



Northwest Louisiana
Mathematics
Association

A Case for Connections

Presented by

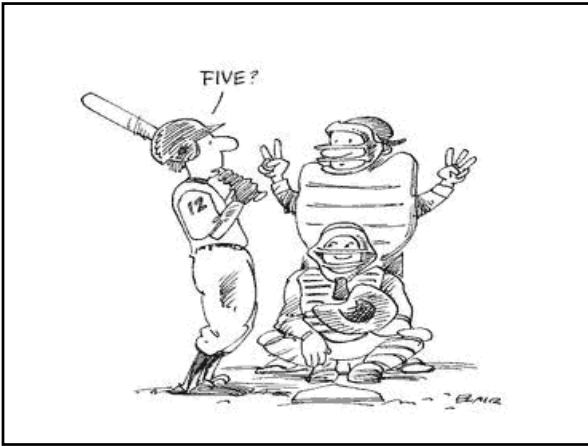
Dr. Karol L. Yeatts

"So much of our understanding of the world depends on mathematics. Without math, our culture couldn't function."

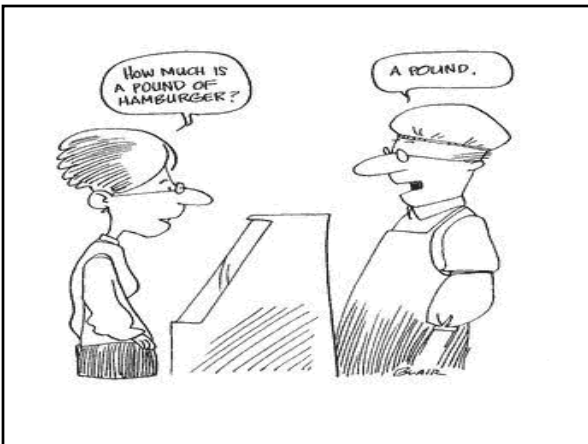
-Elizabeth Spelke
Harvard University psychologist
Cambridge, Massachusetts



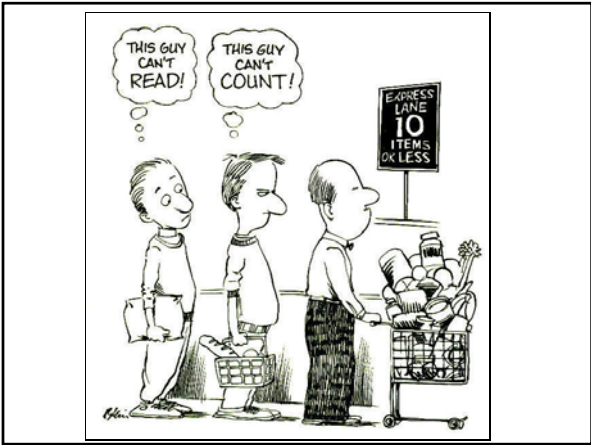


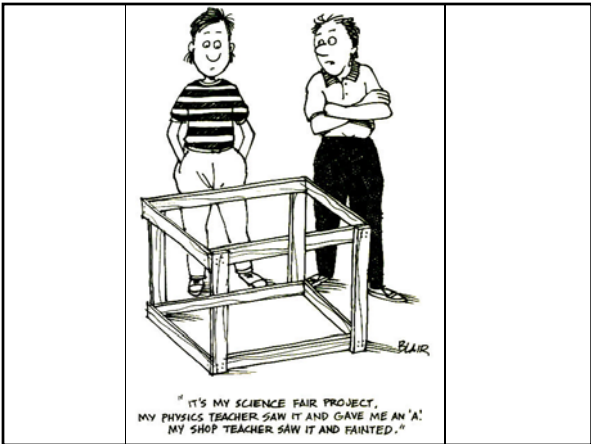












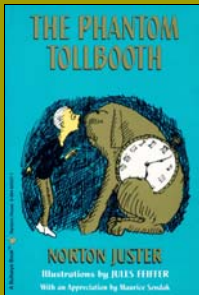
“For the things of this world cannot be made known without a knowledge of mathematics.”



-Roger Bacon

1214 -1292; English Scholastic philosopher and scientist, one of the most influential teachers of the 13th century.

