New York Learning Standards
Mathematics, Science, and Technology

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.

Standard 2: Information Systems
Students will access, generate, process, and transfer information using appropriate technologies.

Standard 3: Mathematics
Students will understand mathematics and become mathematically confident by communicating and reasoning mathematically, by applying mathematics in real- world settings, and by solving problems through the integrated study of number systems, geometry, algebra, data analysis, probability, and trigonometry.

Standard 4: Science
Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

Standard 5: Technology
Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

Standard 6: Interconnectedness: Common Themes
Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.

Standard 7: Interdisciplinary Problem Solving
Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real- life problems and make informed decisions.

Standard 1—Analysis, Inquiry, and Design

Elementary

Mathematical Analysis

1. Abstraction and symbolic representation are used to communicate mathematically.

Students:

- **use special mathematical notation and symbolism to communicate in mathematics and to compare and describe quantities, express relationships, and relate mathematics to their immediate environments.**

This is evident, for example, when students:

▲ describe their ages as an inequality such as $7 < \square < 10$.

2. Deductive and inductive reasoning are used to reach mathematical conclusions.

Students:

- **use simple logical reasoning to develop conclusions, recognizing that patterns and relationships present in the environment assist them in reaching these conclusions.**

3. Critical thinking skills are used in the solution of mathematical problems.

Students:

- **explore and solve problems generated from school, home, and community situations, using concrete objects or manipulative materials when possible.**

Scientific Inquiry

1. The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

Students:

- **ask "why" questions in attempts to seek greater understanding concerning objects and events they have observed and heard about.**
- **question the explanations they hear from others and read about, seeking clarification and comparing them with their own observations and understandings.**
- **develop relationships among observations to construct descriptions of objects and events and to form their own tentative explanations of what they have observed.**

This is evident, for example, when students:

▲ observe *a variety of objects that either sink or float when placed in a container of water.** Working in groups, they propose an explanation of *why objects sink or float.* After sharing and discussing their proposed explanation, they refine it and submit it for assessment. The explanation is rated on clarity and plausibility.

2. Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Students:

- **develop written plans for exploring phenomena or for evaluating explanations guided by questions or proposed explanations they have helped formulate.**
- **share their research plans with others and revise them based on their suggestions.**
- **carry out their plans for exploring phenomena through direct observation and through the use of simple instruments that permit measurements of quantities (e.g., length, mass, volume, temperature, and time).**

This is evident, for example, when students:

▲ are asked to develop a way of testing their explanation of *why objects sink or float when placed in a container of water*.* They tell what procedures and materials they will use and indicate what results will support their explanation. Their plan is critiqued by others, they revise it, and submit it for assessment. The plan is rated on clarity, soundness in addressing the issue, and feasibility. After the teacher suggests modifications, the plan is carried out.

Key ideas are identified by numbers (1).
Performance indicators are identified by bullets (•).
Sample tasks are identified by triangles (▲).

Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

3. The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

Students:

- **organize observations and measurements of objects and events through classification and the preparation of simple charts and tables.**
- **interpret organized observations and measurements, recognizing simple patterns, sequences, and relationships.**
- **share their findings with others and actively seek their interpretations and ideas.**
- **adjust their explanations and understandings of objects and events based on their findings and new ideas.**

This is evident, for example, when students:

▲ prepare tables or other representations of their observations and look for evidence which supports or refutes their explanation of *why objects sink or float when placed in a container of water*.* After sharing and discussing their results with other groups, they prepare a brief research report that includes methods, findings, and conclusions. The report is rated on its clarity, care in carrying out the plan, and presentation of evidence supporting the conclusions.

Engineering Design

1. Engineering design is an iterative process involving modeling and optimization finding the best solution within given constraints which is used to develop technological solutions to problems within given constraints.

Students engage in the following steps in a design process:

- **describe objects, imaginary or real, that might be modeled or made differently and suggest ways in which the objects can be changed, fixed, or improved.**
- **investigate prior solutions and ideas from books, magazines, family, friends, neighbors, and community members.**
- **generate ideas for possible solutions, individually and through group activity; apply age-appropriate mathematics and science skills; evaluate the ideas and determine the best solution; and explain reasons for the choices.**
- **plan and build, under supervision, a model of the solution using familiar materials, processes, and hand tools.**
- **discuss how best to test the solution; perform the test under teacher supervision; record and portray results through numerical and graphic means; discuss orally why things worked or didn't work; and summarize results in writing, suggesting ways to make the solution better.**

This is evident, for example, when students:

▲ read a story called *Humpty's Big Day* wherein the readers visit the place where Humpty Dumpty had his accident, and are asked to design and model a way to get to the top of the wall and down again safely.

▲ generate, draw, and model ideas for a space station that includes a pleasant living and working environment.

▲ design and model footwear that they could use to walk on a cold, sandy surface.

* A variety of content-specific items can be substituted for the italicized text

Standard 2—Information Systems
Elementary

Information Systems

1. Information technology is used to retrieve, process, and communicate information and as a tool to enhance learning.

Students:
- **use a variety of equipment and software packages to enter, process, display, and communicate information in different forms using text, tables, pictures, and sound.**
- **telecommunicate a message to a distant location with teacher help.**
- **access needed information from printed media, electronic data bases, and community resources.**

This is evident, for example, when students:

▲ use the newspaper or magazine index in a library to find information on a particular topic.

▲ invite local experts to the school to share their expertise.

2. Knowledge of the impacts and limitations of information systems is essential to its effective and ethical use.

Students:
- **describe the uses of information systems in homes, schools, and businesses.**
- **understand that computers are used to store personal information.**
- **demonstrate ability to evaluate information.**

This is evident, for example, when students:

▲ look for differences among species of bugs collected on the school grounds, and classify them according to preferred habitat.

