Recommendations from the High School Mathematics Instruction Meeting
September 8, 2006

Recommendations:

1. A required Senior Mathematics Class focusing on the NMHSCE and on Problem Solving
    - Implication: The students would have 4 years of mathematics required
    - Implication: The students would have 19 required credits and 9 electives. These electives could almost be completed by enrolling in multiple courses in Band, orchestra, Football, Basketball, etc.
2. Juniors should take the Compass test as part of the course
3. At the end of the course, seniors should take the NMSU Mathematics Placement exam.
    - Implication: Students would have a better chance of passing the test if it is administered as soon after the course as possible.
4. All high school mathematics teachers should take the mathematics portion of the compass test too.
5. A teacher collaboration schedule and process will be designed so that teachers Grades 6-12 can meet and share ideas, procedures, and as well as assist the high school teachers with implementation of the new concepts.
6. The Grades 9-12 mathematics adoption will be one of the following:
    - IMP (Interactive Mathematics Program), the continuation of the K-8 sequence of the NSF-CMP published by Key Curriculum Press or, (It integrates traditional material with additional topics recommended by the NCTM Standards, such as statistics, probability, curve fitting, and matrix algebra. IMP units are generally structured around a complex central problem. Although each unit has a specific mathematical focus, other topics are brought in as needed to solve the central problem, rather than narrowly restricting the mathematical content. Ideas that are developed in one unit are usually revisited and deepened in one or more units.) For more information go to http://www.mathimp.org/general_info/intro.html
    - Math Connections, published by It's about time, a NSF sponsored curriculum. (It is organized in traditional sequence, yet integrates statistics concepts aligned to New Mexico Standards and provides for problem solving, reasoning, and communicating mathematical ideas as a basis for instruction.) For more information go to http://www.its-about-time.com/htmls/mc/mcall.html
7. The implementation of the new math courses and content will begin during the 2007-2008 school year. These courses will complete the K-8 sequence of the NSF-CMP curriculum.
8. During the summer of 2007, all high school mathematics teachers will begin their professional development to establish a base for problem solving instruction 9-12. The problem solving instruction will begin to re-establish a balance between the tools of mathematics, i.e. arithmetic and the problem solving nature of mathematics. This balance will further the ability of students to apply their mathematics knowledge on the New Mexico tests.

Math Connections

Traditional Sequence

The *Connections* series, published by It's About Time, is a National Science Foundation sponsored curriculum resource. It is organized in traditional sequence, yet integrates statistics concepts aligned to New Mexico Standards and provides opportunities for problem solving, reasoning, and communicating mathematical ideas as a basis for instruction.

- Math Connections is a blended curriculum that addresses algebra, geometry and data analysis at every level which matches the high school standards and benchmarks.
- Promotes the process standards of problem solving, reasoning and proof, communication, representation and connections.
- Year 1 is equivalent to Algebra 1, Year 2 is equivalent to Geometry, and Year 3 is equivalent to Algebra 2.
- Data analysis is present throughout the curriculum.
- The curriculum is modular and each unit has a real life connection.
- For more information go to: http://www.its-about-time.com/htmls/mc/mcall.html

---

Evidence of Success

Preliminary studies of student performance and participation show that the Math Connections curriculum improves students' learning of mathematics...

- On standardized tests, Math Connections student perform as well as, and often better than, their peers studying a traditional high school mathematics textbook.
- Math Connections students attain important mathematical concepts including: slope, intuitive introduction to calculus, systems of linear equations, functions, and data analysis
- For an extensive review of Math Connections go to: www.ithaca.edu/compass/project/htm

---

Program Overview

Algebra I

MATH *Connections* 1a

begins and ends with data analysis. It starts with hands-on data gathering, presentation, and analysis, then poses questions about correlating two sets of data. This establishes the goal of the term -– that students be able to use the linear regression capabilities of a graphing calculator to do defensible forecasting in real-world settings. They reach this goal by mastering the algebra of first-degree equations and the coordinate geometry of straight lines, gaining familiarity with graphing calculators along the way.

