Bethlehem Area School District

High School

Pre Calculus Curriculum

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Julie Victory, Supervisor of Mathematics
Name of Course: Honors Pre Calculus, Pre Calculus

Grade Level(s): 11 or 12

Unit 1: Algebraic Concepts and Linear Functions

Estimated Instructional Time: 10 days

PA Academic Standards:
2.1.11 Numbers, Number Systems and Number Relationships
2.2.11 Computation and Estimation
2.4.11 Mathematical Reasoning and Connections
2.5.11 Mathematical Problem Solving and Communication
2.8.11 Algebra and Functions

Unit (Strand) Objectives:
1.1 Understand and use patterns, relations, and functions
1.2 Represent and analyze mathematical situations and structures using algebraic symbols
1.3 Use mathematical models to represent and understand quantitative relationships
1.4 Use communication, including mathematical vocabulary, appropriate for algebra and functions

Enabling Objectives (Explore, Develop, Master): Master unless otherwise indicated.

Honors Pre Calculus and Pre Calculus
Continue to master finding the slope of a line
Continue to master writing and sketching linear equations given points on lines and their slopes.
Decide whether relations between two variables represent a function.
Use function notation
Evaluate and find the domains and ranges of functions
Use functions to model and solve real-life problems
Use the vertical line test
Determine intervals on which functions are increasing, decreasing, or constant
Determine relative maximum and relative minimum values of functions
Identify and graph piecewise-defined functions
Identify even and odd functions
Recognize graphs of common functions
Use vertical and horizontal shifts, reflections, and non-rigid transformations to graph functions
Add, subtract, multiply and divide functions
Calculate the composition of one function with another function
Use compositions of functions to model and solve real-life problems
Find inverse functions informally graphically, and algebraically
Verify that two functions are inverses of each other
Determine if functions are one-to-one

Vocabulary: slope, point-slope form, slope-intercept form, parallel, perpendicular, function, domain, range, dependent variable, independent variable, function notation, implied domain, increasing, decreasing, constant, relative minimum, relative maximum, step function, vertical, horizontal, reflection, rigid transformation, non-rigid transformation, stretch, shrink, composition, inverse function, one-to-one

**Text/Resource Materials:**


**Assessment:**

Class work, homework, class participation, quizzes, tests, independent projects, common district final exam

**Extensions:**

http://www.college.hmco.com/students/index.html

**Remediation:**

http://www.college.hmco.com/students/index.html

**Special Education**

See Appendix I
Guided Problem Solving

**ESOL**

Three *global strategies* are essential for supporting the learning of English Language Learners in the mathematics classroom:

1. *Creating and Maintaining Access to Lessons*
   - Draw students’ attention to related concepts, skills, and situations that they already understand.
   - Form context for subsequent instruction and conversation by establishing schedules and routines, including an initial announcement of what topic will be studied, what students will do, and how they will be grouped during a lesson.
   - Use cooperative group and partner work.
2 Using Visual Tools
Assist students in generating nonlinguistic representations for new knowledge. Use pictures, objects, chalkboard drawings with accompanying text, graphic organizers, posters, manipulative materials, and mathematical diagrams.

3 Providing Language Support
Realize that all students can benefit from listening to, and thinking about, a wide variety of questions.
Model problem-solving by thinking aloud.
Understanding of specific mathematical vocabulary is enhanced by purposeful instruction.
Word walls and student glossaries visibly display important math vocabulary.
Post graphic organizers to serve as reminders of new concepts and skills.
Provide purposeful instruction in understanding mathematical symbols: reading, or understanding the concepts represented by symbols; verbalizing, or translating symbols into spoken language; and, writing symbols, or producing symbols to represent a mathematical relationship.
Encourage analytical thinking by having students discuss why incorrect answers are incorrect.