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Performance indicators are identified by bullets (•).
Sample tasks are identified by triangles (▲).

Students will access, generate, process, and transfer information using appropriate technologies.

3. Information technology can have positive and negative impacts on society, depending upon how it is used.

Students:

- **describe the uses of information systems in homes and schools.**
- **demonstrate ability to evaluate information critically.**

Standard 3—Mathematics
Elementary

Mathematical Reasoning

1. Students use mathematical reasoning to analyze mathematical situations, make conjectures, gather evidence, and construct an argument.

Students:
- **use models, facts, and relationships to draw conclusions about mathematics and explain their thinking.**
- **use patterns and relationships to analyze mathematical situations.**
- **justify their answers and solution processes.**
- **use logical reasoning to reach simple conclusions.**

This is evident, for example, when students:

▲ build geometric figures out of straws.
▲ find patterns in sequences of numbers, such as the triangular numbers 1, 3, 6, 10, ...
▲ explore number relationships with a calculator (e.g., 12 + 6 = 18, 11 + 7 = 18, etc.) and draw conclusions.

Number and Numeration

2. Students use number sense and numeration to develop an understanding of the multiple uses of numbers in the real world, the use of numbers to communicate mathematically, and the use of numbers in the development of mathematical ideas.

Students:
- **use whole numbers and fractions to identify locations, quantify groups of objects, and measure distances.**
- **use concrete materials to model numbers and number relationships for whole numbers and common fractions, including decimal fractions.**
- **relate counting to grouping and to place-value.**
- **recognize the order of whole numbers and commonly used fractions and decimals.**
- **demonstrate the concept of percent through problems related to actual situations.**

This is evident, for example, when students:

▲ count out 15 small cubes and exchange ten of the cubes for a rod ten cubes long.
▲ use the number line to show the position of 1/4.
▲ figure the tax on $4.00 knowing that taxes are 7 cents per $1.00.

Sample Problems

16. Marlene is designing a uniform for her soccer team. She can choose from 2 different shirts and 3 different pairs of shorts. How many different uniforms can she make if she uses all the shirts and all the shorts?

Answer ____________________

Explain how you got your answer with a picture or diagram.

Ms. Rivera's class must collect 180 soda cans to win the recycling contest. The chart below shows how the class is doing. How many cans must they collect in the fourth week to reach the goal of 180?

Week	Cans
1	42
2	74
3	18
4	
Goal	180

Answer ____________________

Key ideas are identified by numbers (1).
Performance indicators are identified by bullets (•).
Sample tasks are identified by triangles (▲).

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Operations

3. Students use mathematical operations and relationships among them to understand mathematics.

Students:

- **add, subtract, multiply, and divide whole numbers.**
- **develop strategies for selecting the appropriate computational and operational method in problem-solving situations.**
- **know single digit addition, subtraction, multiplication, and division facts.**
- **understand the commutative and associative properties.**

This is evident, for example, when students:

▲ use the fact that multiplication is commutative (e.g., 2 x 7 = 7 x 2), to assist them with their memorizing of the basic facts.

▲ solve multiple-step problems that require at least two different operations.

▲ progress from base ten blocks to concrete models and then to paper and pencil algorithms.

Modeling/Multiple Representation

4. Students use mathematical modeling/multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.

Students:

- **use concrete materials to model spatial relationships.**
- **construct tables, charts, and graphs to display and analyze real-world data.**
- **use multiple representations (simulations, manipulative materials, pictures, and diagrams) as tools to explain the operation of everyday procedures.**
- **use variables such as height, weight, and hand size to predict changes over time.**
- **use physical materials, pictures, and diagrams to explain mathematical ideas and processes and to demonstrate geometric concepts.**

This is evident, for example, when students:

▲ build a 3 x 3 x 3 cube out of blocks.

▲ use square tiles to model various rectangles with an area of 24 square units.

▲ read a bar graph of population trends and write an explanation of the information it contains.

Sample Problems

7. Shanelle earns $3.50 per hour for babysitting. Each week she babysits for 4 hours.

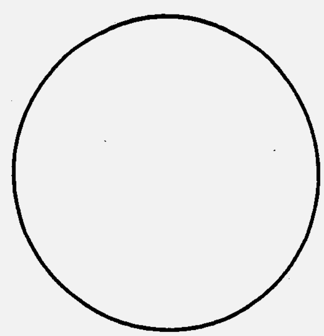
A) How much money does she earn in 1 week?

Answer ________________

B) How much money does she earn in 4 weeks?

Answer ________________

11. Bobbie's family bought a pizza. Her mother and sister together ate $\frac{1}{2}$ of the pizza. Bobbie ate $\frac{1}{2}$ of what was left. Use the circle to draw a picture that shows how much of the pizza Bobbi ate.



What fraction of the whole pizza did Bobbie eat?

Answer ______

Standard 3—Mathematics
Elementary

Measurement

5. Students use measurement in both metric and English measure to provide a major link between the abstractions of mathematics and the real world in order to describe and compare objects and data.

Students:
- **understand that measurement is approximate, never exact.**
- **select appropriate standard and nonstandard measurement tools in measurement activities.**
- **understand the attributes of area, length, capacity, weight, volume, time, temperature, and angle.**
- **estimate and find measures such as length, perimeter, area, and volume using both nonstandard and standard units.**
- **collect and display data.**
- **use statistical methods such as graphs, tables, and charts to interpret data.**

This is evident, for example, when students:

▲ measure with paper clips or finger width.
▲ estimate, then calculate, how much paint would be needed to cover one wall.
▲ create a chart to display the results of a survey conducted among the classes in the school, or graph the amounts of survey responses by grade level.

