Mathematics, Science & Technology

PART I.1

Best Practices: 5 Guiding Principles............2

NOTE: This document is a work in progress. Parts II and III, in particular, are in need of further development, and we invite the submission of additional learning experiences and local performance tasks for these sections. Inquiries regarding submission of materials should be directed to: The Mathematics, Science, and Technology Resource Guide, Room 681 EBA, New York State Education Department, Albany, NY 12234 (tel. 518-474-5922).

http://www.nysed.gov

5 Guiding Principles of Best Practice in Mathematics, Science, and Technology

There is an emerging consensus about what activities in education constitute *Best Practices*. The following five guiding principles reflect the best practices of mathematics, science, and technology teachers and are the basis for the work which follows in this Resource Guide. Attending to these principles will result in teaching and learning activities which will provide rich and rigorous curriculum, instruction, and assessment for all students in classrooms of New York State.

MST

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5 6 7

Planning Strategy

ELEMENTARY
INTERMEDIATE
COMMENCEMENT

INQUIRY APPROACHES

Standard one is not just first in a series. Rather it is the over-arching umbrella for all the other standards. Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

MATHEMATICS, SCIENCE, AND TECHNOLOGY INTEGRATION

Today’s students will be adults in a technological society. They must see connections across the three disciplines as they work and function as effective citizens.

EQUITY

All planning for mathematics, science, and technology education must take specific steps to include females and people of lower socioeconomic classes. In a technological society these groups could be marginalized by their lack of knowledge and by traditional attitudes which denied them opportunity.

SEVEN STANDARDS

People accustomed to thinking about separate disciplines may be tempted to emphasize Standards 3, 4, and 5. Best practices remind us that each of the seven standards is critical in the total education of all students.

SCOPE AND SEQUENCE

Planning effective learning contexts for students requires attention to the continuity and progression of content throughout schooling. Teachers will create developmentally appropriate lessons for all students which are grounded in mathematics and science, and which can be applied in the design activities of technology.

Exploring Inquiry Approaches to Learning

The teacher asks:

What makes something inquiry? Was the problem we just worked on an inquiry?

Students respond:

Nah.

Teacher:

Why not?

Students respond:

I got the answer too fast.

It was just “draw a picture.”

We didn’t get help from anyone.

We didn’t need each other.

> *I find, as a person who gets asked about inquiry a lot, that it’s very hard to define. You almost have to inquire in order to talk about inquiry really well. I hear over and over, ‘Can we see a sample lesson plan?’ Teachers are accustomed to a formula, and this kind of teaching is absolutely non-formulaic. Before, I was headed in this direction, but I didn’t feel I had permission to move forward. Now, with. . . the backing of my colleagues, I feel I can take that risk.*
>
> Lynn Gatto. Fourth-grade teacher, School #39, Rochester.

Standard One sets the tone of all the mathematics, science, and technology standards by focusing on inquiry. It is based on the belief that such an approach is essential in enabling all children to learn. Every child’s question about a phenomenon can lead to learning. Any approach a child takes in working out a problem is worth delving into as a path toward understanding.

It’s not an easy philosophy, and it takes time. Ateacher who has been involved in inquiry learning for three years said, “You can’t easily pass it along to another. You have to experience it, to be physically involved.” Teachers find themselves in a new role as facilitator of students’ learning rather than as the repository of knowledge. The new role makes different social demands and requires different social and communication skills.

As one teacher remarked, “It’s not one of those things that’s, ‘Now say to the children. . . . There are no short cuts.’” Another teacher noted, “I’m a very structured person, and planning an inquiry is hard. It takes a lot of time.” Teachers have to try out different ways of being together with their students in the classroom.

Still, teachers are finding it liberating to be a learner of mathematics, science, and technology along with their students. Teachers are astonished by the depth of thinking they observe when students are allowed to investigate phenomena at their own pace, to follow their own questions, and during whole group discussions, to show and to reflect on the different approaches they and their classmates have taken in investigating a problem.