See Appendix II: Instructional Adaptations For the ESOL Student in the Regular Education Classroom

Use additional activities for understanding mathematics vocabulary (Vocabulary and Study Skills), adapted chapter tests, additional worksheets for reading and writing math symbols.
Name of Course: Honors Pre Calculus, Pre Calculus

Grade Level(s): 11 or 12

Unit 2: Polynomial, Rational, Exponential, and Logarithmic Functions

Estimated Instructional Time: 19 days

PA Academic Standards:
2.1.11 Numbers, Number Systems and Number Relationships
2.2.11 Computation and Estimation
2.4.11 Mathematical Reasoning and Connections
2.5.11 Mathematical Problem Solving and Communication
2.8.11 Algebra and Functions

Unit (Strand) Objectives:

2-1 Use key characteristics of functions in order to graph them
2-2 Use appropriate theorems to find all zeros
2-3 Recognize express, and solve problems that can be modeled using polynomial, rational, exponential and logarithmic functions
2-4 Use communication, including mathematical vocabulary, appropriate for various types of functions

Enabling Objectives (Explore, Develop, Master): Master unless otherwise indicated.

Honors Pre Calculus and Pre Calculus
Analyze graphs of quadratic functions
Write quadratic functions in standard form and use the results to sketch graphs of functions
Find minimum and maximum values of functions in real-life applications
Use transformations to sketch graphs of polynomial functions
Use the leading coefficient test
Find and use zeros of polynomial functions as sketching aids
Use the intermediate value theorem
Use long division to divide polynomials by other polynomials
Use synthetic division to divide polynomials by binomials of the form (x-k)
Use the Remainder and Factor Theorem
Use the Rational Zero Test
Use Descartes Rule of Signs
Add, subtract and multiply complex numbers
Use complex conjugates to write the quotient of two complex numbers in standard form
Plot complex numbers in the complex plane
Use the fundamental theorem of Algebra to determine the number of zeros of a polynomial function

Pre Calculus
Unit 2-- Polynomial, Rational, Exponential, and Logarithmic Functions
Page 1
Find all zeros of polynomial functions, including complex zeros
Find conjugate pairs of complex zeros
Continue to Master finding zeros of polynomials by factoring
Recognize, graph, and evaluate exponential functions
Recognize, graph, and evaluate logarithmic functions
Evaluate, expand and condense logarithmic expressions
Solve exponential and logarithmic equations
Use exponential growth and decay functions to model and solve real-life problems
Vocabulary: quadratic function, parabola, axis of symmetry, vertex, extrema, minima, maxima, multiplicity, imaginary unit i, complex numbers, pure imaginary number, complex conjugates, prime, irreducible, transcendental functions, natural base, natural exponential function, continuous compounding, logarithmic function, exponential growth, exponential decay

*Honors Pre Calculus only*
Find domains of rational functions
Find horizontal, vertical and slant asymptotes of graphs of rational functions
Analyze and sketch graphs of rational functions
Vocabulary: horizontal asymptote, vertical asymptote, slant asymptote

**Text/Resource Materials:**


**Assessment:**
Class work, homework, class participation, quizzes, independent projects, tests, common district final exam

**Extensions:**
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**Special Education**
See Appendix I
Guided Problem Solving
ESOL

Three global strategies are essential for supporting the learning of English Language Learners in the mathematics classroom:

1. Creating and Maintaining Access to Lessons
   - Draw students’ attention to related concepts, skills, and situations that they already understand.
   - Form context for subsequent instruction and conversation by establishing schedules and routines, including an initial announcement of what topic will be studied, what students will do, and how they will be grouped during a lesson.
   - Use cooperative group and partner work.

2. Using Visual Tools
   - Assist students in generating nonlinguistic representations for new knowledge.
   - Use pictures, objects, chalkboard drawings with accompanying text, graphic organizers, posters, manipulative materials, and mathematical diagrams.