Uncertainty

6. Students use ideas of uncertainty to illustrate that mathematics involves more than exactness when dealing with everyday situations.

Students:
- **make estimates to compare to actual results of both formal and informal measurement.**
- **make estimates to compare to actual results of computations.**
- **recognize situations where only an estimate is required.**
- **develop a wide variety of estimation skills and strategies.**
- **determine the reasonableness of results.**
- **predict experimental probabilities.**
- **make predictions using unbiased random samples.**
- **determine probabilities of simple events.**

This is evident, for example, when students:

▲ estimate the length of the room before measuring.
▲ predict the average number of red candies in a bag before opening a group of bags, counting the candies, and then averaging the number that were red.
▲ determine the probability of picking an even numbered slip from a hat containing slips of paper numbered 1, 2, 3, 4, 5, and 6.

Sample Problems

It's Saturday and you're going to meet your friends for lunch and a movie. You have to leave your home at 11:30 AM. Your parents say you can't go until you finish your work. Your work includes your homework and your Saturday chores:

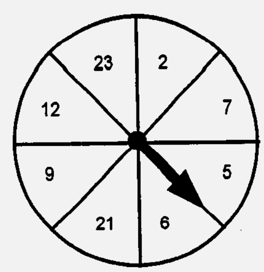
40 minutes of math homework.
30 minutes to clean your room.
15 minutes to fold the laundry
5 minutes to take out the garbage
60 minutes to eat and get ready to go

A) At what time should you get started doing your work? Show all the math you did to figure this out.

Answer ________________ AM

B) Describe how you would use your time between when you wake up and when you leave at 11:30 AM to go to lunch and the movie.

The spinner below was used by Jodie's class for the school fair:



A) If the spinner is spun once, what is the probability of the spinner landing on an even number?

Answer ______

B) If the spinner is spun a second time, what is the probability of the spinner landing on a number that is divisible by 3?

Answer ______

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Patterns/Functions

7. Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.

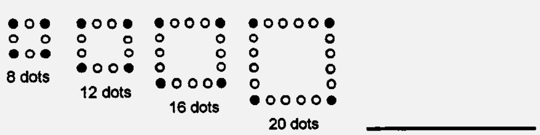
Students:

- **recognize, describe, extend, and create a wide variety of patterns.**
- **represent and describe mathematical relationships.**
- **explore and express relationships using variables and open sentences.**
- **solve for an unknown using manipulative materials.**
- **use a variety of manipulative materials and technologies to explore patterns.**
- **interpret graphs.**
- **explore and develop relationships among two- and three-dimensional geometric shapes.**
- **discover patterns in nature, art, music, and literature.**

This is evident, for example, when students:

- ▲ represent three more than a number is equal to nine as $n + 3 = 9$.
- ▲ draw leaves, simple wallpaper patterns, or write number sequences to illustrate recurring patterns.
- ▲ write generalizations or conclusions from display data in charts or graphs.

Sample Problem



Draw the next figure in this pattern. How many dots are in the figure you drew?

Answer ____________________

Write one or two sentences to describe how the figure is changing.

____

____

____

____

____

Standard 4—Science
Elementary

Physical Setting

1. The Earth and celestial phenomena can be described by principles of relative motion and perspective.

Students:
- **describe patterns of daily, monthly, and seasonal changes in their environment.**

This is evident, for example, when students:

▲ conduct a long-term weather investigation, such as running a weather station or collecting weather data.
▲ keep a journal of the phases of the moon over a one-month period. This information is collected for several different one-month periods and compared.

2. Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

Students:
- **describe the relationships among air, water, and land on Earth.**

This is evident, for example, when students:

▲ observe a puddle of water outdoors after a rainstorm. On a return visit after the puddle has disappeared, students describe where the water came from and possible locations for it now.
▲ assemble rock and mineral collections based on characteristics such as erosional features or crystal size features.

Key ideas are identified by numbers (1).
Performance indicators are identified by bullets (•).
Sample tasks are identified by triangles (▲).

3. Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

Students:
- **observe and describe properties of materials using appropriate tools.**
- **describe chemical and physical changes, including changes in states of matter.**

This is evident, for example, when students:

▲ compare the appearance of materials when seen with and without the aid of a magnifying glass.
▲ investigate simple physical and chemical reactions and the chemistry of household products, e.g., freezing, melting, and evaporating; a comparison of new and rusty nails; the role of baking soda in cooking.

4. Energy exists in many forms, and when these forms change energy is conserved.

Students:
- **describe a variety of forms of energy (e.g., heat, chemical, light) and the changes that occur in objects when they interact with those forms of energy.**
- **observe the way one form of energy can be transformed into another form of energy present in common situations (e.g., mechanical to heat energy, mechanical to electrical energy, chemical to heat energy).**

This is evident, for example, when students:

▲ investigate the interactions of liquids and powders that result in chemical reactions (e.g., vinegar and baking soda) compared to interactions that do not (e.g., water and sugar).
▲ in order to demonstrate the transformation of chemical to electrical energy, construct electrical cells from objects, such as lemons or potatoes, using pennies and aluminum foil inserted in slits at each end of fruits or vegetables; the penny and aluminum are attached by wires to a milliammeter. Students can compare the success of a variety of these electrical cells.