Students who learn in an inquiry environment expect to be finding out things about what they want to know. Their curiosity drives learning. One teacher, new to inquiry, borrowed a container of brine shrimp and put it in the back of the classroom directing every student to write

Source: Dr. Sybillyn Jennings. Consultant, New York State Systemic Initiative.

down in a class log one thing they observed. Aweek later the students were still observing and asking many questions about the brine shrimp. Another teacher commented, “We need to continue growing as teachers. We need to experience what the children are experiencing.”

Teachers, principals, district mathematics, science, and technology supervisors, and families who are unfamiliar with the inquiry philosophy may be put off by classroom investigations they catch a glimpse of or hear about. Hearing, for example, that seventh-graders are using manipulatives and second-graders are doing mental mathematics may lead them to think that content is not being covered appropriately.

Hands-on learning is often a starting point for inquiry, but inquiry goes deeper, requiring experimentation, reasoning, and the communication and testing of explanations. Inquiry cuts through the concrete-abstract opposition that pervades school thinking about younger and older learners, basic and higher content, bottom and top students. This is one reason why it is so significant that inquiry is identified explicitly in the first mathematics, science, and technology learning standard.

“

Teachers need to build their own capacity to recognize the right circumstance for good inquiry and how to capitalize on it. It’s all about getting students to ask questions that will help them develop inquiry skills in mathematics, science, and technology.
Asking why something was designed a certain way is rich in inquiry possibilities for students. It can develop the curiosity of children to ask questions and build on their existing knowledge of the world. Working with students this way is what I call 'guided inquiry’ and it can be an effective way to teach critical thinking.

Thomas Liao. Department of Science, Technology, and Society, State University of New York at Stony Brook.

Why Integrate Mathematics, Science, and Technology ?

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The growth of mathematics, science, and technology in recent decades has had significant effects on human society and the designed world. An important goal of an integrated approach to mathematics, science, and technology education is to prepare students to assume a constructive role as adults.

As citizens in a highly technological society, students must to be able to use mathematics, science, and technology to improve their lives, the lives of others in their community, and the lives of other organisms on the planet. In addition, because so many jobs now demand more knowledge of mathematics, science, and technology, all students need to have access to these fields of study.

In the everyday world, mathematics, science, and technology are not separate and distinct, but are used in combination to analyze and solve problems in research, business, communications, humanities, and the arts. Integrating mathematics, science, and technology education will help students to function in the challenging environment of the 21st century. Other discipline areas such as language arts and social studies can also be included through science, technology, and society units.

There are compelling reasons for integrating the three subjects:

- We cannot explain scientific inquiry well without also discussing how mathematical analysis and engineering design expand the power of such inquiry.
- Today's engineers and technologists need principles and theories produced by scientific inquiry to help design and build optimum technological tools and techniques.
- Many complex ethical issues resulting from interactions of mathematics, science, technology, and society will face citizens of tomorrow. Studying these subjects now will prepare students to deal wisely with issues such as environmental protection and health care.
- Motivation to study mathematics and science is enhanced when students deal directly with real-world applications.

What are some Approaches to Mathematics, Science, and Technology Integration?

As shown in the diagram on page 7, integrating mathematics, science, and technology can be viewed as a continuum that ranges from changes made by individual classroom teachers, to developing interdisciplinary units, to team teaching mathematics, science, and technology courses and programs.

For teachers who want to strengthen their teaching in relation to the State standards, a good way to start might be to meet with other mathematics, science, and technology teachers to think about ways to enrich their own teaching by making connections to the other disciplines.

