat.*
NYS MST Standards	· Performance Indicator 4.2: Observe and describe heating and cooling events.
Performance Tasks	· Students place a cup with cold water in a warm water bath and measure the temp of the cold water, warm water bath, and room at 5-minute intervals until all reach the same temperature. Students graph and analyze their results and draw diagrams of the system to indicate the direction of heat flow.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 Standard 4: The Physical Setting · Major Understanding: 4.2a

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. and Kemer, E. Science Projects about Temperature and Heat · NeoSCI: How Heat Flows: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct line graphs to demonstrate data that has been collected.
Technology Connections	· Construct line graphs using Microsoft Excel · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *What Is Heat?* (sciLINKS Number: HSTP240) · NeoSCI: Heat & Energy: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: Heat and Temperature: *Heat vs. Temperature*
Literacy Connections	· Write a lab report incorporating informational and narrative procedure writing.
Key Idea	· ***Thermal energy*** *is the sum total of the kinetic energy of all the* ***particles*** *in a quantity of a substance. At the same temperature, a larger* ***volume*** *has a greater thermal energy than a smaller volume of the same substance because there are more particles of the substance in the larger volume.*
NYS MST Standards	· Performance Indicator 4.2: Observe and describe heating and cooling events.
Performance Tasks	· Students place 200ml, 500ml, and 1L of hot water into 3 separate containers. Students measure the temperature of the water in each container for 30 minutes at 5-minute intervals. Students graph and analyze their results. · Students conduct a similar experiment, placing an ice cube in each container of hot water and timing how long it takes for the ice cube to melt. Students graph and analyze their results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 Standard 4: The Physical Setting · Major Understanding: 4.2a

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. and Kemer, E. Science Projects about Temperature and Heat · NeoSCI: How Heat Flows: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct line graphs to demonstrate data that has been collected.
Technology Connections	· Construct line graphs using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *What Is Heat?* (sciLINKS Number: HSTP240) · NeoSCI: Heat & Energy: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: Heat and Temperature: *Heat vs. Temperature*
Literacy Connections	· Write a lab report incorporating informational and narrative procedure writing.
Key Idea	· ***Heat** is **transferred** through materials by the **collision** of atoms (**conduction**) or across space (**radiation**) via **electromagnetic waves**. In a liquid or a gas, **currents** facilitate transfer of heat (**convection**).*
NYS MST Standards	· Performance Indicator 4.2: Observe and describe heating and cooling events.
Performance Tasks	· Students use conduction kits to observe heat transfer through materials. · Students observe their home heating system and explain what types of heat transfer are involved.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 Standard 4: The Physical Setting · Major Understanding: 4.2b

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. and Kemer, E. Science Projects about Temperature and Heat · NeoSCI: How Heat Flows: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct line graphs to demonstrate data that has been collected.
Technology Connections	· Construct line graphs using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Conduction, Convection, and Radiation* (sciLINKS Number: HSTP245) · NeoSCI: Heat & Energy: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: Heat and Temperature: *Convection and insulation; Radiation*
Literacy Connections	· Prepare a lab report incorporating informational and narrative rocedure writing
Key Idea	· *Most substances **expand** when heated and **contract** when cooled. Water is an exception, expanding when changing to ice.*
NYS MST Standards	· Performance Indicator 4.2: Observe and describe heating and cooling events.
Performance Tasks	· At Home Lab: Students fill a plastic container 2/3 of the way with water and use a marker to indicate the water level. Students place the container in the freezer and allow the water to freeze overnight. Once frozen, students compare the level of the ice to the original water level. Students explain their observations and findings in a laboratory notebook.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 Process Skills Based on Standard 4 · General Skills: 1 – 4 Standard 4: The Physical Setting · Major Understanding: 4.2d

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. and Kemer, E. Science Projects about Temperature and Heat · NeoSCI: How Heat Flows: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *What Is Temperature?* (sciLINKS Number: HSTP230) · NeoSCI: Heat & Energy: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: Heat and Temperature: *Expansion and Contraction*
Literacy Connections	· Summarize and explain observations and findings in a laboratory notebook.
Key Idea	· *During a **phase change**, heat energy is **absorbed** or **released**. Energy is absorbed when a solid changes to a liquid or a gas. Energy is released when a gas changes to a liquid and when a liquid changes to a solid.*
NYS MST Standards	· Performance Indicator 4.2: Observe and describe heating and cooling events.
Performance Tasks	· Students boil water using a hot plate or alcohol lamp. Students observe that the temperature rises until the water starts to boil. Once the water starts boiling, the temperature stays the same. Students explain their results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1 – 4 Standard 4: The Physical Setting · Major Understanding: 4.2c

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. and Kemer, E. Science Projects about Temperature and Heat · NeoSCI: How Heat Flows: Lab Investigation Kit · Cooper, C. Eyewitness Science: Matter · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct a line graph to demonstrate data that has been collected.
Technology Connections	· Construct a line graph using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Changes of State* (sciLINKS Number: HSTP250) · NeoSCI: Heat & Energy: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: What's the Matter: *States of Matter; Changing States;* Physical Science Volume 1: Heat and Temperature: *Melting, Freezing and Boiling Points*
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Electricity and Magnetism	**Suggested Time: 6 weeks**
Key Idea	· *Some materials hold their charges more strongly than other materials. Those materials that **accumulate** charges are **negatively charged** and those that **lose** charges become **positively charged**. **Neutral** objects can be **charged by contact (friction/conduction)** or by **induction**.* · ***Like charges repel** each other and **unlike charges attract** each other. Without touching, charged materials may either attract or repel other charged materials.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

Performance Tasks	· Given a balloon, a piece of wool cloth, and a handful of puffed rice, students explore static electricity. First students blow up the balloon, tie the end and see if the puffed rice is attracted. Then they charge the balloon by rubbing it with the piece of wool cloth (hair also works) and see if the puffed rice is attracted. Students draw and label diagrams to illustrate the movement of charges. · Students cut 6-8 small squares of tissue paper (2 cm x 2 cm) and place them on their desk, then hold a plastic comb close to the paper squares (but not touching) and record their observations. Students rub the comb with a piece of silk cloth for about 30 seconds, then hold the comb close to the paper squares and record their observations. Students repeat both steps using a metal rod and record their observations. Students analyze and explain their results. · Students construct an electroscope or a versorium or use a ready-made one to explore static electricity. · Students draw and label diagrams to illustrate the charging of neutral objects by contact and by induction.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4f Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Electrical Connections: *Static Electricity; Static Strokes; Static Extensions* · Gardner, R. Science Projects about Electricity and Magnets · Holt, Rinehart, and Winston: Holt Science & Technology: Physical Science: *Investigate: Charge over Matter* · NeoSCI: Investigating Electricity: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Parker. Eyewitness Science: Electricity · Riley, P. Straightforward Science: Electricity · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.

Technology Connections	· Draw and label diagrams illustrating the charging of neutral objects by contact and by induction using Dabbler or Microsoft Word draw tools. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Static Electricity* (sciLINKS Number: HSTP405) · NeoSCI: Electricity & Electromagnetism: CD-ROM · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Electricity and Magnetism: *What is Electricity?; Attracting and Repelling*
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Inquiry Activity	· Students explore variables such as the size of the balloon, types of cloth or materials used to charge the balloon, or the length of time the balloon is charged and their affect on the number of puffed rice pieces that are attracted.
Key Idea	· ***Electrical circuits*** *provide a means of* ***transferring electrical energy****. The steady* ***flow*** *of electric charges in a wire path is an* ***electric current****.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Given a wire, a battery, and a bulb, students explore, discover, and record four ways to make the bulb light. · Given a battery holder, a battery, two wires, and a bulb, students explore, discover, and record how to make the bulb light. · Given a battery holder, a battery, two wires, a bulb holder, and a bulb, students explore, discover, and record how to make the bulb light. Students then add an additional battery to the circuit and observe the brightness of the bulb.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 3.1I Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· AIMS: Electrical Connections: *Path Finders* · Gardner, R. Science Projects about Electricity and Magnets · National Science Resources Center: Science & Technology for Children: Electrical Circuits · NeoSCI: Investigating Electricity: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Parker. Eyewitness Science: Electricity · Riley, P. Straightforward Science: Electricity · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Draw and label diagrams of the circuits using Dabbler or Microsoft Word draw tools. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Electrical Energy* (sciLINKS Number: HSTP410)*; Electric Current* (sciLINKS Number: HSTP415)*; Electric Circuits* (sciLINKS Number: HSTP420) · NeoSCI: Electricity & Electromagnetism: CD-ROM · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Virtual Labs: Electricity: *Battery and Bulb; Follow the Path; Light Up My Life*
Literacy Connections	· Draw and label diagrams of the circuits.
Key Idea	· *Materials that **conduct** an **electric current** easily are called **conductors** (most metals). Materials that do not conduct electric currents easily are **insulators** (wood, plastic).*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Given a battery holder, a battery, three wires, a bulb holder, and a bulb, students construct a circuit and use it to test whether a variety of materials (i.e. spoon, penny, glass, wooden dowel, aluminum foil, eraser, straw, paper clip, cloth, paper) are insulators or conductors. Students are encouraged to bring items from home to test.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4e Process Skills Based on Standard 4 · General Skills: 1 – 4 · Physical Setting Skills: 15