5. Energy and matter interact through forces that result in changes in motion.

Students:
- **describe the effects of common forces (pushes and pulls) on objects, such as those caused by gravity, magnetism, and mechanical forces.**
- **describe how forces can operate across distances.**

This is evident, for example, when students:

▲ investigate simple machines and use them to perform tasks.

Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

The Living Environment

1. Living things are both similar to and different from each other and nonliving things.

Students:
- **describe the characteristics of and variations between living and nonliving things.**
- **describe the life processes common to all living things.**

This is evident, for example, when students:

▲ grow a plant or observe a pet, investigating what it requires to stay alive, including evaluating the relative importance and necessity of each item.

▲ investigate differences in personal body characteristics, such as temperature, pulse, heart rate, blood pressure, and reaction time.

2. Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.

Students:
- **recognize that traits of living things are both inherited and acquired or learned.**
- **recognize that for humans and other living things there is genetic continuity between generations.**

This is evident, for example, when students:

▲ interact with a classroom pet, observe its behaviors, and record what they are able to teach the animal, such as navigation of a maze or performance of tricks, compared to that which remains constant, such as eye color, or number of digits on an appendage.

▲ use breeding records and photographs of racing horses or pedigreed animals to recognize that variations exist from generation to generation but "like begets like."

3. Individual organisms and species change over time.

Students:
- **describe how the structures of plants and animals complement the environment of the plant or animal.**
- **observe that differences within a species may give individuals an advantage in surviving and reproducing.**

This is evident, for example, when students:

▲ relate physical characteristics of organisms to habitat characteristics (e.g., long hair and fur color change for mammals living in cold climates).

▲ visit a farm or a zoo and make a written or pictorial comparison of members of a litter and identify characteristics that may provide an advantage.

4. The continuity of life is sustained through reproduction and development.

Students:
- **describe the major stages in the life cycles of selected plants and animals.**
- **describe evidence of growth, repair, and maintenance, such as nails, hair, and bone, and the healing of cuts and bruises.**

This is evident, for example, when students:

▲ grow bean plants or butterflies; record and describe stages of development.

5. Organisms maintain a dynamic equilibrium that sustains life.

Students:
- **describe basic life functions of common living specimens (guppy, mealworm, gerbil).**
- **describe some survival behaviors of common living specimens.**
- **describe the factors that help promote good health and growth in humans.**

This is evident, for example, when students:

▲ observe a single organism over a period of weeks and describe such life functions as moving, eating, resting, and eliminating.

▲ observe and demonstrate reflexes such as pupil dilation and contraction and relate such reflexes to improved survival.

▲ analyze the extent to which diet and exercise habits meet cardiovascular, energy, and nutrient requirements.

6. Plants and animals depend on each other and their physical environment.

Students:
- **describe how plants and animals, including humans, depend upon each other and the nonliving environment.**
- **describe the relationship of the sun as an energy source for living and nonliving cycles.**

This is evident, for example, when students:

▲ investigate how humans depend on their environment (neighborhood), by observing, recording, and discussing the interactions that occur in carrying out their everyday lives.

▲ observe the effects of sunlight on growth for a garden vegetable.

7. Human decisions and activities have had a profound impact on the physical and living environment.

Students:
- **identify ways in which humans have changed their environment and the effects of those changes.**

This is evident, for example, when students:

▲ give examples of how inventions and innovations have changed the environment; describe benefits and burdens of those changes.

Standard 5—Technology
Elementary

Engineering Design

1. Engineering design is an iterative process involving *modeling* and *optimization* used to develop technological solutions to problems within given constraints.

Students:

- **describe objects, imaginary or real, that might be modeled or made differently and suggest ways in which the objects can be changed, fixed, or improved.**
- **investigate prior solutions and ideas from books, magazines, family, friends, neighbors, and community members.**
- **generate ideas for possible solutions, individually and through group activity; apply age-appropriate mathematics and science skills; evaluate the ideas and determine the best solution; and explain reasons for the choices.**
- **plan and build, under supervision, a model of the solution using familiar materials, processes, and hand tools.**
- **discuss how best to test the solution; perform the test under teacher supervision; record and portray results through numerical and graphic means; discuss orally why things worked or didn't work; and summarize results in writing, suggesting ways to make the solution better.**

This is evident, for example, when students:

▲ read a story called *Humpty's Big Day* wherein the readers visit the place where Humpty Dumpty had his accident, and are asked to design and model a way to get to the top of the wall and down again safely.

▲ generate and draw ideas for a space station that includes a pleasant living and working environment.

▲ design and model footwear that they could use to walk on a cold, sandy surface.

Tools, Resources, and Technological Processes

2. Technological tools, materials, and other resources should be selected on the basis of safety, cost, availability, appropriateness, and environmental impact; technological processes change energy, information, and material resources into more useful forms.

Students:

- **explore, use, and process a variety of materials and energy sources to design and construct things.**
- **understand the importance of safety, cost, ease of use, and availability in selecting tools and resources for a specific purpose.**
- **develop basic skill in the use of hand tools.**
- **use simple manufacturing processes (e.g., assembly, multiple stages of production, quality control) to produce a product.**
- **use appropriate graphic and electronic tools and techniques to process information.**

This is evident, for example, when students:

▲ explore and use materials, joining them with the use of adhesives and mechanical fasteners to make a cardboard marionette with moving parts.

▲ explore materials and use forming processes to heat and bend plastic into a shape that can hold napkins.

▲ explore energy sources by making a simple motor that uses electrical energy to produce continuous mechanical motion.

▲ develop skill with a variety of hand tools and use them to make or fix things.

▲ process information electronically such as using a video system to advertise a product or service.

▲ process information graphically such as taking photos and developing and printing the pictures.