Numbers are Important

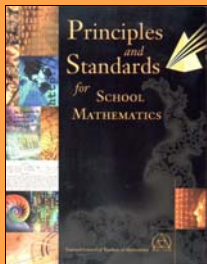


“Could you have tea for two without the two or three blind mice without the three? Would there be four corners of the earth if there weren't a four? And how would you sail the seven seas without a seven?...If you had high hopes, how would you know how high they were? And did you know that narrow escapes come in all different widths?...Why numbers are the most beautiful and valuable things in the world.”

-page 177

A Case for Connections

Connections is one of the NCTM Process Standards.



“Understanding connections eliminates the barriers that separate the mathematics learned in school from the mathematics learned elsewhere. It helps students realize the beauty of mathematics and its function as a means of more clearly observing, representing, and interpreting the world around them” - page 132

A Case for Connections

- Ways students can experience mathematical connections include:
 - Using mathematics in other curriculum areas;
 - Using mathematics in daily life activities;
 - Applying mathematical thinking and modeling to solve problems that arise in other disciplines such as art, music, psychology, science, and business;
 - Using and valuing the connections among mathematical topics.

A Case for Connections

- *Constructivists maintain that all knowledge is personal and arises from our active attempts to interpret the world around us.*
- *Providing curriculum connections such as an integrated study is one way in which children can explore knowledge in various subjects related to certain aspects of their environment.*



A Case for Connections

There is a strong belief among those who support curriculum connections that schools must look at education as a process for developing abilities required by life in the twenty-first century, rather than discrete, departmentalized subject matter.



A Case for Connections

- Integrated curriculum helps students apply skills.
- An integrated knowledge base leads to faster retrieval of information.
- Multiple perspectives lead to a more integrated knowledge base.
- Integrated curriculum encourages depth and breadth in learning.



- Integrated curriculum helps students see relationships among ideas and concepts.
- Integrated curriculum promotes positive attitudes in students.
- Integrated curriculum provides for more quality time for curriculum exploration.

A Case for Connections

- In general, definitions of integrated curriculum or interdisciplinary curriculum include:
 - A combination of subjects
 - An emphasis on projects
 - Multiple resources
 - Flexible schedules
 - Relationships among concepts
 - Flexible student groupings
 - Thematic units as organizing principles



Name	Description	Advantages	Disadvantages
Fragmented	Separate and distinct disciplines.	Clear and distinct view of a discipline.	Connections are not made clear for students, less transfer of learning.
Connected	Topics within a discipline are connected.	Key concepts are connected, leading to the review, reconceptualization and assimilation of ideas within a discipline.	Disciplines are not related, content focus remains within the discipline.
Nested	Social thinking and content skills are targeted within a subject area.	Gives attention to several areas at once, leading to enriched and enhanced learning.	Students may be confused and lose sight of the main concepts of the activity or lesson.
Sequenced	Similar ideas are taught in concert, although subjects are separate.	Facilitates transfer of learning across content areas.	Requires ongoing collaboration and flexibility, as teachers have less autonomy in sequencing curricula.
Shared	Team planning and/or teaching that involves two disciplines focuses on shared concepts, skills or attitudes.	Shared instructional experiences with two teachers on a team it is less difficult to collaborate.	Requires time, flexibility, commitment and compromise.
Webbed	Thematic teaching using a theme as a base for instruction in many disciplines.	Motivating for students, helps students see connections between ideas.	Theme must be carefully and thoughtfully selected to be meaningful with relevant and rigorous content.
Threaded	Thinking skills, social skills, multiple intelligences, and study skills are "threaded" throughout the disciplines.	Students learn how they are learning, facilitating future transfer of learning.	Disciplines remain separate.
Integrated	Priorities that overlap multiple disciplines are examined for common skills, concepts, and attitudes.	Encourages students to see interconnectiveness and interrelationships among disciplines, students are motivated as they see these connections.	Requires interdepartmental teams with common planning and teaching time.
Immersed	Learner integrates by viewing all learning through the perspective of one area of interest.	Integration takes place with the learner.	May narrow the focus of the learner.
Networked	Learner directs the integration process through selection of a network of experts and resources.	Pro-active with learner stimulated by new information, skills or concepts.	Learner can be spread too thin, efforts become ineffective.