Questions to ask:

- *How can we help our students make connections between what they learn in our classes with what they are learning in other classes?*
- *How can we realign units so that students can make associations between what is being taught in the various disciplines?*
- *How can we integrate the common themes from Standard 6 into the material already being taught?*
- *Who can we use as resources to help us and our students learn more about the other disciplines?*

Teachers who want to take another step in the continuum might want to develop an interdisciplinary unit, either on their own, or with other teachers. Examples of how to go about developing such units are included elsewhere in this Resource Guide. Or one might adopt integrated programs such as the New York Science Technology Education Program (NYSTEP) modules for middle school. For information about the NYSTEPmodules, contact Dr. William Peruzzi, 674 EBA, New York State Education Department, Albany, NY 12234. 518-473-9471.

Avaluable resource for technology education exists in school districts. Technology teachers at the middle school can help elementary teachers who want to strengthen their technology education program. Discussions and brainstorming sessions among mathematics, science, and technology teachers at various levels in districts can help generate ideas and resources for interdisciplinary units.

Afurther step along the continuum is team teaching. Teachers who are interested might begin with one team-taught class. Courses such as Principles of Engineering at the high school level lend themselves to team teaching because they incorporate all three disciplines.

Schools that are furthest along on the integration continuum have developed mathematics, science, and technology courses and programs.

A Continuum of Mathematics, Science, and Technology (MST) Implementation Models

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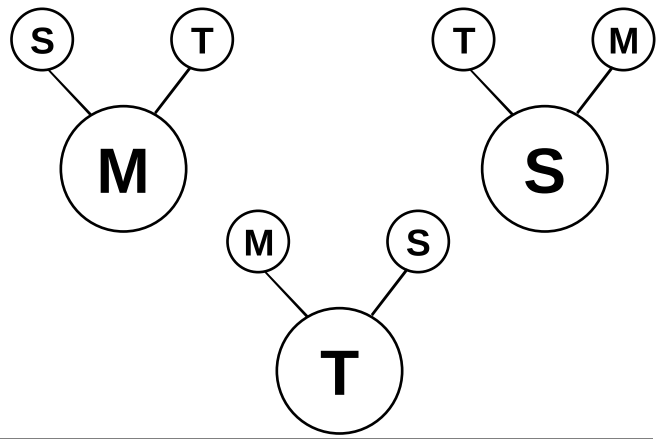
The three models below illustrate ways that schools across the State are integrating mathematics, science, and technology instruction.

MODEL 1

In this model, individual teachers help students make explicit connections between what they learn in a particular M, S, or T class and what they are learning in other classes. (School 14, Yonkers, DeWitt Middle School, Ithaca, and Stuyvesant High School, New York City)

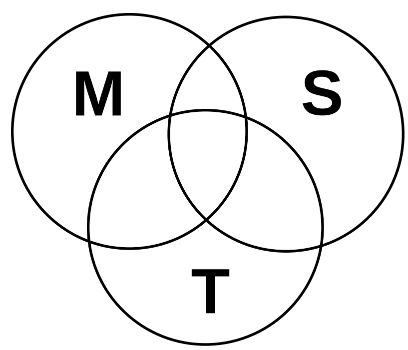
MST and/or STM and/or TMS



MODEL 2

In this model, teachers work together to develop interdisciplinary units. (Pelham Central School District and Smithtown Central School District)

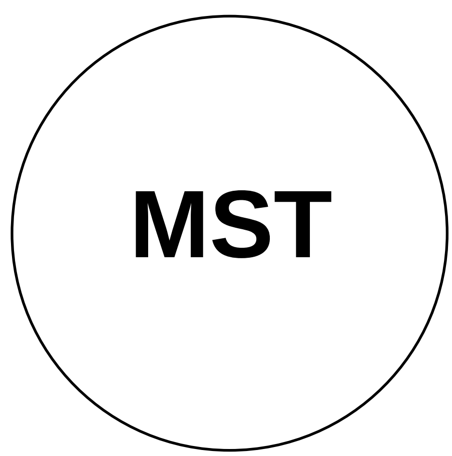
M + S +T+ (MST)



MODEL 3

This model illustrates a fully integrated approach. Students are either block-scheduled into three periods of mathematics, science, and technology or an integrated mathematics, science, and technology course where teachers team teach. (North Colonie Central School District and Bayshore Union Free School District)

MST Integrated Program



A Nature Study Center to Integrate Mathematics, Science, and Technology

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Teaching and Learning Strategy

ELEMENTARY

In the Chenango Forks Central School District, the John Harshaw Primary School's principal, staff, and students are in the first stage of creating a Nature Study Center on school grounds. This is a project that integrates mathematics, science, and technology in order to meet the mathematics, science, and technology learning standards.