Key ideas are identified by numbers (1).
Performance indicators are identified by bullets (•).
Sample tasks are identified by triangles (▲).

Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

Computer Technology

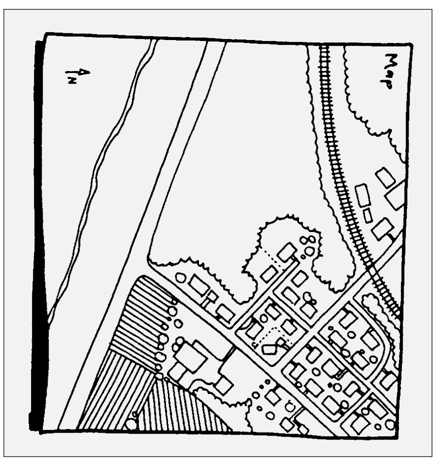
3. Computers, as tools for design, modeling, information processing, communication, and system control, have greatly increased human productivity and knowledge.

Students:
- **identify and describe the function of the major components of a computer system.**
- **use the computer as a tool for generating and drawing ideas.**
- **control computerized devices and systems through programming.**
- **model and simulate the design of a complex environment by giving direct commands.**

This is evident, for example, when students:

▲ control the operation of a toy or household appliance by programming it to perform a task.
▲ execute a computer program, such as SimCity, Theme Park, or The Factory to model and simulate an environment.
▲ model and simulate a system using construction modeling software, such as The Incredible Machine.

Sample Problem/Activity



Computer design for model community

Technological Systems

4. Technological systems are designed to achieve specific results and produce outputs, such as products, structures, services, energy, or other systems.

Students:
- **identify familiar examples of technological systems that are used to satisfy human needs and wants, and select them on the basis of safety, cost, and function.**
- **assemble and operate simple technological systems, including those with interconnecting mechanisms to achieve different kinds of movement.**
- **understand that larger systems are made up of smaller component subsystems.**

This is evident, for example, when students:

▲ assemble and operate a system made up from a battery, switch, and doorbell connected in a series circuit.
▲ assemble a system with interconnecting mechanisms, such as a jack-in-the-box that pops up from a box with a hinged lid.
▲ model a community-based transportation system which includes subsystems such as roadways, rails, vehicles, and traffic controls.

Standard 5—Technology
Elementary

History and Evolution of Technology

5. Technology has been the driving force in the evolution of society from an agricultural to an industrial to an information base.

Students:
- **identify technological developments that have significantly accelerated human progress.**

This is evident, for example, when students:

▲ construct a model of an historical or future-oriented technological device or system and describe how it has contributed or might contribute to human progress.
▲ make a technological timeline in the form of a hanging mobile of technological devices.
▲ model a variety of timekeeping devices that reflect historical and modern methods of keeping time.
▲ make a display contrasting early devices or tools with their modern counterparts.

Impacts of Technology

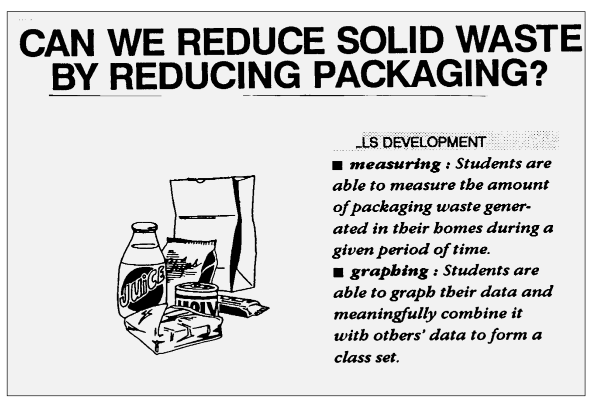
6. Technology can have positive and negative impacts on individuals, society, and the environment and humans have the capability and responsibility to constrain or promote technological development.

Students:
- **describe how technology can have positive and negative effects on the environment and on the way people live and work.**

This is evident, for example, when students:

▲ handmake an item and then participate in a line production experience where a quantity of the item is mass produced; compare the benefits and disadvantages of mass production and craft production.
▲ describe through example, how familiar technologies (including computers) can have positive and negative impacts on the environment and on the way people live and work.
▲ identify the pros and cons of several possible packaging materials for a student-made product.

Sample Problem/Activity



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Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.

Management of Technology

7. Project management is essential to ensuring that technological endeavors are profitable and that products and systems are of high quality and built safely, on schedule, and within budget.

Students:
- **participate in small group projects and in structured group tasks requiring planning, financing, production, quality control, and follow-up.**
- **speculate on and model possible technological solutions that can improve the safety and quality of the school or community environment.**

This is evident, for example, when students:

▲ help a group to plan and implement a school project or activity, such as a school picnic or a fund-raising event.

▲ plan as a group, division of tasks and construction steps needed to build a simple model of a structure or vehicle.

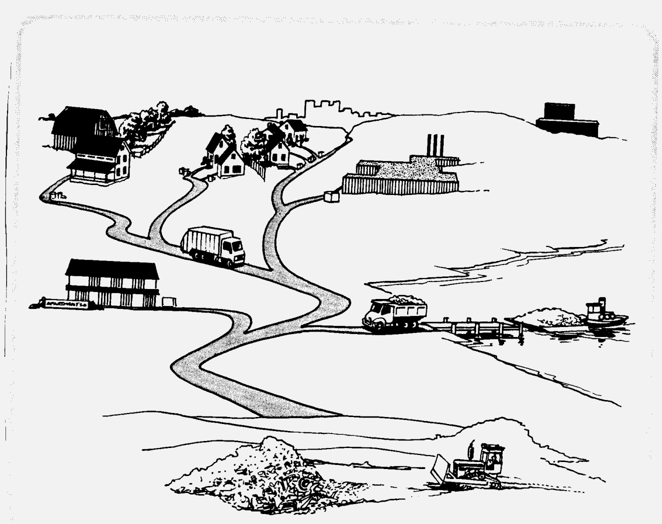
▲ redesign the work area in their classroom with an eye toward improving safety.