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Electrical Connections: *Conductor or Insulator?* · Gardner, R. Science Projects about Electricity and Magnets · Glencoe: Physical Science: *Identifying Conductors and Insulators* · National Science Resources Center: Science & Technology for Children: Electrical Circuits · NeoSCI: Investigating Electricity: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Parker. Eyewitness Science: Electricity · Riley, P. Straightforward Science: Electricity · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Use Inspiration to create a chart or Venn diagram showing which objects were conductors and which were not. · NeoSCI: Electricity & Electromagnetism: CD-ROM · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Virtual Labs: Electricity: *Good Conductor, Bad Conductor* · Windows on Science Laser Disc: Physical Science Volumes 2 & 3: Electricity and Magnetism: *Conductors and Insulators*
Literacy Connections	· Summarize and explain observations and findings in a laboratory notebook.
Key Idea	· ***Series** and **parallel circuits** are the two basic types of **electrical circuits.** A series circuit connects all the parts in a single **loop**. A parallel circuit connects each of the parts on a separate **branch** to the power source. Most of the wiring in homes consists of parallel circuits.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

Performance Tasks	· Given a 6-V dry cell power source, a switch, 3 light bulb holders, 3 light bulbs, and a number of insulated wires, students construct and test a series circuit. Students determine whether all bulbs light with the same intensity and see what happens when one light bulb is unscrewed. Students connect an ammeter at different points along the circuit and take readings and then connect a voltmeter across each of the bulbs and take readings. Students draw a diagram of the circuit and label each of the current and voltage readings on the diagram. Students then construct a parallel circuit and proceed to test it in the same manner. · Students construct switches using tag board squares, brass paper fasteners, masking tape, wires, and paper clips to control the circuits constructed above.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4e Process Skills Based on Standard 4 · General Skills: 1 – 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Electrical Connections: *Electric Circuits; Make a Switch* · Gardner, R. Science Projects about Electricity and Magnets · Glencoe: Physical Science: *Comparing Series and Parallel Circuits.* · Holt, Rinehart & Winston: Holt Science & Technology: Physical Science: *Circuity 101.* · National Science Resources Center: Science & Technology for Children: Electrical Circuits · NeoSCI: Investigating Electricity: Lab Investigation Kit · Prentice Hall: Science Explorer: Integrated Science Laboratory Manual: *Building Electric Circuits* · Gardner: Science Projects About Physics in the Home · Parker. Eyewitness Science: Electricity · Riley, P. Straightforward Science: Electricity · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.

Technology Connections	· Draw and label diagrams of the circuits using Dabbler or Microsoft Word draw tools. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Electrical Energy* (sciLINKS Number: HSTP410); *Electric Current* (sciLINKS Number: HSTP415); *Electric Circuits* (sciLINKS Number: HSTP420) · NeoSCI: Electricity & Electromagnetism: CD-ROM · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Virtual Labs: Electricity: *All in a Row; A Fork in the Road; Circuit Combo; Hi Voltage! 1; Hi Voltage! 2; Hi Voltage! 3* · Windows on Science Laser Disc: Physical Science: Electricity and Magnetism: *Current Electricity; Series vs. Parallel Circuits; Measuring Electric Current*
Literacy Connections	· Draw and label diagrams of the circuits.
Key Idea	· ***Electrical energy*** *can be produced from a variety of energy sources and can be* ***transformed*** *into almost any other form of energy, such as* ***light*** *and* ***heat****. An* ***electrical motor converts*** *electrical energy to* ***mechanical energy****. A* ***generator*** *converts mechanical energy to electrical energy.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Students research and categorize everyday appliances and machines according to the type of energy source used (oil, gasoline, electrical, nuclear, wind…) and the type(s) of output energy produced (mechanical, light, heat, sound…). · Students research the source(s) of electrical energy used in their homes and/or school. · At Home Lab: Students take a meter reading and draw the dials on their home electric meter at the same time every day for one week. Students calculate the kilowatt hours used each day by subtracting the first day's reading from the second day's, then the second day's reading from the third day's, etc., and construct a bar graph of the amount of electricity used each day. Students also record the types electricity used each day and use that information to explain fluctuations in energy usage during the week. Students who are unable to access their electric meters, should keep an energy usage log detailing the types of electric appliances used and approximate times they are in use.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4d Process Skills Based on Standard 4 · General Skills: 4

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. Science Projects about Electricity and Magnets · National Science Resources Center: Science &Technology for Children: Electrical Circuits · NeoSCI: Investigating Electricity: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Parker. Eyewitness Science: Electricity · Riley, P. Straightforward Science: Electricity · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct a bar graph to demonstrate data that has been collected.
Technology Connections	· Use Inspiration to create a chart indicating input and output energy for everyday appliances. · Use Microsoft Excel to construct a bar graph illustrating daily home energy use. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Electrical Energy* (sciLINKS Number: HSTP410); *Electric Current* (sciLINKS Number: HSTP415) · NeoSCI: Electricity & Electromagnetism: CD-ROM · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Virtual Labs: Electricity: *It's the Power* · Windows on Science Laser Disc: Physical Science: Electricity and Magnetism: *How Much Electric Power are You Using?*
Literacy Connections	· Summarize observations and findings in a laboratory notebook.
Key Idea	· ***Magnetism** is a **force** of **attraction** or **repulsion** exerted by one object on another object. Magnetic forces are strongest at the **poles** of a magnet. **Unlike** magnetic poles attract, while **like** magnetic poles repel.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

Performance Tasks	· Students explore the properties and uses of magnets by observing the interactions between two magnets and between magnets and other materials. Students suspend a bar magnet from a string and observe the magnetic force operating between like and unlike poles as well as magnetic and nonmagnetic materials. Students then predict and test a variety of materials for magnetic attraction. · Students conduct experiments to determine the strength of different combinations of similar magnets. For example, students take one ring magnet and see how many paper clips the magnet will hold. Students bend one side of a large paper clip down to form a hook, place the hook against the side of the magnet, then see how many small paperclips they can place on the hook before it falls off. Students test two more ring magnets I the same way and compare and contrast their results using a bar graph. Students predict what will happen if they put two or three magnets together, then test their predictions.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4g Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Mostly Magnets: *Holding Power* · Gardner, R. Science Projects about Electricity and Magnets · National Science Resources Center: Science & Technology for Children: Magnets and Motors · NeoSCI: Magnets & Magnetism: Lab Investigation Kit
Mathematics Connections	· Construct a bar graph to demonstrate data that has been collected.
Technology Connections	· Use Inspiration to create a chart or Venn diagram categorizing magnetic and nonmagnetic materials. · Use Microsoft Excel to construct a bar graph illustrating strength of magnet combinations. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Magnetism* (sciLINKS Number: HSTP430) · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science: Electricity and Magnetism: *Magnetism*
Literacy Connections	· Write a lab report incorporating informational and narrative procedure writing.