3. Providing Language Support
   - Realize that all students can benefit from listening to, and thinking about, a wide variety of questions.
   - Model problem-solving by thinking aloud.
   - Understanding of specific mathematical vocabulary is enhanced by purposeful instruction.
   - Word walls and student glossaries visibly display important math vocabulary.
   - Post graphic organizers to serve as reminders of new concepts and skills.
   - Provide purposeful instruction in understanding mathematical symbols: reading, or understanding the concepts represented by symbols; verbalizing, or translating symbols into spoken language; and, writing symbols, or producing symbols to represent a mathematical relationship.
   - Encourage analytical thinking by having students discuss why incorrect answers are incorrect.

See Appendix II: Instructional Adaptations For the ESOL Student in the Regular Education Classroom

Use additional activities for understanding mathematics vocabulary (Vocabulary and Study Skills), adapted chapter tests, additional worksheets for reading and writing math symbols.
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<th>Name of Course: Honors Pre Calculus, Pre Calculus</th>
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<td>Grade Level(s): 11 or 12</td>
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<td>Unit 3: Trigonometry</td>
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<td>Estimated Instructional Time: 30 days</td>
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<td>PA Academic Standards:</td>
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<td>2.1.11 Numbers, Number Systems and Number Relationships</td>
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<td>2.9.11 Geometry</td>
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<td>2.10.11 Trigonometry</td>
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<td>2.11.11 Concepts of Calculus</td>
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<td>Unit (Strand) Objectives:</td>
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<tr>
<td>3-1 Use key characteristics of trigonometric functions</td>
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<td>3-2 Recognize, express, and solve problems that can be modeled using trigonometry</td>
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<td>3-3 Represent trigonometry using tables, graphs, verbal statements, and equations</td>
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<td>3-4 Use communication, including mathematical vocabulary, appropriate for trigonometric functions</td>
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<td>Enabling Objectives (Explore, Develop, Master): Master unless otherwise indicated.</td>
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*Honors Pre Calculus and Pre Calculus*

Describe angles
Convert between radian and degree measure
Evaluate trigonometric functions using the unit circle
Use domain and period to evaluate sine and cosine functions
Evaluate trigonometric functions of any angle
Use the fundamental trigonometric identities
Use a calculator to evaluate trigonometric functions
Use reference angles to evaluate trigonometric functions
Evaluate trigonometric functions of real numbers
Sketch graphs of basic sine and cosine functions
Sketch translations of graphs of sine and cosine functions
Solve real-life problems involving right triangles
Recognize and write the fundamental trigonometric identities
Use the fundamental trigonometric identities to evaluate trigonometric functions, simplify trigonometric expressions, and rewrite trigonometric expressions
Use standard algebraic techniques to solve trigonometric equations
Use the Law of Sines
Use the Law of Cosines
Find the area of oblique triangles
Use Heron’s formula
Vocabulary: angle, initial side, terminal side, standard position, coterminal, central angle, radian, degree, rotation, complementary, supplementary, linear speed, angular speed, unit circle, sine, cosine, tangent, secant, cosecant, cotangent, periodic, period, hypotenuse, adjacent side, opposite side, reference angle, amplitude, phase shift, angle of elevation, angle of depression, oblique triangle, semi-perimeter

**Honors Pre Calculus only**

Sketch graphs of tangent, cotangent, secant, and cosecant functions
Evaluate inverse trigonometric functions
Solve real-life problems involving directional bearings and harmonic motion
Verify trigonometric identities
Use sum and difference formulas to evaluate trigonometric functions, verify identities, and solve trigonometric equations
Use multiple angle formulas to rewrite and evaluate trigonometric functions
Represent vectors as directed line segments
Write the component form of vectors
Perform basic vector operations
Find the direction angles of vectors
Find the dot product of two vectors and use properties of the dot product
Find angles between two vectors and determine whether two vectors are orthogonal
Write vectors as sums of two vector components
Vocabulary: frequency, bearings, magnitude, scalar multiplication, resultant, unit vector, linear combination, direction angle, dot product, orthogonal

**Text/Resource Materials:**


**Assessment:**
Class work, homework, class participation, quizzes, tests, independent projects, common district final exam

**Extensions:** [http://www.college.hmco.com/students/index.html](http://www.college.hmco.com/students/index.html)

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Special Education

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Guided Problem Solving

ESOL

Three global strategies are essential for supporting the learning of English Language Learners in the mathematics classroom:

1. Creating and Maintaining Access to Lessons
   - Draw students’ attention to related concepts, skills, and situations that they already understand.
   - Form context for subsequent instruction and conversation by establishing schedules and routines, including an initial announcement of what topic will be studied, what students will do, and how they will be grouped during a lesson.
   - Use cooperative group and partner work.

2. Using Visual Tools
   - Assist students in generating nonlinguistic representations for new knowledge.
   - Use pictures, objects, chalkboard drawings with accompanying text, graphic organizers, posters, manipulative materials, and mathematical diagrams.

3. Providing Language Support
   - Realize that all students can benefit from listening to, and thinking about, a wide variety of questions.
   - Model problem-solving by thinking aloud.
   - Understanding of specific mathematical vocabulary is enhanced by purposeful instruction.
   - Word walls and student glossaries visibly display important math vocabulary.
   - Post graphic organizers to serve as reminders of new concepts and skills.
   - Provide purposeful instruction in understanding mathematical symbols: reading, or understanding the concepts represented by symbols; verbalizing, or translating symbols into spoken language; and, writing symbols, or producing symbols to represent a mathematical relationship.
   - Encourage analytical thinking by having students discuss why incorrect answers are incorrect.

See Appendix II: Instructional Adaptations For the ESOL Student in the Regular Education Classroom

Use additional activities for understanding mathematics vocabulary (Vocabulary and Study Skills), adapted chapter tests, additional worksheets for reading and writing math symbols.
Name of Course: Honors Pre Calculus, Pre Calculus

Grade Level(s): 11 or 12

Unit 4: Sequences, Series, and Probability

Estimated Instructional Time: 12 days

PA Academic Standards:
2.1.11 Numbers, Number Systems and Number Relationships
2.2.11 Computation and Estimation
2.4.11 Mathematical Reasoning and Connections
2.5.11 Mathematical Problem Solving and Communication
2.8.11 Algebra and Functions

Unit (Strand) Objectives:

4-1 Recognize, express, and solve problems that can be modeled using sequences and series
4-2 Apply the properties of the binomial theorem and use them to calculate binomial coefficients and write binomial expansions
4-3 Use key characteristics of counting principles and probability
4-4 Use communication, including mathematical vocabulary, appropriate for sequences, series, and probability

Enabling Objectives (Explore, Develop, Master): Master unless otherwise indicated.

Honors Pre Calculus only
Write the terms of sequences using sequence notation
Use factorial and summation notation
Find sums of infinite series
Recognize, write and find the nth terms of arithmetic and geometric sequences
Find the nth partial sums of arithmetic and geometric sequences
Find sums of infinite geometric series
Use mathematical induction to prove statements involving a positive integer n
Find the sums of powers of integers
Find finite differences of sequences
Use Binomial theorem
Use Pascal’s triangle
Use the fundamental Counting Principle
Use permutations and combinations to solve counting problems
Find probabilities of events
Find probabilities of mutually exclusive events
Find probabilities of independent events
Vocabulary: infinite sequence, finite sequence, factorial, summation, finite series, partial sum, arithmetic, geometric, common difference, common ratio, infinite geometric series, increasing annuity, mathematical induction, binomial coefficients, binomial theorem, permutation, combination, probability, experiment, outcomes, sample space, event, mutually exclusive, independent event, complement of an event

Text/Resource Materials:


Assessment:
Class work, homework, class participation, quizzes, independent projects, tests, common district final exam

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Special Education

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   - Form context for subsequent instruction and conversation by establishing schedules and routines, including an initial announcement of what topic will be studied, what students will do, and how they will be grouped during a lesson.
   - Use cooperative group and partner work.

2. **Using Visual Tools**
   - Assist students in generating nonlinguistic representations for new knowledge.
   - Use pictures, objects, chalkboard drawings with accompanying text, graphic organizers, posters, manipulative materials, and mathematical diagrams.

3. **Providing Language Support**
   - Realize that all students can benefit from listening to, and thinking about, a wide
variety of questions.
Model problem-solving by thinking aloud.
Understanding of specific mathematical vocabulary is enhanced by purposeful instruction.
Word walls and student glossaries visibly display important math vocabulary.
Post graphic organizers to serve as reminders of new concepts and skills.
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Name of Course:  Honors Pre Calculus, Pre Calculus

Grade Level(s):  11 or 12

Unit 5:  Analytic Geometry

Estimated Instructional Time:  15 days

PA Academic Standards:
2.1.11  Numbers, Number Systems and Number Relationships
2.2.11  Computation and Estimation
2.4.11  Mathematical Reasoning and Connections
2.5.11  Mathematical Problem Solving and Communication
2.8.11  Algebra and Functions
2.9.11  Geometry

Unit (Strand) Objectives:

5-1 Use key characteristics of conic functions
5-2 Represent conics using tables, graphs, verbal statements, and equations
5-3 Recognize, express, and solve problems that can be modeled using conic sections
5-4 Use communication, including mathematical vocabulary, appropriate for analytic geometry

Enabling Objectives (Explore, Develop, Master): (Master unless otherwise indicated. PSSA Eligible Content is indicated where relevant.)

**Honors Pre Calculus and Pre Calculus**
Recognize a conic as the intersection of a plane and a double-napped cone
Write equations of parabolas, ellipses, and hyperbolas in standard form
Find eccentricities of ellipses
Find asymptotes of hyperbolas
Classify conics from their general equations
Use properties of conics to solve real-life problems
Vocabulary:  Conic, locus, parabola, directrix, focus, vertex, axis, focal chord, latus, rectum, ellipse, foci, major axis, minor axis, eccentricity, hyperbola, transverse axis, center, conjugate axis, asymptote

**Honors Pre Calculus only**
Use the discriminant to classify conics
Solve systems of quadratic equations
Evaluate sets of parametric equations for given values of the parameter
Graph curves that are represented by sets of parametric equations
Plot points in the polar coordinate system
Convert points and equations from rectangular to polar form and visa versa
Vocabulary: parameter, parametric equations, plane curve, pole, polar axis, polar coordinates, directed angle, directed distance,

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2 *Using Visual Tools*
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   - Use pictures, objects, chalkboard drawings with accompanying text, graphic organizers, posters, manipulative materials, and mathematical diagrams.

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Appendix I

Instructional Adaptations
For the Special Education Student in the Regular Education Classroom

1. Assign a peer tutor, peer support, or “study buddy” to each special education student. This would be a reliable student who could help with problems, share notes, explain concepts and check problems that have been completed. This would give immediate help to the student and would mean that they wouldn’t have to wait to receive help from the teacher. It would also mean that the teacher would have more time to spend with other students. Also research shows that students increase their understanding of material when they teach it to others so it would benefit the regular education student too.

2. Extended time for assignments, projects and tests. This will enable the special education student the chance to review problems, check more thoroughly for errors and to receive help for problems where they need tutoring. The ultimate goal is for the student to learn the concepts and this may take a little extra time, more than one chance on a test and the opportunity to retake a test or redo a project or homework assignment.

3. Modified assignments. A good example of this would be if the class were assigned 20 problems (#1-20) from a text, then the special education student would only be expected to complete the odd or even numbered questions. This would enable to student the time to thoroughly understand the 10 problems instead of having to rush through 20 problems and make mistakes or become overwhelmed with the workload.

4. Simple graphic organizers that outline a step by step procedure to solve problems. Many math problems require a sequential, step by step approach and it would be beneficial for special education students to have simple graphic organizers that break problem solving down into smaller steps. Examples would also be useful since they serve as a good model for the special education student to utilize.

5. Supplemental materials from textbooks with lower reading levels. These will help the special education student who has difficulty with reading and comprehension. Many times these students cannot even attempt a problem because they do not understand what the question is asking them to do. Once a comfort level has been established then more difficult reading can be incorporated.

6. Access to a calculator, tables and a comprehensive “tool kit” will be valuable to the special education student and will allow them more time to spend solving the problem than figuring out the arithmetic. It will also reduce the number of simple errors made by the student.

7. Study guides and chapter outline checklists are useful tools for the special education student and help them with organizing their work.

8. Regular notebook checks by the teacher are also helpful to increase organization.
9. Close and regular contact with the skill development teacher will help increase the success of the special education student. Supplying the skill development teacher with a condensed packet of notes is another useful tool.

10. Arranging after school tutoring for the special education student will provide a more comfortable atmosphere to ask questions and increase comprehension.

11. Students learn using a variety of modalities. Some special education students will learn more through the use of manipulatives, visual aids and using computer programs as opposed to the traditional pen, pencil, chalkboard approach.
Appendix II

Instructional Adaptations
For the ESOL Student in the Regular Education Classroom

1. Manipulatives/Visuals - Use diagrams, pictures, graphs, and tables to express concepts instead of sentences. These are used very often in every chapter of this book.

2. Cooperative/Peer Support – Permit students to work in Groups, helping and learning from each other. There are many activities in which students can be assigned to work in groups.

3. Word Bank/Vocabulary - New terms should go on a word wall which can be a room display or a personal/portable word wall. Have students make posters of glossary terms.

4. Graphic Organizers – Try using webs, maps, charts, and diagrams. They provide a visual representation of key concepts and related terms, helping students see relationships among ideas and show how ideas link together.

5. Student/Led discussions - Many discussions and questions motivate students to answer questions individually or as a group.

6. Rephrasing/Clarifying - Short sentences and explanations allow students to understand a concept without relying so much on the language. Students need to rephrase information in their own words.

7. Calculator Support - Calculators should be used throughout the entire book to review or explain concepts and objectives.

8. Individual Support – This must be given by the classroom teacher to help students who have problems understanding the language or using information.

9. Extended Completion Time – This will be necessary in some instances to assure students have enough time to complete a task or assignment. It usually takes an ESOL student longer to read and understand concepts because of the language barrier.

10. It is the responsibility of the classroom teacher to work on student’s prior knowledge by asking questions before introducing a concept for the first time.

11. Modified Lessons - Objectives in every chapter are explained in simple words or phrases. Common words are used to describe objectives.
12. Word Banks/Vocabulary – This adaptation can be used at the end of every chapter or unit of study.

13. Graphs/Charts – These should be used frequently

14. Highlight Key Concepts - Key concepts can be highlighted in different colors to attract students’ attention.


16. Verbalize Strategies - Students are asked to describe or explain important concepts in their own words.

17. Technology Programs – PHSchool.com

18. Alternative Assessments - Different types of alternative assessments may be used. Concept maps, review questions, open ended questions, problem solving, oral responses, using calculators to solve problems, multiple choice questions, self evaluations, group projects, comparing similarities and differences, and oral presentations are some examples.

19. Study Guides/Outlines – These should be used to stress important information.

20. Modified Coaching Rubrics- Rubrics are used for projects. Rubrics should be clear, well written, and easy to understand.

22. Mathematical Operations - Division is written differently in certain countries. For example, the division sign is written backwards in the Dominican Republic. Some countries use a comma where we would use a decimal point. Some students learn to subtract by compensating the subtrahend, not “borrowing from” the minuend.

23. Recognizing role models, in math and other natural sciences, that belong to different countries should be examined.

24. Additional warm ups and activities for better understanding of vocabulary should be used when working with ESOL students.

25. Create a glossary of geometry terms that students can review when necessary.

26. Integrate language arts, the sciences, and social studies into the study of data representation.

27. There are many reasons the language and vocabulary used in math can challenge even able readers: conceptual density of math text; overlap between math vocab and vocab used in everyday English; math symbolism; and, concepts embedded within
concepts. Marzano asserts that direct instruction on words that are an integral part of new content has a big impact on learning.