The Social Studies Connection

<http://library.thinkquest.org/4116/>



Mathematics and Social Studies

National Council of Social Studies

[Ten Thematic Strands in Social Studies](#)

- I. Culture
- II. Time, Continuity, and Change
- III. People, Places, and Environment
- IV. Individual Development and Identity
- V. Individuals, Groups, and Institutions
- VI. Power, Authority, and Governance
- VII. Production, Distribution, and Consumption
- VIII. Science, Technology, and Society
- IX. Global Connections
- X. Civic Ideals and Practices

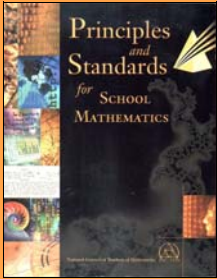
Culture

• *Instruction should include experiences that provide for the study of culture and cultural diversity.*

• *Performance Expectation*
–*Describe ways in which language stories, folklore, music and artistic creations serve as expressions of culture and influence behavior of people living in a particular culture.*



Culture

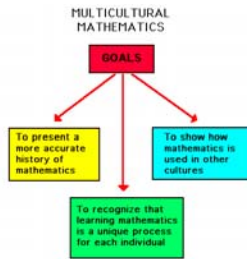


“Mathematics is one of the greatest cultural and intellectual achievements of humankind, and citizens should develop an appreciation an understanding of that achievement, including its aesthetic and even recreational aspects.”

- page 4

Culture

- [Multicultural Math Lessons](http://www.deltacollege.edu/dept/bas/math/Multicultural_Math.htm)
– http://www.deltacollege.edu/dept/bas/math/Multicultural_Math.htm
- Multicultural Math
– <http://people.clarityconnect.com/webpages/terri/multicultural.html>
- Multicultural Math Fair
– <http://mathforum.org/alejandre/mathfair/mmfinks.html>





Mathematics the Art

Many of the movements in classical, impressionist, or modern art have been based upon geometric principles: Cubism, OpArt of the 1960's, and Digital Illustration rely heavily on math.



Detecting True Art

- Now, researchers have found a new way to tell the real from the fake—using mathematics.
- The researchers start with a digital image. They use a mathematical technique, known as wavelet decomposition, that breaks this image down into a collection of smaller, more-basic images
– <http://www.sciencenewsforkids.org/articles/20041208/Note2.asp>

When researchers used math to analyze an old painting called "Virgin and Child with Saints," they discovered that it was apparently painted by several different artists. The analysis suggested that areas 1, 2, and 3 were done by one painter and each of the other areas by another painter.





Mathematics and Art

- Students can visit the Smithsonian American Art Museum's or another online museum or art gallery, and identify examples of math in the art they find.
– <http://americanart.si.edu/index3.cfm>



- The Meadows Museum of Art at Centenary College in Shreveport, LA opened its doors in 1967 and originally housed three hundred and fifty paintings, watercolors and drawings by the French Academic artist Jean Despujols.
- Since that time, the Museum has added significantly to its permanent collection, which now includes 1,500 works reflecting a variety of world cultures and traditions.
• <http://www.meadowsmuseum.org/>



Mathematics and Art



- **Mathematics in Art and Architecture**
– <http://www.math.nus.edu.sg/aslaksen/teaching/math-art-arch.shtml>
- **Fractals** - A unit on fractals for elementary and middle school students.
– <http://math.rice.edu/~lanius/frac/>
- **Tessellation Tutorials** - Includes tutorials and templates for teaching and creating tessellations.
– <http://mathforum.org/sum95/suzanne/tess.intro.html>
– <http://library.thinkquest.org/16661/escher.html>
- **Geometry Through Art** - Provides lessons on teaching geometry through art, for students of all ages.
– <http://mathforum.org/~sarah/shapiro/>
- Piet Mondrian
– <http://www.artchive.com/artchive/M/mondrian.html#images>

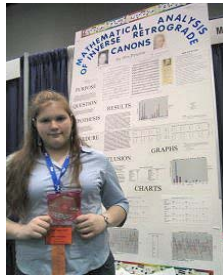
Mathematics and Music



Math Beat

"Music can make you better at math...Both help each other. Music stimulates your brain, and you use math so much in music. You can't have one without the other."

-Ana Peterlin
a 13-year-old freshman
from Fairbanks, Alaska

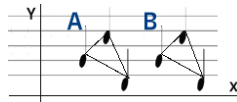


Ana holds a CD containing a musical piece that she composed and analyzed mathematically.

• <http://www.sciencenewsforkids.org/articles/20040602/Feature1.asp>

Mathematics and Music

- The famous Greek mathematician, [Pythagoras](#), and his followers studied numbers and their relationship to musical harmony.
- The Pythagoreans believed that harmony consisted of numerical ratios. The concept that ratio between two numbers is an entity is essential in music theory.
- For example: The chromatic scale (C, C#, D, D#, ..., B, C) is made up of notes defined by frequencies that grow in a "geometric progression" whose ratio is the 12th root of 2 ; spanning one octave!





Mathematics and Music

Name	Note Symbol	Fraction of measure	# notes that fit in a measure
Whole		1/1	$1 = 2^0$
Half		1/2	$2 = 2^1$
Quarter		1/4	$4 = 2^2$
Eighth		1/8	$8 = 2^3$
Sixteenth		1/16	$16 = 2^4$

Mathematics and Music

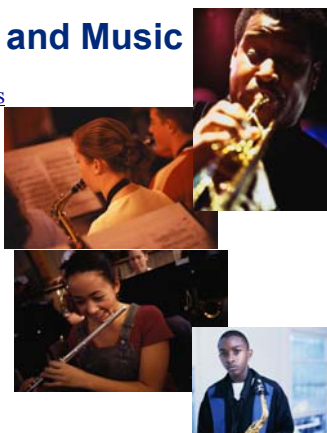
- Explore different musical notes that represent the rhythm, or time, of a piece of music,
- Explore tone and tune through discussions of pitch, frequency, and amplitude.
- Explore the mathematical relationship of adjacent notes on a keyboard and the theory that ratio is essential to harmony.
- Give students an opportunity to listen to a variety of musical styles and to discuss the rhythm, tone, and tune of each selection, then ask students to compose a tune of their own.
- Encourage older students to research the lives of some classical musicians to discover how many were also mathematicians.



Mathematics and Music

• [The Sound of Mathematics](#)

- Sound files of algorithmic music.
- <http://www.geocities.com/Vienna/9349/index.html>
- <http://www.geocities.com/Vienna/9349/pi.mid>



Mathematics and Dance

- George Balanchine of the New York City Ballet was obsessed with geometric patterns and movements for his dancers. His choreography stressed straight lines and intricate timing.



The Math of Dance



Concepts such as symmetry, spatial awareness, counting problems and patterns are also found in dance.

Drum with Your Feet



"I didn't know math could be so fun." - 5th Grader



"I had a lot of fun this week. I learned about different kinds of symmetry like slide, flip, and turn. I learned about center/zero/origin. Math in your feet was really cool. I wish we could do it again!" 5th Grader

Time, Continuity, and Change

- *Instruction should include experiences that provide for the study of the ways human beings view themselves in and over time.*

- *Performance Expectation*

– *Demonstrate an ability to use correctly vocabulary associated with time such as past, present, future, and long ago; read and construct simple timelines; identify examples of change; and recognize examples of cause and effect relationships.*

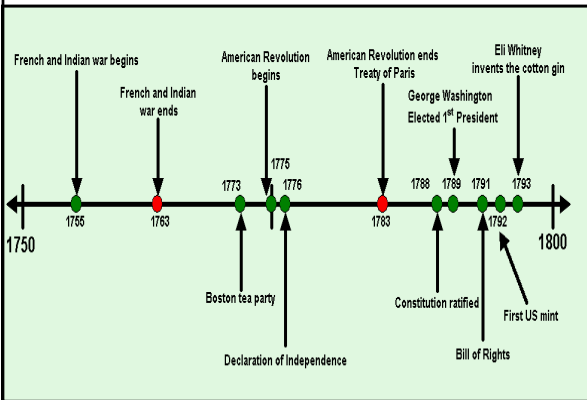


Time, Continuity, and Change

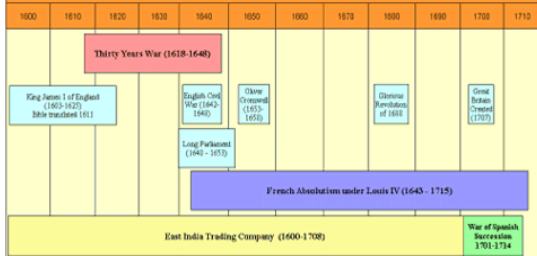
- No matter where we are or what we do, time is constant. Every second, each minute, through all the hours of a day, week, month, or year, time moves on regardless of what is happening around us.
- From the use of sundials, escapements, and pendulums to the invention of automatic, synchronome, and calendar clocks, the mechanics of timekeeping has been an important part of all cultures throughout the centuries.
- Clocks – Teaching Time
– <http://fi.edu/qa00/attic3/index.html>
- Time Keepers
– <http://fi.edu/time/keepers/index.html>
- Journey in Time
– <http://fi.edu/time/keepers/index.html>



AMERICAN HISTORY FROM 1750 TO 1800



EUROPE IN THE 17th CENTURY



 HOLY ROMAN EMPIRE	 SPAIN
 ENGLAND	 TRADE
 FRANCE	

People, Places, and Environment

- We use a map to find out how to get from one place to another.
- We also use it to estimate what the driving distance is between point A and point B and plan out the alternative or shortest route to get there.