Key Idea	· *The **force** of a **magnet** can operate through materials such as paper, wood, plastic, and cloth.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Students explore how magnetic forces operate through a variety of materials. · Students conduct experiments to determine the strength of magnets through different amounts of paper (1 sheet vs. multiple sheets) and graph their results. Students use the graph to predict magnet strength through an untested number of sheets and then test their predictions. · Extension: Students conduct a similar experiment with different magnets or combinations of magnets.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4g Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Mostly Magnets: *Through It All* · Gardner, R. Science Projects about Electricity and Magnets · National Science Resources Center: Science & Technology for Children: Magnets and Motors · NeoSCI: Magnets & Magnetism: Lab Investigation Kit
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct a bar graph of magnetic strength.
Technology Connections	· Use PowerPoint to create an animation of radiant energy generated by infrared remotes and light bulbs. · Eyewitness: Science Encyclopedia: CD-ROM · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Magnetism* (sciLINKS Number: HSTP430) · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· *A **magnetic field** is a **region** around a magnet within which magnetic forces operate.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

Performance Tasks	· Students observe magnetic fields by sprinkling iron filings over paper with a magnet underneath. Students measure the dimensions of and compare and contrast the magnetic fields produced by different shaped magnets and different combinations of magnets. · Students use a small compass to map the magnetic field lines around different shaped magnets. Students use small arrows to show magnetic north at each location. · Demonstration: Construct a temporary three-dimensional magnetic field by placing sifted iron filings into a thick clear liquid, such as corn syrup or glycerin. Place a strong bar magnet into a test tube and suspend the test tube in the liquid.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4g Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. Science Projects about Electricity and Magnets · National Science Resources Center: Science & Technology for Children: Magnets and Motors · NeoSCI: Magnets & Magnetism: Lab Investigation Kit
Mathematics Connections	· Make and use metric measurements of length.
Technology Connections	· Draw magnetic fields using Dabbler or Microsoft draw tools. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Magnetism* (sciLINKS Number: HSTP430); *Types of Magnets* (sciLINKS Number: HSTP435) · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science: Electricity and Magnetism: *Magnetism: Mapping a Magnet; Magnetic Fields*
Literacy Connections	· Summarize observations and findings in a laboratory notebook.
Key Idea	· *Within a magnet, the **alignment** of its **atoms** creates specialized regions known as **magnetic domains**. Objects can behave like magnets if their atoms are aligned by a **true magnet**.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

Performance Tasks	· Students create temporary magnets by rubbing a bar magnet along the length of a nail. Students test the magnetic properties of the nail with magnetic and nonmagnetic materials. · Students observe the weak magnetic field in the temporary magnet by sprinkling iron filings over paper with a magnetized and a non-magnetized nail underneath. Students test the strength of the temporary nail magnet by seeing how many staples it can hold over time.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4g Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Mostly Magnets: *What Makes a Thing Magnetic; Making Magnets* · Gardner, R. Science Projects about Electricity and Magnets · National Science Resources Center: Science & Technology for Children: Magnets and Motors · NeoSCI: Magnets & Magnetism: Lab Investigation Kit
Mathematics Connections	· Explore methods of collecting and organizing data · Construct a bar graph to demonstrate data that has been collected.
Technology Connections	· Draw magnetic fields using Dabbler or Microsoft draw tools. · Create a bar graph of magnet strength using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Magnetism* (sciLINKS Number: HSTP430); *Types of Magnets* (sciLINKS Number: HSTP435) · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM
Literacy Connections	· Summarize observations and findings in a laboratory notebook.
Key Idea	· ***Moving charges**, such as those in an electric current, produce **magnetic fields**. When no current is flowing, the magnetic field disappears. An **electromagnet** is a **temporary magnet** made by placing a piece of iron inside a current-carrying coil of wire. An electromagnet behaves like any other magnet as long as the current is flowing. A magnet can **induce** electric current in a wire.* · *Electromagnets are used in **generators** to change movement into electricity and to change electricity into mechanical movement in **electric motors**.* · ***Electric currents** and **magnets** can exert a **force** on each other.*

NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Leaving about 10cm of wire free at each end, students wrap insulated wire around the length of a large nail from head to tip. Students remove about 2cm of insulation from each end of the wire then use a compass to check for magnetic fields all around the nail. Students connect each end of the wire to the terminals of a 6V dry cell battery and test the nail again with the compass. Students reverse the wires connected to the dry cell and repeat the compass test. Students test the strength of the electromagnet by determining how many paper clips it can pick up. · Students wrap wire around a cardboard tube then attach either end to a galvanometer and take a reading. Students pass a bar magnet through the coil and take another reading. Students try moving the magnet at different speeds and in different directions around the outside of the coil. Students determine under which circumstances the greatest current is generated and what influences the direction of the current in the wire. Students record their observations and explain their results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4d, 5.2b Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Electrical Connections: *The Electromagnetic Connection; Electromagnetism; Electromagnets* · Gardner, R. Science Projects about Electricity and Magnets · Glencoe: Physical Science: *Electricity and Magnetism; Putting Electromagnets to Work* · National Science Resources Center: Science & Technology for Children: Electrical Circuits · NeoSCI: Magnets & Magnetism: Lab Investigation Kit · Prentice Hall: Science Explorer: Integrated Science Laboratory Manual: *Electromagnetism*
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct a bar graph to demonstrate data that has been collected.

Technology Connections	· Draw magnetic fields using Dabbler or Microsoft draw tools. · Create a bar graph of magnet strength using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Electromagnetism* (sciLINKS Number: HSTP440); *Electromagnetic Induction* (sciLINKS Number: HSTP445) · NeoSCI: Electricity & Electromagnetism: CD-ROM · NeoSCI: Electricity & Magnetism: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science: Electricity and Magnetism: *Electromagnets: Making an Electromagnet; Electricity and Magnets*
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Inquiry Activities	· Students vary the number of coils around the nail and determine the effect on the strength of their electromagnet. · Students vary the number of coils or strength of the magnet to see the effect on the amount of current induced by the magnet in the wire.
Waves, Sound and Light	**Suggested Time: 4 weeks**
Key Idea	· *A **wave** is a **disturbance** that **transfers energy** through **matter** or through **space**.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Using a pencil (or dropper), students regularly tap (or drip water into) a shallow pan of water and observe how the waves travel, observing waves spreading out from the source and reflecting once they reach the edge of the pan. Students then increase the rate of tapping and draw and label diagrams to illustrate the waves formed at the two different rates. Students float a small cork in the water and observe the motion of the cork with respect to the waves.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4c Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6b-e Scientific Communication · S7a-e
Resources	· Gardner, R. Science Projects about Light · Holt, Rinehart and Winston: Holt Science & Technology: Physical Science: *Investigate: Making Waves* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics*

Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Use a digital camera to photograph the waves. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Nature of Waves* (sciLINKS Number: HSTP480) · Windows on Science Laser Disc: Physical Science: Sound: *Sound Waves;* Physical Science: Light: *Light Waves*
Literacy Connections	· Summarize observations and findings in a laboratory notebook.
Key Idea	· *Two types of waves are **transverse** and **longitudinal (compressional)**. The basic properties of waves are **amplitude, wavelength, frequency,** and **speed**.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Using 2m of rope, students observe transverse waves by tying one end to a chair leg and moving the end of the rope from side to side along the floor. Students experiment with moving the rope at different speeds and/or using wider/shorter hand movements and observe any differences in the waves formed. Students count the numbers of waves and measure the average wavelength. Students sketch their observations, labeling crests, troughs, amplitude, rest position, and wavelengths. · Students observe how transverse and longitudinal waves travel in a spring toy (slinky). Two students stretch the spring lengthwise, measure the length of the spring, and move one end of the spring sideways to create a single wave pulse. Students time how long it takes for the wave pulse to travel to the end of the spring and record the data in a table. Students stretch the coil to the same length and time the wave pulse two more times, then calculate the wave speed (speed = distance/time) and average wave speed. Two students stretch the spring lengthwise and create a transverse wave with several wavelengths. A third student stands at the center of the spring and counts the number of wavelengths that pass by in 10 seconds. For each of the next two trials, the students move the spring faster or slower to create a different wavelength. Students calculate the frequency (number of wavelengths counted/time) and the wavelength (wavelength = average wave speed/frequency). Students then stretch the spring lengthwise and compress 15-20 coils to observe longitudinal or compressional waves.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4a, 4.4c Process Skills Based on Standard 4 · General Skills: 1, 4

