C^3: Communication, Creativity, & Connections in the Middle School Math Class

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Overview

Teachers are used to hearing older students (and even adults) mutter, "I hate math." Children seem to love mathematics until some time during their middle school years. What happens between 5th and 9th grade that causes such a change in learner attitudes about mathematics?

Primary grade students are still learning to read, so their mathematical concepts are built through games and fun activities that are, for the most part, teacher led. They are not expected to interpret complex text in order to build on their growing knowledge. Once they reach middle school, however, they are expected to "read to learn", that is, they should be able to use their established reading skills to independently acquire new information in many different academic subjects. Unfortunately, many Pittsburgh Public School students have not developed the reading or communication skills necessary for successful acquisition of new knowledge.

This curriculum supplement will provide 6th through 8th grade students with opportunities to broaden their reading fluency and comprehension in the math classroom. It will also help teachers to establish real-world context and applications for the mathematical concepts as they are being taught. *C^3: Communication, Creativity, & Connections in the Middle School Math Class* is not intended to be a separate unit or alternative to the current curriculum being used by Pittsburgh Public Schools middle school math teachers. By design, it is simply a literacy and creativity component that aligns with each established PPS unit.

Rationale

In an ideal world, children would be able to glide easily from one academic discipline to the next. They would be confident in their approaches to education and would engage each other in meaningful, didactic conversations in all of their classes. Most curricula written in the current academic climate seem to assume that adolescents are adequately capable of reading and interpreting text. Unfortunately, many students in the Pittsburgh Public Schools (PPS) are not performing at proficient levels in language arts or mathematics and are, therefore, falling further and further behind their more fluent peers. Their inability to decipher the important information and expectations in written math situations leads to a breakdown in confidence, participation, and comprehension.

The Pittsburgh Public Schools (PPS) middle school mathematics curriculum is based, primarily, on the revised Connected Mathematics Project (CMP2). CMP2 is an NSF-funded, investigation based series that presents complex math concepts in real-world situations. An independent study at Claremont Graduate University reported that students using CMP2 showed significantly greater improvements in math communication, reasoning, and problem-solving strategies than students using other math programs (Eddy, 2008). CMP2 has been successfully implemented in Pittsburgh schools, but not all students are benefiting from the expected gains.

While many PPS schools have seen an increase in student achievement in both reading and mathematics, based on the Pennsylvania System of School Assessment (PSSA), approximately thirty percent of low-income and African-American 8th graders are still testing at basic or below-basic levels (A+ Schools, 2008). The reasons for this discrepancy are debatable, but one significant factor may be the lack of experiential opportunities these children are provided in their young lives.

It is not uncommon for low-income students to claim that they "hate reading" and state that there are no books in their homes. Reading is seen as something they are forced to do in school, but they cannot see any value in books outside of the classroom. What reluctant readers fail to realize is the fact that books, magazines, newspapers, and other literature offer opportunities to broaden their awareness of the huge world outside of their small neighborhoods.

Limited life experiences make it exceptionally difficult for children to find meaning and connections in their curriculum materials. One CMP2 unit (*Variables and Patterns*) centers around a Summer bike tour that several teenagers are planning. The tour starts in Atlantic City, New Jersey and culminates in Norfolk, Virginia. Many PPS 7^{th} graders have never been outside of their own city, let alone ridden a bicycle outside of their own neighborhoods. They find it very difficult to conceptualize what is entailed in a coastal bike tour.

In addition to lack of context, lower-achieving students also struggle with fluency and comprehension when reading instructional text. In math class, they are much more

comfortable when given an algorithm and numeric problems. These students struggle with word problems and situations in which they are expected to decipher, discuss, and display their approaches. More often than not, they will ignore the problem and wait until a teacher guides them, step-by-step, through the problem-solving process. Their participation in their own learning consists, primarily, of copying down whatever they see on the board.

Although a proficient reader may have little difficulty when interpreting mathematical text, lower-achieving students find it nearly impossible to navigate. Reading mathematical text requires a learner to do more than just decipher words. The student is expected to comprehend the global meaning of the mathematical ideas and connect those ideas to procedures and graphical representations (Freitag, 1997). In order to be truly successful in this endeavor, struggling students must be guided through the process. With the proper scaffolding and guidance, they should, eventually, become more confident in their approach to written math.