Ratio is the mathematical concept that is used to develop scaled maps as maps are often drawn to a reduced scale such as 1 inch to 20 miles.

People, Places, and Environment

- At [The Stowaway Adventure](#), "stowaways" in grades 6-12 can plot latitude and longitude to locate the route of the ship they're hiding on.
- [http://www.mcwdn.org/MAPS &GLOBES/Latitude.html](http://www.mcwdn.org/MAPS&GLOBES/Latitude.html)
- They use that information, along with their math knowledge, to determine the ship's speed, distance traveled, and projected destination.
 - <http://www.ciese.org/curriculum/shipproj/index.html>



People, Places, and Environment

- There is a relationship between the number of cities one might go to and the number of possible routes to get to those cities.
- Learn how to select the shortest route while planning for your trips. For additional information of pattern in math, to go to the 'Pascal's Triangle' page.
 - <http://library.thinkquest.org/4116/History/pascal's.htm>
- For example, the number of possible routes between three cities is two routes;
 - for four cities, there are six routes
 - for five cities, there are twenty-four routes.

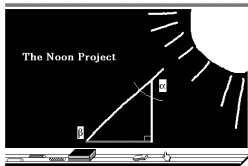


The table below shows that the number of routes forms a pattern in relationship to the number of cities.

Number of Cities	Number of Possible Routes	Pattern A	Pattern B
3	2	2!	2 ' 1
4	6	3!	3 ' 2 ' 1
5	24	4!	4 ' 3 ' 2 ' 1
6	120	5!	5 ' 4 ' 3 ' 2 ' 1
7	720	6!	6 ' 5 ' 4 ' 3 ' 2 ' 1
8	5,040	7!	7 ' 6 ' 5 ' 4 ' 3 ' 2 ' 1

People, Places, and Environment

- [The Noon Observation Project Students](#) in grades 6-12 use their knowledge of Math, geography, and the Internet to estimate the circumference of Earth.



<http://www.ed.uiuc.edu/noon-project/>

Individual Development and Identity

- *Instruction should include experiences that provide for the study of individual development and identity.*
- *Performance Expectation*
 - *Describe personal changes over time, such as those related to physical development and personal interests.*





Individual Development and Identity

- Anthropometry is the study of human body sizes and proportions.
- An anthropometrist is a scientific person who gathers information on the size of the human body and its components.
- People use this data to design clothing, car interiors, furniture, and interiors for homes and offices.
- Artists use this information to accurately draw and sculpt the human form.

Anatomical studies by Leonardoda Vinci



Vitruvian Man
1492



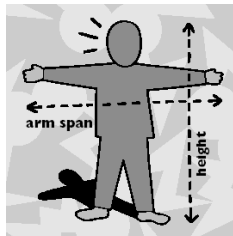
Study on the proportions of head and eyes



Study of proportion
1490

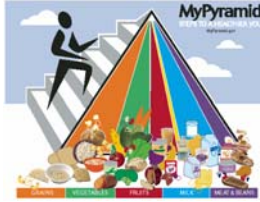
Individual Development and Identity

- There are no "exact rules" to predict a body measurement based entirely on the relationship of one part of a body to another body measurement.
- But, there are relationships that can be called "rules of thumb" that are useful in relating one body measurement to another.



Individual Development and Identity

- At [Fat Counting](#), students in grades 1-6 study and discuss the food pyramid.
- Then they compare the foods on the pyramid to the foods they eat, keep a fat-counting diary, calculate the number of calories from fat they eat in a week, find their daily average of fat, and compare their fat intake with that of other students.