Sample Problem/Activity

HOW CAN WE REDUCE SOLID WASTE IN OUR SCHOOL?

Evaluation

Students will be able to develop and implement useful solid waste reduction strategies within their school based upon their investigations of the current solid waste stream.



Standard 6—Interconnectedness: Common Themes Elementary

Systems Thinking

1. Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform specific functions.

Students:
- **observe and describe interactions among components of simple systems.**
- **identify common things that can be considered to be systems (e.g., a plant population, a subway system, human beings).**

Models

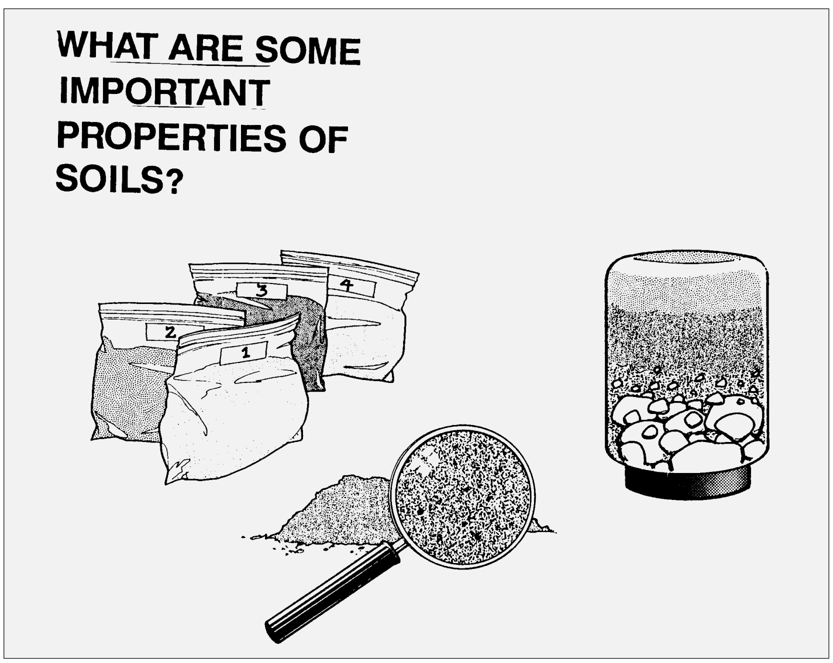
2. Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.

Students:
- **analyze, construct, and operate models in order to discover attributes of the real thing.**
- **discover that a model of something is different from the real thing but can be used to study the real thing.**
- **use different types of models, such as graphs, sketches, diagrams, and maps, to represent various aspects of the real world.**

This is evident, for example, when students:

▲ compare toy cars with real automobiles in terms of size and function.
▲ model structures with building blocks.
▲ design and construct a working model of the human circulatory system to explore how varying pumping pressure might affect blood flow.
▲ describe the limitations of model cars, planes, or houses.
▲ use model vehicles or structures to illustrate how the real object functions.
▲ use a road map to determine distances between towns and cities.

Sample Problem/Activity



Key ideas are identified by numbers (1).
Performance indicators are identified by bullets (•).
Sample tasks are identified by triangles (▲).

Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.

Magnitude and Scale

3. The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the behavior and design of systems.

Students:

- **provide examples of natural and manufactured things that belong to the same category yet have very different sizes, weights, ages, speeds, and other measurements.**
- **identify the biggest and the smallest values as well as the average value of a system when given information about its characteristics and behavior.**

This is evident, for example, when students:

▲ compare the weight of small and large animals.
▲ compare the speed of bicycles, cars, and planes.
▲ compare the life spans of insects and trees.
▲ collect and analyze data related to the height of the students in their class, identifying the tallest, the shortest, and the average height.
▲ compare the annual temperature range of their locality.

Equilibrium and Stability

4. Equilibrium is a state of stability due either to a lack of changes (static equilibrium) or a balance between opposing forces (dynamic equilibrium).

Students:

- **cite examples of systems in which some features stay the same while other features change.**
- **distinguish between reasons for stability—from lack of changes to changes that counterbalance one another to changes within cycles.**

This is evident, for example, when students:

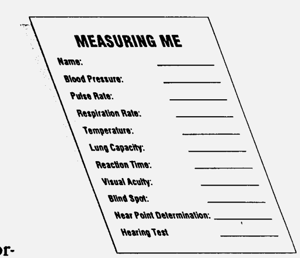
▲ record their body temperatures in different weather conditions and observe that the temperature of a healthy human being stays almost constant even though the external temperature changes.
▲ identify the reasons for the changing amount of fresh water in a reservoir and determine how a constant supply is maintained.

Sample Problem/Activity

What can I learn about my body?

CONTENT UNDERSTANDINGS
■ *Soil consists of weathered rock fragments that contain organic material*

➢ How do your results compare to your classmates' results?
➢ What factors do you think could account for the differences?
➢ Who would benefit from the information you gathered and how?
➢ What other information do you think would complete your knowledge of your body?
➢ Are there some data on your form that you would rather keep confidential? Which data?
➢ Who should and should not have access to this information? Give reasons for your answers.