One of the most difficult aspects of reading mathematical text is the content-specific terminology. As mathematical concepts get more complex, students are constantly introduced to new vocabulary (*algorithm, quotient, parabola*, etc.) In addition, many common words have different meanings when used in math. For example, in everyday use, *regular* means the same thing as "normal", but in mathematics, *regular* refers to very specific properties of polygons. *Similar* may mean "alike" in most cases, but is used mathematically to describe two or more shapes with congruent corresponding angles and corresponding sides with equivalent ratios. Other words that have different meanings in math include *prime, median, mode, product, combine, dividend, height, difference,* and *operation* (Metsisto, 2005).

Another component of the CMP2 program is written mathematical reflection after each investigation. A series of questions are posed to students, then those students are directed to discuss their thoughts with a partner, their teacher, and the class before writing a summary response. The reflection questions are not particularly complex, but can be very daunting for learners with poor writing skills. These students will frequently write one- or two-sentence responses with very little substance, organization, or demonstration of comprehension. They fail to appreciate the unique opportunities to express their own thoughts and new ideas—perhaps because they are unable to concretely develop those concepts into structured written form.

When asked to write or speak about their mathematical thinking and solutions, low-achieving students are unable to adequately explain their processes; they lack the language skills necessary for reflection and discourse. According to the National Council of Teachers of Mathematics (NCTM) a student must be able to "communicate their mathematical thinking coherently and clearly to peers, teachers, and others." (2000, p. 402). Encouragement and support of reading, writing, discussion, and independent thinking in the math classroom helps student move beyond procedural, algorithmic knowledge to written communication of thoughts, explanations, and clarifications.

When frustrated learners ask for help, they are not always able to verbalize the nature of their confusion. They will simply say, "I don't get it" and expect their teacher to, essentially, solve their problem or do their work for them. These students seem to be conditioned to think that, by expressing bewilderment, they will be exempt from difficult work. Proper communication in the math classroom must include a protocol for finding clarification that never includes "giving up."

One of the most critical issues in mathematics education is the connection between mathematics and the rest of the world. Students think of mathematics as an isolated subject that is only about "finding the right answers", and not an integral part of their everyday lives. Children often fail to recognize the practical applications of numbers, patterns, geometry, measurement, data representation, and problem solving that humans constantly encounter. How many times have math teachers heard, "It's not like we're ever going to need this…"? In addition to situational word problems, students should be provided with practical opportunities to discover and employ mathematics in many different disciplines. Through their contextual explorations, they will develop a greater understanding of the world around (and beyond) them and deepen their concepts of mathematical applications.

Objectives

As a result of participation in an integrated communications component in their math curriculum, students will increase their oral reading fluencies and comprehension skills while strengthening their independent problem solving skills. Through various learning opportunities, they will develop situational context for mathematical concepts by broadening their scope of experience (real or virtual.) Students will also discover everyday applications of mathematics in unexpected places.

Middle school mathematics students will create original artwork and literature that illustrates complex mathematical concepts. In their math class, they will apply appropriate terminology and use detailed, verbose statements to communicate their thoughts and solutions/questions throughout lessons.

Any unit planned for use in the Pittsburgh Public Schools must correlate to Pennsylvania Academic Standards. *C3: Communication, Creativity, and Connections in the Middle School Math Class* is designed to touch every standard, at least in part. The ability to communicate mathematical thinking is primarily highlighted in Standard 2.5 (*Mathematical Problem Solving and Communication*) but is also covered in Standard 2.4 (*Mathematical Reasoning and Connections.)* Students are expected to use precise language to verify and interpret their results throughout mathematical investigations.

Strategies

Successful implementation of *C^3: Communication, Creativity, & Connections in the Middle School Math Class* requires planning and preparation, but will enhance the mathematics class in myriad ways. Some strategies, including journal writing and word walls, will be employed throughout the school year, while others may be introduced depending on the curriculum unit.

An introductory activity that will be useful at all grade levels is a "Math Autobiography." Each student will write a personal history of their experiences with mathematics. This will help the student begin to communicate their mathematical thinking and it will give the teacher some insight into each student's attitude toward math.

Year-Long Strategies

In order to create a literature-friendly climate in the classroom, a "Mathy Books" library will be established and available for students. Many language arts teachers provide a quiet reading area in their rooms, but few math classes have a comfortable space where students can read. The library should include picture books, novels, poetry, puzzle books, art & architecture catalogues, and any other literature that contains even the vaguest reference to, or application of mathematics. Students will be invited to make suggestions and contribute to the library. (See Student Reading List for suggestions.)

Because of the extensive vocabulary introduced in middle school mathematics, each grade level should participate in a "growing" word wall, or "word garden." As new terminology is introduced, students will post these words on the wall and illustrate the concepts with artistic and/or graphical representations. When a term has both "real-world" and "math-world" meanings, both definitions should be posted with illustrations.

Student journals are an essential component of the middle school math curriculum. They should be used daily for the recording of objectives and new vocabulary, notes during investigations, and reflections after lessons are completed. Students will also use their journals to draft specific writing assignments and for communication with the teacher. It is imperative that the teacher frequently check these journals and respond to any questions from students.

Unit-Specific Strategies

Each unit, at each grade level, will be accompanied by at least one published work of literature. These books and book excerpts will be used to introduce the math concepts in the unit. Picture books will be read aloud to students and discussed using strategies similar to those used during "Text Talk" in the primary grades. The teacher will pause periodically and ask students to make predictions, use context clues for new terminology, and find connections.

Excerpts from longer books will be distributed to each student and read "popcorn" style by the class. Each student will read out loud, but may call on another student to read after they have completed at least one paragraph or passage. Another reading strategy that may be useful is literature circles. Students will be divided into small groups and each group will read a portion of the text. The class will reconvene, then each group will present the mathematical concepts in their particular section.

In addition to daily journal writing, each unit will also require at least one well-developed essay or other written work. Students will utilize organizational methods such as *Write Tools*, the PPS-supported writing process, to plan and construct various portfolio pieces including compare/contrast essays, "how-to" guides, friendly and formal letters, research reports, and figurative poetry.

Opportunities for creative expression will also be provided in each unit. Students will produce original works of art as they explore various mathematical concepts. Area and perimeter will be represented with glass mosaics. Exponential growth patterns can be illustrated with string art. Students will also examine fractions as they are found in musical notation and paper-folding (origami.)

Curriculum-Specific Strategies

The Pittsburgh Public Schools currently use two different products in their middle school math curriculum. CMP2, as previously stated, is an investigation-based approach to mathematics in context. Prentice Hall Middle School Mathematics, Levels I-III, is a traditional, procedural program that focuses more on skill development than exploration of concepts.

Each CMP2 investigation is followed by a "Mathematical Reflection" assignment. These reflections are written in to the PPS curriculum and should be used, with scaffolded guidance, to develop communication skills and to informally assess student comprehension. Several CMP2 units also provide frameworks for unit projects. These long-term assignments are in-depth explorations and reports with multiple components.

The Prentice Hall basal program, at each level, provides numerous resources for development of reading comprehension and communication skills. These resources are not currently prescribed by the PPS curriculum, but may be utilized for support and extension. Each unit has supplemental note-taking guides, graphic organizers, reading comprehension practice, and guided problem solving practice. The latter is particularly useful for scaffolded instruction of approaches to written mathematics. All of these materials are available on CD-ROM (Every PPS middle school math teacher should have a set.) and at pearsonsuccessnet.com, the online-support subscription purchased by PPS in 2008.

Technology

Technological resources will be available throughout the school year, including streaming videos from Discovery Learning and BrainPop, virtual fieldtrips, Java applets, geometric sketchpad software, multi-media presentation applications, and various websites. Both Discovery Learning and BrainPop require subscriptions for full access, but it is possible to register, at no cost, for a free trial of both programs. The software required for some activities, such as HyperStudio and Geometer's Sketchpad, are available at many schools, but free trials are also available online.

Classroom Activities

The following are descriptions of intended supplemental activities, broken down by grade level and aligned to PPS 2008-2009 middle school math curriculum units.

6th grade

Unit 1: Factors and Multiples

The unit will be introduced by reading both One Hundred Angry Ants and A Remainder of One by Elinor J. Pinczes. These picture books introduce the concepts of factors and multiples, arrays, prime and composite numbers, and perfect squares. As an extension, students may write and illustrate their own story about any or all of the topics.

The CMP2 Unit Project for this book (*Prime Time*) is titled "My Special Number." At the beginning of the unit, students will choose a number that has some special significance for them. As they work through the unit, they will add details about their number, then develop a comprehensive report and presentation.

To illustrate their growing comprehension of factors and multiples, 6th graders will write a friendly letter to a younger child, explaining the process of determining factors and multiple of numbers.