<http://commtechlab.msu.edu/sites/letsnet/noframes/Subjects/math/>

Production, Distribution and Consumption

- *Instruction should include experiences that provide for the study of how people organize for the production, distribution, and consumption of goods and services.*
- *Performance Expectation*
 - *Explain and demonstrate the role of money in everyday life.*
 - *Describe the relationship of price to supply and demand.*



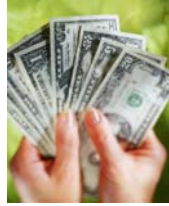
Production, Distribution and Consumption

- [Moneyopolis](#), a site maintained by the accounting firm of Ernst & Young, provides a simple and effective financial planning curriculum for students in grades 6 through 8. Students are guided through the financial planning process.
 - <http://www.moneyopolis.com/new/home.asp>



Production, Distribution and Consumption

- [The Mint](http://themint.org/), a comprehensive site designed for middle- and high-school students, provides lots of financial information and activities as students devise a savings plan
 - study investment strategies
 - learn about compound interest
 - learn about the federal deficit
 - explore the world of credit cards
 - learn about making a budget
 - <http://themint.org/>



Production, Distribution and Consumption

- Next time you're in a grocery store, check out the oranges.
- Chances are the spherical fruits are stacked in the most efficient way possible.
- Above the first layer, each orange sits in a pocket formed by a triangle of three oranges below it.
- A pile of spheres arranged in this way takes up 74 percent of available space. The rest is just air.



A Sweet Advance in Candy Packing

- Curious to see what squashed spheres would do, Torquato and his coworkers poured M&Ms into two, differently shaped containers.
 - To their surprise, they found that the candies took up as much as 68 percent of the space.
 - That's better than you can do just pouring spheres into containers
- <http://www.sciencenewsforkids.org/articles/20040218/Note3.asp>



Researchers Paul Chaikin and Salvatore Torquato of Princeton University used M&Ms to study how objects pack together.

Science, Technology and Society

- *Instruction should include experiences that provide for the study of relationships among science, technology, and society.*



- *Performance Expectation*
 - *Examine and describe the influences of culture on scientific and technological choices and advancements such as transportation and medicine.*

Science, Technology and Society

“Mathematics is the door and the key to the sciences.” - Roger Bacon



Science, Technology and Society

To the young mind everything is individual, stands by itself. By and by, it finds how to join two things and see in them one nature; then three, then three thousand ... discovering roots running underground whereby contrary and remote things cohere and flower out from one stem... The astronomer discovers that geometry, a pure abstraction of the human mind, is the measure of planetary motion. The chemist finds proportions and intelligible method throughout matter, and science is nothing but the finding of analogy, identity, in the most remote parts.

- **Ralph Waldo Emerson (1803-1882)**

Science, Technology and Society

- [Project SkyMath: Making Mathematical Connections -- Using the Science and Language of Patterns to Explore the Weather](#) is a multidisciplinary curriculum for middle-school students uses real-time weather data as a basis for hands-on math activities.
 - <http://eo.ucar.edu/skymath/>
- [Circles of Light: The Mathematics of Rainbows](#) Examines a mathematical model of light passing through a drop of water.
 - <http://www.geom.uiuc.edu/education/calc-init/rainbow/>



Science, Technology and Society

- Americans seem to have love affairs with cars. We drive to school, to work, and on trips.
- Math can help us with our cars and in our driving in many different ways.
- For example, we can save money by using math in:
 - Choosing limited or unlimited mileage in car rentals
 - Determining the best routes for our trips
 - Analyzing cost trade off of driving various size cars
 - Calculating braking distances
 - Applying scale and ratio to read maps
 - Finding the gas mileage



Civic Ideals and Practices

- *Instruction should include experiences that provide for the study of the ideals, principles, and practices of citizenship in a democratic republic.*
- *Performance Expectation*
 - *Identify key ideals of the United States' democratic republican form of government.*



Civic Ideals and Practices



- <http://www.timeforkids.com/TFK/election04/>



- <http://exchange-connect.net/Teleprojects/project/?pid=5&cid=1>

A Case for Connections

“As students and teachers continue to “think connections,” the connectedness of the mathematics will grow and become dominate. When that occurs, all will wonder why anyone had ever thought of mathematics in any other way!”

-NCTM 1995 Yearbook-

Connecting Mathematics across the Curriculum page 12





A Case for Connections

“But there’s so much to learn,” he said... “Yes, that’s true” admitted Rhyme; “but it’s not just learning things that’s important. It’s learning what to do with what you learn and learning why you learn things at all that matters.”

“You may not see it now,” said the Princess of Pure reason ...but whatever we learn has a purpose and whatever we do affects everything and everyone else, if even in the tiniest way.”

—page 233