Standard 6—Interconnectedness: Common Themes Elementary

Patterns of Change

5. Identifying patterns of change is necessary for making predictions about future behavior and conditions.

Students:

- **use simple instruments to measure such quantities as distance, size, and weight and look for patterns in the data.**
- **analyze data by making tables and graphs and looking for patterns of change.**

This is evident, for example, when students:

▲ compare shoe size with the height of people to determine if there is a trend.

▲ collect data on the speed of balls rolling down ramps of different slopes and determine the relationship between speed and steepness of the ramp.

▲ take data they have collected and generate tables and graphs to begin the search for patterns of change.

Optimization

6. In order to arrive at the best solution that meets criteria within constraints, it is often necessary to make trade-offs.

Students:

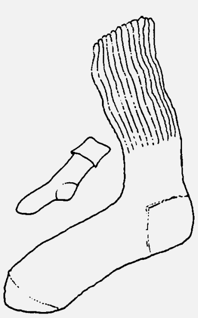
- **determine the criteria and constraints of a simple decision making problem.**
- **use simple quantitative methods, such as ratios, to compare costs to benefits of a decision problem.**

This is evident, for example, when students:

▲ describe the criteria (e.g., size, color, model) and constraints (e.g., budget) used to select the best bicycle to buy.

▲ compare the cost of cereal to number of servings to figure out the best buy.

Sample Problem/Activity

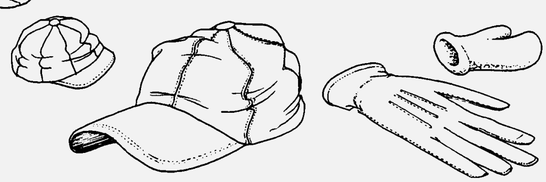


Ask each student to measure the length of the head and the height of three adults and three children (two years old or younger) as an outside assignment. Show them how to calculate the ratio of head length to height. With the class, calculate the average ratio for the children and for the adults.

➢ How does the average ratio for the children compare to that for the adults?

➢ How can we describe in words the change in ratios?

➢ What does this tell us about human growth and development?



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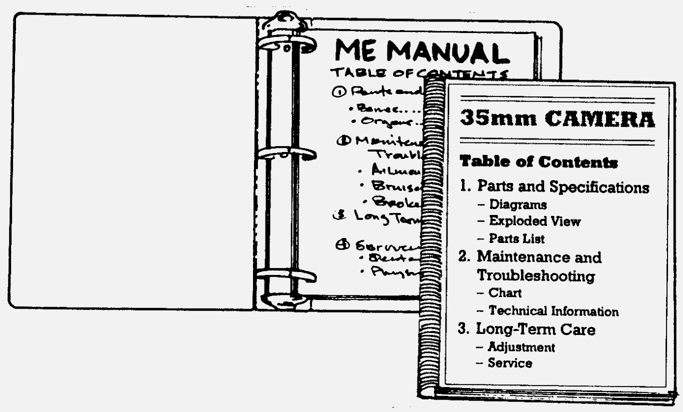
Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.

Sample Problem/Activity

Why would I need an owner's manual?

Students will be able to describe similarities and differences between a manual they create for a device and a personal manual they will create throughout the course of this module and perhaps beyond.



Interdisciplinary Connections

These activities focus on devices as technologies:

➤ **Technology:** Compare electronics information about several types of devices, and account for their similarities and differences.

➤ **Social Studies:** Talk to a lawyer, paralegal, or representative of the Better Business Bureau about written and implied warranties.

➤ **Language Arts:** Develop a second version of your manual that contains a limited number of technical words. Consult your language arts teacher, a children's writer, or a technical writer for assistance in using this kind of controlled approach to manual writing.

➤ **Mathematics:** Locate and read selected magazine articles to determine the nature and extent of the market in various devices. Prepare graphs and charts that show relative percentages of kinds of goods sold and other pertinent information.

➤ **Health:** Interview a nurse, audiologist, pediatrician, or other health specialist regarding hearing losses associated with one or more entertainment devices.

➤ **Home and Career Skills:** Conduct a survey of the electronic devices in your home, including entertainment and nonentertainment devices. Compare your results with an informal survey of one or more older persons regarding electronic devices used in a typical home in the early sixties.

➤ **Foreign Languages and Cultures:** Look through a number of owners' manuals at home or at a car dealership or electronics store. Note whether these manuals are written only in English or in other languages as well. Try to explain why the manufacturer chose certain languages.

Standard 7—Interdisciplinary Problem Solving Elementary

Connections

1. The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.

Students:

- **analyze science/technology/society problems and issues that affect their home, school, orcommunity, and carry out a remedial course of action.**
- **make informed consumer decisions by applying knowledge about the attributes of particular products and making cost/benefit tradeoffs to arrive at an optimal choice.**
- **design solutions to problems involving a familiar and real context, investigate related science concepts to inform the solution, and use mathematics to model, quantify, measure, and compute.**
- **observe phenomena and evaluate them scientifically and mathematically by conducting a fair test of the effect of variables and using mathematical knowledge and technological tools to collect, analyze, and present data and conclusions.**

This is evident, for example, when students:

▲ develop and implement a plan to reduce water or energy consumption in their home.
▲ choose paper towels based on tests of absorption quality, strength, and cost per sheet.
▲ design a wheeled vehicle, sketch and develop plans, test different wheel and axle designs to reduce friction, chart results, and produce a working model with correct measurements.
▲ collect leaves of similar size from different varieties of trees, and compare the ratios of length to width in order to determinet whether the ratios are the same for all species.