Some students, after measuring and designing small garden plots, planted a variety of bulbs in the fall. Other students observed the head of a sunflower, estimated, and then counted the seeds. Some seeds were planted and their growth monitored in the classroom for future transplantation to a garden area.

The principal and all second grade students, for the last several Arbor Days, have planted black walnut trees on school grounds. Future activities for the Nature Study Center include:

(l) research for developing a butterfly garden

(2) research to find shrubbery that will attract wildlife

(3) construction of bird and bat houses.

Anearby wetland area will be prepared for safe access for extending this mathematics, science, and technology project.

Source: Robert Bundy, Principal, and Merri Earl and Colleen Cawley, Teacher coordinators, Chenango Forks Central Schools.

Strategies For Assuring Students Access to Mathematics, Science, and Technology Education

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The National Science Foundation suggests that school districts ask the following questions as they move to create equitable access to mathematics, science, and technology programs for all students.

Ask:

Do school, district, and State policies ensure that teacher and administrators values diversity?

Do partnerships with parents and businesses provide opportunities to discuss value related to equity?

Do public awareness activities and educational opportunities exist to lesson inequities and to encourage participation by traditionally underrepresented groups?

Are curriculum and instructional materials planned and selected to ensure that they are free from bias, represent all groups, and encourage participation?

Do educational and professional development prepare and support all teachers—including those who are themselves from underrepresented groups—to teach in diverse populations of students in K-12 classrooms?

Are methods of student assessment sensitive to diverse student populations and aligned to teaching strategies and instructional materials which are also sensitive to all students?

Do students have equitable access to technology education and equipment?

Are all school activities geared toward increased inclusiveness?

Do student performance measures demonstrate a significant increase in the rate of achievement of traditionally underrepresented students in mathematics and science?

"*The way science is presented in many classrooms makes it irrelevant to most students. . . The key is that science learning must begin with phenomena that have meaning to the students, that are significant to them. Science is concerned with making meaning of the world, both physical and cultural. By focusing on that world through scientific inquiry, students develop scientific knowledge. They begin to see that science is not just in books. It's not just in an alien middle-class world. If they apply themselves to inquiry and investigations, they will become scientifically literate.*

Adapted from: Hubert Dyasi. Ph.D. Professor of Science Education, City College of New York.

Adapted from: George, Y.S., and Van Horne, V.V., *Science Education Reform for All: ALook at How Departments of Education are Infusing Equity and Excellence into PreK-12 Systemic Reform.*

Posing Questions
Seeking Answers
Developing Solutions

MST

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Teaching and Learning Strategy

ELEMENTARY

For Susan Gillen, the power of inquiry in the classroom can best be seen in the new found enthusiasm and excitement that her students have for science and mathematics. “When we came back from vacation break my students kept asking, “When are we going to do science again?”

Susan and colleague Patty Schmidt have developed new curriculum units and instructional strategies to promote active, independent learning.

“Inquiry creates a *healthy hum* in the classroom,” reports Patty. “Because you’re asking so many questions of the students, with so much give-and-take, the children are totally engaged in what they are learning. Students are truly on task when they are engaged in inquiry.” Susan states that: “It’s wonderful having someone like Patty to work with; it’s really made a difference.”

Principal Joan Valerius agrees. “The partnership with the college and university professors has had a powerful and positive impact at Meachem. Without this support it would have been extremely difficult to make these changes at Meachem.”

Gillen, Susan. Second-grade teacher, Meachem Elementary School, Syracuse City Schools and Schmitt, Dr. Patricia. Le Moyne College, Syracuse.

“

There are lessons that lend themselves to inquiry very naturally. You pose a question, a very broad question, and you have the students come up with questions and answers. That’s a form of inquiry. I call it ‘gut learning.’ It comes directly from them. Students create their own drive, their own motivation. If they seem not to have that, then the role of the teacher is to get it going.

I think teaching in this way encourages females, particularly, to want to learn more math, science, and technology. You’re not limiting them to one problem, one answer, with inquiry learning. It’s so stifling when you do it that way. Not everyone finds their forte in math, but it’s something you need to know. I never get my kids to memorize formulas anymore. They can look those up. It’s much, much better to get them to research, and to think independently.

Therese Bennett. Seventh-grade math teacher, Hackett Middle School, Albany City Schools.

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Teaching and Learning Strategy

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Homework Hotline

Anew program in Yonkers using communications technology is making a big impact on the way teachers and parents communicate with each other. The program was piloted at Emerson Junior High School.

With a $140,000 grant from a consortium of corporations seeking to help working parents, the district has installed voice-mail systems in the schools for use by parents, teachers, and administrators. Parents can now dial their child's school 24 hours a day and get information about homework assignments, testing, special events, and other activities at the school such as the sports schedule and conference days. For many parents with busy schedules, the voice-mail operation at Emerson has made a real difference in their ability to keep up with what's going on in school.

Parent Kathy Harris says, "In the middle school there are seven or eight instructors, and it's hard to keep in touch with all of them. With the voice-mail set up at Emerson, I can dial into a teacher's individual mailbox and get a message about lesson plans, homework assignments, and when the tests are. Teachers update their messages daily, so I always know what's going on. I can leave messages, too, if I have a question or concern. This system makes a really important connection between home and school—it's great."

Emerson Junior High School, Yonkers City Schools.

Advantages of Graphing Calculators

Today's graphing calculators provide the mathematics community with a tool that facilitates students' investigation of problems by using multiple representations: numeric, analytical, and graphical. The advantages of teaching with them include:

- Students can move from one mode of presentation to another in a seamless environment.
- Students' conjectures can be tested and verified independent of their mastery of older computational algorithms.
- Users have access to investigations and explorations that would have been prohibitive in the past.

Graphing calculators used within mathematics instruction can:

- allow students to process real life data
- conjecture as to the relationships between and among data

* allow students to hypothesize as to the meaning behind the relationships

* make mathematics come alive for students

* help students to conceptualize mathematics through visualization and multiple representations.

Source: Caroscio, William. Technology teacher, Elmira Southside High School, Elmira City Schools.

Interdisciplinary Computerized Travels

For the past two years, students at Emerson Junior High School have participated in MayaQuest, an interdisciplinary, interactive archaeological adventure. Using the PRODIGY program, students communicated with archaeologists who were touring Mayan ruins in Mexico and Central America. The students helped to direct the expedition by posing questions and suggesting site investigations. On March 21, 1996 a satellite-beamed video allowed students to participate in a live question and answer session.

As an outgrowth of MayaQuest, students studied units in tropical rain forests, Mayan mythology, and modern Mayan society. They also created a model archaeological ruin.

Mrs. Pat Guski, head teacher for MayaQuest, felt that the project and its accompanying technology, "Opened up the world for students and teachers."

Source: Teachers from Emerson Junior High School, Yonkers City Schools.

Gardens and Geometry

MST 3

Teaching and Learning Strategy

ELEMENTARY

The children at School #14 in Yonkers apply their knowledge of geometry and math to real world situations in the school garden. One challenge was to decide how they could create a perfect circle around each of two weeping cherry trees so that they create a circular planting area.