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. Science Projects about Light · Glencoe: Physical Science: *Measuring Wave Properties* · Holt, Rinehart and Winston: Holt Science & Technology: Physical Science: *Quick Lab: Energetic Waves; Quicl Lab: Springy Waves* · Prentice Hall: Science Explorer: Integrated Science Laboratory Manual: *Making Waves* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics*
Mathematics Connections	· Explore methods of collecting and organizing data. · Explore the concepts of rates. · Describe functions and generalize them by the use of rules and algebraic expressions. · Evaluate algebraic expressions.
Technology Connections	· Use a digital camera to photograph the waves. · Use PowerPoint to prepare a slideshow describing the properties of waves. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Types of Waves* (sciLINKS Number: HSTP490)*; Properties of Waves* (sciLINKS Number: HSTP485) · Windows on Science Laser Disc: Physical Science: Sound: *Sound Waves;* Physical Science: Light: *Light Waves*
Literacy Connections	· Prepare and give a poster presentation.
Key Idea	· ***Reflection, refraction, diffraction*** *and* ***interference are wave interactions*** *with other matter and among themselves.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

Performance Tasks	· Students sit on the floor and roll a tennis ball against the wall. First they roll the ball directly toward the wall and then at increasing angles to the normal (an imaginary line perpendicular to the wall). Students observe the angle of incidence (formed by the path of ball toward the wall and the normal) and the angle of reflection (formed by the path of the ball away from the wall and the normal). · Students observe refraction by placing a pencil into a clear glass of water at an angle. The pencil will appear to be broken. Students sketch their observations. · Students observe diffraction by taping two flat pieces of metal or plastic in an upright position to the center of a pan, leaving a slit between the two pieces. Students fill the pan with water then use pencils to tap the water and generate waves. Students sketch the form of the waves before reach the barrier and after they emerge from the slit. · Demonstration: A pair of students demonstrates constructive and destructive interference as well as standing waves using a jump rope. Students sketch and describe the wave patterns formed.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4a Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Glencoe: Physical Science: *Reflection Activity* · Burnie, ,D. Eyewitness Science: Light · Gardner, R. Science Projects about Light · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics*
Mathematics Connections	· Explore methods of collecting and organizing data. · Make and use angular measurements.
Technology Connections	· Use a digital camera to document wave diffraction. · Use PowerPoint to prepare a slideshow describing the process of diffraction. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Interactions of Waves* (sciLINKS Number: HSTP495); *Interactions of Sound Waves* (sciLINKS Number: HSTP520)
Literacy Connections	· Summarize observations and findings in a laboratory notebook.

Inquiry Activity	· Students vary the size of the slit, number of slits, depth of water, rate of tapping, or type of medium and observe the effect on diffraction.
Key Idea	· ***Vibrations*** *in materials set up* ***wave-like disturbances*** *that spread away from the* ***source****.* ***Sound waves*** *are an example****.*** ***Vibrational waves*** *move at different* ***speeds*** *in different materials. Sound cannot travel in a* ***vacuum****.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Students listen to the sound produced by a vibrating tuning fork and then touch the tuning fork to their hand to feel the vibrations. Students place a vibrating tuning fork in a shallow pan of water and then in a shallow pan of oil. Students compare, contrast, and explain their observations. · Students construct string telephones using two paper cups and about 10 meters of string. After testing the string telephones, students predict what would happen with different lengths/types of string or different sizes/types of cups. Students construct additional string telephones and test their observations.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4c Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Holt, Rinehart and Winston: Holt Science & Technology: Physical Science: *Quick Lab: Good Vibrations* · NeoSCI: Investigating Sound: Lab Investigation Kit · Prentice Hall: Science Explorer: Integrated Science Laboratory Manual: *Tuning Forks* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics*
Mathematics Connections	· Explore methods of collecting and organizing data.

Technology Connections	· Use a digital camera to document construction and testing of string telephones. · Use PowerPoint to create a multimedia design journal for the string telephones. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *What Is Sound* (sciLINKS Number: HSTP505) · NeoSCI: Waves & Sound: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science: Sound: *What Is Sound?*
Literacy Connections	· Summarize observations and findings in a lab notebook.
Key Idea	· ***Sound** has **properties** of **intensity/loudness, frequency and pitch,** and **resonance**. Loudness is the **human perception** of intensity or the amount of energy that flows through a certain area in a specific amount of time. Pitch is also a human perception how **high** or **low** a sound appears to be. As frequency increases, pitch gets higher. Resonance is the ability of an object to **vibrate** by **absorbing energy** at its **natural frequency**.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Students observe resonance by striking a tuning fork and bring it within a few centimeters of a second tuning fork of the *same* frequency. Students listen to the second tuning fork and record their observations. Repeat the procedure, but hold the first tuning fork near a tuning fork that has a *different* frequency. Students try the same activity with different combinations of tuning forks and explain their results. · Students construct a variety of hand held musical instruments using balloons, tubes, rubber bands, cans, small cardboard boxes, beans, etc. Students explore the properties of sound with the instruments. · Students explore a variety of musical instruments (percussion, wood wind, brass, and string) and determine how the pitch can be changed and how they amplify sound.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4c Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· Holt, Rinehart and Winston: Holt Science & Technology: Physical Science: *Investigate: A Homemade Guitar* · NeoSCI: Investigating Sound: Lab Investigation Kit · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics*
Mathematics Connections	· Make and use measurements in real-world situations. · Explore methods of collecting and organizing data.
Technology Connections	· Use a digital camera to document construction and testing of the musical instruments. · Use PowerPoint to create a multimedia design journal for the musical instruments that explains the properties of sound. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Properties of Sound* (sciLINKS Number: HSTP515) · NeoSCI: Waves & Sound: NeoSIMULATION CD-ROM · Windows on Science Laser Disc: Physical Science: Sound: *Describing Sound: Frequency; Pitch; Intensity*
Literacy Connections	· Summarize observations and findings in a lab notebook. · Prepare a design journal.
Key Idea	· *The **ear** is a specialized **organ** with compartments **that collect, transmit** and **convert sound waves**.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Demonstration: Students cup their hands around the back of their ears to hear how they can catch more sound waves. · Students analyze a drawing or model of the ear and classify the structures as those that collect, transmit, and convert sound waves. · To collect data about how well people can locate the source of a sound, one student sits in a chair blindfolded, while another snaps or taps two spoons together from different positions and distances around the seated student. A grid should be mapped out on the floor to aid data collection. The student in the chair points to the direction of the sound. A third student records the data by plotting points on the grid and using an arrow to indicate direction. Students take turns locating sounds then compare and contrast their results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4c Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2: 2.1-2.3 Process Skills Based on Standard 4 · General Skills: 1, 4

NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Dowling Bruun, R. and Bruun, B. The Human Body: Your Body and How it Works. · Dorling Kindersley: Atlas Visual del Cuerpo Humano. · Dorling Kindersley: Eyewitness Visual Dictionaries: The Visual Dictionary of the Human Body · Parker, S. Readers Digest: How the Body Works · Stein, S. The Body Book · The Nature Company Discoveries Library: The Human Body · Time Life: Understanding Science & Nature: Human Body · Time Life: Enciclopedia Ilustrada de Sciencia y Naturaleza: El Cuerpo Humano. · Time Life: Student Library: Human Body
Mathematics Connections	· Make and use metric measurements. · Use a coordinate system to plot points.
Technology Connections	· National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Ear* (sciLINKS Number: HSTP510) · Windows on Science Laser Disc: Life Science Volume 2: Don't Get Nervous!: *Eyes*
Literacy Connections	· Summarize observations and findings in a lab notebook.
Key Idea	· *Unlike sound and water waves, which transfer energy from particle to particle,* ***electromagnetic waves*** *are* ***transverse waves*** *made by* ***vibrating electric charges,*** *which travel by* ***transferring energy*** *between* ***vibrating electric and magnetic fields.*** *Both electric and magnetic fields can exist in space where matter is not present. Electromagnetic waves travel outward from a vibrating charge in all directions; the energy the waves carry is called* ***radiant energy****.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· At-Home Lab: Students explore electromagnetic waves (infrared) by pointing the television remote in different directions and observing whether it will still control the television. Students then place various materials, such as glass, plastic, metal, paper, their hand, and a book in front of the infrared receiver on the television and observe whether the remote will still control the television. Students explain their results. · Students set up a lamp with a bulb and no reflector shield. Students take both temperature and light readings at a set distance from the bulb in all directions. After turning off the lamp and allowing it to cool, students replace the reflector shield and repeat the data collection. Students compare and contrast their results for both trials.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4a Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. Science Projects about Light · Glencoe: Physical Science: *Mini LAB: Investigating Electromagnetic Waves.* · Burnie, D. Eyewitness Science: Light · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner, R. Science Projects about Light
Mathematics Connections	· Explore methods of collecting and organizing data. · Make and use metric measurements of length.
Technology Connections	· Use PowerPoint to create an animation of radiant energy produced by infrared remotes and/or light bulbs. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Light Energy* (sciLINKS Number: HSTP529)
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· *All **electromagnetic waves** travel at the same **speed** but different forms of electromagnetic energy have different **wavelengths** and different **frequencies**. The **electromagnetic spectrum** is the **range** of electromagnetic waves placed in order of increasing frequency. Some examples of electromagnetic energy are **radio waves, microwaves, infrared light, visible light, ultraviolet rays, X-rays,** and **gamma rays**.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

Performance Tasks	· Using two small beakers or baby food jars, students place 50 mL of dry sand into each and add 20 mL of room-temperature water to one of the jars and stir well. Students then record the temperature of the sand in both jars. Students place one of the jars into a microwave for 10 seconds, remove the jar, immediately take and record the temperature, then repeat the procedure for the other jar. Students compare the initial and final temperatures for the wet and dry sand and explain any differences. · Students research and describe the properties and uses of the different types of electromagnetic waves. For example, students can explore the television, radio, cell phone, pager, X-Ray machine, ultrasound devices, magnetic resonance imaging, communications satellites, radar, etc. Students prepare poster displays and presentations summarizing their research and findings.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4a Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner, R. Science Projects about Light · Glencoe: Physical Science: *Mini LAB: Heating Food with Microwaves.* · Burnie, D. Eyewitness Science: Light · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner, R. Science Projects about Light
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Create a double-bar graph to illustrate initial and final temperatures of the wet and dry sand using Microsoft Excel. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Electromagnetic Spectrum* (sciLINKS Number: HSTP530) · Windows on Science Laser Disc: Physical Science: Light: *The Electromagnetic Spectrum*
Literacy Connections	· Summarize observations and findings in a lab notebook.
Key Idea	· ***Light*** *passes through some materials, sometimes* ***refracting*** *in the process. Materials* ***absorb, reflect****, and may* ***transmit*** *light. There are many different* ***sources*** *of light energy.*

NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Students use flashlights to test a variety of materials for their ability to absorb, reflect, or transmit light. · Students observe reflection of light by drawing a large letter T on a sheet of paper and stand a flat mirror at the top of the T. Students cover the lens of the flashlight with a disc of paper with a small hole in the center to create a narrow beam, then shine a flashlight into the mirror aiming at the point where the vertical line of the T meets the top of the T (Turn lights off in room.). Students sketch the beam approaching and leaving the mirror. Students use protractors to measure the angle of incidence and angle of reflection. Students predict what would happen if they change the angle of incidence and then test their predictions. · Students observe refraction by placing a penny at the bottom of a short, opaque cup. One partner slowly slides the cup away from the other partner until the other partner *cannot* see the penny, measures the distance; then slowly adds water to the cup until the partner *can* see the penny. Students measure the final distance, switch roles, repeat the exercise; then explain their observations using principles of refraction.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.4b Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· AIMS: Ray's Reflections: *Likely Reflections* · Gardner, R. Science Projects about Light · Glencoe: Physical Science: *Mini LAB*: *Observing Refraction in Water.* · Burnie, D. Eyewitness Science: Light · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner, R. Science Projects about Light
Mathematics Connections	· Explore methods of collecting and organizing data. · Make and use angular measurements.

Technology Connections	· Use a digital camera to document angle of incidence and angle of reflection. · Use PowerPoint to animate reflection of light. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Reflection and Refraction* (sciLINKS Number: HSTP545) · Windows on Science Laser Disc: Physical Science: Light: *Reflection and Refraction*
Literacy Connections	· Summarize observations and findings in a lab notebook.
Key Idea	· *To see an object, light **emitted** by that object, or **reflected** from it, must enter the eye. In a healthy eye, the light is **focused** by the **lens** onto the **retina**, which converts **light energy** into **nerve impulses** that are **transmitted** to the **brain**.*
NYS MST Standards	· Performance Indicator 4.4: Observe and describe the properties of sound, light, magnetism, and electricity.
Performance Tasks	· Students analyze a drawing or model of the eye and identify the functions of each structure. · Students use Eye Charts to test the vision of each student in the group. Students then compile class data and use tables and graphs to illustrate results.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 Standard 4: The Physical Setting · Major Understanding: 4.4b Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2: 2.1-2.3 Process Skills Based on Standard 4 · General Skills: 1, 4
NYC Performance Standards	Physical Science Concepts · S1c Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Dowling Bruun, R. and Bruun, B. The Human Body: Your Body and How it Works. · Dorling Kindersley: Atlas Visual del Cuerpo Humano. · Dorling Kindersley: Eyewitness Visual Dictionaries: The Visual Dictionary of the Human Body · Gardner, R. Science Projects about Light · Parker, S. Readers Digest: How the Body Works · Stein, S. The Body Book · The Nature Company Discoveries Library: The Human Body · Time Life: Understanding Science & Nature: Human Body · Time Life: Enciclopedia Ilustrada de Sciencia y Naturaleza: El Cuerpo Humano. · Time Life: Student Library: Human Body

Mathematics Connections	· Construct tables and graphs to illustrate data that has been collected.
Technology Connections	· Use Microsoft Excel to construct tables and graphs. · Eyewitness: Science Encyclopedia: CD-ROM · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Eye* (sciLINKS Number: HSTP570) · Windows on Science Laser Disc: Life Science Volume 2: Don't Get Nervous!: *Eyes*
Literacy Connections	· Summarize observations and findings in a lab notebook.
Atoms, Elements, and Compounds	**Suggested Time: 2 weeks**
Key Idea	· *All living and nonliving material (**matter**) is composed of **elements**, or combinations of elements (**compounds**), which are made of small particles, called **atoms**. Atoms are far too small to be seen with a light microscope. The atoms of any one element are different from the atoms of other elements.*
NYS MST Standards	· Performance Indicator 3.3: Develop mental models to explain common chemical reactions and changes in states of matter.
Performance Tasks	· Students research the nature of elements such as oxygen, hydrogen, carbon, and nitrogen. Students describe the properties of the element, where it is likely to be found, its relative abundance, and its importance in biotic and/or abiotic processes as well as to modern technology.
NYS MST Standards	Standard 2: Information Systems · Key Idea 1: 1.1-1.3 Standard 4: The Physical Setting · Key Idea 3: Major Understandings: 3.3a. 3.3e, 3.3f Process Skills Based on Standard 4 · Physical Setting Skills: 11
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5c, S5f Scientific Communication · S7b-e
Resources	· Strauss: Where Puddles Go: Investigating Science with Kids · NeoSCI: Elements, Mixtures, &Compounds: Lab Investigation Kit · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing numerical information.

Technology Connections	· National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Elements* (sciLINKS Number: HSTP085) · NeoSCI: Elements, Mixtures, & Compounds: Neo/LAB CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: What's the Matter?: *Elements; Types of Elements*
Literacy Connections	· Use at least three sources of information to write a report.
Key Idea	· *There are more than 100* ***elements****. Elements cannot be* ***chemically*** *or* ***physically changed*** *into other substances. Elements combine in a multitude of ways to produce* ***compounds*** *that account for all living and nonliving substances. Few elements are found in their pure form.*
NYS MST Standards	· Performance Indicator 3.3: Develop mental models to explain common chemical reactions and changes in states of matter.
Performance Tasks	· Students isolate copper (a pure element) from a copper chloride solution (compond) using electrolysis. Students straighten two paper clips into a hook shape, then push the longs ends through an index card. The two clips (electrodes) should be 2-3 cm apart. After placing 50-100 mL of copper chloride solution (0.6M) into a glass jar or beaker, students place the index card set up on top. The ends of the paper clip should be covered at least halfway with copper chloride solution. Students attach wires to each pole of a 6-volt battery and attach the end of each of the wires to a separate paper clip. Students observe the setup for 2-3 minutes, looking for signs of physical and chemical changes (bubbling, odors, deposits, color changes, etc.). Students disconnect the wires and observe what has happened to the tips of the electrodes. Note: Students should wear eye goggles during this experiment and be careful not to get copper chloride solution on their skin or clothes.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding 3.3f Standard 7: Interdisciplinary Problem-Solving: Connections · Key Idea 1.4 Process Skills Based on Standard 4 · General Skills: 1, 2 · Physical Setting Skills: 13
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e

Resources	· Strauss: Where Puddles Go: Investigating Science with Kids · Prentice Hall: Science Explorer: Chemical Building Blocks: Teaching Resources: *Isolating Copper.* · NeoSCI: Elements, Mixtures, & Compounds: Lab Investigation Kit · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Make and use metric measurements of liquid volume. · Explore methods of collecting and organizing data.
Technology Connections	· National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Elements:* (sciLINKS Number: HSTP085); *Compounds* (sciLINKS Number: HSTP090) · NeoSCI: Elements: CD-ROM · NeoSCI: Elements, Mixtures, &Compounds: Neo/LAB CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: What's the Matter?: *Elements*
Literacy Connections	· Use informational writing to list and describe elements and compounds commonly found in the home.
Key Idea	· *The **periodic table** is one useful model for **classifying elements**. The periodic table can be used to predict **properties** of **elements**. Substances are often placed in **categories** if they react in similar ways. Examples of categories include **metals, nonmetals, and noble gases**.*
NYS MST Standards	· Performance Indicator 3.3: Develop mental models to explain common chemical reactions and changes in states of matter.
Performance Tasks	· Given a periodic table with several elements removed, students predict the properties of the missing elements. Students compare their predictions with the properties of the actual elements. Each student group then researches one of the missing elements, explaining its actual properties, the properties that are common to other elements in the same category, its relative abundance, and its importance in biotic and/or abiotic processes, as well as modern technology. · Students compile a list of common materials they see in their homes (wood, plastic, aluminum, cloth, iron, steel, gold, etc.). Using a periodic table and other sources of information, students determine which materials are made from pure elements and which are made from compounds.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 Standard 4: The Physical Setting · Major Understanding 3.3g Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2.1, 2.2 Process Skills Based on Standard 4 · General Skills: 1, 2 · Physical Setting Skills: 12

NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5b-c, S5f Scientific Communication · S7a-b, S7d-e
Resources	· Strauss: Where Puddles Go: Investigating Science with Kids · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing numerical information.
Technology Connections	· National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *The Periodic Table* (sciLINKS Number: HSTP280); *Metals* (sciLINKS Number: HSTP285); *Metalloids* (sciLINKS Number: HSTP290); *Nonmetals* (sciLINKS Number: HSTP295) · NeoSCI: Elements: CD-ROM · NeoSCI: The Periodic Table: Video · Windows on Science Laser Disc: Physical Science Volume 1: What's the Matter: *Elements; The Periodic Table of the Elements; Types of Elements; Groups of Elements*
Literacy Connections	· Use informational writing to describe the properties of the missing elements. · Use at least three sources of information to write a report.
Chemical Reactions and Solutions	**Suggested Time: 5 weeks**
Key Idea	· *During a **physical change**, a substance keeps its **chemical composition** and **properties**. Examples of physical changes include freezing, evaporation, tearing, and crushing. During a **chemical change**, matter, with new **chemical composition** and **properties**, is formed.*
NYS MST Standards	· Performance Indicator 3.2: Distinguish between chemical and physical changes.
Performance Tasks	· Students test separate samples of a variety of white kitchen powders, such as sugar, baking soda, and cornstarch by adding a few drops water, vinegar, and an iodine solution to small samples of each powder. Students record all observations and characterize the type of change that occurs (physical or chemical).
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Process Skills Based on Standard 4 · General Skills: 1, 4 · Physical Setting Skills: 13 Standard 4: The Physical Setting · Major Understanding 3.2a, 3.2c

NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner: Kitchen Chemistry, *Chapter 5: Chemistry All Around the Kitchen* · Holt, Rinehart, and Winston: Holt Science & Technology: Physical Science: *White Before Your Eyes* · Strauss: Where Puddles Go: Investigating Science with Kids · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Use a digital camera to document chemical changes. · Create a PowerPoint slideshow describing the changes. · Windows on Science Laser Disc: Physical Science: Physical and Chemical Change: *Types of Change*
Literacy Connections	· Write a lab report incorporating informational and narrative procedure writing.
Key Idea	· ***Atoms** may join together in well-defined **molecules (compounds)** or may be arranged in regular **geometric patterns (crystals)**.*
NYS MST Standards	· Performance Indicator 3.3: Develop mental models to explain common chemical reactions and changes in states of matter.
Performance Tasks	· Students construct 2- or 3-dimensional models of simple compounds and crystals, such as water, carbon dioxide, calcium carbonate, glucose and salt.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 Standard 4: The Physical Setting · Major Understanding: 3.3c Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2.2 Process Skills Based on Standard 4 · General Skills: 1, 2

NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5b-c, S5f Scientific Communication · S7a-b, S7d-e
Resources	· Strauss: Where Puddles Go: Investigating Science with Kids · NeoSCI: Elements, Mixtures, & Compounds: Lab Investigation Kit · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Construct two- and three-dimensional figures.
Technology Connections	· National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Compounds* (sciLINKS Number: HSTP090) · NeoSCI: Elements, Mixtures, & Compounds: Neo/LAB CD-ROM · Windows on Science Laser Disc: Physical Science Volume 1: What's the Matter?: *The Atom*
Literacy Connections	· Write a narrative procedure to explain how the models were constructed. · Use informational writing to describe the models and the compounds they represent.
Key Idea	· ***Chemical reactions** result in changes in the **properties** of matter. Chemical reactions occur when **chemical bonds** are either formed or broken apart. The result of a chemical reaction is a new substance.*
NYS MST Standards	· Performance Indicator 3.2: Distinguish between chemical and physical changes.
Performance Tasks	· Students observe three chemicals: baking soda, calcium chloride, and phenol red solution, describe their physical properties, and discover what happens when they are mixed together in a plastic bag. Students record changes in temperature, color, and types of materials present.
NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 3.3c Standard 6: Interconnectedness: Common Themes: Models · Key Idea 3.2c, 3.2d Process Skills Based on Standard 4 · General Skills: 1-4

NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· GEMS: Chemical Reactions: Part 1: Discovering the Chemical Reaction · NeoSCI: Chemical Reactions: Lab Investigation Kit · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Use temperature probes and computers to collect, organize and display temperature data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Chemical Reactions:* (sciLINKS Number: HSTP 330); *Types of Chemical Bonds* (sciLINKS Number: HSTP315) · NeoSCI: Chemical Reactions: Neo/LAB CD-ROM
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· *Chemical reactions are often described by **chemical equations** and **formulas**, which utilize **symbols** for the **reactants** and **products**.* · *The **Law of Conservation of Mass** states that during a chemical reaction matter cannot be created or destroyed. In chemical reactions, the total mass of the reactants equals the total mass of the products.*
NYS MST Standards	· Performance Indicator 3.2: Distinguish between chemical and physical changes. · Performance Indicator 3.3: Develop mental models to explain common chemical reactions and changes in states of matter.
Performance Tasks	· Students identify the reactants and products of common chemical reactions by analyzing their chemical equations. Students observe conservation of mass by counting each type of atom in the reactants and then the products. · Using a chemical reaction they are familiar with (i.e. vinegar and baking soda, alka seltzer and water, any of the above, etc.), students determine the mass of the reactants using a triple beam balance, perform the reaction in a sealable plastic bag; then determine the mass of the products.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 3.2e, 3.3c Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2.2 Process Skills Based on Standard 4 · General Skills: 1-4
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· NeoSCI: Chemical Reactions: Lab Investigation Kit · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Chemical Formulas* (sciLINKS Number: HSTP335); *Chemical Equations* (sciLINKS Number: HSTP340) · NeoSCI: Chemical Reactions: Neo/LAB CD-ROM
Literacy Connections	· Write a lab report incorporating informational and narrative procedure writing.
Key Idea	· *Every chemical reaction involves a transfer of energy. Some reactions **release energy** and others **absorb energy**. In addition to **heat**, other forms of energy, such as **light**, **electricity**, or **mechanical motion** may be involved in such transfers.*
NYS MST Standards	· Performance Indicator 4.3: Observe and describe energy changes related to chemical changes.
Performance Tasks	· Students place about 30 mL of vinegar in a cup or beaker, then measure and record the temperature. At time = 0 seconds, students add one-half spoonful of baking soda, stir, then add another half spoonful. Students measure the temperature of the reactants at 30-second intervals for 5 minutes. Students repeat the above procedure using 30 mL of water and calcium chloride, graph and analyze their results; then characterize the reactions as those that release or absorb energy.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 4.3a Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2.2 Process Skills Based on Standard 4 · General Skills: 1, 2
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· NeoSCI: Chemical Reactions: Lab Investigation Kit · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data. · Construct a line graph to demonstrate data that has been collected.
Technology Connections	· Use a temperature probes and computer to collect, organize, and display temperature data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Exothermic and Endothermic Reactions* (sciLINKS Number: HSTP345) · NeoSCI: Chemical Reactions: Neo/LAB CD-ROM
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· ***Solutions** are **mixtures** in which one substance that is more abundant (**solvent**) **dissolves** a substance present in a smaller amount (**solute**).*
NYS MST Standards	· Performance Indicator 3.1: Observe and describe properties of materials, such as density, conductivity, and solubility.
Performance Tasks	· Students form a variety of solutions, such as food coloring in water, salt in water, drink mix and water, etc., and determine which substance is the solute and which is the solvent.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 3.1b Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2.2 Process Skills Based on Standard 4 · General Skills: 1, 2
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner: Kitchen Chemistry, *Chapter 1: Chemistry in and Near the Kitchen Sink, Chapter 3, Chemistry on the Stove* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Make and use metric measurements of volume and mass.
Technology Connections	· Create a PowerPoint slide show describing solutions and solvents. Use animations to illustrate examples of solutions.
Literacy Connections	· Summarize observations and findings in a lab notebook.
Key Idea	· *When solutions form, particles of the solute leave each other and become surrounded by particles of the solvent. Among the factors that affect the* ***solubility*** *of a substance are* ***temperature*** *and the* ***type of solvent****.*
NYS MST Standards	· Performance Indicator 3.1: Observe and describe properties of materials, such as density, conductivity, and solubility. · Performance Indicator 4.2: Observe and describe heating and cooling events.
Performance Tasks	· Students place a sugar cube in ice water, room temperature water, and very warm water and observe which sugar cube dissolves fastest. · Given room temperature water and sugar cubes, students are challenged to find other ways to make the sugar cube dissolve faster (i.e., crushing the sugar cube, stirring, etc.). · Students place sugar cubes in water, oil, and alcohol and compare dissolution rates.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1- S1.4 · Key Idea 2: S2.1 Standard 4: The Physical Setting · Major Understanding: 3.1b Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2.2 Process Skills Based on Standard 4 · General Skills: 1, 2
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Gardner: Kitchen Chemistry, *Chapter 1: Chemistry in and Near the Kitchen Sink, Chapter 3, Chemistry on the Stove* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Use Microsoft Excel to construct, tables, charts, and graphs of data. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Mixtures* (sciLINKS Number: HSTP095)
Literacy Connections	· Prepare a lab report incorporating informational and narrative procedure writing.
Key Idea	· *A solid substance can be separated from a liquid substance by such processes as **filtration, settling,** and **evaporation**.*
NYS MST Standards	· Performance Indicator 3.1: Observe and describe properties of materials, such as density, conductivity, and solubility.
Performance Tasks	· Given a mixture of "dirty water" (water, oil, soil, glitter, and food coloring), students attempt to "clean" the dirty water using settling and filtration techniques. Students use a combination of substances such as gravel, sand, paper towel, and cotton balls to develop and test the optimal filtration system to clean the water. Students record the time it takes to complete the filtration process with each setup and analyze both the efficiency and effectiveness of their filtration system.

NYS MST Standards	Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry · Key Idea 1: S1.1 - S1.4 · Key Idea 2: S2.1 - S2.3 · Key Idea 3: S3.1 - S3.3 Standard 4: The Physical Setting · Major Understanding: 3.2b Standard 6: Interconnectedness: Common Themes: Models · Key Idea 2.2 Process Skills Based on Standard 4 · General Skills: 1, 2
NYC Performance Standards	Physical Science Concepts · S1a Scientific Connections and Applications · S4a Scientific Thinking · S5a-f Scientific Tools and Technologies · S6a-e Scientific Communication · S7a-e
Resources	· Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Chemistry* · Challoner, J. Eyewitness Visual Dictionaries: *The Visual Dictionary of Physics* · Gardner: Science Projects About Physics in the Home · Riley, P. Straightforward Science: Materials and Processes · Time Life: Understanding Science and Nature: Structure of Matter · Time Life: Enciclopedia Ilustrada de Ciencia y Naturaleza: La Estructura de la Materia
Mathematics Connections	· Explore methods of collecting and organizing data.
Technology Connections	· Draw a diagram of the filtration system using Dabbler or Microsoft draw tools. · National Science Teachers Association: www.scilinks.org: sciLINKS Topic: *Mixtures* (sciLINKS Number: HSTP095)
Literacy Connections	· Prepare a design journal for the filtration system.

Appendix A: Materials List Per Class: Grade 7

Description	Quantity
Compound Microscope with 4x, 10x, and 40x Objectives	10
Triple Beam Balance	10
Calculators	10
Alcohol Lamp	10
Goggles	35
Thermometer, Metal Back, -40 °C to 110 °C	30
Spring Scales, 500g/5N	20
Mass Set	10
Bathroom Scale	2
Stopwatch	10
Meter Stick	10
Measuring Tapes	16
Lamps	10
Thermometers, Metal Back –40°C—110°C	30
Metric Rulers, 30cm	10
Scissors	10
Forceps, Fine Tip, 115 mm	10
Compass with Pencil	10
Protractor, Plastic	10
Wire Cutters	10
Wire Strippers	10
Ring Stand	10
Ring Stand Clamps	10
Wire Gauze, Square	10
Compass, Magnetic	10
Compass, Small	10
Magnet, Bar	10
Magnet, Horseshoe	10
Magnet, Ring	50
Pulley (Movable, Single Fixed)	10
Beaker, Pyrex, Low form (100 mL,250 mL, 500 mL, 1000 mL)	20
Measuring Cup, Plastic, 8 ounce	10
Graduated Cylinder (10 mL, 100 mL)	10
Plastic Dropper Pipettes	50
Magnet, Bar with Marked Poles, 3”	10
Funnel, Plastic, 3.25”	10
Jar, Plastic, 8 oz	10
Jar, Plastic, Wide-mouth	30
Trays	20
Petri Dish, Polystyrene, 100 x 15 mm	40
Spoons, Plastic, Package of 24	1
Stirring Rods, Polypropylene	10
Test Tubes, Pyrex, 9 mL	100
Test Tubes, Pyrex, 21 mL	100
Test Tube Rack	10
Test Tube Holders	20

Appendix A: Materials List Per Class: Grade 7	
Description	**Quantity**
Kitchen Gloves, Plastic, Washable	35
Wire, Copper, Insulated (Roll)	1
Battery, D-Cell	20
Alligator Clips	40
Bulb, Flashlight plus Holder	20
Iron Filings	10
Switch, Contact	10
Tuning Fork (3 different sizes)	10 each
pH Paper, Vial	8
Litmus Paper, Red and Blue, Vials	8 each
Slides, Glass, Box of 72	1
Coverslips, Plastic, Box of 100	1

Appendix B: Resources for Teachers

Abramson, D. D. (2001). Mastering Basic Skills in Science: Preparing for Your Intermediate Level Science Exam. New York: AMSCO, 204 pp. [ISBN: 0-87720-047-5].

AIMS Education Foundation. (2000). Ray's Reflections. AIMS Education Foundation [ISBN: 1-881431-84-3].

Alcoze, T. et al. (1993). Multiculturalism in Mathematics, Science, and Technology: Readings and Activities. New York: Addison-Wesley Publishing Company, 204 pp. [ISBN: 0-201-29417-6].

American Association for the Advancement of Science (1993). Benchmarks for Science Literacy. New York: Oxford University press, 415 pp. [ISBN: 0-19-508986-3].

Barber, J., Buegler, M. E., Lowell, L., and Willard, C. (1988). GEMS: Discovering Density. University of California at Berkeley: Lawrence Hall of Science [ISBN: 0-912511-117-6]

Board of Education of the City of New York. (1999). Performance Standards: Science: New York City First Edition. New York: Board of Education of the City of New York, 216 pp. [ISBN: 1-55839-505-9].

Breazeale, W. H. and Hathoway, R. (2000). Science Explorer: Integrated Science Laboratory Manual. Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-436370-1].

Butzow, C. M., and Butzow, J. W. (1994). Intermediate Science Through Children's Literature. Colorado: Teacher Ideas Press, 194 pp. [ISBN: 0-87287-946-1].

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Clifford, C. (2000). Science Explorer: Sound and Light Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-436642-5].

Cordel, B. and Hillen, J. (1995). Floaters and Sinkers: Mass, Volume, and Density. AIMS Education Foundation: Fresno California. [ISBN: 1-881431-58-4].

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Clifford, C. (2000). Science Explorer: Sound and Light. Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-434574-6 (Teacher); ISBN: 0-13-434493-6 (Student)].

Edwards, J. (2000). Science Explorer: Motion, Forces and Energy. Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-434573-8 (Teacher); ISBN: 0-13-434492-8 (Student)].

Edwards, J. (2000). Science Explorer: Chemical Interactions. Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-434562-2 (Teacher); ISBN: 0-13-434482-0 (Student)].

Edwards, J. (2000). Science Explorer: Motion, Forces and Energy. Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-436641-7].

Gardner, R. (1999). Science Projects About Kitchen Chemistry. New Jersey: Enslow Publisher, 128 pp. [ISBN: 0-89490-953-3].

Jenner, J. (2000). Science Explorer: Chemical Interactions. Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-436633-6].

McLaughin, C. (2002). Glencoe Science: Physical Science. New York: Glencoe McGraw Hill. [ISBN: 0-07-822745-3].

Molnar, A. (2000). Science Explorer: Electricity and Magnetism. Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-434566-5 (Teacher); ISBN: 0-13-434485-5 (Student)].

Monar, A. (2000). Science Explorer: Electricity and Magnetism Needham, Massachusetts: Prentice Hall. [ISBN: 0-13-436636-0].

Appendix B: Resources for Teachers

National Research Council. (1996). National Science Education Standards. Washington, DC: National Academy Press, 262 pp. [0-309-05326-9].

Robert, N. (1993). Benchmarks for Science Literacy. New York: Oxford University Press. [ISBN: 0-19-508986-3].

Silvani, H. (1995). Off the Wall Science: A Poster Series Revisted. Fresno, California: AIMS Education Foundation. (ISBN: 1-881431-50-9].

Strauss, M. (1995). Where Puddles Go. Portsmouth, NH: Heinemann Publishers, 210 pp. [ISBN: 0-435-08367-8].

Thompson, W. (1999). Performance Standards. Board of Education: City of New York. [ISBN: 1-55839-505-9].

Wiebe, A., ed. (1987). Our Wonderful World: Solutions for Math + Science. California: AIMS Education Foundation, 36 pp. [ISBN: 1-881431-08-8]

Winkleman, G. and Young, D. Eds. (1991). Electrical Connections. California: AIMS Education Foundation, 36 pp. [ISBN: 1-881431-28-2]

Winkleman, G. Ed. (1991) Mostly Magnets. California: AIMS Education Foundation, 36 pp. [ISBN: 1-881431-29-0]

Appendix C: Classroom Library Titles

Ardley, N. (1992). The Science Book of Energy. Gulliver Books, New York. [ISBN: 0-15-200611-7].

Bridgeman, R. (1993). Eyewitness Science: Electronics. New York: Dorling Kindersley Publishing. [ISBN: 1-56458-324-4].

Bridgeman, R. (1993). Eyewitness Science: Technology. New York: Dorling Kindersley Publishing. [ISBN: 1-56458-883-1].

Burnie, D. (1988). Eyewitness Science: Light. New York: Dorling Kindersley Publishing. [ISBN: 1-879431-79-3].

Catherall, E. (1991). Exploring Uses of Energy. Steck Vaughn Library: Austin, Texas. [ISBN: 0-8114-2598-3].

Challoner, J. (1993). Eyewitness Science: Energy. New York: Dorling Kindersley Publishing. [ISBN: 1-56458-232-9].

Cooper, C. (1992). Eyewitness Science: Matter. New York: Dorling Kindersley Publishing. [ISBN: 1-879431-88-2].

Fallow, A. (1990). Time Life: Understanding Science & Nature: Structure of Matter. Alexandria, Virginia: Time Life. [ISBN: 0-8094-9662-3].

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Gutnit, J. (1994). Projects that Explore: Energy. The Millbrook Press: Connecticut. [ISBN: 1-56294-334-0].

Kentley, E. (1992). Eyewitness Science: Boat. New York: Dorling Kindersley Publishing. [ISBN: 0-679-816778-x].

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Nahum, A. (1990). Eyewitness Science: Flying Machines. New York: Dorling Kindersley Publishing, New York. [ISBN: 0-679-80744-6].

Parker, S. (1992). Eyewitness Science: Electricity. New York: Dorling Kindersley Publishing. [ISBN: 1-879431-82-3].

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Sutton, R. (1990). Eyewitness Science: Car. New York: Dorling Kindersley Publishing. [ISBN: 0-679-80753-8].

Appendix D: New York City Performance Standards in Science

Overview of the Middle Level Performance Standards (pp. 66-67)

S1. Physical Sciences Concepts

S1a: Demonstrates understanding of properties and changes of properties in matter

S1b: Demonstrates understanding of position and motion and forces.

S1c: Demonstrates understanding of transfer of energy and the nature of a chemical reaction.

S2. Life Sciences Concepts

S2a: Demonstrates understanding of structure and function in living systems.

S2b: Demonstrates understanding of reproduction and heredity and the role of genes and environment on trait expression.

S2c: Demonstrates understanding of regulation and behavior and response to environmental stimuli.

S2d: Demonstrates understanding of populations and ecosystems and the effects of resources and energy transfer on populations.

S2e: Demonstrates understanding of evolution, diversity, and adaptation of organisms.

S3. Earth and Space Sciences Concepts

S3a: Demonstrates understanding of structure of the Earth System.

S3b: Demonstrates understanding of Earth's history.

S3c: Demonstrates understanding of Earth in the Solar System.

S3d: Demonstrates understanding of natural resource management.

S4. Scientific Connections and Applications

S4a: Demonstrates understanding of big ideas and unifying concepts.

S4b: Demonstrates understanding of the designed world.

S4c: Demonstrates understanding of health.

S4d: Demonstrates understanding of impact of technology.

S4e: Demonstrates understanding of impact of science.

Appendix D: New York City Performance Standards in Science (continued)

Overview of the Middle Level Performance Standards

S5. Scientific Thinking

S5a: Frames questions to distinguish cause and effect; and identifies or controls variables.
S5b: Uses concepts from Science Standards 1 to 4 to explain a variety of observations and phenomena.
S5c: Use evidence from reliable sources to develop descriptions, explanations, and models.
S5d: Proposes, recognizes, analyzes, considers, and critiques alternative explanations; and distinguishes between fact and opinion.
S5e: Identifies problems; proposes and implements solutions; and evaluates the accuracy, design, and outcomes of investigations.
S5f: Works individually and in teams to collect and share information and ideas.

S6. Scientific Tools and Technologies

S6a: Uses technology and tools to observe and measure objects, organisms, and phenomena, directly, indirectly, and remotely.
S6b: Records and stores data using a variety of formats.

S6c: Collects and analyzes data using concepts and techniques in Mathematics Standard 4.
S6d: Acquires information from multiple sources.

S6e: Recognizes sources of bias in data.

S7. Scientific Communication

S7a: Represents data and results in multiple ways.

S7b: Argues from evidence.

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.

S8. Scientific Investigation

S8a: Demonstrates scientific competence by completing a controlled experiment.

S8b: Demonstrates scientific competence by completing fieldwork.

S8c: Demonstrates scientific competence by completing a design.

S8d: Demonstrates scientific competence by completing secondary research.

Appendix E
NYS Intermediate Level Science Core Curriculum