As an art extension, students will create glass mosaic arrays. Each student will be given a specific number of colored glass tiles, then decide how to arrange them. Their "Artist's Statement" should include their decision making and fabrication process.

Unit 2: Understanding Fractions, Decimals, & Percents

The unit will be introduced by reading Murderous Maths: The Mean and Vulgar Bits: Fractions and Averages by Kjartan Postkitt. This is a silly, yet concept-rich comic book from the *Murderous Maths* series. If possible, a class set of the entire series will be provided and students will read and discuss in small groups.

As they learn about fractions, decimals, and percents, 6th graders will record their observations and ideas in their daily journal writing. The final project will be a 5 paragraph informative essay, using the *Write Tools* program, that compares fractions, decimals & percents. Students should be able to discuss how these three representations are similar and give examples of situations where they would be most likely to use each form

Unit 3: Two Dimensional Geometry

Instead of an introductory picture book, the reading component for this unit will be Flatland: A Romance of Many Dimensions, by Edwin A. Abbot. This book may be difficult for 6th grade students to read, but contains many intriguing ideas about dimensions, polygons, and social issues. It will be read and discussed throughout the entire 4-5 week unit. As a writing extension, students may construct a "character map" detailing the personality and physical traits of one character.

Euclidian constructions (with compass & straightedge) will be introduced and students will design mandalas representing either themselves or their chosen characters from Flatland . They will also use pattern blocks to explore tessellations and create multiple-polygon mosaics.

Unit 4: Using Fraction Operations

The introductory story for this unit is The Wishing Club: A Story About Fractions by Donna Jo Napoli. Addition of fractions is introduced in an accessible story about siblings and wishes.

As students develop algorithms for fraction operations, they will record their ideas in their journals. They will demonstrate their comprehension by constructing visual representations and story problems for each operation (addition, subtraction, multiplication, and division.)

One possible extension activity may be having students write or transcribe recipes using alternate combinations of measuring cups. Instead of listing "1 ½ c. of sugar", they might change it to "2/4c. + 1/2c. + 4/8 c. of sugar." They may also illustrate combinations of fractions that equal one whole by composing short musical pieces in various time signatures

Unit 5: Statistics

6th graders will find real-world applications of data and statistics by reading newspapers, *Time for Kids*, Guinness Book of World Records, and other fact-filled materials.

Students will demonstrate their new ideas and knowledge by developing a comprehensive plan for data investigation in which they formulate and pose questions, then collect, represent, and analyze, and report on data.

Unit 6: Computing with Decimals & Percents

Students will revisit The Wishing Club: A Story About Fractions by Donna Jo Napoli, then re-tell the story using decimal and/or percentage representations.

As an extension activity, they will design a comic book that illustrates different situations involving operations with decimals & percents (shopping, traveling, sharing, etc.)

Unit 7: Two-dimensional Measurement

This unit will be introduced through Marilyn Burns' book, Spaghetti & Meatballs for All! The students should share and defend their ideas about possible seating arrangements.

The writing piece will be a short story, with illustrations, about a situation in which measuring perimeter and area helped answer practical questions or settle a dispute.

Unit 8: Understanding Probability

This unit will be introduced by reading the book, No Fair!, by Donna Jo Napoli. Students will discuss, in small groups, what it means for a situation to be "fair:. Throughout the unit, they may also read selections from Murderous Maths - Do You Feel Lucky?

Students will demonstrate their comprehension of "fairness" by working with a partner to creating an original game that would be fair to all players. They will also need to design an instructional pamphlet that any new player could use, without help.

7th Grade

Unit 1: Introducing Algebra

The overarching question of this unit is, "How can we use mathematics to describe change?"

The curriculum-based reading comprehension tools for Unit 1 include the Prentice Hall (PH) Unit 4 Graphic Organizer & Reading Comprehension lessons. Murderous Maths - The Phantom X, by Kjartan Postkitt may be a helpful tool in introducing the idea of an "unknown" variable.

After students begin to understand the connections between written reports, tables, and graphs, they will write a first-person narrative of their daily ride, based on the graph of the bike tour's progress in Investigation 1.4

As a creativity extension have students work in pairs to match graphic representations to situations. One student draws a graph, then the other student creates a situation that could be represented.

Unit 2: Similarity Transformations

When shapes shrink or grow, what changes and what stays the same?