Working cooperatively, they used their inquiry skills to try to come up with feasible solutions. The groups decided which plans they wanted to try. The most successful solution was to use a string the length of the radius of the circle and tie it to the trunk. The other end was tied to a plastic bottle with a narrow neck that was filled with flour (ecologically correct). As they walked around the tree trunk they created their first circumference. Two smaller ones were created inside the circle later, to denote where planting would occur.

These circles were used to plan a bulb planting project. The children worked cooperatively to come up with the best plan they could agree on to plant tulips and daffodils for the spring. The students surveyed the area, and were asked to try to come up with a plan. After a time of trial and error, they realized they did not have enough information.

It was only then that they were given what they asked for, namely, how many bulbs of each kind and color had been purchased. After that, even though they did begin to create a key for their plan, they realized that they were not accurately planning the spacing of the bulbs in the circles they had drawn on their planning sheets. After awhile, the concept of a grid and scale was introduced and the children worked cooperatively to plan their designs for the area. They decided among themselves which was the best plan. The entire class used this plan to plant the bulbs. As problems arose in executing the plan, the designers were called to meet with the class to interpret their symbols or explain their markings.

This same process was used with a group of children who planted bulbs in a bed that was the shape of a scalene triangle. This project can be adapted to any similar geometric shape.

Source: Lacchia, Linda, Science magnet teacher, School #14, Yonkers City Schools.

“

I teach classes that include [some] students with learning disabilities, and I have found that inquiry lends itself very well to teaching in this setting. All students get excited about learning when they initiate the questions and that’s what inquiry is all about. I help all students design simple, hands-on investigations to explore their questions, and I guide them to where they can go to get additional information—the library, the computer, textbooks—and they report back to their classmates with their results.

Linda Jeffress. Fourth-grade inclusion teacher, Meachem Elementary School, Syracuse City Schools.

Square Foot Gardening

MST 3
Teaching and Learning Strategy
ELEMENTARY

Urban children used their math skills in a real world setting, based on the practices of Mail Bartholomew, the author of the book, *Square Foot Gardening.* The garden is divided into square foot units and students must plan the planting of vegetables and flowers in this space. The raised beds were measured by the students. Using the concept of planting within the squares, a plan for each kind of plant was developed.

For instance, peppers and tomatoes grow to be fairly large, so one plant was planted in each square foot. Radishes, scallions and carrots (to feed our little animals) were planted three inches apart so that 16 fit into each square foot planting grid. In some cases children brainstormed, using grids and manipulatives, how to get more plants in their space. They came up with the idea of staggering the rows. In some cases, after studying the growth patterns of the plants, they decided that a trellis or stake was needed to support a plant in its designated area.

Students used both measuring skills and calculating skills in order to determine the number of seeds, plants, plant markers, starter pots, and potting soil needed. Mathematical opportunities in this garden were many and varied. For instance, the largest tomato was shown to all the children and they weighed it using pounds and ounces as the measure. They were challenged to convert the weight into grams.

The longest carrot was measured in inches and the children were challenged to convert its length into centimeters. We also tallied our sunflower seed yields after inventing a process to do it. Solutions ranged from *guesstimating,* to measuring the diameter of the seed area and calculating how many seeds in a square inch, to counting by tens and hundreds. Aserendipitous happening was the arrival of flocks of American golden finches who came to dine on our Mexican sunflower seeds.

Source: Lacchia, Linda, Science magnet teacher, School #14, Yonkers City Schools.

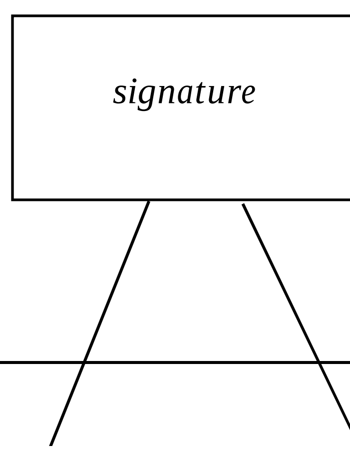
A Real World Application of Chemistry

MST 4
Teaching and Learning Strategy
COMMENCEMENT

This activity is an example of a real world application of chemistry in which students at Glens Falls High School have engaged.

The mole is a unit of measurement used by chemists to "count" particles of matter, to relate the mass of an element or compound to the number of particles in a sample, and to relate the volume of a gas to either the mass of a sample or the number of particles in the sample. This study of the quantitative relationships derived from chemical formulas and chemical equations is termed *stoichiometry*.

"In this lab performance test, you will use stoichiometry and whatever lab equipment necessary to determine the number of formula units of calcium carbonate in your signature written in chalk. You will also calculate the number of atoms of Ca, C, and O in your signature. Your report should include materials used, procedure, results, and a discussion. GOOD LUCK!!"



Source: Danna, Steve and Parrott, Pamela. Glens Falls High School, Glens Falls City Schools.

Interdisciplinary Study of the Iroquois Nation

MST 5

Teaching and Learning Strategy

ELEMENTARY

Students at School 39 in Rochester are involved in an interdisciplinary study of the Iroquois. Their social studies, English language arts, and science teachers have collaborated to develop a curriculum that makes connections between three core subject areas and aligns with mathematics, science, and technology standards.

Highly motivating interdisciplinary units, based on science topics, provide a forum for children to see how math, science, technology, social studies, and language arts are related to one another within the context of meaningful experiences.

Decorations in the hallway leading to our classroom makes the unit we are studying quite obvious. The Iroquois longhouse in progress invites anyone who walks through it to share in what we've learned about the "old ways" of the Iroquois Nation. The hallway entrance has been covered with a deerskin. Hanging on it is our clan sign made from a large piece of bark and decorated with a charcoal drawing done by one of the students. Students made authentic clay pots and corn husk dolls which are displayed on shelves made by lashing twigs together. The clay pots hold leaves, pine cones, rocks, gourds, and herbs the children collected. Dried ears of corn, life-sized animal-skin cutouts, medicine wheels, dream catchers, and baskets are suspended from the longhouse ceiling poles. Alarge bunkbed—made by lashing branches together—hangs from one of the longhouse walls. Tools made from rocks, leather strips, and branches are also displayed on the walls.

The Iroquois were farmers. Corn, beans, and squash, their three main crops, were called the "Three Sisters." Students made a collage honoring the three sisters which hangs by the entrance to the longhouse.

To sum up and assess the unit, students held a pow wow. All the information students learned contributed to create a Native American environment complete with handmade costumes, authentic food, and Iroquois music and dance.

This unit helped students gain respect for their environment and appreciate another culture. They understand, as the Iroquois did that, "We all share the earth together and we must leave it for those that come after us."

Source: Teachers from School 39, Rochester City Schools.

MST 6

Teaching and Learning Strategy

INTERMEDIATE COMMENCEMENT

1 Making Connections: Through a Theme

As teachers focus on integrating instructional approaches, they will want to help students see the connection in mathematics, science, and technology to other disciplines. The following three examples suggest natural connections to other areas of the core curriculum.

Magnitude and Scale

Mathematics
Students express the sizes of planets to Earth in ratios and use exponents to express the distance of planets from the sun.

Technology
Students learn how technological devices have enabled people to observe the planets and measure their sizes and distances from the sun.

Science
Students learn about the relative sizes and distances from the sun of the planets.

Activities
Students make a scale model of the solar system, using calculators and measuring tools to determine the sizes and locations of planets in the model.

Other Connections:
Music: listen to *The Planets* by Holtz
Art: draw pictures of the planets
Social Studies: research the history of knowledge about the solar system
English Language Arts: read and/or write poems about the planets; read a science fiction story about life on another planet

Making Connections: Through a Topic 2

Human Genetics

Mathematics
Students apply probability to predicting the traits of offspring.

Technology
Students learn about the technology used to make prenatal diagnoses of genetic conditions.

Science
Students learn the basic Mendelian patterns of inheritance and apply them to analyzing patterns of inheritance in humans.

Activities
Students construct a pedigree for their families, showing transmission of a specific trait, such as eye color.
Students analyze photographs of karyotypes to identify specific chromosomal conditions.
Students make squashes of onion root tips to observe and draw chromosomes.

Other Connections:
Music: make analogy between musical notation and genetic code
Art: draw pictures of chromosomes seen through a microscope; raw pedigrees
Social Studies: investigate effect of eugenics on immigration policies in the first half of the 20th century
English Language Arts: write a report on a human genetic condition; read an article in a magazine or newspaper about a recent advance in genetics

3 Making Connections: Through an Issue

> *One thing I have learned from paying close attention is the importance of context in children's learning. For young children, . . . that means connecting the problem to some previous experience, some person or persons or some event in their lives. It's important for children to find those connecting points.*
>
> *When I hear a child say, "Oh, yeah, it's like. . ." then I know that child has found a connection and is fitting new ideas into an already existing framework. . . . when [I]. . . hear what a child says. . . [it] teaches me how to build context as I present new mathematical ideas and concepts.*
>
> Caren, Ann. In-school staff developer, Beverly J. Martin Elementary School, Ithaca City Schools.

Should Fishing Off the New England Coast be Suspended?

Mathematics
Students graph catch data for fish in New England coastal waters and learn basic equations for population growth.

Technology
Students learn how technology has changed the fishing industry in recent years and how it is used to estimate fish populations.

Science
Students study the dynamics of wildlife populations.

Activity
Students participate in a simulation to demonstrate effects of different policies on fish populations.

Other Connections:
Music: sea chanteys
Art: paintings of fishing
Social Studies: effect of suspension of fishing on the industry and fishermen
English Language Arts: write letters to Congressmen from viewpoints of fishermen, environmentalists, etc.; read stories about the lives of fishermen

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7

Teaching and Learning Strategy

ELEMENTARY
INTERMEDIATE

Native Americans: The Iroquois Nation

This chart reflects interdisciplinary activities related to the Iroquois Nation that teachers can use with their students to illuminate the mathematics, science, and technology standards.

ACTIVITIES

- Keeping journals
- Participating in a nature retreat
- Researching, planning, and planting Three Sisters Garden
- Visiting Ganondagan Site
- Reading *The Indian In the Cupboard*
- Visiting Rochester Museum and Science Center (Iroquois Exhibit)
- Researching, planning, and constructing a hallway longhouse
- Researching, designing, sewing, and constructing clothing and tools for a Pow Wow

GOALS AND OBJECTIVES

Science

- Design experiments and explain the outcomes. Show how plant pollen depends on environmental conditions for dispersal.
- Describe form and function of plants and how they are important to the reproductive cycle.
- Create classification systems.
- Explain how changes in the environment can affect a habitat.
- Observe and illustrate details.
- Create and interpret graphs to show data collected.
- Create an awareness of scientific careers related to archeology, conservation and horticulture.

Values

- Develop teamwork attitudes and skills.
- Respect and understand the importance of our New York State environment.
- Heighten awareness of environmental issues in our community.
- Ask questions.
- Create respectful attitudes for personal and cultural differences.

Mathematics

- Introduce area and perimeter.
- Reinforce multiplication and division through arrays.
- Improve measurement to the nearest inch.
- Solve problems using measurement, division, and multiplication.
- Estimate to the nearest thousand.
- Introduce coordinate points.

Social Studies

- Compare and contrast life in an 18th century Iroquois village to their own lives today.
- Identify science and technology in history.
- Learn New York State geography.
- Acquire map reading and directionality skills.

English Language Arts

- Improve reading fluency and comprehension.
- Develop written skills through opinion, comparison, reporting, and description essays, as well as letters.
- Develop oral skills through reporting, explaining, and defending.
- Increase vocabulary and correct spelling through thematic related words.
- Introduce and study skills by using reference books and the computer.

Source: Teachers from School 39, Rochester City Schools.