MATH *Connections* 1b

generalizes and expands ideas begun in Book 1a. It begins with techniques for solving linear equations in two unknowns and interpreting such solutions in real-world contexts. Functional relationships in everyday life are identified, generalized, brought into mathematical focus, and linked with the algebra and coordinate geometry already developed. These ideas are then linked to an examination of the fundamental counting principles of discrete mathematics and to the basic ideas of probability.

Interactive Mathematics Program (IMP)

Integrated Sequence (Years 1-4)

The IMP curriculum resource, published by Key Curriculum Press, integrates traditional material with additional topics recommended by the NCTM Standards, such as statistics, probability, curve fitting, and matrix algebra. IMP units are generally structured around a complex central problem. Although each unit has a specific mathematical focus, other topics are brought in as needed to solve the central problem, rather than narrowly restricting the mathematical content. Ideas that are developed in one unit are usually revisited and deepened in one or more later units. For more information , visit the IMP website: http://www.mathimp.org/general_info/intro.html

- The IMP curriculum resources are fully aligned with New Mexico Mathematics Standards and Benchmarks and provide a rich and rigorous program for students.
- The IMP curriculum is an NSF funded curriculum that employs the process standards of problem solving, reasoning and proof, communication, representation and connections.
- IMP Year 1 and Year 2 are equivalent to Algebra I and Geometry. Students must complete both courses in order to complete the Algebra I and Geometry curriculum.
- The IMP Year three course corresponds to Algebra II.

Evidence of Success

Several long-term studies of student performance and participation show that the IMP curriculum improves students' learning and increases the study of advanced mathematics…

- On standardized tests, IMP student consistently perform as well as, and often better than, their peers enrolled in traditional high school mathematics course sequence.
- On tests focusing on quantitative reasoning, general problem solving, and statistics, IMP students significantly outperform their peers in traditional programs.
- For the complete study, refer to the following website: http://www.mathimp.org/downloads/IMPWhitePaper.pdf

---

Textbook Sequence Overview

Year 1

The first-year curriculum contains an introduction to problem-solving strategies, the use of variables, and the meaning and use of functions and graphs, as well as concepts from statistics, geometry, and trigonometry. These mathematics ideas are set in varied contexts, such as the settlement of the American West, games of chance, Edgar Allan Poe's *The Pit and the Pendulum*, and measurement of shadows.

Year 2

Students work with powerful mathematical ideas, including the chi-square statistic, the Pythagorean theorem, and linear programming, and learn a variety of approaches to solving equations. Problem contexts include statistical comparison of populations, the geometry of the honeycomb, and maximization of profits from a cookie store.

IMP Content for Year 1

From Algebra

- Using **variables and algebraic expressions** to represent concrete situations, generalize results, and describe functions
- Using different **representations of functions**—symbolic, graphical, situational, and numerical—and understanding the connections between these representations
- Understanding and using **function notation**
- Understanding, modeling, and computing with **signed numbers**
- Solving equations using **trial and error**
- Interpreting **graphs** and using graphs to represent situations
- Relating graphs to their equations, with emphasis on **linear relationships**
- Solving pairs of **linear equations** by graphing
- **Fitting equations to data**, both with and without graphing calculators

From Geometry

- Understanding the meaning of **angles** and their measurement
- Developing **relationships among angles of polygons**, including angle-sum formulas
- Defining and developing criteria for establishing **similarity and congruence**
- Using properties of **similar polygons** to solve real-world problems

From Trigonometry

- Using **similarity** to define right-triangle trigonometric functions
- Applying **right-triangle trigonometry** to real-world problems

From Probability and Statistics

- Developing basic methods for calculating **probabilities**
- Constructing **area models and tree diagrams**
- Distinguishing between **theoretical and experimental probabilities**
- Planning and carrying out **simulations**
- Collecting and **analyzing data**
- Constructing **frequency bar graphs**
- Understanding, calculating, and interpreting **expected value**
- Applying the concept of expected value to **real-world situations**
- Learning about **normal distributions** and their properties
- Calculating **mean and standard deviation**
- Using **normal distribution, mean, and standard deviation**

From Logic

- Making and testing **conjectures**
- Formulating **counterexamples**
- Constructing sound **logical arguments**
- Understanding the idea of **proof**
- **Writing proofs**
- Developing and describing **algorithms and strategies**

IMP Content for Year 3

From Algebra

- Solving quadratic equations by **factoring**
- Studying the number of **roots of a quadratic equation** and relating this number to the graph of the associated quadratic function
- Using the method of **completing the square** to analyze the graphs of quadratic equations and to solve quadratic equations
- Working with **exponential and logarithmic functions**
- Describing their **graphs**
- Understanding the relationship between **logarithms and exponents**
- Finding that the **derivative of an exponential function** is proportional to the value of the function
- Developing general **laws of exponents**
- Understanding the meaning and significance of *e*
- Approximating data by an **exponential function**
- Developing and using the **elimination method for solving systems of linear equations** in up to four variables
- Extending the concepts of dependent, inconsistent, and independent **systems of linear equations** to more than two variables
- Working with **matrices**
- Developing the operations of **matrix addition and multiplication** in the context of applied problems
- Understanding the use of matrices in representing **systems of linear equations**
- Developing the concepts of **identity element and inverse in the context of matrices**
- Understanding the use of matrices and **matrix inverses** to solve systems of linear equations
- Relating the existence of matrix inverses to the **uniqueness of the solution** of corresponding systems of linear equations
- Using calculators to **multiply and invert matrices** and to solve systems of linear equations
- Extending concepts of **linear programming** to problems with several variables

From Analytic and Coordinate Geometry

- Defining **slope** and understanding its relationship to rate of change and to equations for straight lines
- Developing **equations for straight lines** from two points and from point-slope information
- Developing and applying various **formulas from coordinate geometry**, including:
  - **Distance** formula
  - **Midpoint** formula
  - Equation of a **circle** with arbitrary center and radius
- Finding the **distance** from a point to a line
- Developing and working with **equations of planes** in three-dimensional coordinate geometry

From Precalculus

- Understanding and using **inverse functions**
- Understanding the meaning of the **derivative of a function** at a point and its relationship to instantaneous rate of change
- Approximating the **value of a derivative** at a given point

IMP Content for Year 4

From Algebra

- Proving and using the **quadratic formula**
- Expressing the **physical laws of falling bodies** in terms of quadratic functions

From Analytic and Coordinate Geometry

- Defining **polar coordinates**
- Studying **graphs of polar equations**
- Expressing **geometric transformations**—translations, rotations, and reflections—in analytic terms
- Using **matrices** to represent geometric transformations
- Developing an **analytic expression** for projection onto a plane from a point perspective
- Representing a line in 3-dimensional space **algebraically**

From Precalculus

- Studying and using **families of functions** from several perspectives:
  - Through their **algebraic representations**
  - In relationship to their **graphs**
  - As **tables** of values
  - In terms of **real-world situations** that they describe
- Studying the effect of **changing parameters** on functions in a given family
- Working with **asymptotes of rational functions**
- Working with **the algebra of functions**, including composition and inverse functions
- Defining the **least-squares approximation** and using a calculator's regression facility to do curve-fitting

From Trigonometry

- Extending the right-triangle trigonometric functions to **circular functions**
- Using trigonometric functions to work with **polar coordinates**
- **Defining radian measure**
- Graphing the **sine and cosine functions** and variations of these functions
- Working with **inverse trigonometric functions**
- Developing and using various **trigonometric formulas**, including:
  - The **Pythagorean** identity
  - Formulas for the **sine and cosine** of a sum of angles
  - The **law of sines and the law of cosines**

From Probability and Statistics

- Using the **binomial distribution** to model a polling situation
- Distinguishing between **sampling** with replacement and sampling without replacement
- Understanding the **central limit theorem** as a statement about approximating a binomial distribution by a normal distribution
- Using **area estimates** to understand and use a normal distribution table
- Extending the concepts of mean and standard deviation from sets of data to **probability distributions**
- Developing formulas for **mean and standard deviation** for binomial sampling situations
- Using the normal approximation for **binomial sampling** to assess the significance of poll results
- Working with the concepts of **confidence interval, confidence level, and margin of error**
- Understanding the **relationship** between poll size and margin of error

From Programming

- **Using loops**
- **Writing and interpreting programs**
- **Using a graphing calculator** to create programs involving animation