Introductory reading should include excerpts from Alice's Adventures in Wonderland, by Lewis Carroll— particularly the situation in which Alice shrinks and grows. Students may benefit from having an opportunity to draw and share their mental image of what Alice looked like before and after the transformations.

Students will work with a partner to make a "How-To": manual with illustrations, explaining the process for determining whether two objects are similar and/ or how to find missing side lengths in similar figures

The ongoing CMP2 unit project should be implemented as a final assessment. 7th graders will shrink or enlarge 2-D images and use appropriate terminology to write a reflective report on the process.

Unit 3: Ratios, Proportions, & Percents

As a brief introductory reading piece, the teacher may read aloud an excerpt from the novel I am a Taxi by Deborah Ellis. This will give the students an opportunity to experience ratios in a dramatic, real-world situation. Students should then discuss and reflect on the reading. Appropriate writing prompts might include: *What mathematics did you find in these 4 pages*? *What were some of the issues that made it more difficult for the characters to solve the math problems*?

The CMP2 Text for this unit, *Comparing and Scaling*, (along with many other program materials) uses very complex vocabulary in the investigations. For full student comprehension, the teacher should guide them through Investigation 1 and define terms including "proposed statements" and "most effective." The teacher should also help the students break down individual questions and model appropriate communication of student thinking.

Unit 4: Reasoning with Uncertainty

Murderous Maths - Do You Feel Lucky? by Kjartan Postkitt, may also be used in the 7th grade to reintroduce probability. If class sets are available, students should read in small groups and discuss ideas before sharing with the class.

This unit provides appropriate material to reinforce writing methods from the language arts curriculum. Students will write a compare/contrast essay (using *Write Tools*) regarding theoretical vs. experimental probability

Unit 5: Extending the Number Line to the Left

Students have a hard time imaging the real life application of negative integers, but always seem to understand any concept regarding money. They should be given daily opportunities to find examples of real-world applications of negative numbers, including newspapers (stock reports, sports pages, weather.)

As a creative writing piece, they will write a poem in response to the question, 'What lies on the other side?"

They would also benefit from interpreting a bank account ledger. They could write a narrative describing each transaction.

Unit 6: Linear Functions

This may be a fun time to introduce The Dot and the Line: A Romance in Lower Mathematics by Norton Juster. Students understand that "linear" means "in a line", but they often miss some of the critical properties of lines (never bending and never ending in either direction.)

A creative writing project might include "The Never Bending Story", in which students use concepts such as slope and y-intercept to describe constant- rate situations.

Unit 7: The Third Dimension, Measurement and Geometry

This is the last unit in the PPS 7th grade curriculum and rarely gets completed by most classes. The concepts of surface area and volume are listed as eligible content for the 8th grade PSSA, but very few students are proficient in measurement of three-dimensional objects.

Students who struggle with measurement will benefit from reading and discussing Murderous Maths: Desperate Measures.

As a writing exercise, students will create a poster illustrating the reason that x^2 is referred to as "x squared" and x^3 is referred to as "x cubed" They will include written examples of objects measured in square inches, square feet, cubic centimeters, cubic feet, etc.

8th grade

Unit 1: The Pythagorean Theorem and Irrational Numbers

Appropriate introductory reading material includes Murderous Maths Guaranteed to Mash Your Mind and What's your Angle, Pythagoras? by Julie Ellis.

One writing exercise will be an expository essay, using *Write Tools* methods, that describes the meaning behind the formula $a^2 + b^2 = c^2$. Students may also write poems using syllable counts in Pythagorean triples (3,4,5; 5,12,13; 8,15,17, etc.) to share their new ideas, including the meaning of "irrational numbers."

Unit 2: Exponential Functions

Appropriate introductory reading material includes Murderous Maths: Guaranteed to Bend Your Brain, in which bacteria particles double every ten minutes, and The Token Gift, by Hugh William McKibbon, in which a young boy tricks a king by using a chessboard and asking for doubled amounts of rice grains on each square. The latter story, in particular, is excellent for establishing context related to the CMP2 unit book, *Growing, Growing, Growing.*

A creative writing piece might be a response to the question, "If you walk half the distance to a door, then half of that distance, then half of *that* distance, when will you actually walk through the door?

Unit 3: Probability and Statistics

Students will read newspapers and other periodicals (particularly magazines such as *Newsweek* and *Time*) to find examples of real-world uses of measures of central tendency.

In order to concretely illustrate the influence of sample size, students will study preselected data from the 2000 US Census, then conduct a survey with the same information among a small group of their peers. They will write a letter to the Census Bureau sharing their own findings and explaining any discrepancies they found when comparing the two data sets.

Unit 4: Quadratic Functions

Picture books, although intended for younger audiences, will be very helpful when introducing complex math concepts such as quadratic functions. Three books that may help establish context are Bats on Parade by Kathi Appelt, The 12 Circus Rings by Seymour Chwast and One Watermelon Seed by Celia Barker Lottridge.

After reading Bats on Parade, the teacher should model the process of symbolic mathematical representation based on the situations in the book. The equation $y = x^2$ can be used to find the number of bats in section x of the marching band. Students will then use a situation from one of the other two books, write a quadratic equation, explain each variable in the equation, and create a graph of the relationship.

Unit 5: Equivalent Expressions

This unit is scheduled to be taught at the end of February, which is also Black History Month. Students will read about the civil rights movement and the struggle for equality, then write an "I Have a Dream" speech expressing their own hopes and perceptions of equality. Within their speech, they should use at least 2 examples of mathematical equality as either figurative or literal elements.

Unit 6: Linear Systems and Inequalities & Unit 7: Symmetry and Transformations

Many 8^{th} grade classes never finish these last two units. In lieu of content-specific activities for the end of the school year, a culminating project has been designed.

Students will read Shelley Pearsall's novel, None of the Above. This is the story of an unlikely group of inner city teens who decide, for different reasons, to build the world's largest tetrahedron. They struggle with many personal issues that sometimes keep them from their goal, but end up pulling it off.

The ultimate goal of this end-of-the –year project is a dramatic production of Ms. Pearsall's story. Students will turn the dialogue into a script, build basic sets from descriptions in the text, and present the mathematic concepts through an entertaining medium. They may also prepare refreshments from recipes that are found throughout the book. All students will be involved in some manner; Participation is not optional, but students may work where they are most comfortable. Each student, however, must submit a proposal detailing their desired job and listing at least three ways they will use mathematics in that position.

Annotated Bibliography

Works Cited/Teacher Reading List

Haven, K.F.. *Marvels of Math: Fascinating Reads and Awesome Activities*. Engelwood: Teacher Idea Press, 1998.
This is a collection of fun stories and classroom activities for added support.

Lappan, G., Fey, J.T., Fitzgerald, W.M., Friel, Susan N., Phillips, E.D., *Connected Mathematics 2*. Michigan: Michigan State University. Pearson Publishing, 2009
This is the PPS middle school mathematics curriculum program.

Martinie, Sherrie. "Monkey Paws, English Pounds, and Leagues: Using Literature in the Middle School". *Mathematics Teaching in the Middle School* October 2005: 125-131.

The National Council of Teachers of Mathematics. *Principles and Standards for School Mathematics*. Reston, VA: NCTM, 2000
This is the NCTM published guide to their Principles and Standards, with classroom examples.

Reys, Robert E., Mary M. Lindquist, Diana V. Lambdin, Nancy L. Smith, and Marilyn N. Suydam. *Helping Children Learn Mathematics*. Sixth ed. New York, NY: John Wiley & Sons, Inc., 2001

Schiro, Michael Stephen, *Oral Storytelling and Teaching Mathematics: Pedagogical and Multicultural Perspectives*. CA: Sage Publications, 2004.

Tucker, Maggie. "Teaching to the Type". *SchoolArts: The Art Education Magazine for Teachers* October 2008: 42-43.
This article explains the use of art in mathematics, and vice-versa.

Wallace, Faith. "How Come? What If? So What? Reading in the Mathematics Classroom". *Mathematics Teaching in the Middle School* September 2006: 108-115.
This is a helpful explanation of the necessity for connections in middle school mathematics.

Worsley, Dale. "Teaching for Depth: Where Math Meets the Humanities". Portsmouth: Heinemann. 2002.

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Student Reading List

Abbot, E. A., *Flatland, A Romance in Many Dimensions*
This classic book uses properties of polygons and dimensions to make social commentary.

Anno, M.. *Socrates and the Three Little Pigs*. New York: Philomel Books, 1986.
Permutations and combinations

Appelt, K., *Bats on Parade.* Harper Collins, 1999.
Quadratic functions

Burns, M.. *Spaghetti and Meatballs for All!*. New York: Scholastic Press, 1997.
Perimeter, area, factor and multiples.

Carroll, L., *Alice's Adventures in Wonderland.* Various publishers, originally printed 1946.
Portions may be used for discussion of stretching and shrinking

Chwast , S., *The 12 Circus Rings* . Houghton Mifflin Harcourt, 1993.
Quadratic functions

Ellis, D., *I am a Taxi*. Groundwood Books, 2008

Ellis, J., *What's Your Angle, Pythagoras?* Charlesbridge Publishing, 2004

Enzensberger, H.M.. *The Number Devil*. New York: Henry Holt & Company, 1997.

Glass, J. & Walz, R., *The Fly on the Ceiling: A Math Myth*. Toronto: Random House of Canada, 1998.
This will be an excellent book to use with *Moving Straight Along.*

Juster, N., *The Dot and the Line: A Romance in Lower Mathematics.* Chronicle Books, 2000.

Lottridge, C. B., *One Watermelon Seed.* Oxford University Press, USA, 1990
Quadratic and linear functions

McKibbon, W. & Cameron, S., *The Token Gift*. Toronto: Annick Press, 1998.
As stated in the classroom activites, this story is a great introduction to exponential growth.

Napoli, D. J., *The Wishing Club; A Story about Fractions.* Henry Holt and Co., 2007
Combination of fractions to make a whole

Pearsall, S., *All of the Above.* New York: Little, Brown, and Company, 2006.
This is an excellent young adult novel about inner city teens and their problems, with tons of math thrown in.

Pinczes, E. J., *One Hundred Angry Ants.* Sandpiper, 1999.
Factors, multiples, arrays, perfect squares

Pinczes, E.J., *A Remainder of One.* Sandpiper, 2002.
Factors, multiples, arrays, and remainders

Postkitt, K. *Murderous Maths.* Scholastic Hippo Publishers, 1999-2009.
This is a fantastic series of "comic books" that present various complec math concepts in silly, accessible stories and jokes.

Westerfeld, S. *Midnighters: The Secret Hour.* New York: Eos-HarperCollins Publishers, 2004
This is the first book in a fantastic series about a group of teenagers who gain special powers and an extra hour at midnight.

Technology Resources

Brain Pop. http://www.brainpop.com
- *Fibonacci Sequence*
- *Kinetic Energy*
- *Metric vs. Imperial (measurement)*
- *Potential Energy*
- *Standard & Scientific Notation*

Brain Pop is a subscription-based education website. They have brief cartoons and quizzes on many topcs.

United Streaming. Discovery Education. http://www.unitedstreaming.com.
- "Discovering Math: The Nature and Use of Mathematics." (32:50) 2006
- "Discovering Math: Rational Number Concepts." (56:00) 2005
- "Exploring Gravity." (16:20) 1993
- "How Scientists Work: What is Pattern Discovery?" (22:00) 2003
- "Mathematical Eye: Number Patterns: Fibinacci and Others" (20:53) 1994
- "Project Mathematics: Early History of Mathematics." (29:00) 1996
- "Project Mathematics: The Story of Pi." (24:00) 1996
- "Videomath: Circles." (15:59) 1990

Discovery Education videos are useful for establishing real-world context.

The National Library of Virtual Manipulatives: www.matti.usu.edu
This website provides Java applets for use as mathematics manipulatives.

Pearson Successnet: www.pearsonsuccessnet.com
This is the user-interface for access to all CMP2 and Prentice Hall printables.

CyberChase website: www.pbskids.org
Students may watch cartoons that focus on mathematical problem solving and play games.

Appendix: Pennsylvania State Academic Standards

PA State Academic Standard 2.1.8

Numbers, Number Systems and Number Relationships

A. Represent and use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, exponents, scientific notation, square roots).

B. Simplify numerical expressions involving exponents, scientific notation and using order of operations.

C. Distinguish between and order rational and irrational numbers.

D. Apply ratio and proportion to mathematical problem situations involving distance, rate, time and similar triangles.

E. Simplify and expand algebraic expressions using exponential forms.

PA State Academic Standard 2.2.8

Computation and Estimation

A. Complete calculations by applying the order of operations.

B. Add, subtract, multiply and divide different kinds and forms of rational numbers including integers, decimal fractions, percents and proper and improper fractions.

C. Estimate the value of irrational numbers.

D. Estimate amount of tips and discounts using ratios, proportions and percents.

E. Determine the appropriateness of overestimating or underestimating in computation.

F. Identify the difference between exact value and approximation and determine which is appropriate for a given situation.

PA State Academic Standard 2.3.8

Measurement and Estimation

A. Develop formulas and procedures for determining measurements (e.g., area, volume, distance).

B. Solve rate problems (e.g., rate × time = distance, principal × interest rate = interest).

C. Measure angles in degrees and determine relations of angles.

D. Estimate, use and describe measures of distance, rate, perimeter, area, volume, weight, mass and angles.

E. Describe how a change in linear dimension of an object affects its perimeter, area and volume.

F. Use scale measurements to interpret maps or drawings.

G. Create and use scale models.

PA State Academic Standard 2.5.8

Mathematical Problem Solving and Communication

A. Invent, select, use and justify the appropriate methods, materials and strategies to solve problems.

B. Verify and interpret results using precise mathematical language, notation and representations, including numerical tables and equations, simple algebraic equations and formulas, charts, graphs and diagrams.

C. Justify strategies and defend approaches used and conclusions reached.

D. Determine pertinent information in problem situations and whether any further information is needed for solution.

PA State Academic Standard 2.6.8

Statistics and Data Analysis

A. Compare and contrast different plots of data using values of mean, median, mode, quartiles and range.

B. Explain effects of sampling procedures and missing or incorrect information on reliability.

C. Fit a line to the scatter plot of two quantities and describe any correlation of the variables.

D. Design and carry out a random sampling procedure.

E. Analyze and display data in stem-and-leaf and box-and-whisker plots.

F. Use scientific and graphing calculators and computer spreadsheets to organize and analyze data.

G. Determine the validity of the sampling method described in studies published in local or national newspapers.

PA State Academic Standard 2.7.8

Probability and Predictions

A. Determine the number of combinations and permutations for an event.

B. Present the results of an experiment using visual representations (e.g., tables, charts, graphs).

C. Analyze predictions (e.g., election polls).

D. Compare and contrast results from observations and mathematical models.

E. Make valid inferences, predictions and arguments based on probability

PA State Academic Standard 2.8.8

Algebra and Functions

A. Apply simple algebraic patterns to basic number theory and to spatial relations

B. Discover, describe and generalize patterns, including linear, exponential and simple quadratic relationships.

C. Create and interpret expressions, equations or inequalities that model problem situations.

D. Use concrete objects to model algebraic concepts.

E. Select and use a strategy to solve an equation or inequality, explain the solution and check the solution for accuracy.

F. Solve and graph equations and inequalities using scientific and graphing calculators

and computer spreadsheets.

G. Represent relationships with tables or graphs in the coordinate plane and verbal or symbolic rules.

H. Graph a linear function from a rule or table.

I. Generate a table or graph from a function and use graphing calculators and computer spreadsheets to graph and analyze functions.

J. Show that an equality relationship between two quantities remains the same as long as the same change is made to both quantities; explain how a change in one quantity determines another quantity in a functional relationship.

PA State Academic Standard 2.9.8

Geometry

A. Construct figures incorporating perpendicular and parallel lines, the perpendicular bisector of a line segment and an angle bisector using computer software.

B. Draw, label, measure and list the properties of complementary, supplementary and vertical angles.

C. Classify familiar polygons as regular or irregular up to a decagon.

D. Identify, name, draw and list all properties of squares, cubes, pyramids, parallelograms, quadrilaterals, trapezoids, polygons, rectangles, rhombi, circles, spheres, triangles, prisms and cylinders.

E. Construct parallel lines, draw a transversal and measure and compare angles formed (e.g., alternate interior and exterior angles).

F. Distinguish between similar and congruent polygons.

G. Use simple geometric figures (e.g., triangles, squares) to create, through rotation, transformational figures in three dimensions.

H. Generate transformations using computer software.

I. Analyze geometric patterns (e.g., tessellations, sequences of shapes) and develop descriptions of the patterns.

J. Analyze objects to determine whether they illustrate tessellations, symmetry, congruence, similarity and scale.

PA State Academic Standard 2.10.8

Trigonometry

A. Compute measures of sides and angles using proportions, the Pythagorean Theorem and right triangle relationships.

B. Solve problems requiring indirect measurement for lengths of sides of triangles.

PA State Academic Standard 2.10.8

Calculus

A. Analyze graphs of related quantities for minimum and maximum values and justify the findings.

B. Describe the concept of unit rate, ratio and slope in the context of rate of change.

C. Continue a pattern of numbers or objects that could be extended infinitely.