Strategies

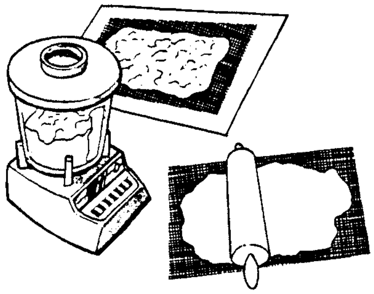
2. Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.

Students participate in an extended, culminating mathematics, science, and technology project. The project would require students to:

- **work effectively**
- **gather and process information**
- **generate and analyze ideas**
- **observe common themes**
- **realize ideas**
- **present results**

This is evident, for example, when students, addressing the issue of solid waste at the school in an interdisciplinary science/technology/society project:

▲ use the newspaper index to find out about how solid waste is handled in their community, and interview the custodial staff to collect data about how much solid waste is generated in the school, and they make and use tables and graphs to look for patterns of change. Students work together to reach consensus on the need for recycling and on choosing a material to recycle—in this case, paper.
▲ investigate the types of paper that could be recycled, measure the amount (weight, volume) of this type of paper in their school during a one-week period, and calculate the cost. Students investigate the processes involved in changing used paper into a useable product and how and why those changes work as they do.
▲ using simple mixers, wire screens, and lint, leaves, rags, etc., students recycle used paper into useable sheets and evaluate the quality of the product. They present their results using charts, graphs, illustrations, and photographs to the principal and custodial staff.



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Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

Skills and Strategies for Interdisciplinary Problem Solving

Working Effectively: Contributing to the work of a brainstorming group, laboratory partnership, cooperative learning group, or project team; planning procedures; identify and managing responsibilities of team members; and staying on task, whether working alone or as part of a group.

Gathering and Processing Information: Accessing information from printed media, electronic data bases, and community resources and using the information to develop a definition of the problem and to research possible solutions.

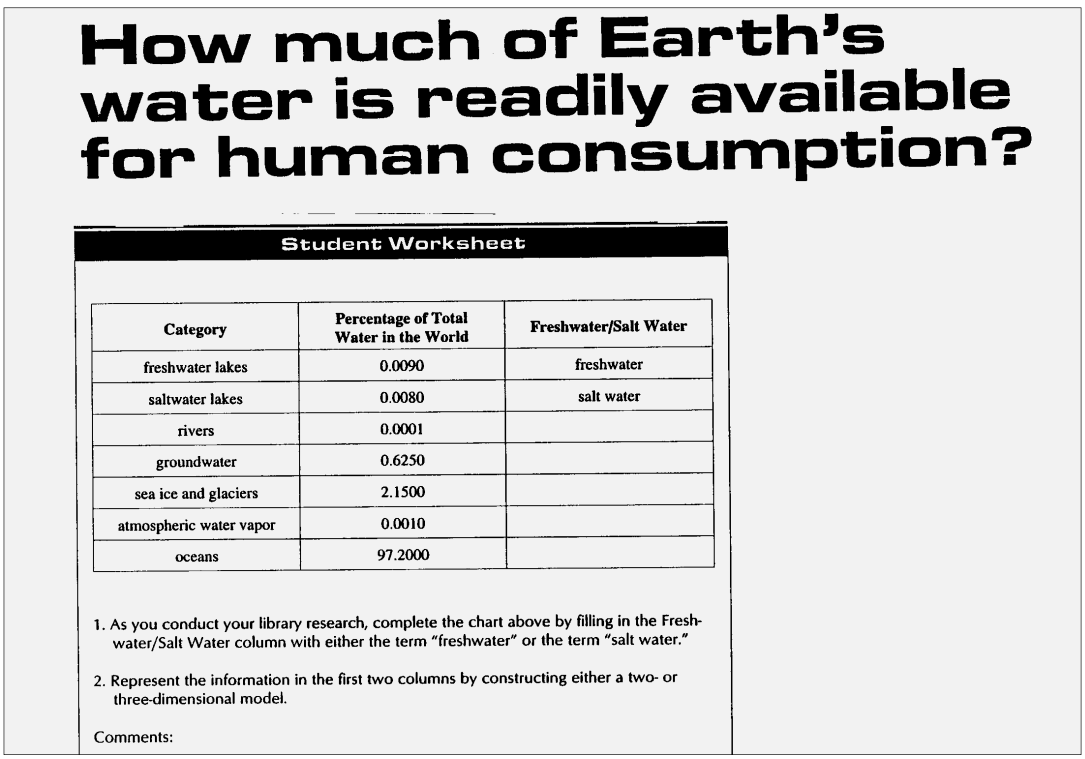
Generating and Analyzing Ideas: Developing ideas for proposed solutions, investigating ideas, collecting data, and showing relationships and patterns in the data.

Common Themes: Observing examples of common unifying themes, applying them to the problem, and using them to better understand the dimensions of the problem.

Realizing Ideas: Constructing components or models, arriving at a solution, and evaluating the result.

Presenting Results: Using a variety of media to present the solution and to communicate the results.

Sample Problem/Activity



How much of Earth's water is readily available for human consumption?

Student Worksheet

Category	Percentage of Total Water in the World	Freshwater/Salt Water
freshwater lakes	0.0090	freshwater
saltwater lakes	0.0080	salt water
rivers	0.0001	
groundwater	0.6250	
sea ice and glaciers	2.1500	
atmospheric water vapor	0.0010	
oceans	97.2000	

1. As you conduct your library research, complete the chart above by filling in the Fresh-water/Salt Water column with either the term "freshwater" or the term "salt water."

2. Represent the information in the first two columns by constructing either a two- or three-dimensional model.

Comments: